Department for Education

Achievement of 15-Year-Olds in England: PISA 2015 Further Analysis Report

Research brief

November 2017

Acknowledgements

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Executive Summary

The three-yearly Programme for International Student Assessment (PISA), led by the Organisation for Economic Co-operation and Development (OECD), provides evidence on how the achievement and abilities of 15-year-olds vary across countries. To compare what pupils know and can do across the three core domains, or subjects (science, reading and mathematics), pupils sit a two-hour test that is designed to provide a comparative measure internationally. In each round, one of the core subjects is tested in more detail than the others; for 2015 this major domain was science. Pupils and their schools also complete a background questionnaire that enables more detailed analysis of how performance is shaped by pupils' characteristics, perceptions and experiences of school and teaching within and across countries. Our participation in the PISA study enables us to benchmark the performance of pupils in England against their peers across the rest of the world, to understand the extent to which pupil performance varies and what drives this, and to spotlight particular strengths and weaknesses in our education system.

The most recent PISA study was conducted in England in the autumn term of 2015. The pupils who sat PISA went on to take their GCSEs in the summer of 2011. This research brief summarises the results of some further analysis of England's PISA 2015 results. It examines the association between PISA scores and GCSE performance, the distribution of average PISA scores by region and the characteristics of high and low achievers across England.

The link between PISA and GCSE performance

There is a positive relationship between how pupils perform in the PISA tests (in science, reading and maths) and their subsequent GCSE grades (in science, english and maths). In each subject, an increase of one GCSE grade is associated with achieving a PISA score of approximately 40 points higher.

The range of pupil ability in England is at least as wide as that seen between an average pupil in Singapore (the top performing country in PISA 2015) and the average pupil in the Dominican Republic (the lowest performing country).

Pupils in England achieving an A* grade in their GCSEs outperform the average pupil in top performing Singapore in each subject. The average pupil in Singapore is on a par with pupils in England achieving the equivalent of a B grade in their science (EBacc pillar) GCSE, a B grade in their English GCSE and an A grade in their maths GCSE.

The variation in PISA performance across regions in England

Pupils in the South East of England scored highest, on average, in the PISA 2015 tests and significantly better in all subjects than their peers in the three lowest performing regions, which are the West Midlands, the North East, Yorkshire and Humber and the North West.

The gap in average performance between the South East and the northern regions is widest in science and reading (in which pupils in the South East are ahead by around 40 PISA points or the equivalent of one GCSE grade) and narrowest in maths (30 PISA points). The narrower gap in maths is due to pupils in the South East not performing as far ahead in maths as they do in reading. In science, the average pupil in every English region performs above the OECD average.

The characteristics of high and low performers

The key characteristics that distinguish between high and low achievers in England are: social economic status and free school meal (FSM) eligibility amongst low achieving pupils; and gender and school type amongst high achieving pupils.

1. Introduction

1.1 What is PISA?

PISA (the Programme for International Student Assessment) is a global benchmarking study of pupil performance led by the Organisation for Economic Co-operation and Development (OECD). The study provides participating countries with a comparison of what 15-year-olds across the world know and can do in the core subjects of science, reading and mathematics. PISA enables us to make international comparisons, benchmark ourselves within the rest of the world, and to spot particular strengths and weaknesses in our education system. PISA is carried out on a three-year cycle with an alternating focus on the three core subjects. In 2015 the main focus of the assessment was science. Pupils are also assessed in an innovative domain, which was collaborative problem solving (CPS) in 2015. In 2015 PISA was administered in the majority of countries as a computer-based assessment (CBA) for the first time.

The first PISA study took place in 2000 and was undertaken in 43 countries. In 2015, over 70 countries and territories participated in the PISA core subjects, including all OECD member states and all four countries within the United Kingdom. In England, PISA was conducted between November and December 2015. A total of 206 schools and 5,194 pupils took part. The vast majority of England's participating pupils were born between September 1999 and August 2000, meaning they came to the end of primary school during 2010, and took their GCSEs in Summer 2016, as the last cohort to take the GCSE examinations before they were reformed.

Following the publication of the PISA 2015 results in December 2016, DfE commissioned the UCL Institute of Education to undertake further analysis of the results specifically to look at three key areas. Firstly, at the association between PISA scores and pupil GCSE performance in the same subjects. Secondly, estimating average PISA scores by region and how these fit on an international scale and, finally, examining the characteristics of high- and low-achievers across England in order to better understand who high- and low-achievers are.

2. PISA scores and GCSE link

Using information about the GCSE results of the sample of pupils who sat PISA in England in 2015, we can establish a link between the PISA and GCSE measures of science, maths and reading (or English language) performance and position other countries' PISA performance against more familiar measures. The analysis suggests a close positive relationship between PISA score and GCSE grade achieved across all three subjects, with those who achieved A*-B at GCSE having performed significantly better on average in PISA than those performing at C grade or below.

2.1 Science

Pupils in England perform above the OECD average in the PISA science assessment, scoring an average of 512 compared to the OECD average of 501 PISA points. However, pupils who went on to achieve a GCSE science EBacc pillar score of 8 (an average of an A* across double or triple science GCSEs) scored over 650 PISA points in science, while pupils who achieved a GCSE science score of 5 (a C) scored just over 500 PISA points.

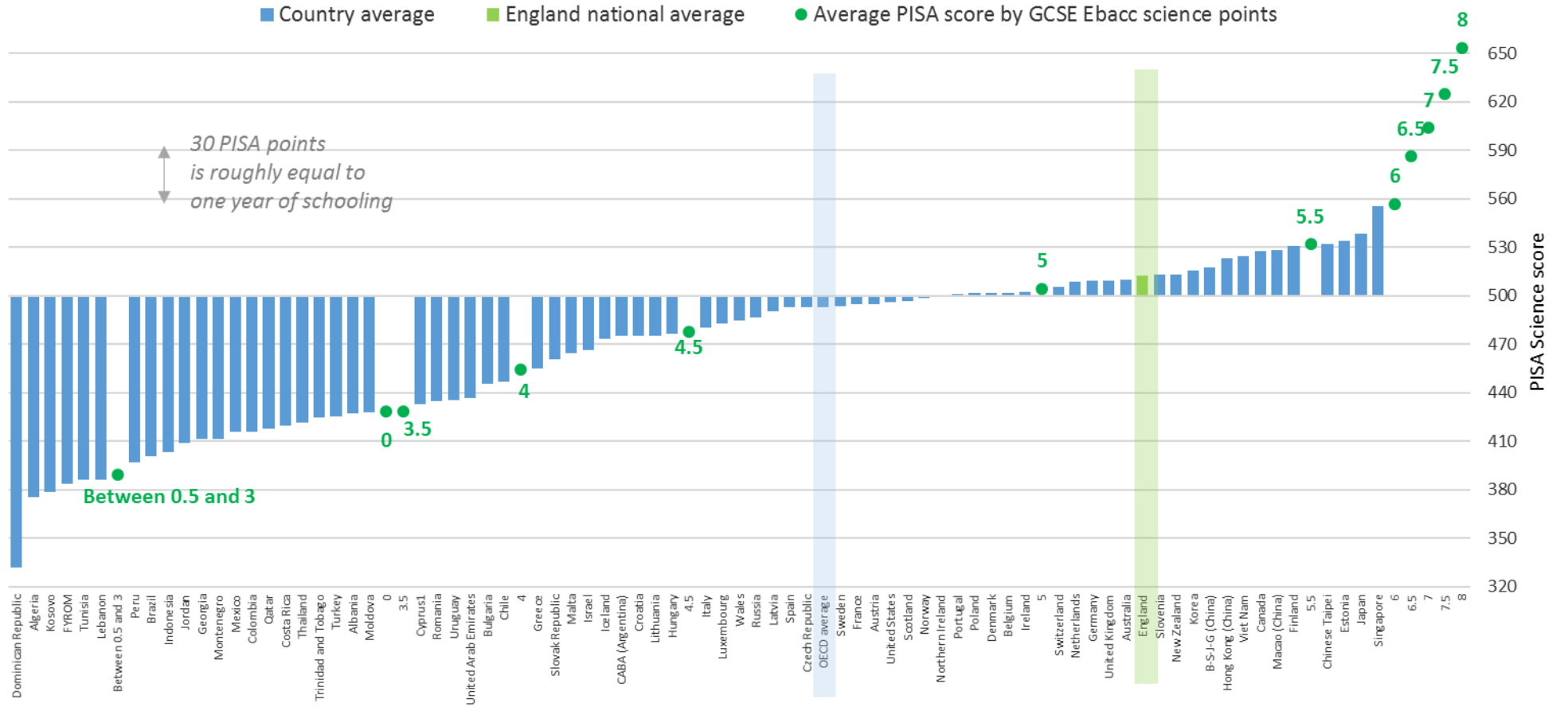**Figure 1 - A comparison between GCSE and PISA 2015 science performance**
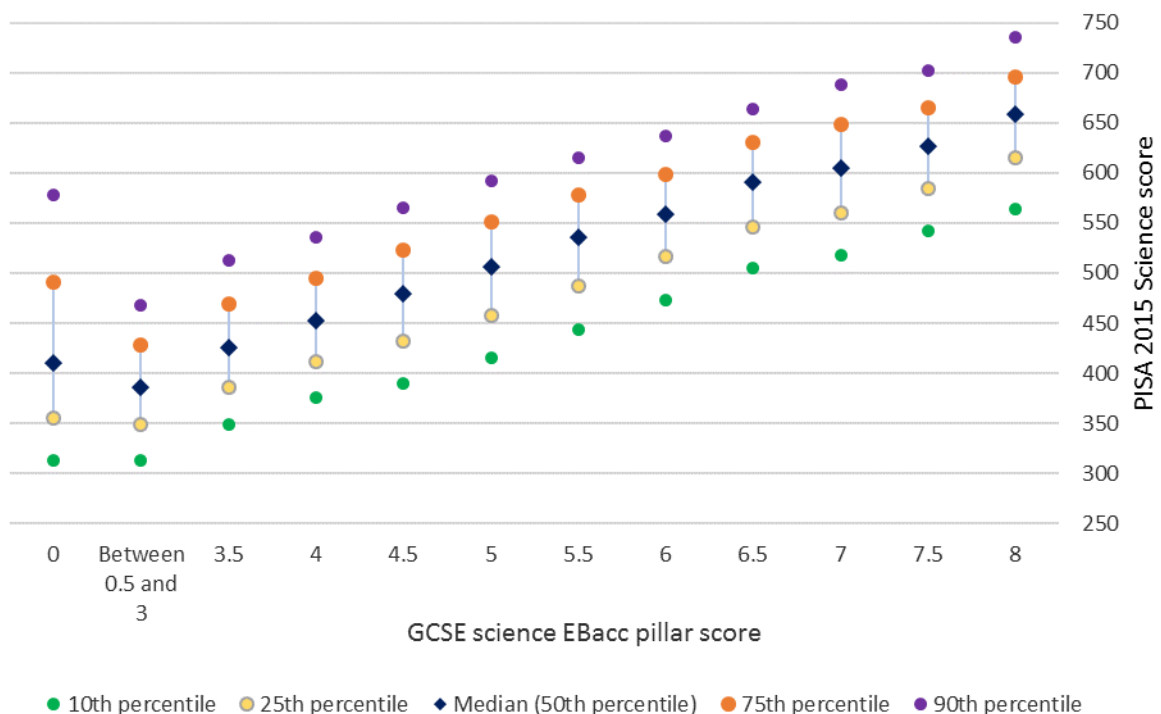
Source: Analysis of PISA 2015 data matched to the National Pupil Database

The analysis comparing GCSE science results and PISA science performance shows a positive linear trend, with pupils who scored higher in PISA going on to achieve higher grades in science at GCSE. This linear trend can be seen across scores 3.5-8 on the GCSE science scale; for every step up in GCSE grade (an equivalent of 1 point on the new numeric scale) a pupil can be expected to have achieved a PISA science score around 40-50 points higher. For example, a pupil who achieved a GCSE science score of 6 (an average of grade B) scored approximately 560 in PISA, whereas a pupil who achieved a GCSE science score of 7 (an average of grade A) scored, on average, around 605 PISA points in science.

The performance of pupils in England who achieved a GCSE science score of 6 (or a B) is approximately equivalent to that of an average pupil in top-performing Singapore. In contrast, pupils in England and a number of other European countries including the Netherlands, Germany and Ireland score the equivalent of a 5 (or a C) and pupils in less high-performing countries such as Greece, Chile and Bulgaria would score, on average, a 4 (or a D). The OECD average PISA score in science is between 4.5 and 5 on the GCSE EBacc science scale in England.

Figure 2 - A comparison of PISA science scores by country and GCSE EBacc science points in England

Legend: ■ Country average ■ England national average ● Average PISA score by GCSE Ebacc science points

30 PISA points is roughly equal to one year of schooling

PISA Science score

Source: Analysis of PISA 2015 data matched to the National Pupil Database

2.2 Reading

England performed just above the OECD average in reading for the first time. This was due to a slight fall in the OECD average between 2012 and 2015 cycles, which was 496 compared with England's average score of 500.

Pupils who achieved an A* in GCSE English (language) scored on average 600 PISA points, while pupils who achieved an F scored on average less than 400 PISA points.

Figure 3 - A comparison between GCSE English and PISA 2015 reading performance
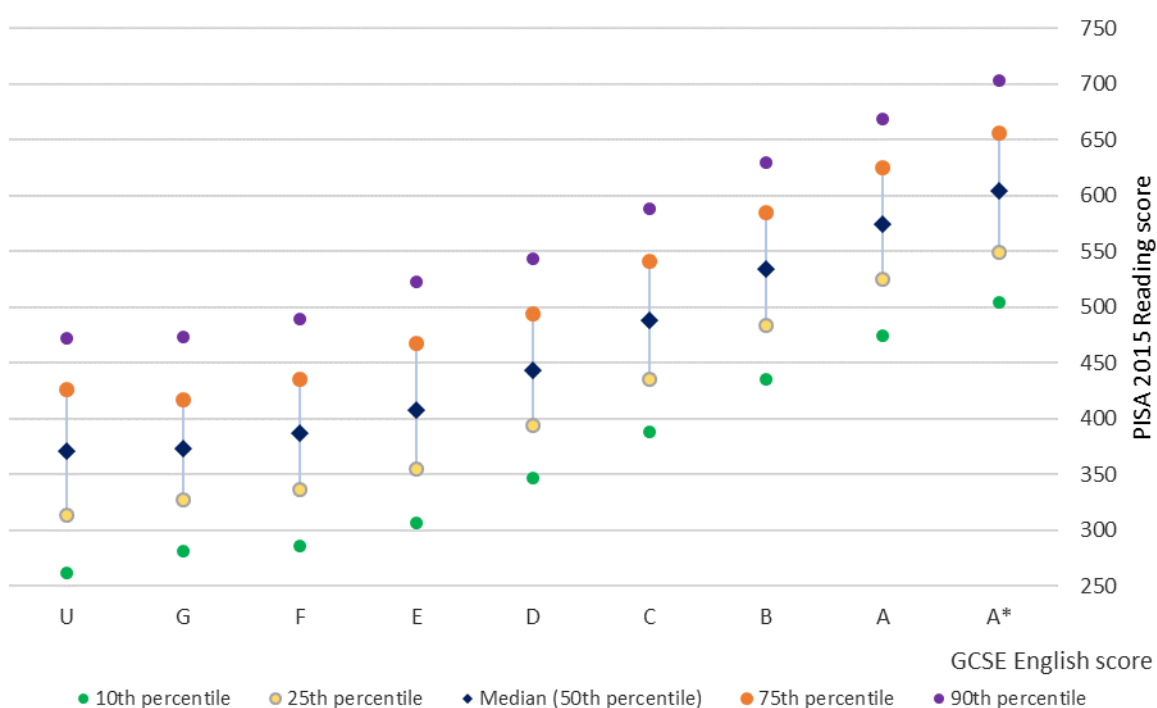
Source: Analysis of PISA 2015 data matched to the National Pupil Database

This analysis again showed a positive linear trend with pupils who scored higher in PISA achieving higher grades in English at GCSE. This trend can be seen across grades A*-E most strongly; every step up in GCSE grade achieved in English is equivalent to pupils scoring approximately 30-40 PISA points more in reading. For example, a pupil who achieved a grade B in GCSE scored on average 530 PISA points, where as a pupil who achieved a grade A scored on average 570 PISA points in reading.

Figure 4 - A comparison of PISA reading scores by country and GCSE English grade

Legend: ■ country average ■ England national average ● Average PISA score by GCSE English grade

30 PISA points is roughly equal to one year of schooling

PISA 2015 Reading score

Countries (left to right): Lebanon, Kosovo, Algeria, FYROM, Dominican Republic, Tunisia, U, G, F, Indonesia, Peru, Georgia, Qatar, Albania, Brazil, Jordan, Thailand, E, Moldova, Mexico, Colombia, Montenegro, Trinidad and Tobago, Costa Rica, Turkey, Bulgaria, United Arab Emirates, Romania, Uruguay, Cyprus1, D, Malta, Slovak Republic, Chile, Greece, Hungary, Lithuania, CABA (Argentina), Wales, Israel, Luxembourg, Iceland, Italy, Austria, Viet Nam, Croatia, Czech Republic, Latvia, C, Switzerland, OECD average, Scotland, B-S-J-G (China), Russia, Spain, United States, Northern Ireland, Chinese Taipei, United Kingdom, Portugal, Belgium, France, England, Denmark, Sweden, Australia, Netherlands, Slovenia, Poland, Macao (China), Germany, New Zealand, Norway, Japan, Korea, Estonia, Ireland, Finland, Canada, Hong Kong (China), B, Singapore, A, A*
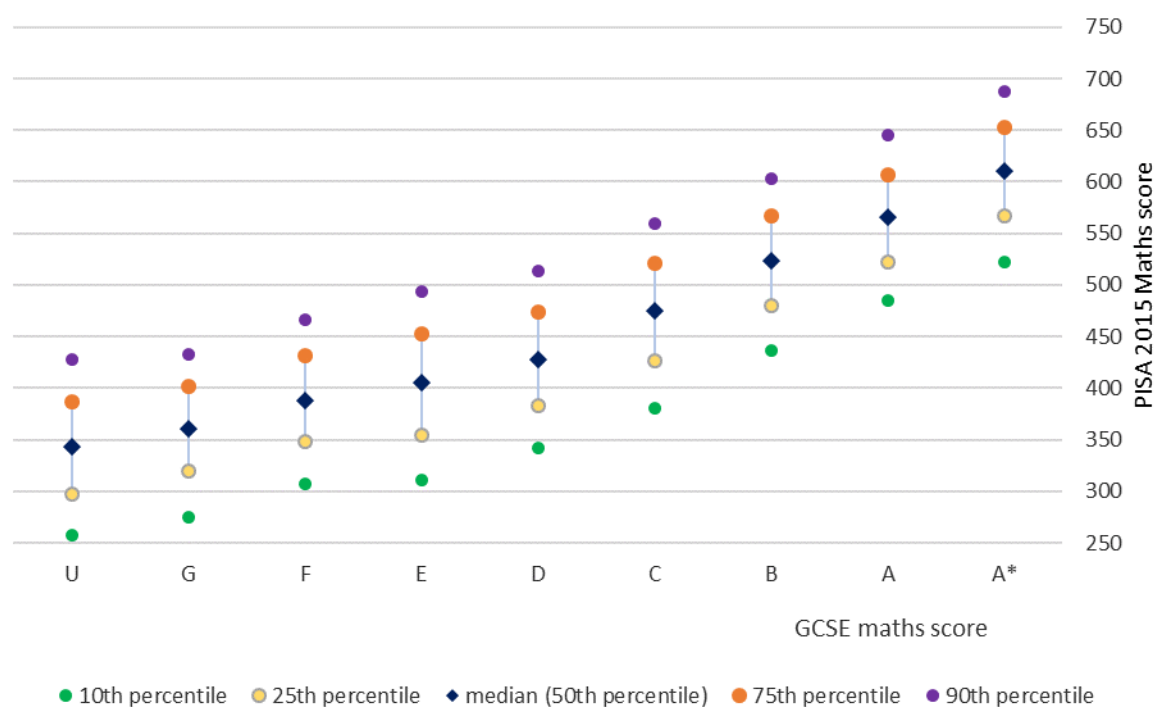
Source: Analysis of PISA 2015 data matched to the National Pupil Database

Pupils who achieved a B in English at GCSE performed equivalently in PISA to an average pupil in top-performing Singapore. In addition, pupils in a number of other European countries including Russia, Switzerland and Scotland score around the OECD average that is equivalent to a GCSE grade C in England. In contrast, pupils in less high-performing countries such as Greece, Chile and Hungary would score, on average, a GCSE grade D. The average performance of a pupil in England in PISA reading is equivalent to between grades B and C at GCSE.

2.3 Maths

The average maths score for England has remained stable since 2006, but maths is England's weakest area in PISA; scoring around the OECD average score of 494. This analysis showed that the better a pupils' performance in GCSE maths, the higher they are likely to have scored in the PISA maths assessment. Pupils achieving an A* in GCSE maths scored over 600 in PISA, while pupils who achieved an F scored just under 400 in PISA. Pupils achieving grades A*-B in England at maths GCSE scored higher in PISA than the OECD average.

Figure 5 - A comparison between GCSE and PISA 2015 mathematics performance

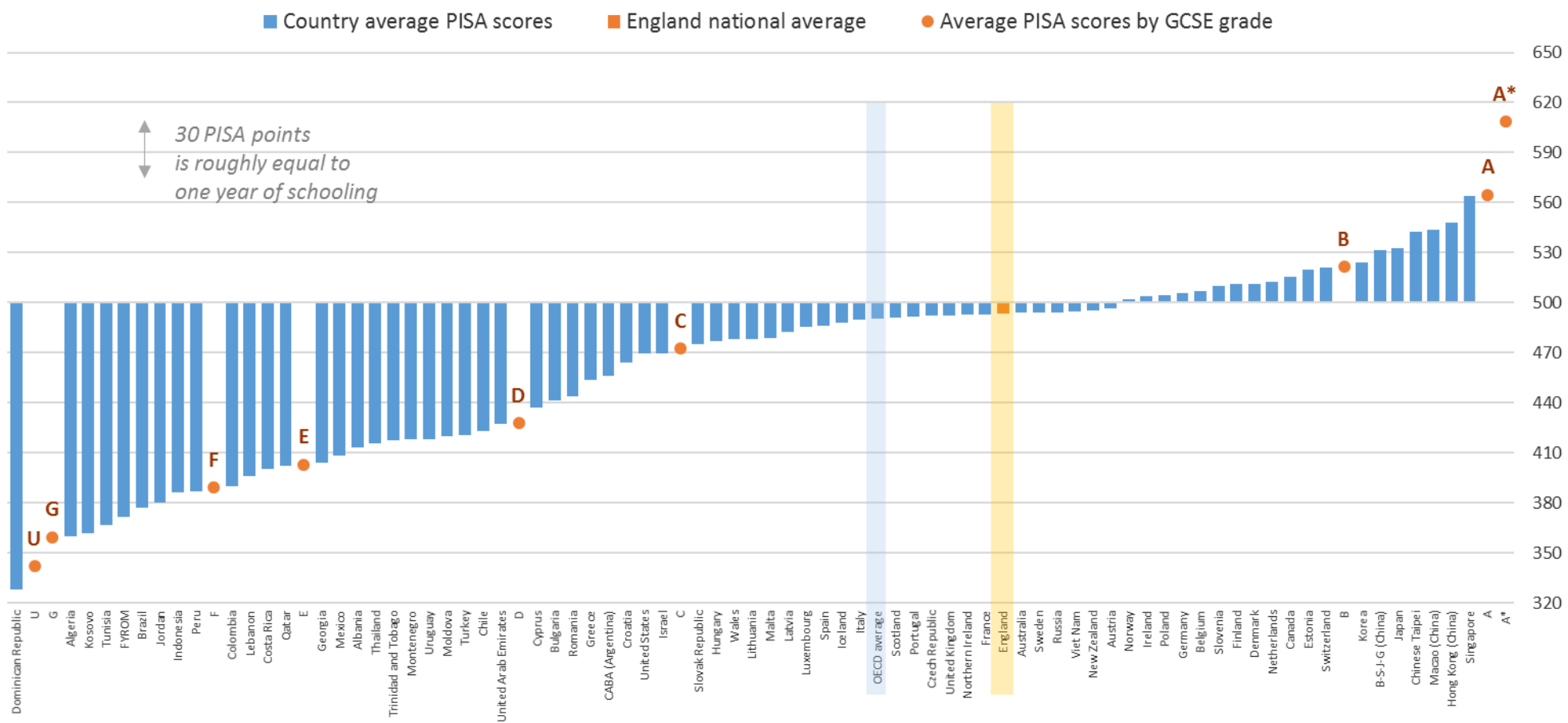*Source: Analysis of PISA 2015 data matched to the National Pupil Database*

This analysis shows a positive linear trend, with pupils who scored higher in PISA achieving higher grades in maths at GCSE. Every step up in maths GCSE grade achieved is equivalent to pupils achieving approximately 40-50 points more in PISA.

For example, pupils who achieved a C in maths GCSE scored on average 475 PISA points and pupils who achieved a B scored 520 points. This linear pattern is strongest from grades A*-D, but for grades E-U there is still a linear trend, with approximately 25 PISA points between grades. This difference is most likely due to less pupils achieving the lower grades so the pattern is based on a much smaller sample size.

England are further behind the top-performing countries in maths than science and reading, with the average pupil in top-performing Singapore performing equivalently to pupils achieving an A grade in GCSE maths, a whole grade higher than in science and reading. Pupils in other high-performing countries such as Korea, Switzerland and Estonia score on average the equivalent of a B in maths GCSE. Meanwhile, pupils who achieved an F at GCSE maths scored on average less than 400 in PISA, which is on par with the lower scoring countries in PISA, such as Colombia and Peru, who scored 390 and 387 PISA points respectively. The average PISA score for England and the OECD average both sit between GCSE grades B and C within England for maths.

This analysis highlights the significant disparity between the highest and lowest scoring pupils in schools in England. The OECD suggest that a difference of 30 PISA points is roughly equivalent to the progress made in one year of schooling. Using this comparison, there is a gap of over eight years of schooling in maths, science and reading between the top and bottom ten per cent of pupils in England. This is a larger gap than in most of the top-performing countries. For example, the difference between the highest and lowest 10% of performers in science for Hong Kong and Estonia was 209 and 233 points respectively, compared to England where the gap was 264 points.

Figure 6 - A comparison of PISA maths scores by country and GCSE maths grade

■ Country average PISA scores   ■ England national average   ● Average PISA scores by GCSE grade

30 PISA points is roughly equal to one year of schooling

Source: Analysis of PISA 2015 data matched to the National Pupil Database

3.   PISA Scores and Regional Analysis

The PISA sample in England was designed to provide a nationally representative picture of the distribution in the abilities of 15-year olds across the whole country. To understand the extent to which pupils' performance varies by geographic region, the location of pupils' schools can be used to estimate average PISA scores for each region in England. For example, the performance of the 1,000 plus pupils sampled in the South East can be compared to that of the 300 plus pupils sampled from the South West. Due to the small and varied sample sizes across regions, it is not possible to provide a highly defined estimate for each region and so the regional estimates are accompanied by confidence intervals throughout this chapter.

3.1 Science

The variation of pupils' science performance within each region in England is relatively large, meaning it is not possible to identify many significant differences across regions. The variation is particularly high in London, the East Midlands and the South West.

It is possible to conclude, however, that pupils in the South East performed significantly better[1] than their peers in North West, the North East, Yorkshire and Humber, and the West Midlands. The mean PISA science score for pupils in the top performing South East was 535 compared to the lowest performing North West, where pupils scored on average just under 500 in PISA.
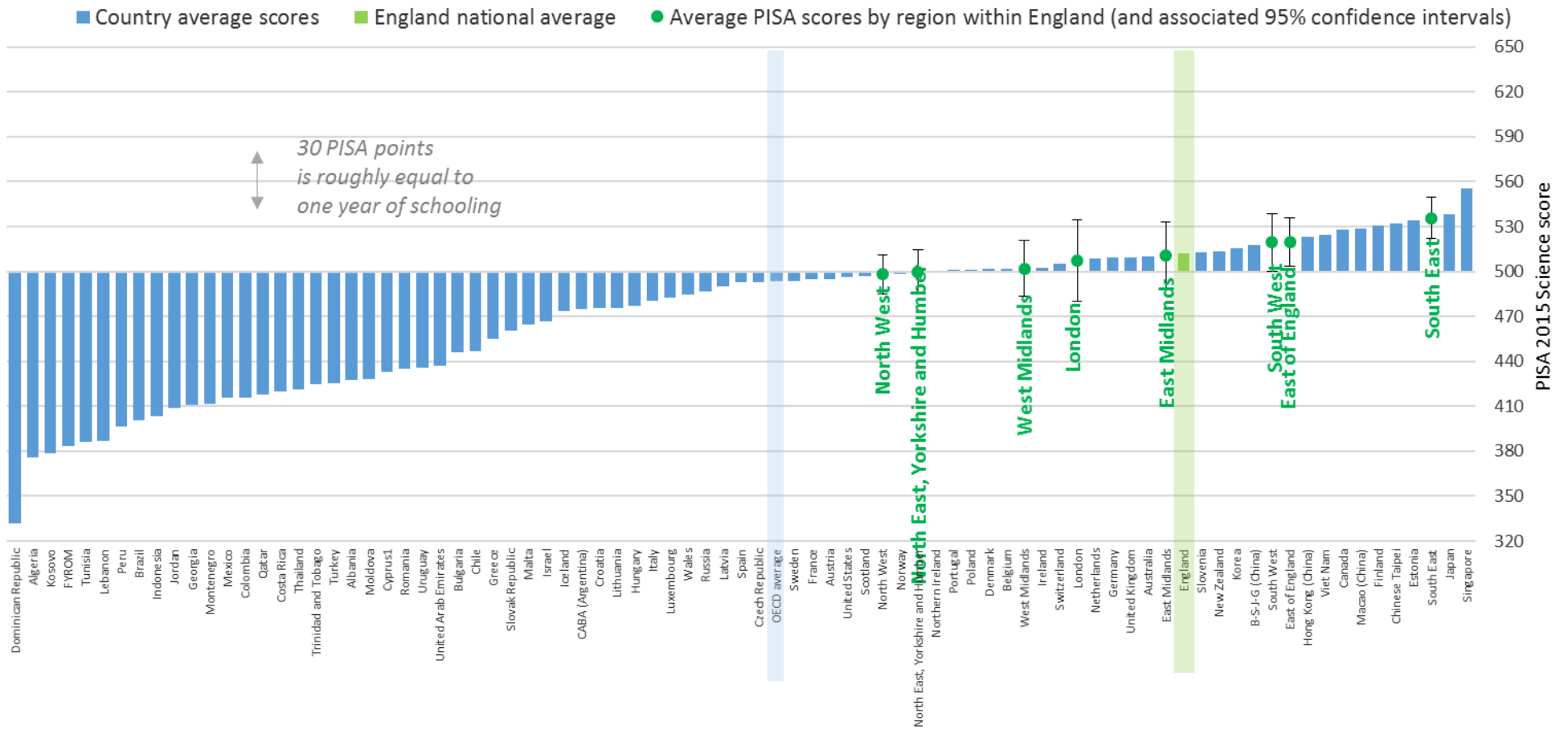

Figure 7 - PISA 2015 science results by region in England
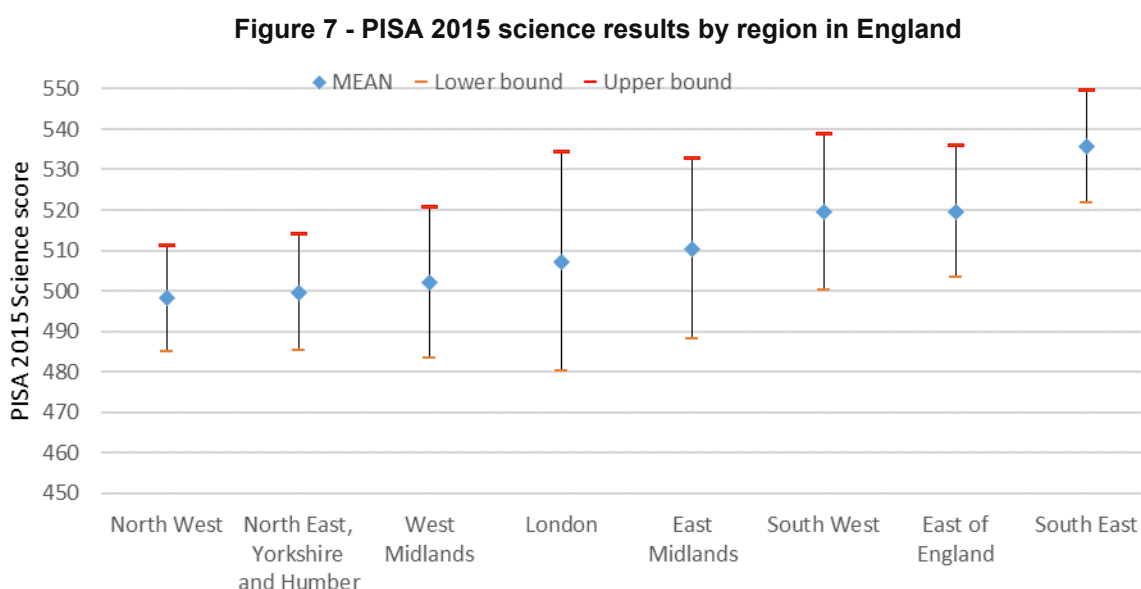
Source: Analysis of PISA 2015 data matched to the National Pupil Database

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[1] We can only comment on performance differences which are statistically significant. The mean scores in most of the higher-performing regions are close enough that we cannot say the performance of each region is significantly different from the others.

The average performance of pupils in the South East of England puts them on a par with the average performance of pupils in high-performing Japan and Estonia; whist the average performance of pupils in the Northern regions of England puts them on a par with their peers in Northern Ireland, Scotland, Norway and the US. Importantly, all regions individually performed better than the OECD average PISA score in science, further demonstrating that science is England's strongest PISA subject.

Figure 8 - A chart comparing PISA 2015 science scores by country and region within England

■ Country average scores   ■ England national average   ● Average PISA scores by region within England (and associated 95% confidence intervals)

30 PISA points is roughly equal to one year of schooling

Source: Analysis of PISA 2015 data matched to the National Pupil Database

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3.2 Reading

There are variations of performance in reading across all of the regions in England, but due to the small sample size not all of these are significant. However, we can conclude that pupils in the South East performed significantly better in PISA reading than pupils in the West Midlands and Northern regions of England. The mean PISA reading score in the highest performing region, the South East, was just under 520 compared to 480 in the lowest performing West Midlands. This is equivalent to over one year's gap of schooling between the highest and lowest performing regions.
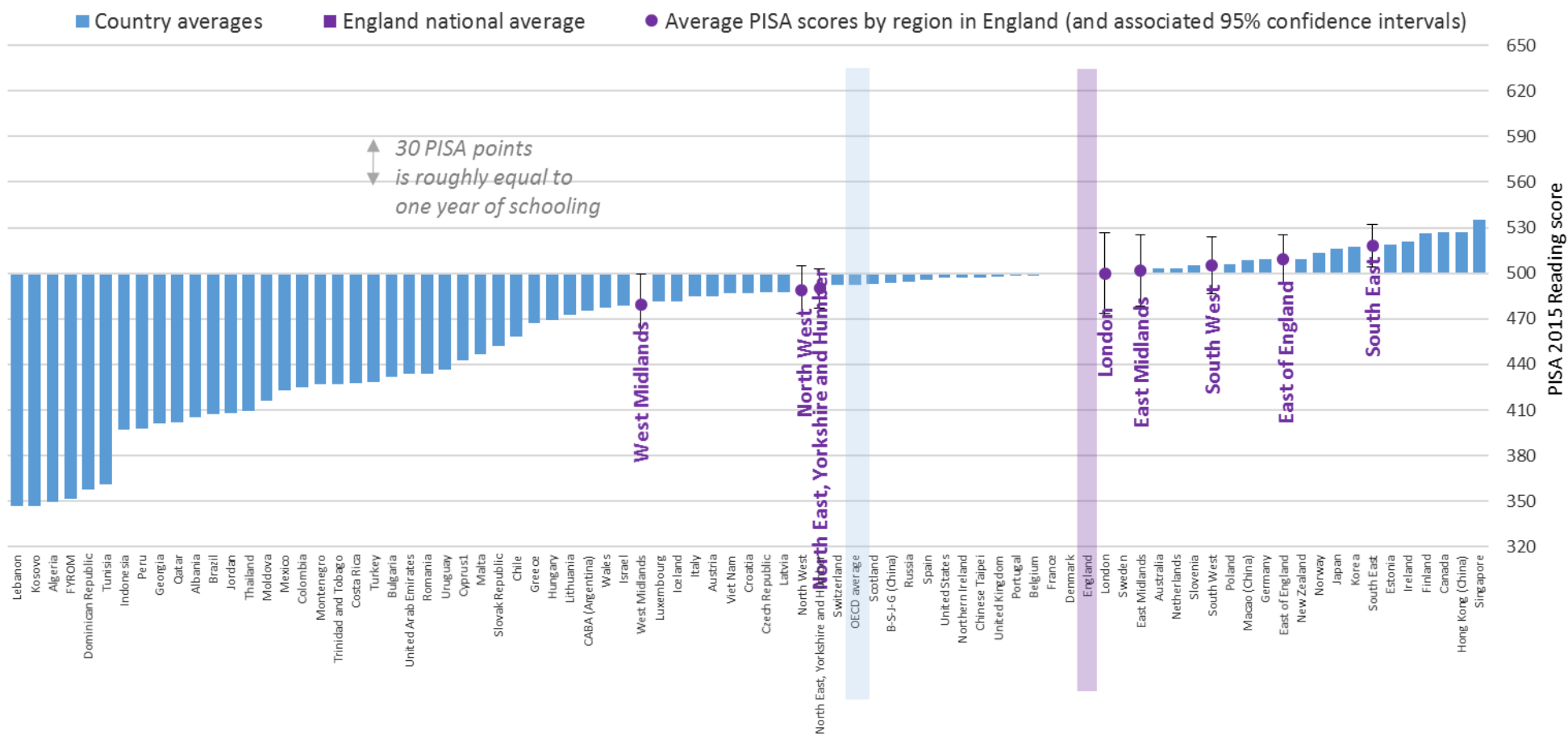
Figure 9 - A chart showing PISA 2015 reading results by region in England
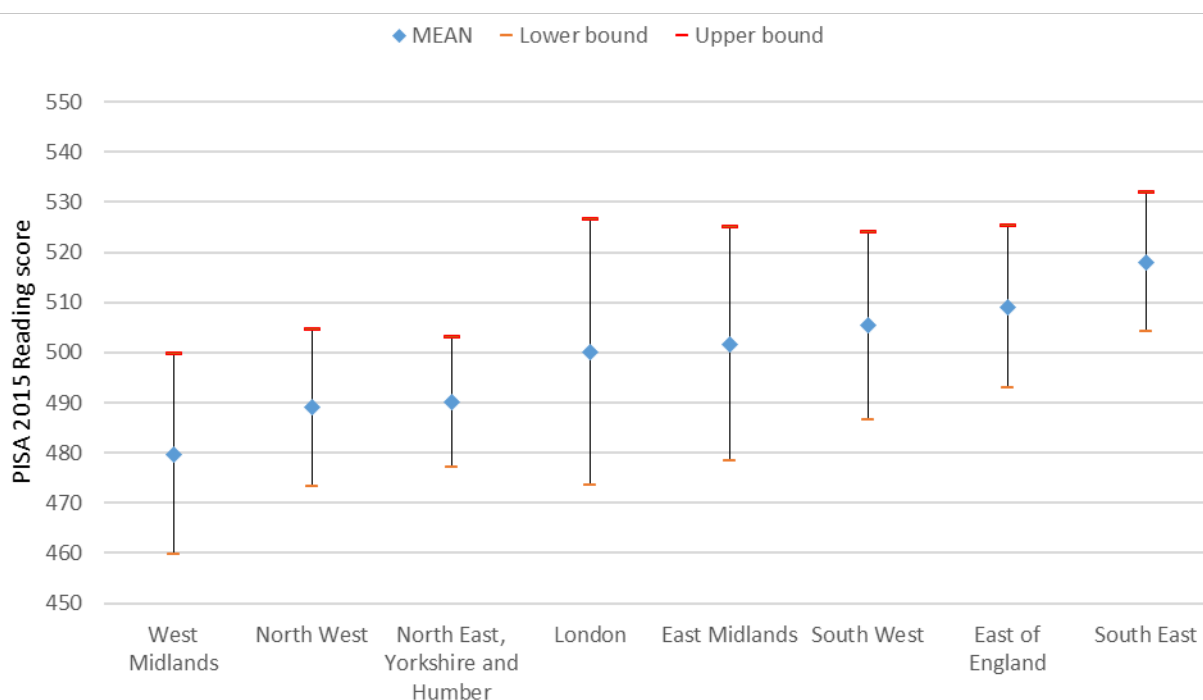
Source: Analysis of PISA 2015 data matched to the National Pupil Database

The average performance of pupils in the South East in reading puts them on par with the average performance of some of the top-performing countries, including Ireland, Estonia and Japan. In contrast, performance of pupils in the West Midlands puts them on par with the average performance of lower performing countries, such as Wales, Luxembourg and Israel. All south and east regions of England and London performed above the England and OECD average reading PISA scores. However, the North East, Yorkshire and Humber, North West and West Midlands all performed below the OECD average.

**Figure 10 - A chart showing a comparison of PISA 2015 reading scores by country and region within England**

Source: Analysis of PISA 2015 data matched to the National Pupil Database

3.3 Maths

In maths, pupil's performance in PISA varied across regions of England. However, we can conclude that pupils in the South East performed significantly better than pupils in the West Midlands, North East, Yorkshire and Humber, and the North West. The mean PISA maths score of pupils in the top performing South East was 512 compared to an average PISA score of 478 for the lowest performing West Midlands region.
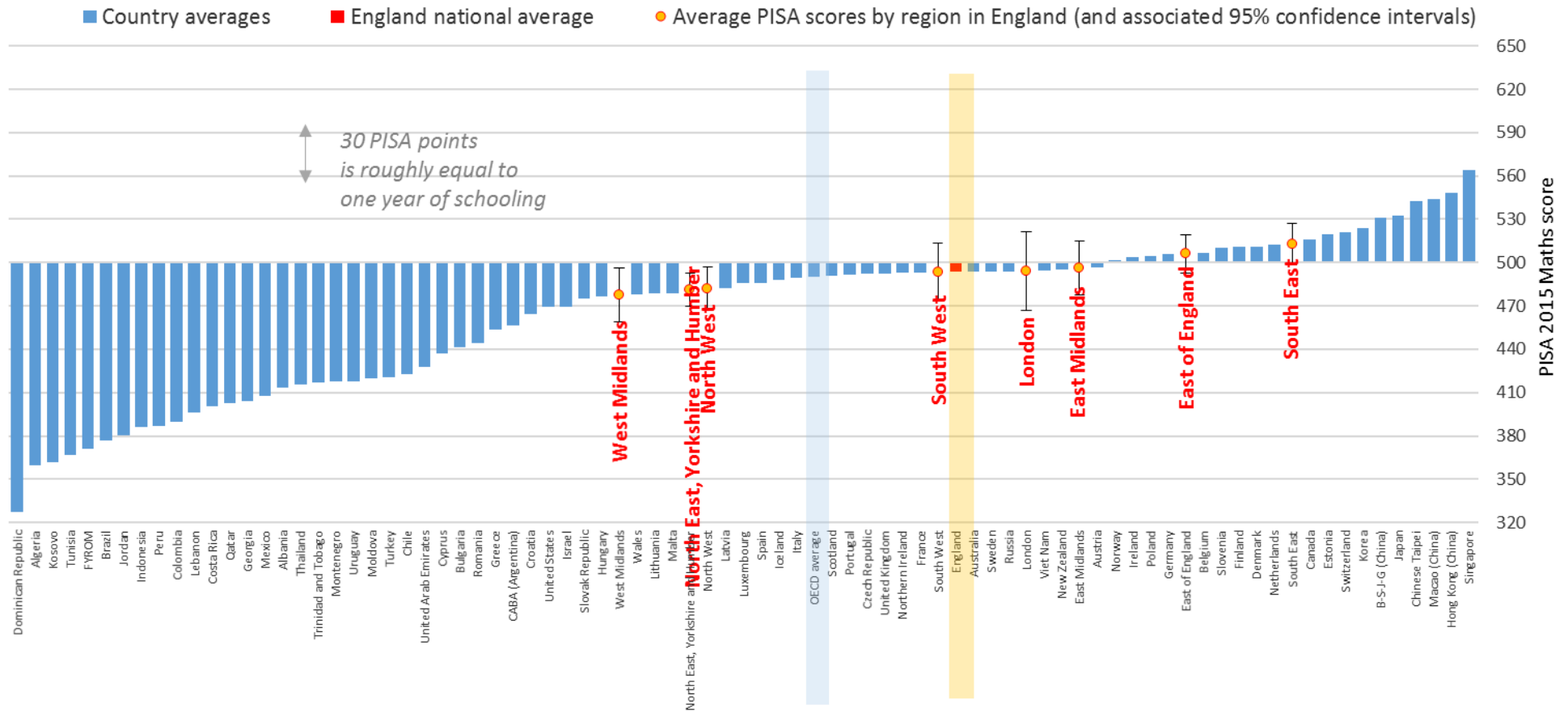
Figure 11 - A chart showing PISA 2015 maths results by region in England
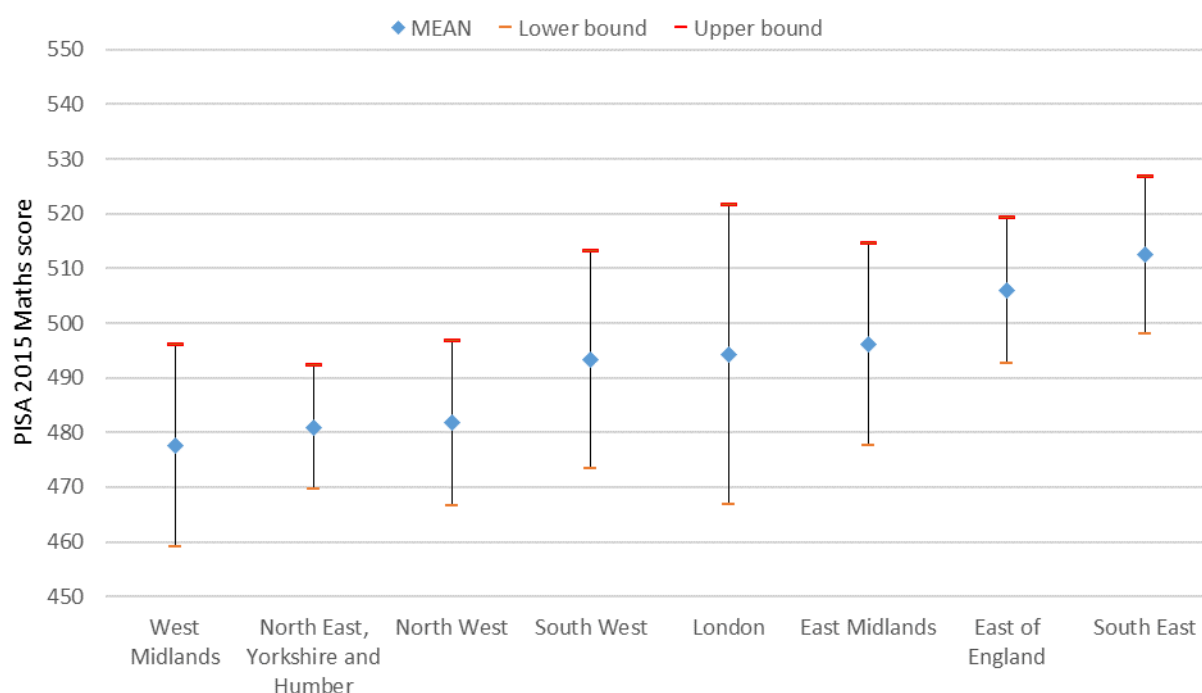
Source: Analysis of PISA 2015 data matched to the National Pupil Database

The average performance of pupils in the South East puts them on par with the performance of average pupils in top performing Estonia, Canada and the Netherlands. In contrast, performance of pupils in the West Midlands is equivalent to that of average pupils in lower performing countries such as Wales, Hungary and Lithuania. This disparity between the South East and West Midlands represents over 30 PISA points difference, which is equivalent to one year of schooling. All south and east regions of England and London performed above the OECD average maths PISA scores. However, the North East, Yorkshire and Humber, North West and West Midlands all performed below the OECD average. The South West region score most closely aligns to England's average national maths PISA score.

Figure 12 - A chart showing a comparison of PISA 2015 maths scores by country and region within England

■ Country averages   ■ England national average   ● Average PISA scores by region in England (and associated 95% confidence intervals)

30 PISA points is roughly equal to one year of schooling

PISA 2015 Maths score

Source: Analysis of PISA 2015 data matched to the National Pupil Database

4.   PISA High and Low Achievers

Finally, through an analysis of the factors most closely associated with pupil performance, we examine the characteristics of high and low performing pupils in England. The OECD translates PISA scores into PISA proficiency levels using score cut-off points (see Table 2.3 in the England PISA 2015 national report[2] for an overview of the proficiency levels). These proficiency levels range from Level 1b, the lowest, to Level 6, the highest (as of PISA 2015, Level 1 has been divided into 1a and 1b). Pupils who obtain a PISA score below Level 2 are classified as 'low-achievers', while pupils who obtain a PISA score at Level 5 or 6 are classified as 'high-achievers'.

About 2 in 5 low-achieving pupils come from a disadvantaged background as measured by socio-economic status; this is compared with less than a quarter of non-low achievers. This position is reversed in the analysis of high achievers. More than double the proportion of high achievers than non-high achievers are from an advantaged background, and three times more non-high achievers than high achievers are from a disadvantaged background. Low achievers are nearly twice as likely to be eligible for Free School Meals (FSM) than non-low achievers, whilst non-high achievers are four times more likely to be eligible for FSM than high achievers.

There is a gender gap amongst high achievers, with boys accounting for 6% more high achievers than girls. This gap is not present amongst non-high, non-low and low achievers. There is also a gap when looking at school type. Pupils in converter academies (successful schools that converted to academies) account for a higher proportion of high achieving pupils than non-high achieving pupils, and of non-low achieving pupils than low achieving pupils. However, this trend is reversed for pupils in sponsored academies (academies set up in place of under-performing schools). Finally, high achievers are more than twice as likely as non-high achievers to be independent school pupils.

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[2] https://www.gov.uk/government/publications/pisa-2015-national-report-for-england

Table 1 - The characteristics of low vs. non-low achievers

	Low-achievers	Non-low-achievers
Proportion of which are…		
Girls	50%	49%
Boys	50%	51%
Low Social Economic Status	39%	22%
High Social Economic Status	11%	28%
Free School Meal pupils	17%	9%
First generation immigrants	13%	8%
Second generation immigrants	9%	9%
Native born	67%	79%
Academy converter pupils	25%	43%
Academy sponsor led pupils	34%	18%
Community school pupils	24%	16%
Voluntary school pupils	7%	8%
Independent school pupils	2%	8%

Table 2 – The characteristics of high vs. non-high achievers

	High-achievers	Non-high-achievers
Proportion of which are…		
Girls	47%	50%
Boys	53%	50%
Low Social Economic Status	9%	27%
High Social Economic Status	49%	22%
Free School Meal pupils	3%	12%
First generation immigrants	7%	9%
Second generation immigrants	6%	9%
Native born	86%	76%
Academy converter pupils	51%	38%
Academy sponsor led pupils	9%	22%
Community school pupils	13%	18%
Voluntary school pupils	6%	8%
Independent school pupils	15%	6%

Source: Analysis of PISA 2015 data matched to the National Pupil Database

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