



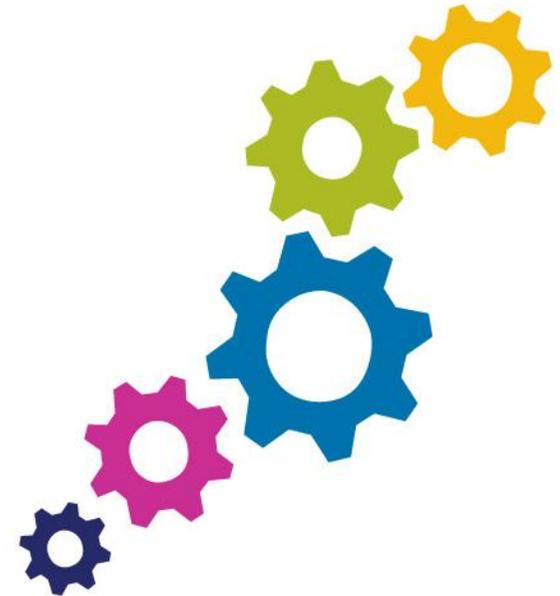
**Evidence for
Excellence in
Education**

Report

**Is mathematics education in
England working for
everyone?**

**NFER analysis of the PISA
performance of disadvantaged
pupils**

**National Foundation for Educational
Research (NFER)**



Is mathematics education in England working for everyone?

NFER analysis of the PISA performance of disadvantaged pupils

Rebecca Wheeler
Ben Durbin
Stephen McNamara
Rachel Classick

Published in December 2016
By the National Foundation for Educational Research,
The Mere, Upton Park, Slough, Berkshire SL1 2DQ
www.nfer.ac.uk

© 2016 National Foundation for Educational Research
Registered Charity No. 313392

ISBN: 978-1-911039-35-8

How to cite this publication:

Wheeler, R., Durbin, B., McNamara, S. and Classick, R. (2016). *Is mathematics education in England working for everyone? NFER analysis of the PISA performance of disadvantaged pupils* Slough: NFER.

Contents

1	Introduction	2
2	At a glance	2
3	Background	3
4	What is disadvantage?	7
5	How well is England supporting the mathematics performance of disadvantaged pupils?	10
6	How does England compare with other countries?	13
7	How does this compare with previous years?	17
8	Are there areas of mathematics at which disadvantaged pupils are particularly weak?	19
9	In what circumstances do disadvantaged pupils tend to perform better?	21
10	Conclusions and recommendations	26
11	References	28

1 Introduction

In her speech to the Conservative party conference on 5th October 2016, Prime Minister Theresa May articulated her vision for a “country that works for everyone” that takes its place on the new, post-Brexit world stage:

“I want us to be a country where it doesn’t matter where you were born, who your parents are, where you went to school ... All that should matter is the talent you have and how hard you’re prepared to work.”

The release of new data from the Programme for International Student Assessment (PISA) alongside the Trends in International Mathematics and Science Study (TIMSS) provides a unique opportunity to examine the impact of disadvantage on pupils in England from an international perspective.

In this report, we focus on performance in mathematics to answer three questions:

- How well is England doing at supporting the mathematics performance of disadvantaged pupils compared with other countries, and has this changed over time?
- Are there aspects of mathematics where disadvantaged pupils are weaker and support could be targeted?
- In what circumstances do disadvantaged pupils tend to beat the odds to perform better, and are there lessons that can be applied more widely?

2 At a glance

The impact of socio-economic background on mathematics performance in England can be seen from the most to least disadvantaged. As socio-economic background of pupils increases, so does average mathematics performance; the gap between the most and least disadvantaged is equivalent to over three years’ of schooling.

However, many factors other than socio-economic background also affect performance, and these other factors are relatively more important to pupil performance in England than in other countries. Furthermore, the impact of socio-economic background is lower among the most disadvantaged half of the population.

Examining other countries and the lack of change over time suggests that it is very difficult for countries to reduce the impact of socio-economic background on performance.

Disadvantaged pupils who perform better than average, given their socio-economic background, tend to be autumn-born, are more confident in their abilities, and are less likely to truant.

Our analysis shows that pupils would benefit from a more granular measure of deprivation; that summer-born pupils need a strategy to ensure they are not left behind; that further research would be beneficial to understand better the characteristics of pupils that perform better than their background would predict; and that schools should be further supported in tackling underperformance of disadvantaged pupils.

3 Background

Disadvantaged pupils

The Government's current focus on families that are "just about managing" follows a number of initiatives introduced since 2010 that target disadvantaged pupils.

Since 2011, disadvantaged pupils have benefited from the pupil premium.

In 2011, the Department for Education the pupil premium was introduced as a new funding stream for schools that was to be used to improve outcomes for disadvantaged pupils. A number of different groups were eligible, including pupils from low income families entitled to free school meals (FSM), and pupils who are or have been in the care system. The value of this funding has increased over time, and in 2016/17 each primary school FSM pupil attracted an additional £1,320 to their school for example.

The Education Endowment Foundation (EEF) was set up to provide evidence for schools of what works to raise the attainment of disadvantaged young people.

EEF is an independent charity established by the Government in 2011, to accompany the introduction of the pupil premium. It funds research into a wide range of classroom practices and interventions. It also communicates the evidence to schools through its online toolkit and scale-up campaigns, in order to equip schools to make well-informed decisions about the approaches likely to be most effective in supporting disadvantaged young people.

The Social Mobility Commission and Fair Education Alliance have further emphasised the need to 'close the gap'.

The Social Mobility Commission is an independent statutory body established to promote, monitor and research social mobility in England. In their 2016 report *State of the Nation 2016: Social Mobility in Great Britain*, the Commission acknowledged some success in narrowing the attainment gap between disadvantaged pupils and their peers. However it also highlights that there is still a lot that needs to be done with our education system to minimise the gap.

The Fair Education Alliance was established in 2014, a collection of teachers' organisations, children's charities and employers setting targets to narrow the gap in literacy and mathematics between advantaged and disadvantaged pupils in England. It also aims to develop pupil's resilience and wellbeing, to benefit them in further education.

The current Government is introducing further initiatives.

In the post-Brexit world our young people may face additional uncertainties as they complete their education and enter the world of work. Recognising the need to improve the opportunities for disadvantaged pupils, the Department for Education recently released details of a social mobility package (Department for Education & Greening, 2016) with the aim to provide funding to improve the social mobility of children in six 'opportunity areas' in England and includes a teaching and leadership innovation fund.

In December 2016, the Government consultation on 'Schools that work for everyone' closed. This consultation proposed expansion of independent schools, higher education institutions, selective and

faith schools, with the aim to increase the number of 'good' school places. Expansion is particularly necessary at secondary school due to a projected increase in pupil numbers by around 10% between 2016 and 2020 (Department for Education, 2016).

The importance of mathematics

The numeracy skills of workers in England are a bigger predictor of economic returns than in many countries.

Attainment in mathematics at school has life-long consequences. A high level of cognitive skill, including basic numeracy skills, is highly regarded in the UK labour market, and provides higher economic returns than many other countries (Crawford et al, 2011). As part of the Government's reforms to raise standards in mathematics education, and prompted by England's unchanged performance in PISA 2012 compared with previous surveys, Minister Truss announced a network of 'maths hubs' to bring England in line with top-performing east Asian Countries (Japan, Singapore and China). This scheme, funded by the Department for Education, set 32 schools and academy trusts as lead hubs across England as models implementing an Asian-style mastery approach to mathematics.

Disadvantaged pupils continue to achieve lower results in mathematics.

Since the introduction of the pupil premium, some progress has been made: the attainment gap for secondary pupils achieving five or more GCSEs at A*-C grades including English and mathematics has closed by 1.6 percentage points (GB. Parliament. HoC. Committee of Public Accounts, 2015). It closed slightly more in

schools participating in the EBacc than those who were not, and researchers have argued more is needed to ensure that disadvantaged pupils have fair access to these subjects (Allen et al., 2016).

There is not yet key stage 4 data available for the first pupils to have benefited from the pupil premium for the whole of their schooling from key stage 2 onwards, and which therefore allows their progress to be tracked. However, data from pupils who sat their GCSEs in 2014 shows that pupils entitled to free school meals continued to make less progress compared with their peers: 45.6% of FSM pupils made the expected level of progress in mathematics compared with 68.8% of all other pupils, a gap of 23.2 percentage points. (Department for Education, 2015).

What can we learn from international surveys?

The release of the Programme for International Student Assessment (PISA) 2015 data on 6 December 2016 alongside the Trends in International Mathematics and Science Study (TIMSS) 2015 on 29 November 2016 provides rich data to look at the mathematics performance of pupils in England over time, and to make comparisons with other countries.

Both PISA and TIMSS assess mathematics (amongst other subjects). PISA assesses *mathematical literacy* and aims to understand how well pupils are able to apply their mathematical skills to unfamiliar and real-world contexts. TIMSS has a greater emphasis on assessing knowledge and is more curriculum focussed. Both surveys collect contextual information from pupils

and teachers so that we can analyse to what extent pupil characteristics and their experiences in school impact on performance.

International surveys provide a unique opportunity to examine the impact of disadvantage on pupils in England.

The pupil questionnaire responses in PISA and TIMSS provide evidence about disadvantage. In particular, PISA’s Economic, Social and Cultural Status (ESCS) measure provides a more sophisticated measure of disadvantage than the binary ‘FSM or not’ measure traditionally considered (see Chapter 4). The studies also enable us to consider the issue from an international perspective, comparing England’s success in closing the gap to that of other countries.

Previously, data from the surveys has shown that although socio-economic status does not wholly determine a pupil’s academic performance, it does have an important influence (OECD, 2014). In PISA 2012, a socio-economically disadvantaged background was identified as an important risk factor for the 13 million 15 year old pupils who were low performers in at least one subject (OECD, 2016b).

The PISA 2015 generation

Pupils participating in PISA 2015 in England were born at the turn of the millennium, and over the course of their schooling have experienced a number of reforms that may have affected their outcomes. Figure 2.1 highlights a selection of these policies which could have had an impact on the results reported in this analysis.

Figure 2.1 Policy timeline for the PISA 2015 generation

Year	Cohort age	Events
1999	-	Sure Start children’s centres introduced
2000	0	First academies announced General Teaching Council established
2001	1	Labour Government re-elected
2002	2	Teach First launches in London
2003	3	London Challenge launched, with a particular focus on disadvantage
2004	4	Every Child Matters becomes law, focused on five key outcomes for children
2005	5	Labour Government re-elected
2006	6	Teach First begins expansion, firstly to Manchester
2007	7	
2008	8	Abolition of Key Stage 3 testing announced, to take effect from 2009
2009	9	Abolition of Key Stage 2 science testing announced, to take effect from 2010
2010	10	Conservative-Lib Dem coalition Government English Baccalaureate announced Academisation accelerated
2011	11	Pupil premium introduced and EEF established New Ofsted framework focuses on achievement
2012	12	General Teaching Council abolished Schools Direct route into teaching introduced
2013	13	
2014	14	
2015	15	PISA 2015 testing takes place

PISA 2015 pupils have experienced a secondary education with greater emphasis on traditional subjects.

In January 2011 (when this cohort were in year 6), the English Baccalaureate (EBacc) was introduced as a new school performance measure. A pupil achieves the EBacc by studying English, mathematics, two sciences, history or geography and a foreign language at GCSE.

New school performance measures (Progress 8 and Attainment 8) were also announced in 2013, to be applied from summer 2016 and therefore being used for the first time with the cohort that sat PISA 2015. Attainment 8 incentivises schools to encourage all pupils to take eight approved high-value subject qualifications, including mathematics, English and sciences. The intended benefit for pupils is to strive for good grades in fewer subjects, and for schools to place more emphasis on subjects such as mathematics (Department for Education, 2014). Progress 8 is a value added measure which compares Attainment 8 performance with performance at the end of primary school and is designed to look at performance across the ability distribution rather than focussing attention on the C/D borderline.

Parents of PISA 2015 pupils had access to the support offered by Sure Start children's centres.

In 1999, the Sure Start programme was introduced around the UK. This Government programme aimed to help families from disadvantaged areas, by supporting children's learning skills, health and well-being, and social and emotional development. PISA 2015 pupils would have been one of the first year groups to experience these programmes, which worked with families whose children were not yet old enough for schools.

A range of policies were introduced targeted specifically at disadvantage.

Although only affecting a subset of the pupils participating in PISA 2015, from 2003 onwards London Challenge was a substantial initiative intended to tackle low performance among schools in the capital. It followed the introduction of the first sponsored academies in 2000 and Teach First in 2002, which – whilst both initially small in scale – were explicitly focussed on schools serving large proportions of disadvantaged pupils. All three initiatives initially focussed on disadvantage and secondary schools, and so had plenty of time to have established by the time the PISA 2015 pupils started secondary school.

Mathematics for everyone

In this report, we focus specifically on performance in mathematics to answer three questions. Firstly, **how well is England doing at supporting the mathematics performance of disadvantaged pupils compared with other countries, and has this changed over time?**

When looking to minimise differences between disadvantaged pupils and their more advantaged peers, **are there aspects of mathematics in which disadvantaged pupils are weaker and support could be targeted?**

And finally, what can we learn from pupils who beat their odds and do well despite their disadvantage? **In what circumstances do disadvantaged pupils tend to perform better, and are there lessons that can be applied more widely?**

4 What is disadvantage?

Defining disadvantage

Although the educational attainment of disadvantaged young people is a widely discussed policy and practice issue, detailed consideration of what we really mean by disadvantage is much rarer. Indeed, in much analysis and discussion, eligibility for free school meals is taken as definitive. The situation is, however, rather more complex.

A theoretical framework that has been widely used in educational research for the past two decades is the intergenerational persistence model (Haveman & Wolfe, 1995). According to this model, children's achievement is assumed to have two determinant factors: heredity and home investment. Heredity refers to innate traits and attributes that a child inherits from his/her parents, and home investment refers to time and a series of "goods" that a family needs to provide to ensure that the child will do well in school.

"Goods" can be concrete (books, a school kit or a healthy packed lunch); services (such as paid tuition or joining an after school club); or intangible (e.g. providing the child with an extensive vocabulary or the confidence to speak in public and answer a teacher's question). In particular, quality schooling can be considered both an essential and a premium "good", and one which requires a considerable investment for many families.

In the same way that each family or household has a certain level of income that allows its members to afford the goods and services necessary to their daily lives, families with school age children

possess "educational capital" that allows them to provide a child with what's necessary to do well at school. Similarly, we can think of poverty/disadvantage in the school context as the lack of sufficient educational capital to afford the necessary "goods".

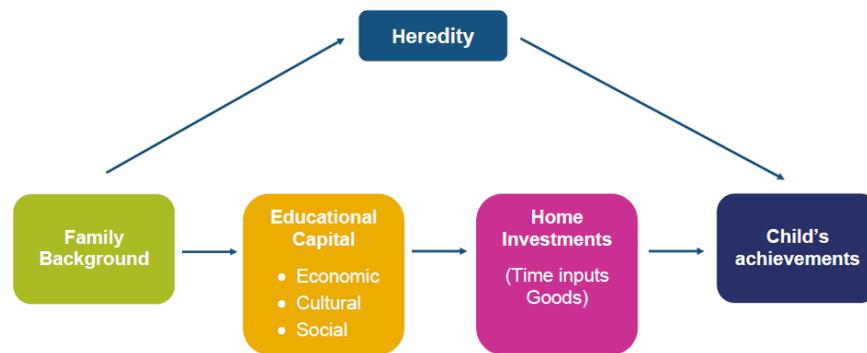
The intergenerational persistence framework is illustrated below. It shows that "educational capital" is the combination of three different types of capital: economic, cultural and social:

- **Economic capital** (a family's income) is an important component of overall educational capital. The links between poverty and a child's educational outcomes are universally acknowledged and a target of policy for many governments. However, it is only part of the picture: economic capital is not equivalent to educational capital.
- **Cultural capital** refers to "non-financial social assets that promote social mobility beyond economic means" (Bourdieu, 1986). In a school context, cultural capital includes parents' education, occupation, knowledge, and the cultural 'consumption' and practices within the household. Indeed, parents' education has been shown to be a more powerful predictor of children's educational attainment than household income alone (Ganzach, 2000; Sullivan & Brown, 2013; Sullivan et al., 2013).
- **Social capital** is defined by the Organisation for Economic Co-operation and Development (OECD) as "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (OECD, 2001) and relates in the school context to how well family members can relate and interact with each other, the community, and schools. Families that experience domestic violence; migrant families that experience discrimination or are not familiar with the host-country's social context; and single-parent

families can all be seen as disadvantaged in terms of social capital.

Economic, cultural and social capital is interconnected, and generally the most disadvantaged households are deprived of all three. However, as we move up the educational advantage/disadvantage spectrum a more nuanced picture emerges. For instance, there are children in lower income households who are endowed with substantial resources in terms of social and cultural capital, and also children that although not living in poverty are nevertheless deprived socially or culturally.

Figure 3.1 Intergenerational persistence of disadvantage



Source: Adapted from Haveman & Wolfe, 1995

Measures of disadvantage

At the present the DfE's main way of identifying disadvantaged children is those in receipt of free school meals (FSM) or who have been recipients at any given point in the previous six years (FSM6) (although additional support is also available for other groups, such as children who have been in care). The main advantage of these measures is that they are easy to compute and rely on a simple piece of information that is already available from schools and local authorities. However, as a measure of disadvantage FSM has three major shortcomings:

1. It groups all children into just two broad categories (FSM or not), not acknowledging that educational chances vary incrementally across the socio-economic spectrum. As a consequence, FSM often fails to identify children of families marginally above the eligibility threshold and of families that are just about managing but don't qualify for benefits (so-called "JAMs") as disadvantaged.
2. It relies on income-level as a proxy for poverty, with anyone earning more than £16,190 per year being automatically disqualified. However, income level per se is not an adequate characterization of economic capital, since factors such as housing or childcare expenses, number of children in the household or even regional variations have to be taken into account.
3. It disregards other important forms of disadvantage discussed above, particularly children whose lack of educational capital is mainly due to a shortage of social or cultural capitals.

For PISA, the OECD has developed an alternative measure of educational capital, the index of economic, social and cultural status (ESCS). Children scoring below the OECD average for ESCS are classified as being disadvantaged. ESCS is calculated as a weighted average of three indices, generated from PISA surveys:

- HISEI - the highest occupational status of a pupil's parents.
- ISCED (PARED) – the highest educational level of a pupil's parents (converted into years of education).
- HOMEPOS – an index of home possessions (measures the availability of 17 household items that act as measurements of family wealth and also the number of books at home).
- By taking socio-cultural factors into account and providing a more sophisticated measure of economic capital ESCS addresses many of the weaknesses of FSM. Unsurprisingly, ESCS is therefore a better predictor of educational achievement than FSM (Knowles & Evans, 2012), and previous (unpublished) analysis of PISA 2009 and 2012 results by NFER statisticians has suggested it could explain up to twice the variation in achievement.

ESCS also has the further advantage of being available for pupils from every country participating in PISA, and therefore offers an ideal lens through which to examine how well England is supporting the mathematics performance of disadvantaged pupils.

What is ESCS?

For the purposes of this report we are using the Economic, Social and Cultural Status (ESCS) index that's estimated for every student who participates in PISA. ESCS is based on pupils' responses to questions about their parents' background and education, and possessions in their homes. The index is set to a mean of zero across OECD countries, with a standard deviation of one. More detailed information about how the ESCS index is calculated is provided in the PISA [technical report](#).

5 How well is England supporting the mathematics performance of disadvantaged pupils?

The gap in mathematics performance between the most and least disadvantaged pupils in England is equivalent to over three years of schooling.

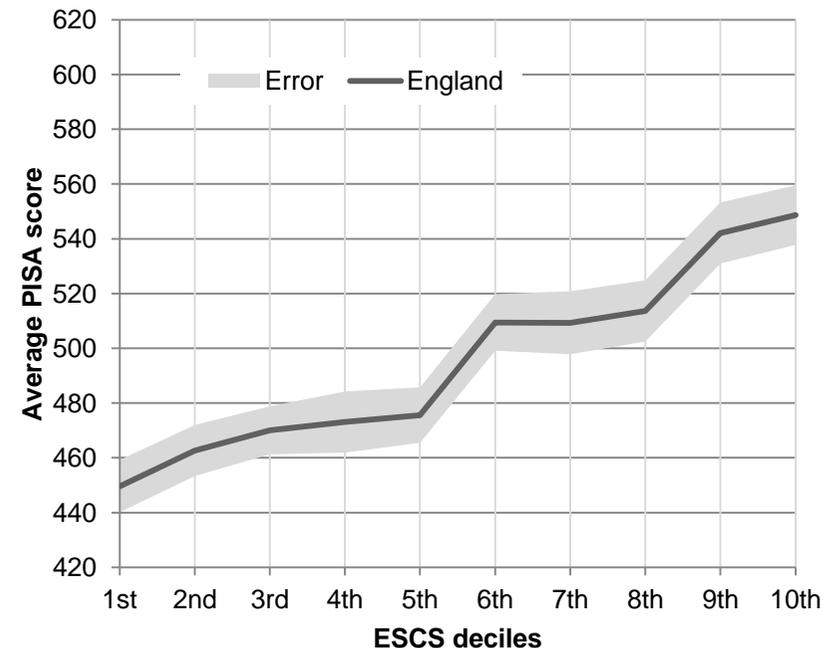
In common with other PISA countries, socio-economic status is associated with attainment in mathematics in England. The difference in achievement for the bottom ten per cent and the top ten per cent of pupils is 99 points, which is equivalent to over three years of schooling and close to the OECD average of 107 points. This is equivalent to the most advantaged pupils in England achieving at the average level of pupils in Hong Kong and the least advantaged pupils at the average level of pupils in Greece.

Socio-economic status affects the mathematics achievement of all pupils

Unlike the FSM measure, which only enables us to make comparisons between the performance of two groups of pupils (roughly 15 per cent of low income pupils and everyone else), ESCS allows us to make comparisons at every level of society. Figure 4.1 illustrates how for pupils at every point along the scale, slightly more 'advantaged' peers on average do better than them. Socio-economic status is therefore an important factor for all pupils – not just the least advantaged. If we are to fully de-couple life-

chances from socio-economic status policy will therefore need to be wide-ranging, addressing every level of society, not just the lower rungs.

Figure 4.1 Average mathematics score by ESCS decile in England



Source: NFER analysis of OECD PISA 2015

Socio-economic status has a smaller impact amongst the most disadvantaged compared with the least advantaged.

Despite these large differences across the range of socio-economic status, there is some evidence that socio-economic status has a smaller impact on mathematics performance for pupils with below average socio-economic status compared with those who have above average socio-economic status. This is evidenced from the smaller increases in score between the 1st and 5th deciles (25 points) compared with the greater increase between the 5th and 10th deciles (72 points).

This effect warrants further investigation, however one possible reason for it could be the impact of school funding linked to FSM eligibility (an important component of the school funding formula even before the introduction of the pupil premium) and – especially since 2011 – the focus on providing additional support to this group.

Across the UK, disadvantaged pupils participating in PISA 2012 reported receiving slightly more contact time in mathematics courses than advantaged pupils (OECD, 2016a). This was only seen in a few other countries e.g. Germany, Sweden and Switzerland.

Although socio-economic background is important, there are many other factors affecting performance.

Whilst the difference between the *average* pupil from high and low socio-economic background is large, there is also a lot of variation in performance *within* these groups. The percentage of the explained variance in mathematics performance for England is only 11 per cent (lower than the OECD average of 13 per cent). This

indicates that factors other than the ESCS have a greater impact in England than across the OECD.

This could be a consequence of pupil-related factors such as other forms of disadvantage, linked for example to gender, race or regional disparity.

It could also be a consequence of school-related factors. Research on the pupil premium in England undertaken by NFER (Macleod et al., 2015) found that although schools' intake and circumstances are influential in predicting attainment of disadvantaged pupils, schools have meaningful scope to make a difference – through effective leadership and intervention.

The research found that schools use a large number of strategies in order to improve the performance of disadvantaged pupils. Those considered most effective by schools were those which focused on teaching and learning, especially paired or small group additional teaching, improving feedback, and one-to-one tuition; all of which are supported by evidence of effectiveness in the Sutton Trust / Education Endowment Foundation's [Teaching and Learning Toolkit](#).

Leaders in schools that were more successful in raising the attainment of disadvantaged pupils emphasised that there was no single intervention that had led to success. Rather, more successful schools appeared to be implementing their strategies in greater depth and with more attention to detail. More successful schools saw raising the attainment of disadvantaged pupils as part of their commitment to help all pupils achieve their full potential. They prioritised quality teaching for all, seeing attendance, behaviour and emotional support as necessary but not sufficient for academic success.

Differences in achievement are also apparent using TIMSS' 'books at home' measure of socio-economic background.

TIMSS uses a 'books at home' measure to obtain pupils' socio-economic status. The results from 2015 for England found there was an association between this measure and pupils' average achievement in mathematics (Greany et al, 2016). Disadvantaged year 5 pupils (with 0-10 books at home) had an average mathematics achievement score 90 scale points lower than their advantaged peers (pupils with more than 200 books at home). For year 9, the scale point difference was 118.

A similar effect was seen when using FSM as the measure of disadvantage. For both year 5 and 9 non-FSM pupils achieved a higher average achievement score in mathematics than their FSM peers, with a difference of 41 scale points and 42 scale points respectively. Whilst year 5 FSM pupils scored above the international mean in TIMSS 2015, year 9 FSM pupils scored below the international mean in mathematics.

6 How does England compare with other countries?

There are two different ways to consider the impact of ESCS on mathematics scores across countries.

PISA data allows us to make two types of comparisons by socioeconomic status – absolute and relative:

- An **absolute ESCS comparison** compares the achievement of two pupils in different countries with the same ESCS (for example, it compares mathematics scores for a pupil in England with an ESCS of 0.2 with a pupil in Estonia who also has an ESCS of 0.2). It is useful insofar that the two pupils should share similar backgrounds, and so in theory should face similar barriers to learning. However, due to overall differences in the distribution of ESCS between the two countries, the two pupils may find themselves in very different positions relative to their peers.
- A **relative ESCS comparison** compares the achievement of two pupils who are at the same point in their country's ESCS distribution (for example, it compares mathematics scores for a pupil from among the most deprived ten percent in England with a pupil from among the most deprived in Estonia). Although they may have different ESCS scores to one another, they both represent the most disadvantaged within their own societies.

The type of comparison that is most appropriate depends on what we are most interested in: how pupils with a particular level of deprivation do compared with other countries, or how different

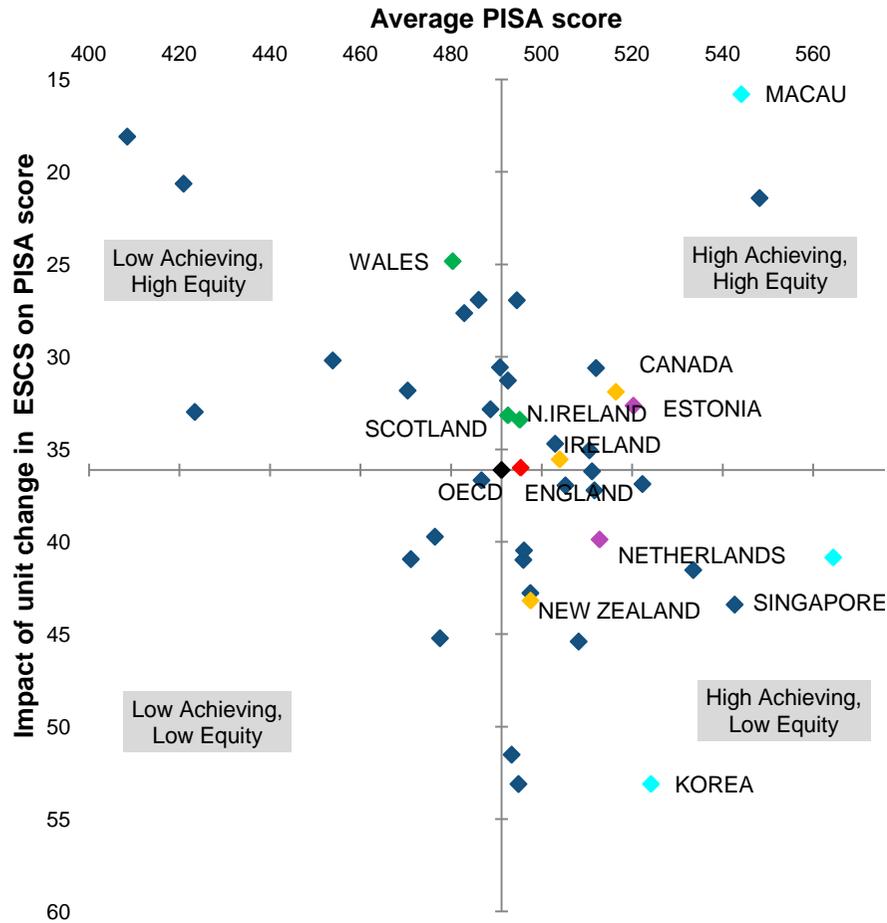
countries manage deprivation and inequality within their country. For the purposes of this report we are particularly interested in the latter, given the current policy narrative of 'a country that works for everyone', and so our analysis focuses on relative ESCS comparisons. TIMSS, on the other hand, uses a scaled score to measure socioeconomic status to determine an absolute measure to use as a country comparison. Therefore caution should be taken when comparing disadvantaged pupils from TIMSS 2015 to PISA 2015.

On average, pupils in England have a higher socio economic-status (0.21) than pupils across the OECD (0). This means that when comparing pupils at the same point in their countries' ESCS distribution (i.e. making relative comparisons), pupils in England will tend to be more advantaged in absolute terms.

On average disadvantage has less of an impact on mathematics achievement in England than in many other countries.

In order to make comparisons between multiple countries, Figure 5.1 plots the strength of the relationship between pupil background and PISA mathematics score on the y-axis. However, it is also important to consider a country's overall performance – if pupils perform poorly in general, the strength of the relationship between pupil background and performance may be small, but equally not something to be emulated. Therefore, the x-axis plots all participating countries by their average score in mathematics. Countries we would be most interested in exploring are those with above average PISA performance and with a smaller than average relationship between ESCS and PISA mathematics performance. These are countries in the top-right quadrant.

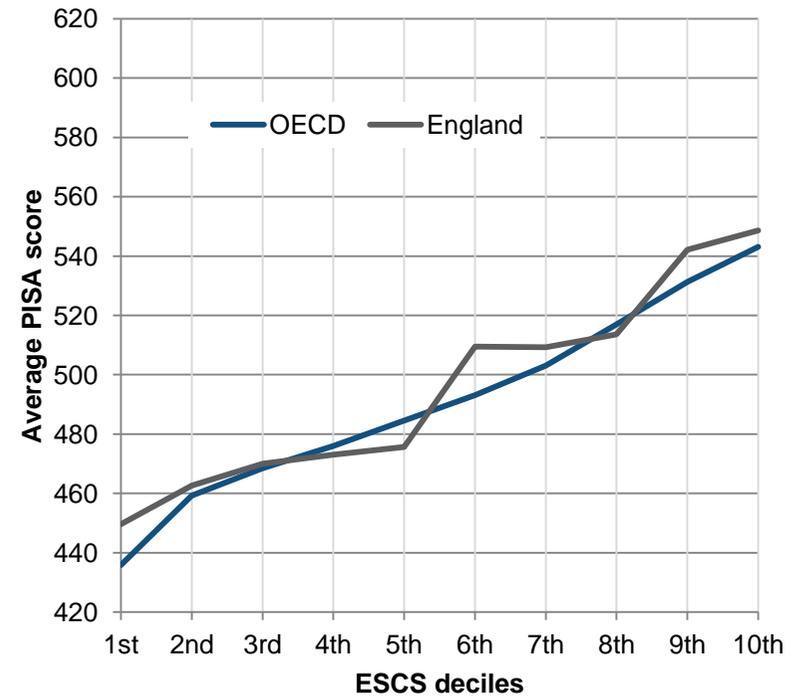
Figure 5.1 Strength of relationship of ESCS and performance in mathematics



Compared with the OECD average, disadvantage in England has similar level of an impact on mathematics achievement, and average mathematics performance across all pupils is very similar.

This is illustrated in figure 5.2 which shows the mathematics performance of pupils in England compared with the OECD average by decile of socio-economic status.

Figure 5.2 Average mathematics score by decile in England compared with the OECD average



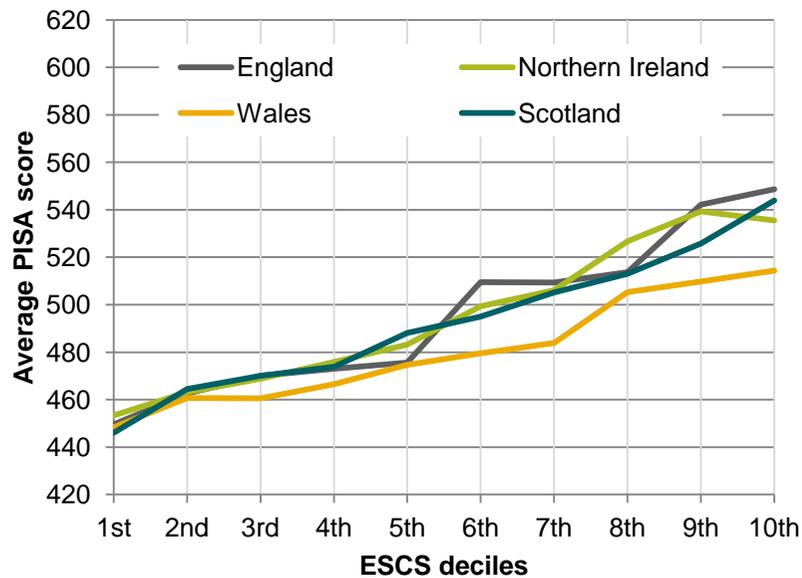
Source: NFER analysis of OECD PISA 2015

If we compare England's performance with other parts of the UK, England has the least equitable outcomes by pupil background. This is illustrated in figure 5.3, which shows the mathematics performance of pupils in each country of the UK by decile of socio-economic status (i.e. the chart compares equality *within* each

country, not pupils of similar socio-economic status across countries). The steeper the slope of mathematics score the greater the impact on average that an increase in ESCS has on mathematics score of pupils.

Wales' flatter slope indicates the lower impact of ESCS on performance compared with other parts of the UK, but the position of its line below the other parts of the UK reflects its poorer performance overall. The ideal, therefore is to maintain a flatter slope, but shift the line upwards with better performance at each decile. Scotland and Northern Ireland have similarly equitable outcomes by pupil background and overall performance to England.

Figure 5.3 Average mathematics score by decile in England, Wales, Northern Ireland and Scotland

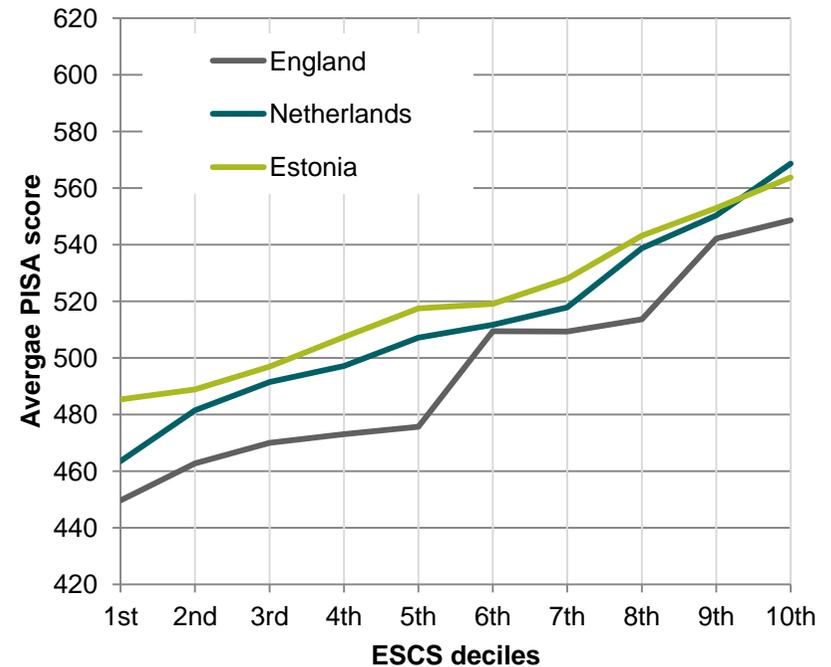


Source: NFER analysis of OECD PISA 2015

The Netherlands and Estonia perform better than England, and Estonia is also more equitable.

Figure 5.4 presents the relationship for England compared with two high performing European countries: the Netherlands and Estonia. Both countries perform better than England, but whereas in Estonia ESCS has a smaller impact on outcomes (indicated by a flatter slope) in the Netherlands the average impact of ESCS is greater.

Figure 5.4 Average mathematics score by decile in England, Netherlands and Estonia

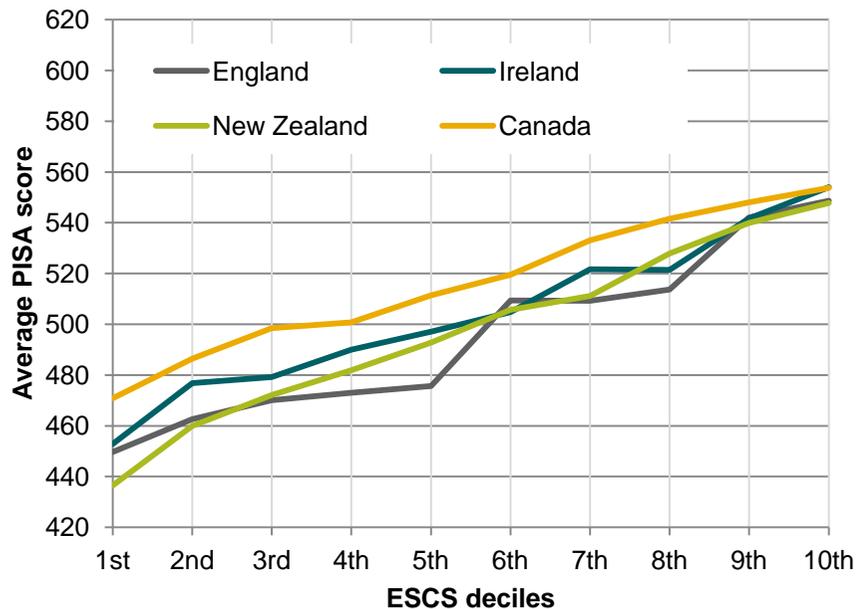


Source: NFER analysis of OECD PISA 2015

Canada is an example of a high performing predominantly English speaking country with more equitable outcomes.

Looking further afield at other predominantly English speaking countries, Figure 5.5 shows that not only does Canada perform very well in PISA overall, the educational outcomes of pupils in Canada are more equitable when pupil background is taken into consideration. This contrasts with the outcomes in Ireland and New Zealand which are more similar to England.

Figure 5.5 Average mathematics score by decile in England, Ireland, New Zealand & Canada

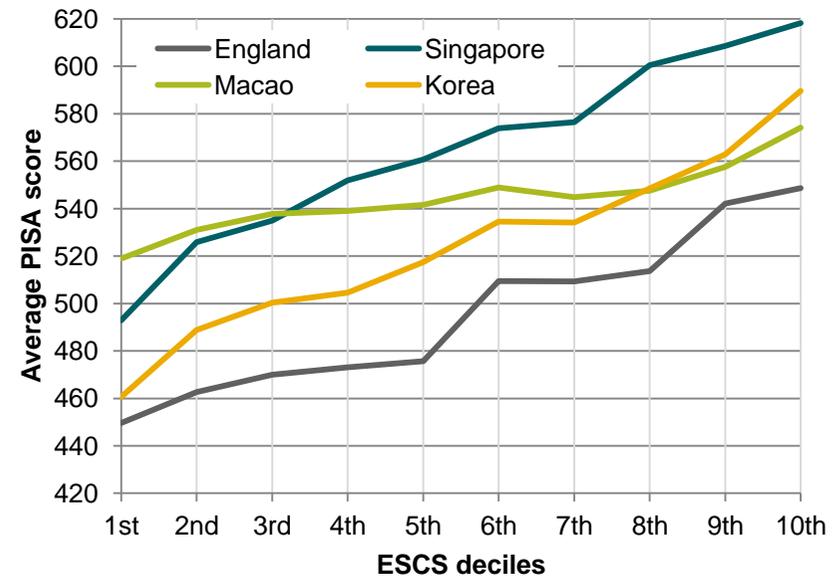


Source: NFER analysis of OECD PISA 2015

The high performing jurisdiction of Macao is the most successful PISA participant at limiting the link between pupils' background and performance.

The performance of pupils in England is often compared with that of high performing South East Asian participants. But how much of an impact does ESCS have on pupils' scores? Macao is particularly successful at limiting the link between ESCS and points score, but is a small city state in very different circumstances to England, and so comparisons should be treated with caution. In contrast, ESCS has a stronger impact on performance in Singapore and Korea than in England.

Figure 5.6 Average mathematics score by decile in England, Singapore, Macao and Korea



Source: NFER analysis of OECD PISA 2015

7 How does this compare with previous years?

The relationship between disadvantage and performance of pupils in England is very similar to the previous round of PISA.

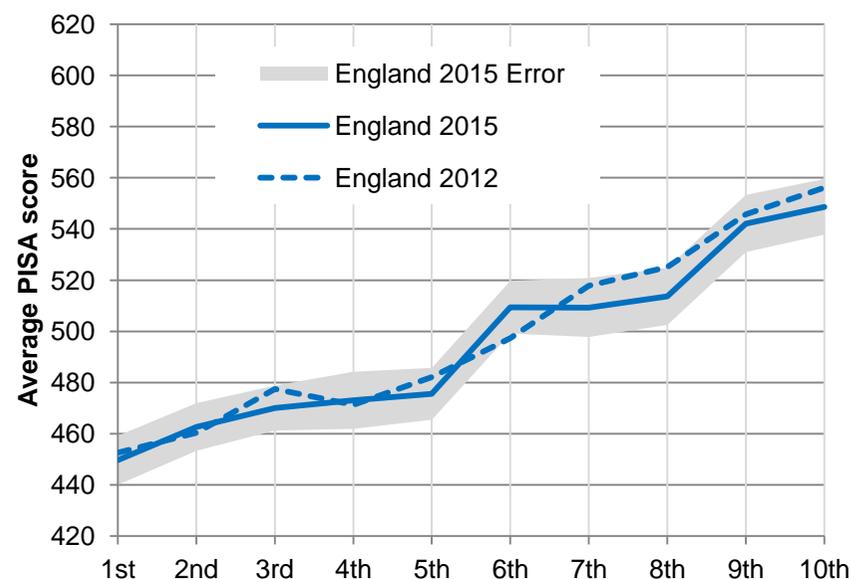
Figure 6.1 compares the performance of pupils in England by decile ESCS in PISA 2015 (solid line) and PISA 2012 (dashed line). The shaded area around the PISA 2015 line shows the error, that is the range that we can be 95% confident the true score for that decile falls within. The PISA 2012 score at each decile falls within the error range at each decile and therefore the impact of background on pupil performance relative to other OECD countries has neither increased nor decreased in the last three years.

In order to consider how the variability of outcomes is changing over time among pupils of given ESCS, we can look at the percentage of pupils who are resilient in each PISA cycle. Resilience is explored further in Chapter 9, and is defined as pupils with high levels of disadvantage who nevertheless achieve highly. There is some evidence of slight improvement over time, with around 23 per cent of disadvantaged pupils classified as resilient in 2006 and 2009, increasing to 26 and 25 per cent in 2012 and 2015 respectively.

Performance of pupils at each level of disadvantage in England has remained static since 2012 whilst performance of other OECD countries has fallen, on average.

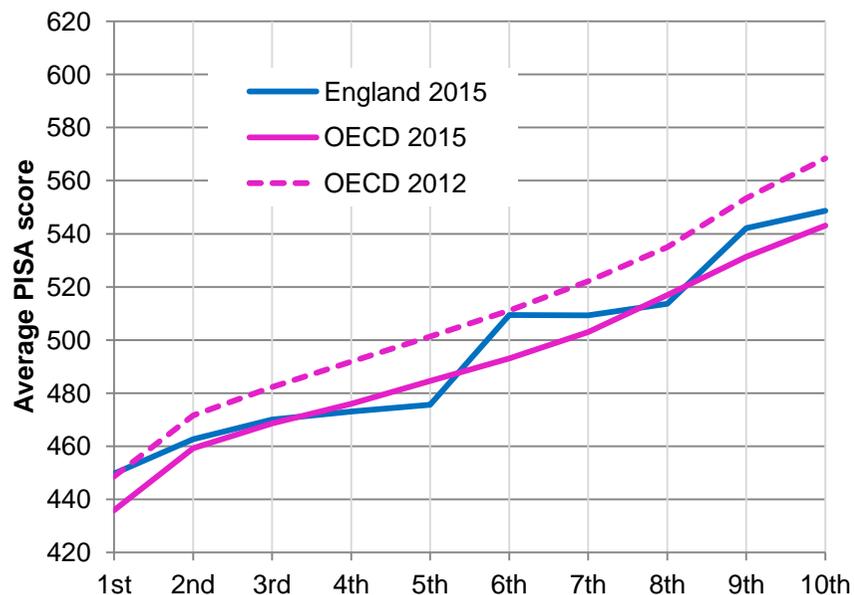
Whilst it is disappointing that performance of pupils in England at each level of ESCS is unchanged since 2012, the performance of pupils in other OECD countries has fallen, on average. This is illustrated in figure 6.2 where the 2015 OECD average (solid pink line) is lower than the 2012 OECD average (dashed pink line).

Figure 6.1 Average mathematics score by decile of pupils participating in PISA 2012 and 2015 in England



Source: NFER analysis of OECD PISA 2012, 2015

Figure 6.2 Average mathematics score by decile of pupils participating in PISA 2012 and 2015 in the OECD



Source: NFER analysis of OECD PISA 2012, 2015

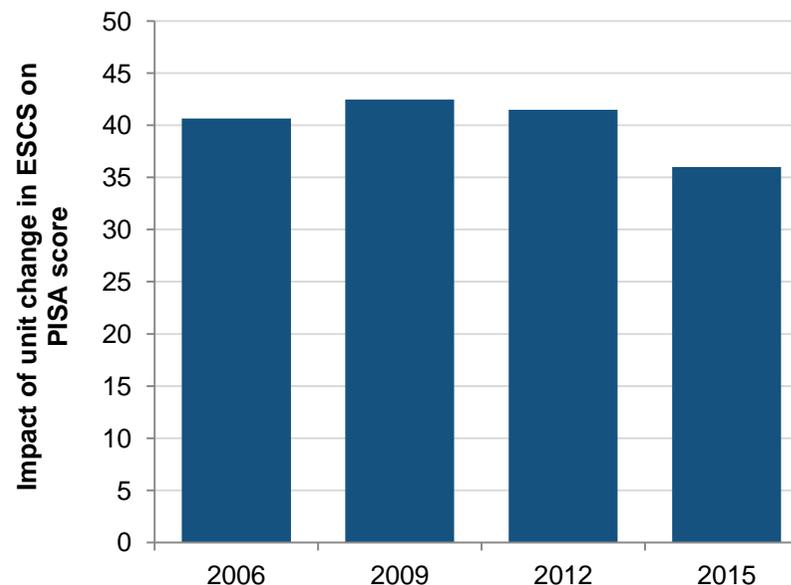
The relationship between disadvantage and achievement is very difficult to break.

The relationship between ESCS and average mathematics score in England has been stable since 2006. Although the average impact of a unit change in ESCS has reduced slightly since 2006 (illustrated in Figure 6.3), this change is not statistically significant.

When the same comparisons are made across all participating countries, only nine countries have significantly reduced the relationship between ESCS and attainment in mathematics

between *any* rounds of PISA since 2006. In many of these cases changes were just one-off, and in other cases they were reversed. The only two countries to have seen a sustained reduction in the impact of disadvantage over successive rounds of PISA are the USA and Mexico. However, neither of these countries performs well overall, and are therefore are not countries we would necessarily seek to emulate.

Figure 6.3 Average ESCS of pupils in England between PISA 2006 and 2015



Source: NFER analysis of OECD PISA 2006, 2009, 2012, 2015

8 Are there areas of mathematics at which disadvantaged pupils are particularly weak?

The performance gap for disadvantaged pupils applies to all areas of mathematics.

PISA 2012 had a focus on mathematics and allows for further analysis to build a deeper understanding of pupil performance in different areas of mathematics (equivalent analysis focussing on science would be possible using PISA 2015 data).

Figure 7.1 shows the average performance of disadvantaged pupils overall in mathematics and for each PISA mathematics content and process area, compared with their advantaged peers (blue dots) and the difference between the two groups (green bars). The two groups refer to pupils who are in the bottom and top 25 per cent of the ESCS distribution respectively.

The gap between these two groups of pupils is very similar for each area, showing that disadvantaged pupils do not disproportionately under perform in any component compared with their advantaged peers. Disadvantaged pupils do perform significantly worse in Space and Shape compared with their overall mathematics achievement; however this is the case for advantaged pupils as well.

There seems to be no pattern in the magnitude of differences between content and processes. The largest difference was observed in the formulate process.

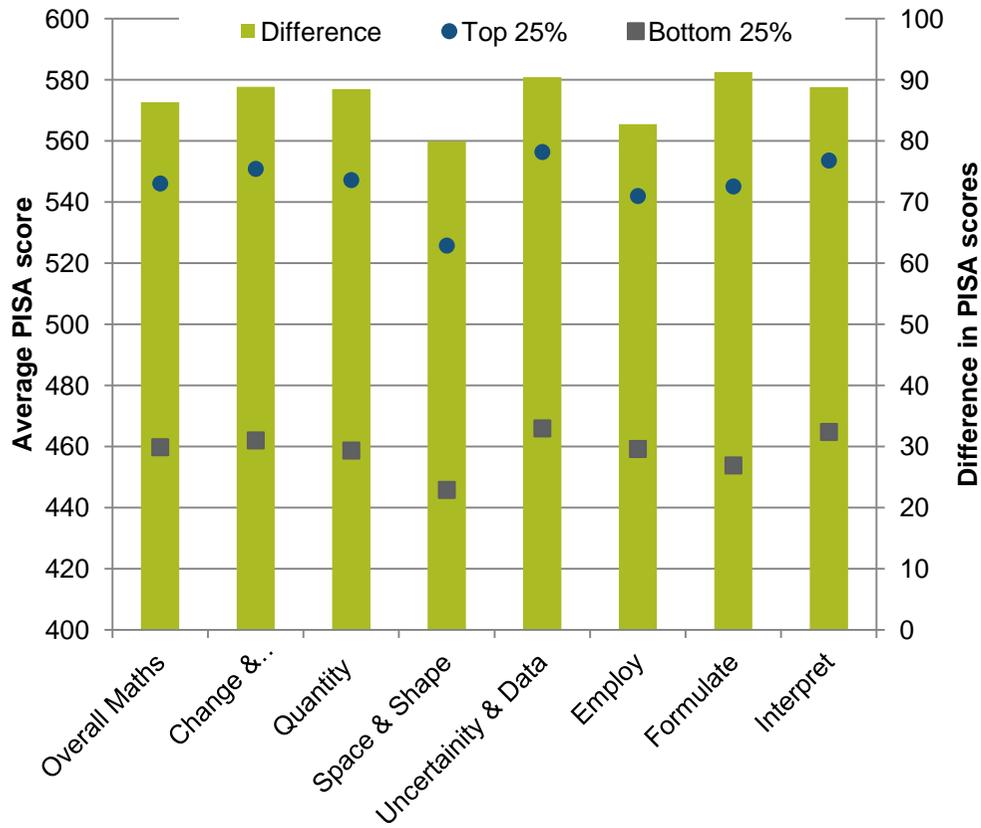
When compared with performance of other countries, England ranks in a similar position across content and process areas of mathematics. This further supports the notion that disadvantaged pupils in England do not show particular areas of strength or weakness.

Mathematical literacy in PISA

PISA assesses mathematics across four content areas (Change & Relationship, Quantity, Space & Shape, Uncertainty & Data) and three processes (Employ, Formulate, Interpret). This provides the opportunity to identify how disadvantaged pupils are performing at different types of mathematical problems, and whether there are areas of particular weakness.

Information regarding domains is featured in [PISA 2012 Assessment and Analytical Framework](#).

Figure 7.1 Score across domains for disadvantaged pupils and their advantaged peers



Source: NFER analysis of OECD PISA 2012

9 In what circumstances do disadvantaged pupils tend to perform better?

As discussed in Chapter 5, there is greater variability in outcomes for pupils with a given ESCS score in England compared with the OECD. There are, therefore, a higher proportion of pupils who “beat the odds” by achieving more than would be expected given their socio-economic status (and also more who do even worse than expected). This section explores whether there are pupil characteristics which are associated with better performance, in spite of socio-economic disadvantage – described in the remainder of this section as “resilient pupils”.

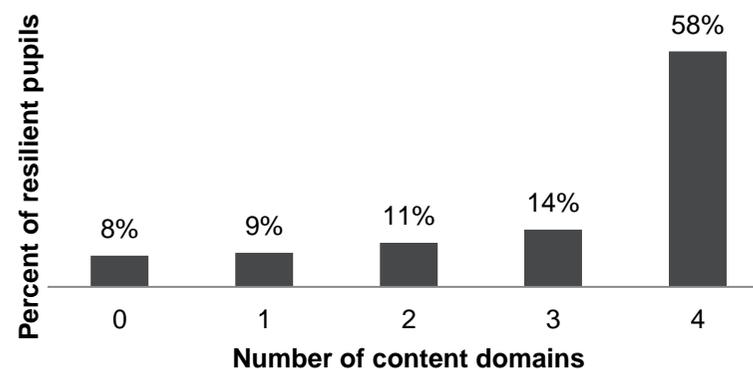
What is resilience?

A resilient pupil is a pupil who outperforms her or his peers sharing the same socio-economic background. Resilient pupils are those who fall into the bottom quarter of their country’s socio-economic background distribution and the top quarter of their country’s performance distribution.

Do resilient pupils have particular strengths?

Resilient pupils tend to perform highly in mathematics as a whole rather than in specific domains. Figures 8.1 and 8.2 show that 58 per cent and 60 per cent of resilient pupils are resilient in all mathematical content areas and all mathematical processes, respectively. In general, high performing, low ESCS pupils show an aptitude towards mathematics overall.

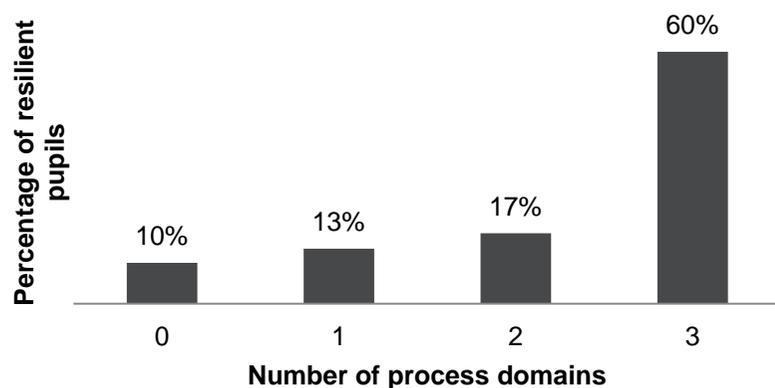
Figure 8.1 Percentage of resilient pupils by number of individual domains for which they are resilient



Source: NFER analysis of OECD PISA 2012

A small proportion of pupils (8 per cent) were resilient in none of the individual content or process areas, but were resilient overall. These pupils were consistent performers who, whilst not achieving in the top 25 per cent for any one area of mathematics, do appear in the top 25 per cent for overall mathematics score.

Figure 8.2 Percentage of resilient pupils by number of mathematical processes for which they are resilient



Source: NFER analysis of OECD PISA 2012

What are the characteristics of resilient pupils in England?

To identify factors associated with resilience we undertook a regression analysis. This predicted the likelihood of a disadvantaged pupil being classified as resilient given their individual characteristics. It is important to note when interpreting these findings that they demonstrate an *association*, but do not prove causality. Indeed, it is possible that the factors identified are a consequence rather than a cause of better mathematics achievement. Nevertheless, this analysis serves to highlight areas for future attention by policymakers, practitioners and researchers.

Figure 8.3 identifies factors which are significantly associated with resilience. The beta values give the relative magnitude of the

effects and, therefore, allow factors to be compared. The higher the degree of significance, identified by the number of stars, the less likely the observed result would occur due to chance. Three factors in the regression were found to have a significant positive association with the likelihood of a disadvantaged child being resilient (highlighted in green), and four were found to have a significant negative association (highlighted in red).

The sections below provide further details of the characteristics of pupils in England who show resilience in mathematics.

Figure 8.3 Characteristics significantly associated with resilience

Variable	Beta & significance
Self Confidence in Mathematics	0.26***
Second Generation Immigrant	-0.20*
Belonging to School	-0.18***
Truancy (late to school)	-0.18**
Exposure to Pure Mathematics	0.15**
Mathematics Intention	-0.10*
Age	0.09**

*($p < 0.05$), **($p < 0.01$), ***($p < 0.001$)

Source: NFER analysis of OECD PISA 2012

What are the characteristics of a resilient pupil?

A resilient pupil is likely to be old for their year (autumn born), feel little belonging to their school, have had exposure to pure mathematics, have little intention of further study or work with mathematics, is confident in mathematics, arrives on time to school, and is not a second generation immigrant.

Self confidence

Relative to the other variables, self confidence in mathematics had the strongest association with resilience, and was found to be highly significant. Disadvantaged pupils who are more confident in mathematics were more likely to be high achievers.

This is consistent with OECD research (2011, 2016a), but as already noted, this does not necessarily indicate causality. For example, whilst a pupil who is more confident in mathematics may go on to achieve better marks, the questions regarding self confidence in the PISA survey lend themselves to more positive answers from high achieving children. Nevertheless, self confidence is important for children to attempt a greater number and difficulty of questions which facilitates higher achievement.

Second generation immigrant

Disadvantaged pupils who are second generation immigrants are less likely to be resilient compared with native British counterparts. Compared with other factors, it had the greatest negative effect

observed. However, the broad category of second generation immigrant used here may not be very informative due to it grouping together culturally and historically distinct ethnic groups.

This is a surprising result, given that lower socio-economic status white British pupils are consistently one of the lowest performing groups in schools and have become a focus of policy (The Education Committee, 2014). At age 16, amongst lower socio-economic status children, all ethnic minority groups significantly outperform white British pupils, apart from black Caribbean boys (Strand, 2014).

The reduction in likelihood is unlikely to be due to English being an additional language (EAL), since no similar effect is seen for first generation immigrant children (although first generation immigrants constituted a very small number in the sample, so even if there was an effect this would be hard to detect). Furthermore, several ethnic groups (likely to comprise 1st, 2nd and subsequent immigrant generations), have smaller socio-economic status attainment gaps in GCSE results when considered using FSM entitlement (Strand 2014).

How then can this be explained? FSM and ESCS are two different measures of disadvantage so comparisons need to be made with care. For example, as a more sophisticated measure of disadvantaged than FSM, ESCS may be accounting for the factors over and above income that normally contribute to other ethnic groups performing well. The same may be true of the other variables included in our regression model (such as self-confidence and sense of belonging) which could act as mediators for the more commonly observed positive association. In which case, the 'second generation immigrant' effect observed here could be

picking up on other underlying factors associated with second generation immigrant status that are not usually detected by more straightforward analyses and which operate alongside these other observed factors.

Sense of belonging

A disadvantaged pupil's sense of belonging to their school is negatively associated with resilience in PISA. The scale indices measured how much a pupil agreed with various statements about feelings of inclusion at school i.e. "I make friends easily at school". Compared with other variables, it had a negative effect and was highly significant. This result is counter-intuitive, since one would expect a child who felt part of the school to be happier and more engaged, possibly resulting in higher performance.

One possible explanation is that resilience is *causing* a feeling of 'otherness' in the sense that they are less likely to match the ESCS standing of other high performing pupils and they outperform peers with similar levels of ESCS. It may also indicate that resilient pupils are independent and motivated learners who are succeeding 'off their own back' and feel little sentimental connection with their school (although other factors such as motivation for mathematics, interest and work ethic are not found to be significant). Another possibility is that high performing children and the aptitude they display may result in them not requiring as much support from staff as other children, reducing a sense of belonging.

Truancy

Truancy, measured by self-reported frequency of late arrival at school, is found to reduce the likelihood of a disadvantaged child being resilient. It showed a similar amount of influence as sense of belonging but a lower level of significance. This reflects OECD research which found the time spent in class by a lower ESCS child was a large predictor of resilience (OECD, 2011).

To improve the performance of disadvantaged pupils and encourage resilience, some schools provide incentives to ensure pupils arrive on time. Although this may result in some improvements, it risks oversimplifying the issue. Consistently arriving late to school could indicate a low level of support and drive for academic success in the family home. Indeed, where parents of disadvantaged children are engaged in their learning, this can be an effective means to support improved achievement (Grayson, 2013).

Pure mathematics

Exposure to pure mathematics was found to have the second greatest positive effect, and third greatest overall, on the likelihood of resilience. OECD research (2016a) has found a similar effect internationally.

The suggested explanation is that pure mathematics provides a firm basis of concepts and understanding upon which other mathematical tasks can be achieved. A great deal of attention has, therefore, been given to disadvantaged pupils' lack of opportunity to learn and engage with pure mathematics; and suggestions that

engaging low performing, low ESCS pupils in pure mathematics will raise overall standards.

However, care is needed with this approach. Greater exposure to pure mathematics for low achieving pupils may overwhelm them and have a negative effect on confidence. There may also be an issue of reverse causality whereby more able (and hence resilient) disadvantaged pupils are being streamed into higher ability classes which focus more on pure maths.

Mathematical intentions

Increased mathematical intentions, measured by whether a pupil intends to further study mathematics or work in a job requiring mathematics, had a weak but significantly negative effect on resilience. Again, this result seems counterintuitive, and is not reflected in related factors such as motivation and work ethic.

It is important to note that we have not considered these pupils' performance in other subjects, and it is possible that high performers in mathematics may also be achieving highly in other disciplines in which they have a greater interest in further study.

Age

The weakest of the positive effects was within year age¹, with disadvantaged children born in the autumn more likely to be resilient than their peers who were born in the following summer. This is consistent with a range of other research, including

¹ All children were aged between 15 years and 3 months and 16 years and 4 months when they participated in PISA

Crawford, Dearden & Greaves (2013) who found age to be a significant predictor at GCSEs, A levels and beyond to higher education. It is nevertheless notable that the effect persists with the alternative outcome measure of PISA score, and even having controlled for a range of other factors.

This finding suggests that policies targeted at supporting pupils who are younger within year could particularly help to tackle disadvantage. Further research into classroom practices that are effective in supporting younger pupils could also be undertaken so that schools are equipped to adopt these practices more widely.

Gender

Notable by its absence, gender was not found to be a significant predictor of resilience. This is despite boys achieving significantly higher than girls in PISA mathematics overall when ESCS is not taken into account (Wheater et al 2013). The absence of a gender effect could be due to the counteracting effect of underperformance among low socio-economic status white British boys (Sammons et al., 2015; Tackey et al., 2011).

However, this is not to say white working class girls do not underperform; compared with other ethnic groups of similar socio-economic status they are also underachievers (Education Committee, 2014). In fact, the parliamentary report on the underachievement of white working class noted that there has been too greater emphasis placed gender (Education Committee, 2014).

9 Conclusions and recommendations

Conclusions

On average England is supporting its disadvantaged pupils no worse than other OECD countries. Nevertheless, the gap in performance between our most and least disadvantaged pupils is equivalent to over 3 years of schooling at age 15. Furthermore, it is an effect that is felt at every point across the socio-economic spectrum. The international evidence shows that this gap is very difficult to shift, but it is lower in other countries, notably including Wales, Northern Ireland and Scotland.

Our analysis has shown that disadvantaged pupils in England do not have weaknesses in particular aspects of mathematics, but rather their performance is weaker across the board. The fact that disadvantage affects all areas of mathematics, and every point of society, suggests that any solutions intended to close the gap will need to be far-reaching (Whitehouse and Burdett, 2013).

One area for attention is grouping pupils by ability, which the evidence suggests is detrimental to the learning of low attaining pupils in mathematics, and is a particularly to the detriment of disadvantaged pupils as they are more likely to be in the low attaining group (Higgins et al., 2013). Setting can in turn lead to low ability pupils being exposed to less rigorous mathematics and so are not given the opportunity to reach their full potential (Schmidt and Burroughs, 2015).

This issue is currently highly relevant due to Government plans to expand selection by ability in England. Critics of grammar schools argue that selective education amplifies tracking, having detrimental consequences for pupils who did not meet the level of proficiency required. However, supporters of grammar schools assert that it removes the socio-economic attainment gap rewarding academic ability rather than the ability to access resources. Either way, it is clear that tracking *within* schools should also receive attention during current debate surrounding allocation of pupils *between* schools.

Recommendations

Pupils would benefit from more sophisticated measures of deprivation.

The impact of social and economic background of a pupil on school performance can be seen at every level in society; for any pupil, an increase in ESCS on average is associated with an increase in maths achievement. Therefore the dichotomous measure of eligibility of free school meals, used to allocate funding and target intervention, is not granular enough to work for everyone. New measures should be explored, for example using additional data sources to supplement if not replace FSM. These should also address forms of disadvantage linked to cultural and social capital in addition to economic capital. Equipped with new measures, policy should then be re-oriented around this broader, more nuanced view of the reach and nature of disadvantage in affecting educational outcomes.

Summer-born pupils need a strategy to ensure that they are not left behind.

Summer-born pupils are less likely to be resilient than their autumn-born counterparts. The comparative poor performance of summer-born children is a consistent finding throughout the research literature.

There have been suggestions that parents of summer-born children should be able to choose the year of schooling they enter, but this approach is likely to be to the detriment of more disadvantaged pupils: parents unable to afford an additional year of childcare may choose to send their children to school early and those from more affluent backgrounds may be more likely to delay the first year of school. This could then exacerbate the problem as instead of a class of pupils with up to 12 months difference in age, the age range could increase to 15 months. In addition, this approach still leaves some children the youngest in the year; and therefore, more targeted support for pupils young for their year may make more sense.

Alternative strategies should therefore be identified, subjected to evaluation, and where successful adopted more widely.

Further research on the characteristics of resilient pupils is needed to understand why some pupils beat the odds.

There is more we can learn from pupils who beat their odds to perform highly in mathematics – pupils identified as ‘resilient’. This report identifies characteristics associated with resilience, but there is more that we would like to learn about these pupils. Linking the PISA database to the national pupil database and other datasets,

such as school workforce data, will give us further clues on resilient pupils.

Further measures are needed to support schools in adopting evidence-informed strategies, including through EEF.

The absence of particular areas of weakness in mathematics among disadvantaged pupils, with poorer attainment seen across the board, suggests that schools should adopt a wide range of strategies to combat poor performance. However, it will be important to focus on interventions with evidence of effectiveness, and for schools to share learning, for example through a growing role for Research Schools and Teaching School Alliances.

10 References

Allen, R., Thompson, D. and Education Datalab (2016). *How are the EBacc and Attainment 8 Reforms Changing Results?* (Research Brief Edition 13). Oxford: The Sutton Trust. [online]. Available: http://www.suttontrust.com/wp-content/uploads/2016/07/Changing-the-subject_V4.pdf [12 December, 2016].

Bourdieu, P. (1986) 'The forms of capital'. In J. Richardson (Ed.) *Handbook of Theory and Research for the Sociology of Education* New York: Greenwood, 241-258.

Crawford, C., Johnson, P., Machin, S. and Vignoles, A. (2011). *Social Mobility: A Literature Review*. London: Department for Business, Innovation & Skills [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32111/11-750-social-mobility-literature-review.pdf [12 December, 2016].

Department for Education (2014). *Factsheet: Progress 8 Measure*. London: DfE [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/285990/P8_factsheet.pdf [12 December 2016].

Department for Education (2015). *GCSE and Equivalent Attainment by Pupil Characteristics, 2013 to 2014 (Revised)* (Statistical First Release). London: DfE. [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/399005/SFR06_2015_Text.pdf [12 December, 2016].

Department for Education (2016). *Schools that work for everyone*. Government consultation. London: DfE [online]. Available: https://consult.education.gov.uk/school-frameworks/schools-that-work-for-everyone/supporting_documents/SCHOOLS%20THAT%20WORK%20FOR%20EVERYONE%20%20FINAL.PDF [12 December, 2016]

Department for Education and Greening, J. (2016). 'Social mobility package unveiled by Education Secretary', *Press Release*, 4 October [online]. Available: <https://www.gov.uk/government/news/social-mobility-package-unveiled-by-education-secretary> [12 December, 2016].

Ganzach, Y. (2000) Parent's education, cognitive ability, educational expectations and educational attainment: Interactive effects., *British Journal of Educational Psychology*, **70**,3, 419-441. [online] Available: <http://onlinelibrary.wiley.com/doi/10.1348/000709900158218/pdf> [14 December 2016].

Grayson, H. (2013). *Rapid Review of Parental Engagement and Narrowing the Gap in Attainment for Disadvantaged Children*. Slough and Oxford: NFER and Oxford University Press. [online]. Available: <https://www.nfer.ac.uk/publications/OUPP01/OUPP01.pdf> [12 December 2016].

Greany, T., Barnes, I., Mostafa, T., Pensiero, N., and Swensson, C. (2016). *Trends in Maths and Science Study (TIMSS): National Report for England*. (Research Report). London: DfE [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/572850/TIMSS_2015_England_Report_FINAL_for_govuk_-_reformatted.pdf [12 December, 2016].

Great Britain. Parliament. House of Commons. Education Committee (2014). *Underachievement in Education by White Working Class Children: First Report of Session 2014-2015*. [online]. Available: <http://www.publications.parliament.uk/pa/cm201415/cmselect/cmeduc/142/14202.htm> [12 December 2016].

Great Britain. Parliament. House of Commons. Committee of Public Accounts (2015). *Funding for Disadvantaged Pupils . Third Report, Together with Formal Minutes Relating to the Report* (HC 327).

London: TSO. [online] Available: <http://www.publications.parliament.uk/pa/cm201516/cmselect/cmpu/bacc/327/327.pdf> [12 December, 2016].

Haveman, R. & Wolfe, B. (1995) The determinants of children's attainment: a review of methods and findings, *Journal of Economic Literature*, **33**, 4, 1829-1878.

Higgins, S., Katsipataki, M., Kokotsaki, D., Coleman, R., Major, L. E., & Coe, R. (2013). The Sutton Trust-Education Endowment Foundation Teaching and Learning Toolkit.

Knowles, E. & Evans, H. (2012): *PISA 2009: How does the social attainment gap in England compare with countries internationally?* London: DfE [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/184110/DFE-RR206.pdf [14 December, 2016]

Macleod, S., Sharp, C., Bernardinelli, D., Skipp, A. and Higgins, S. (2015). *Supporting the Attainment of Disadvantaged Pupils: Articulating Success and Good Practice* (Research Report). London: DfE. [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/473974/DFE-RR411_Supporting_the_attainment_of_disadvantaged_pupils.pdf [12 December, 2016].

OECD (2001) *The Well-Being of Nations: The Role of Human and Social Capital*. Paris: OECD, **41**. [online]. Available: <http://www.oecd.org/site/worldforum/33703702.pdf> [14 December, 2016]

OECD (2011). How do some students overcome their socio-economic background? *PISA in Focus*, 5, June [online]. <http://www.oecd-ilibrary.org/docserver/download/5k9h362p77tf-en.pdf?expires=1481712686&id=id&accname=guest&checksum=DFCF7D34F141F7BC977C67934CB80E59> [14 December, 2016]

OECD (2014). *PISA 2012 Results in Focus: What 15-year-olds Know and What They Can Do With What They Know*. Paris: OECD [online]. Available: <http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf> [12 December, 2016].

OECD (2016). *Equations and Inequalities: Making Mathematics Accessible to All* [online]. Available: http://www.oecd-ilibrary.org/education/equations-and-inequalities_9789264258495-en [12 December, 2016].

OECD (2016b). 'Who are the low-performing students?' *PISA in Focus*, **60**, February [online]. Available: [http://www.oecd.org/pisa/pisaproducts/pisainfocus/pisa-in-focus-n60-\(eng\)-final.pdf](http://www.oecd.org/pisa/pisaproducts/pisainfocus/pisa-in-focus-n60-(eng)-final.pdf) [12 December, 2016].

Sammons, P., Toth, K. and Sylva, K. (2015). *Background to Success: Differences in A-level Entries by Ethnicity, Neighbourhood and Gender*. London: Sutton Trust [online]. Available: <http://www.suttontrust.com/wp-content/uploads/2015/11/Background-to-Success-Final.pdf> [12 December, 2016].

Schmidt, W.H. and Burroughs, N.A. (2015). 'Puzzling out PISA: What Can International Comparison Tell Us about American Education?' *American Educator*, Spring [online]. Available: http://www.aft.org/sites/default/files/ae_spring2015schmidt_burroughs.pdf [12 December, 2016].

Social Mobility Commission (2016). *State of the Nation Report on Social Mobility in Great Britain*. London: TSO [online]. Available: <https://www.gov.uk/government/publications/state-of-the-nation-2016> [12 December, 2016].

Strand, S. (2014). 'Ethnicity, gender, social class and achievement gaps at age 16: Intersectionality and 'getting it' for the white working class', *Research Papers in Education*, **29**, 2, 131-171. [online]. Available: <http://www.tandfonline.com/doi/abs/10.1080/02671522.2013.767370> [12 December, 2016].

Sullivan, A. & Brown, B. (2013) *Social Inequalities in cognitive scores at age 16: The role of reading* (London, CLS Working Paper 2013/10).

Sullivan A., Ketende, S. & Joshi, H. (2013) Social class and inequalities in early cognitive scores, *Sociology*, **47**, 4, 1187-1206 [online]. Available: <http://journals.sagepub.com/doi/pdf/10.1177/0038038512461861> [12 December, 2016]

Tackey, N, D., Barnes, H. and Khambhaita, P. (2011). *Poverty, ethnicity and education*, (JRF programme paper). York: John Rowntree Foundation. [online]. Available: <https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/poverty-ethnicity-education-full.pdf> [12 December, 2016].

Wheater, R., Ager, R., Burge, B. and Sizmur, J. (2013) *Achievement of 15-year-olds in England: PISA 2012 National Report (OECD Programme for Student Assessment)*. London: DfE. [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/299658/programme-for-international-student-assessment-pisa-2012-national-report-for-england.pdf [12 December, 2016].

Whitehouse, G. and Burdett, N. (2013). *Why Mathematics Education Needs Whole-System, Not Piecemeal Reform* (NFER Thinks: What the Evidence Tells Us). Slough: NFER. [online]. Available: <https://www.nfer.ac.uk/publications/99933/99933.pdf> [12 December, 2016].

NFER provides evidence for excellence through its independence and insights, the breadth of its work, its connections, and a focus on outcomes.

- independent
- insights
- breadth
- connections
- outcomes

**National Foundation for
Educational Research**
The Mere, Upton Park
Slough, Berks SL1 2DQ

T: 01753 574123
F: 01753 691632
E: enquiries@nfer.ac.uk
www.nfer.ac.uk

NFER Ref: PIAN

ISBN: 978-1-911039-35-8