The evolution of cognitive skills during childhood across the UK

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Executive Summary

Since devolution in 1999, the four UK nations have been gradually diverging on school and education policies. This has prompted high interest in the degree to which children's skills and educational performance are different across the four nations. Existing evidence is generally based on the OECD Programme for International Student Assessment (PISA) scores of 15-year-olds, published every three years, which includes sub-national comparisons of scores within the UK. Such comparisons tend to show that England performs just above the OECD average over time in numeracy and reading, and notably above average in science. Scores in Northern Ireland are close to the OECD average in reading and numeracy but have fallen over time in science. Reading scores are just above the OECD average in Scotland, but have fallen over time in numeracy and science . In Wales, scores have consistently been lower than in the rest of the UK, which has motivated significant school and education reform efforts.

Whilst valuable, PISA only records cognitive skills at age 15, missing how they evolve throughout childhood and headline results do not reflect the different family backgrounds of children across the four nations. Understanding this evolution is important as it could reveal when inequalities across nations emerge and where policymakers should be focusing, as well as the contribution made by parental background.

In this report, we use the Millennium Cohort Study (MCS) to provide a consistent picture of how the cognitive skills of children living in different countries of the UK evolve during childhood. In particular, we examine how the cognitive skills of a single cohort of children evolve between ages 3 and 14. The cognitive skills captured at different ages can be different, but most relate to reading, vocabulary or language. This analysis relates to a single cohort mostly born in 2000 and 2001, with outcomes measured from around 2003 up to 2015. Whilst this means we are often analysing cognitive skills measured over a decade ago, these are the most consistent measures currently available and these children will be very close in age to the 15-year-olds who took the most recent PISA tests in 2015 and 2018. Crucially, we also account for the large differences in demographics and socio-economic structures across the four nations (in this summary, all differences control for family background). The cognitive skill measures we focus on are not used in education accountability systems and are thus less susceptible to gaming or biases across the nations. We also show how the development of cognitive skills differs by various subgroups including gender, parental educational and household income.

A summary of the evolution of cognitive scores across Wales, Scotland and Northern Ireland, relative to England, is as follows:

Wales

- Most cognitive outcomes in Wales are very similar to England, after controlling for family background. This contrasts with much lower scores on PISA numeracy, reading and science outcomes.
- The main exception is lower performance on reading outcomes, particularly the age 7 reading outcome, which is 0.2 standard deviations below England. This is similar to the deficit seen in PISA and appears to be a persistent problem over time.
- Welsh children from middle income and education families appear to perform slightly better than, or similar to, those in England. In contrast, cognitive outcomes are similar or worse amongst Welsh children from households with high and low levels of income/education. This leads to mostly similar outcomes, on average, across all children.

Scotland

- Children in Scotland initially have the highest cognitive scores at age 3. They also come from families with relatively high education qualifications and parents have high vocabulary scores themselves.
- Despite this strong starting position, scores then fall behind other UK nations at later ages, particularly in maths, where children in Scotland are about 0.15 standard deviations behind England at age 7. This finding only relates to a single cohort, so it is hard to say whether this reflects changes across ages or time. However, we see from PISA that numeracy scores at age 15 have been declining over time.
- Lower maths scores are seen across all income groups, particularly the low-income group.

Northern Ireland

- Initially, children aged 3 in Northern Ireland have higher vocabulary scores, but lower measures of school readiness than children in England.
- From age 5 onwards, children in Northern Ireland score significantly higher, or similar, to England on almost all cognitive outcomes.
- Northern Ireland has the highest scores on six out of the eight cognitive outcomes between ages 5 and 14. Indeed, cognitive scores in Northern Ireland are generally above those in London, which has been widely celebrated as an educational success story.
- High cognitive scores are particularly apparent for children in Northern Ireland coming from a household with low income or parental education levels.

Conclusions and policy implications

This report is the second in our programme of work looking at educational comparisons across the UK. Our first report, published in April 2021, examined differences in institutions, policies and practices.[1] In future work, we will be undertaking more detailed comparisons of educational attainment for similar groups of pupils across England and Wales, making use of administrative data available for each country.

This report shows that there are differences in the development of children's cognitive outcomes across the four nations of the UK, but they do not provide a simple picture. There is clearly a role for broad institutional changes and there is already evidence specific to Wales showing how the removal of league tables reduced GCSE scores. However, these comparisons of the MCS data also show that comparisons of outcomes across the four nations differ by different domains of skills, with reading scores a particular problem in Wales, and maths and numeracy scores lower in Scotland. There is also a mostly positive picture in Northern Ireland, which adopted similar positions to Scotland and Wales on league tables and testing.

We conclude that future work be best directed towards analysing differences in the specific pedagogical and curriculum approaches across the four nations. For example, how the teaching of synthetic phonics was implemented and timed across nations, or how the teaching of maths in primary schools has changed. The differences across outcomes suggest this could be a fruitful area of investigation.

More UK-wide data is required to better understand differences in skills and educational achievement across the four nations, particularly given the large recent divergence in exams and assessments . More education-related surveys should be UK-wide or at least include comparable skill measures, rather than focused on individual countries. A feasibility study for a new UK-wide cohort study is currently under way, which could

[1] https://epi.org.uk/publications-and-research/a-comparison-of-school-institutions-and-policies-across-the-uk/

be very valuable if it translates into a full survey. More use could also be made of private or internal assessment data if such assessments are common or used in similar ways across UK nations.

1. Introduction

International rankings of educational performance, such as Programme for International Student Assessment (PISA) scores, are widely used by policymakers. Low rankings are often used to justify large-scale reforms, as has been the case in Wales. However, interpreting international differences is notoriously difficult. There are large and longstanding differences in educational practices and institutions across countries. There are also differences in cultural and socio-economic structures.

Cross-national differences within the UK are potentially more valuable given greater similarity in educational contexts and institutions, as well as greater availability of large-scale, detailed microdata. Such UK comparisons have been underutilised to date. It is also important to understand whether children living in different countries in the UK can obtain similar levels of education and skills, and ultimately achieve similar life outcomes.

Most existing UK comparisons are focused on PISA data.[2] Such comparisons tend to show that England performs just above the OECD average over time in numeracy and reading, and notably above average in science. Scores in Northern Ireland are close to the OECD average in reading and numeracy but have fallen over time in science. Reading scores are just above the OECD average in Scotland, but have fallen over time in numeracy and science. In Wales, scores have consistently been lower than in the rest of the UK.

While valuable, PISA only records cognitive skills at age 15, missing how they evolve throughout childhood and headline results do not reflect the different family backgrounds of children across the four nations. Understanding this evolution is important as it could reveal when inequalities across nations emerge and where policymakers should be focusing, as well as the contribution made by parental background.

In this report, we use the Millennium Cohort Study (MCS) to provide a consistent picture of how the cognitive skills of children living in different countries of the UK evolve during childhood. In particular, we examine how the cognitive skills of a single cohort of children evolve between ages 3 and 14. The cognitive skills captured at different ages can be different, but most relate to reading, vocabulary or language. This analysis relates to a single cohort born around 2000/2001. Whilst this means we are often analysing cognitive skills measured over a decade ago, these are the most consistent measures currently available and these children will be very close in age to the 15-year-olds who took the most recent PISA tests in 2018. Crucially, our analysis also accounts for the large differences in demographics and socio-economic structures across the four nations. The cognitive skill measures we focus on are not used in education accountability systems and are thus less susceptible to differential focus or biases across the nations. This analysis therefore goes beyond descriptive comparisons and gets us much closer to the true differences in skills across countries, at what point in childhood these gaps emerge and the relative success of policymakers in each country at closing skills gaps. We also examine differences in the performance of similar groups of students across the four nations, such as children from low-income families, differences by gender and by language spoken at home.

This is the second report in our programme of work on UK comparisons of education, complementing a recent report looking at institutional and policy choices of the four nations since devolution . We interpret the differences in cognitive development in light of these institutional and policy choices, though drawing precise causal connections between differences in skill and particular policy choices is not possible. In future work, we will be undertaking more detailed comparisons of educational attainment for similar groups of pupils across England and Wales, making use of administrative data available for each country.

Section 2 begins by setting our analysis in the context of what we already know about cross-national comparisons from PISA and other datasets. Section 3 sets out our data and methodological approach, and

[2] E.g. Jerrim and Shure, (2016); Andrews et al, (2017).

shows differences in key background variables and contexts across the four nations. Section 4 presents our main analysis of the evolution of cognitive skills across the UK, with section 5 analysing differences amongst particular sub-groups of interest (e.g. by gender, level of disadvantage and language spoken at home). Section 6 concludes with a summary and further thoughts on policy implications.

2. Existing cross-national comparisons

Most existing cross-national comparisons of educational attainment and skills are based on the OECD Programme for International Student Assessment (PISA) scores of 15-year-olds, published every 3 years. This includes comparisons of scores within the UK. Figure 2.1 shows the average scores for England, Wales, Scotland and Northern Ireland over time for numeracy, reading and science, together with the OECD average.

The average across OECD countries was 500 when PISA began in 2000 and the standard deviation was 100. Since then, these have been used as a norm or anchoring point. However, the actual mean has declined over time as more countries have joined PISA. The actual mean across OECD countries has therefore declined to about 490 across numeracy, reading and science in 2018. The standard deviation has also changed over time, but remains close to 100. This information is important to note when seeking to understand the relative size of differences in PISA, particularly when comparing against our results based on the MCS.

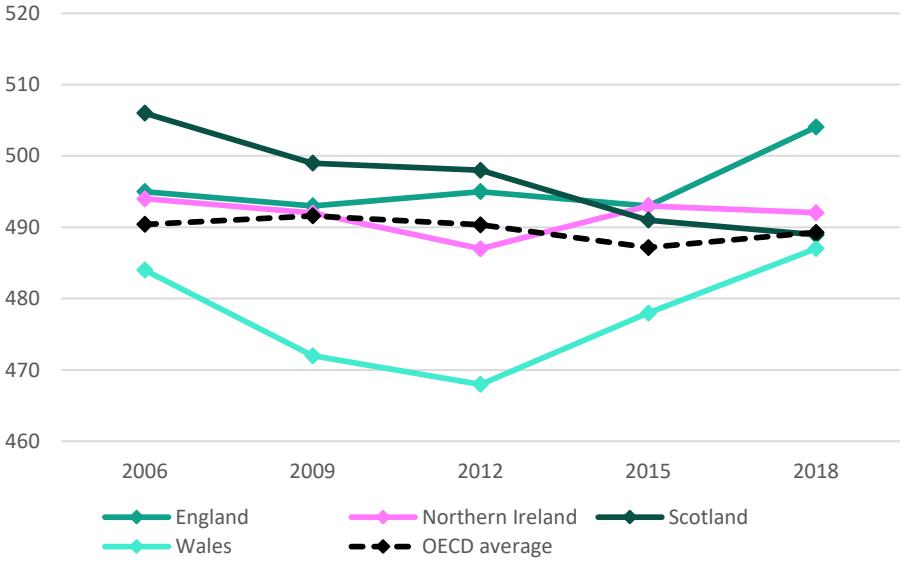
The most notable feature of these differences is the extent to which average scores in Wales are below the OCED average and the rest of the UK. Numeracy scores in Wales were about 20 points below the OECD average in 2009 and 2015, though this deficit fell to 10 points by 2015 (about 0.1 standard deviations) and was close to zero by 2018. Reading scores in Wales have remained around 480 points throughout the period and about 10 PISA points below the OECD average for much of the period. The actual difference relative to the OECD fell in 2018, but this was mostly because the OECD average was falling. The actual difference compared with the rest of the UK in 2018 was about 20 points or about 0.2 standard deviations. Science scores have dropped from 505 in 2006 (above the OECD average) to about 490 in 2018 (close to a declining OECD average).

The differences and trends over time for England, Scotland and Northern Ireland are less dramatic, being generally close to the OECD average over most of the period. However, there has been a clear decrease in numeracy scores for Scotland over time. Average numeracy scores in Scotland were over 500 and above the OECD average in the late 2000s, but have fallen to about 490 (close to the OECD average). There has also been a slight increase in England, where scores are about 0.1 standard deviations above the rest of the UK. Reading scores were around 500 throughout the period for England, Scotland and Northern Ireland, about 0.1 standard deviations above the OECD average.

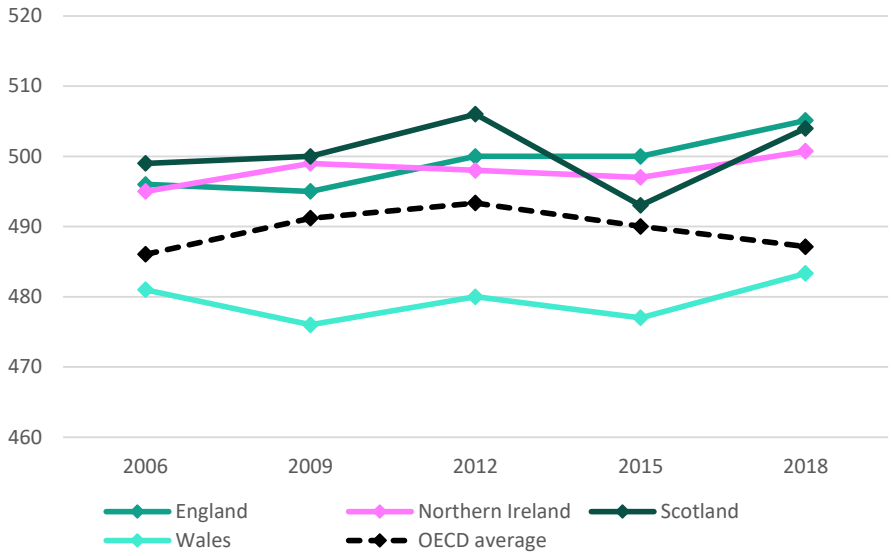
Science scores, however, have fallen across all four nations. In 2018, average science scores were around 490 in Wales, Scotland and Northern Ireland, close to the OECD average, which has fallen over time . This contrasts with 2006 when they were well above the OECD average. In England, science scores in 2018 remained about 20 points or 0.2 standard deviations above the OECD average, but have also clearly fallen over time.

Figure 2.1. Average PISA Scores over time by nation, relative to OECD average

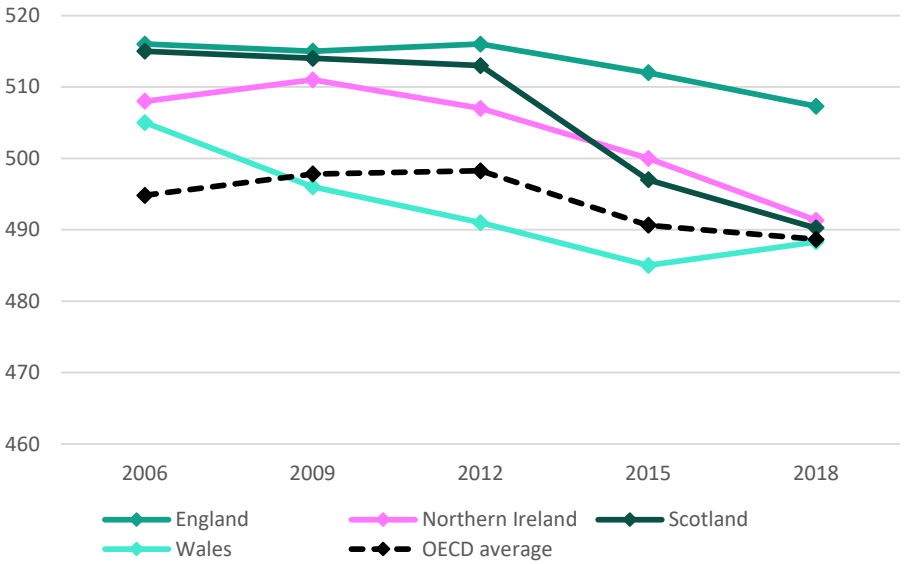
a) Numeracy



b) Reading



c) Science



Source: Department for Education, *PISA 2018: National Report for England* (https://www.gov.uk/government/publications/pisa-2018-national-report-for-england).

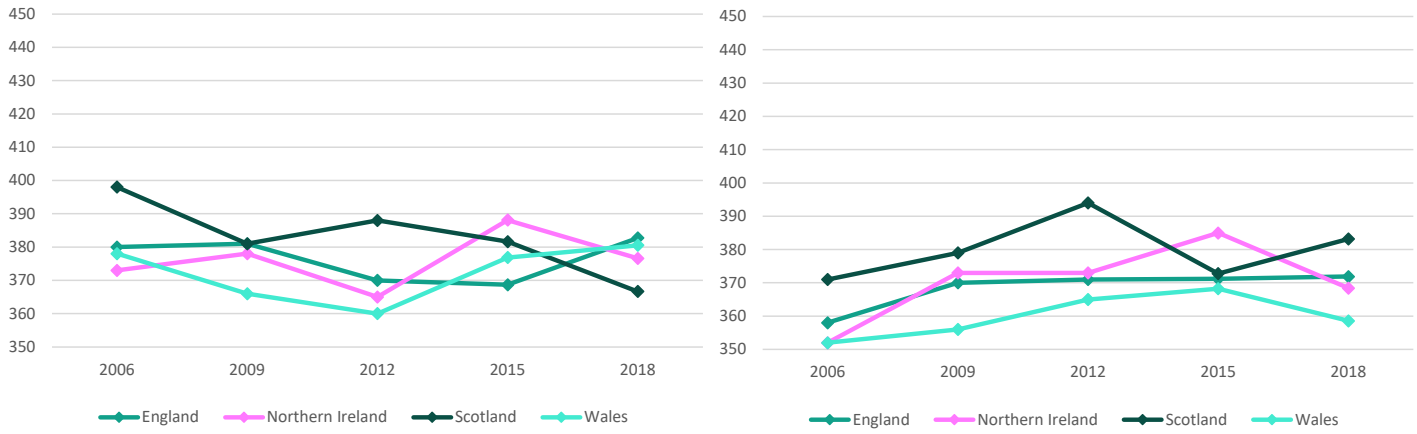
In addition to these differences in average scores, Figures 2.2 and 2.3 show the distribution of scores within each nation over time. In particular, they show the 10th percentiles (Figure 2.2) and 90th percentiles (Figure 2.3) for numeracy and reading. For the most part, this highlights a great deal of similarity across England, Scotland and Northern Ireland. However, in Wales we see a much lower 90th percentile over time across both numeracy and reading. This highlights that lower scores at the top of the distribution represent a major reason for lower average scores in Wales.

There are also other UK comparisons from other sources. Research using the MCS up to age 7 shows that country rankings within the UK are sensitive to specific measures of skills and cross-country demographics, e.g. ethnic mix, (Taylor et al, 2013). There are also summary statistics for particular countries or ages.[3] In this report, we extend this analysis to show how cognitive skills evolve during childhood across the four nations of the UK up to age 14 and controlling for important factors, such as ethnic mix, that could shape these differences.

In addition to PISA, further international comparisons can be made using the Trends in International Mathematics and Science Study (TIMSS). In general, this provides a more positive picture for mathematics and science performance in England and Northern Ireland.[4] Specifically, it shows that performance in mathematics for year 5 and year 9 pupils in England has seen a sustained improvement over the last 20 years and is now significantly above the international average . Mathematics performance is even higher in Northern Ireland. In science, performance in England is also above the international average, but has declined slightly over time. Science performance in Northern Ireland is slightly lower, but still above the international average.[5] Unfortunately, Wales and Scotland are not included in TIMSS. When it was last included, in 2007, Scotland scored slightly below the international average in mathematics.[6]

Figure 2.2. 10th percentiles of PISA numeracy and reading scores over time by nation

(a) Numeracy **(b) Reading**



[3] Brown and Sullivan, 2014; Sullivan et al, 2017

[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941351/TIMSS_2019_National_Report.pdf

[5] For greater discussion of the differences between TIMSS and PISA, see Box 1.1 in Jerrim and Shure (2016).

[6] https://timss.bc.edu/timss2007/PDF/TIMSS2007_InternationalMathematicsReport.pdf

Figure 2.3. 90th percentiles of PISA numeracy and reading scores over time by nation

(a) Numeracy **(b) Reading**

Source: Department for Education, *PISA 2018: National Report for England* (https://www.gov.uk/government/publications/pisa-2018-national-report-for-england).

3. Data and methods

Our analysis makes use of the MCS to track the evolution of cognitive skills during childhood for the different countries of the UK. The MCS is ideally suited for this analysis. It represents a group of about 18,000 children born across the UK in 2000 and 2001. They have been followed up at ages 3, 5, 7, 11 and 14, with rich data collected on demographics, socio-economic background, family behaviours and various cognitive assessments. Further follow-ups have been carried out at later ages, though age 14 is the last point at which the survey undertook cognitive assessments.

Smaller nations were over-sampled and by age 14 the data contained around 2,400 children in Scotland, 2,800 in Wales and about 2,000 in Northern Ireland.

In what follows, we describe the key data assumptions and methods we use in our analysis of cross-country differences in cognitive outcomes. We start by describing the cognitive outcomes we use in our analysis, the set of background variables and the sample we use.

Outcomes

We use the full range of verbal and numerical cognitive assessments available from ages 3 to 14. As shown in Table 3.1 below, the number of available measures differs across ages. For example, vocabulary is assessed using the British Ability Scales (BAS) up to age 11, whilst a shortened version of the Applied Psychology Unit (APU) vocabulary test is used at age 14. A number of key features of the set of outcomes are worth noting for use and interpretation.

First, they measure different domains of cognitive skills. The BAS scales are the most commonly used cognitive assessment across ages, though the domains vary with the age of the child (e.g. at age 3 this covers vocabulary only, but covers picture similarities and pattern construction in addition at age 5). Looking across all the assessments, the majority relate to literacy or vocabulary scores, though even these differ slightly in their specific focus. Beyond this, the Bracken assessment is a measure of school readiness and the NFER maths test is a specific test of mathematical ability. Some of these tests are closer to a measure of knowledge of specific concepts or educational attainment (e.g. maths tests and tests of vocabulary), while others are closer to measures of underlying cognitive ability (e.g. recognising patterns or similarities).

With this in mind, we show differences across all outcomes by age, but are careful to interpret differences across outcomes as capturing both differences in the age of children and the type of skill being captured.

Second, the tests are measured in slightly different units, which account for children's detailed ages in slightly different ways. We therefore standardise all outcomes to have mean zero and standard deviation of one within our analysis sample to aid interpretation of differences across outcomes. We also include detailed controls for age for each wave of data.

There are a small number of cognitive outcomes in the MCS that we do not examine. In particular, we do not examine the Sally-Anne test at age 3 and 5 or the CANTAB assessments of spatial working memory and risk taking at age 14. This is partly because there is no clear summary measure available for the CANTAB assessments and also because these assessments relate to much wider concepts of skills.

As the cognitive assessments can be taken at slightly different ages depending on when families were surveyed, we control for the child's age at the time of the survey. This is based on the most detailed measure of age within each survey. At the age 3 and 5 surveys, children's age at the time of the survey is measured in days, in months for age 7 and 11, and in years for the age 14 survey.

We also control for language spoken at home to allow for the fact that non-English-speakers could have been at a disadvantage in some assessments. In Wales, children could opt to take assessments in Welsh. However, this option was used less than one would expect and sometimes treated in inconsistent ways within the data. For instance, the age 7 reading assessment could be done in Welsh, but such data was not included in the main release of the data as there was no clear external source for age standardisation. Very few individuals opted to take tests in Welsh after age 7.

Appendix Figure A4 shows that these cognitive outcomes are strongly predictive of the probability of achieving a grade C or above in English and maths (or National 5 pass in Scotland). The relationship is stronger for maths, and outcomes at older ages are also more predictive (as one would expect).

Table 3.1 – List of outcomes from the MCS used in our analysis

Outcomes	Description	Overall Focus	Age 3	Age 5	Age 7	Age 11	Age 14
Bracken School Readiness	Assess children's knowledge of school "readiness" concepts	Cognitive/Language	x				
BAS Naming Vocabulary	Index of vocabulary skills and knowledge	Language	x	x			
BAS Picture similarities	Recognise pictures of objects. Use short-term memory and problem-solving	Cognitive		x			
BAS Pattern Construction	Measures the ability to accurately observe, analyse and match designs	Cognitive		x	x		
Progress in Maths (NFER)	Standardised assessment of pupils' mathematical skills and knowledge	Maths			x		
BAS Word Reading	Asked to explain the meaning of individual words	English/Literacy			x		
BAS Verbal Similarities	Measures the individual's level of verbal reasoning ability	Cognitive				x	
Word Activity	Measure knowledge of vocabulary	English					x

Linking data across sweeps

We create a common sample for our analysis across sweeps. This ensures that we are able to compare the cognitive performances of the same individuals over time, rather than results being driven by a changing sample. This is important as a number of individuals drop out of the survey each wave and not all individuals complete all the cognitive assessments each wave.

Given the amount of missing data, we then define two common samples, split by age. We define one common sample for individuals with non-missing outcomes for ages 3 to 7. The second common sample is for individuals with non-missing outcomes for ages 11 and 14. Furthermore, we exclude individuals with missing information for key background variables (ethnicity, mother's age, region of domicile, parental education and home ownership). We refer to this throughout as our 'analysis sample.'[7]

Figure 3.2 shows how these assumptions affect the total sample for the UK as a whole and by individual nation. It shows that, by restricting to our analysis sample, the available sample drops from 15,000 to 10,500 for outcomes up to age 7, and from 13,100 to 10,200 for outcomes at age 11 and 14. Within each nation, the available sample size drops to about 6,600 in England, around 1,600 in Wales, around 1,200 in Scotland and just over 1,000 in in Northern Ireland. The figures differ slightly depending on the age range.

Figure 3.2 – Sample sizes

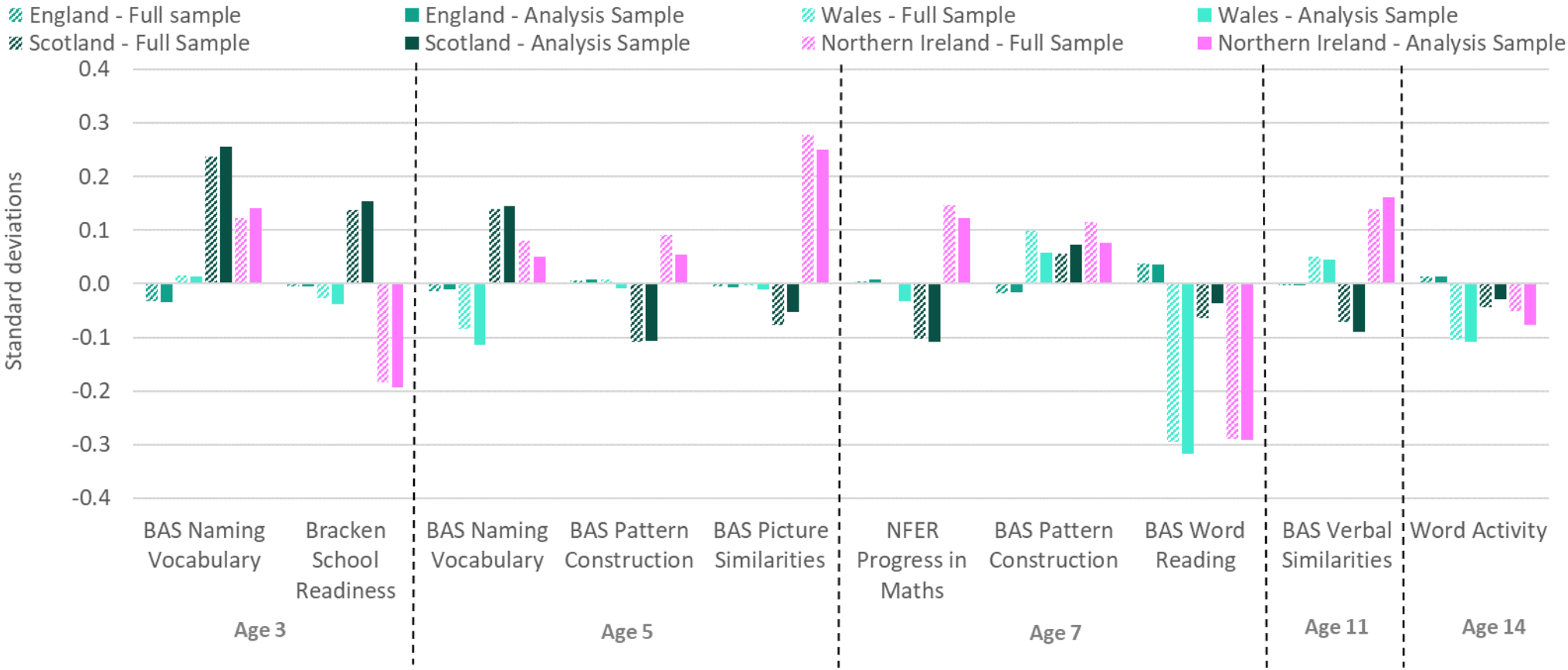
Max Observations	Full Sample		Analysis Sample		Restricted Sample
	Age 3 to 7	Age 11 and 14	Age 3 to 7	Age 11 and 14	
England	9,560	8,450	6,650	6,640	4,900
Wales	2,200	1,850	1,590	1,420	1,110
Scotland	1,800	1,470	1,180	1,110	810
Northern Ireland	1,530	1,300	1,040	1,010	760
UK	15,040	13,070	10,470	10,170	7,580

Note: The two analysis sample columns restrict our sample to those who have no missing data between the ages of 3 to 7 and 11 to 14 respectively. The restricted sample (final column) drops all individuals who have any missing data. The number of observations are rounded to the nearest ten. Authors' calculations using the Millennium Cohort Study.

Figure 3.3 shows average (standardised) outcomes by nation at each age. As can be seen, the restriction to our main analysis sample does not have a sizeable impact on the average outcome across ages and by nation.

[7] This results in a loss of less than 200 observations. Given the small number of cases, we chose not to undertake any imputation of missing values.

Figure 3.3 – Average value of cognitive outcome across nations for full and analysis samples



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response survey weights are always applied.

Figure 3.2 further shows how the sample size would change if we restricted to a common sample across all outcomes, our 'restricted sample', i.e. non-missing outcomes across all ages. This restricted sample would lead to a sizable and further reduction in sample sizes. Appendix Figure A1 makes clear that the estimated differences across nations are not significantly different from our analysis sample. However, the sizeable reduction in the sample size would increase statistical uncertainty and heavily restrict our ability to conduct sub-group analysis. We therefore focus on our analysis sample for the most part.

To further account for non-response, attrition and the survey design, we make use of derived survey non-response weights in all our analysis. In particular, for outcomes up to age 7 we use the survey non-response weights for age 7 and survey non-response weights at age 14 for outcomes at ages 11 and 14. All analysis is weighted by the appropriate survey non-response weight unless clearly stated otherwise.

Background variables

One of the key strengths of the MCS data is the rich set of data about family background, demographics and early life conditions. We account for the following factors:

- Demographics and family structure
    - Child age at most recent sweep, measured in days (age 3 and 5 sweeps), months (age 7 and 11 sweeps) and years (age 14 sweep).
    - Child ethnicity (minor grouping, see Appendix Figure A2 for full list).
    - Parental marital and relationship status (at birth and most recent sweep).
    - Parent(s) age at birth.
    - Language spoken in the household (English only, English plus one or more, other language).
- Socio-economic background
    - Net household equivalised income (all available sweeps).
    - Parents' highest educational qualifications (as defined at age 3 survey).
    - Parents' occupation based on first digit of SOC code (all available sweeps).
    - Parents' employment status (all available sweeps).
    - Parents' cognitive skills (sweep 6).
- Early life conditions
    - Whether breastfed and age last breastfed (in days).
    - Birth weight, including indicator for low birth weight (defined as under 2.5kg).
    - Whether the child experienced early life health problems.
    - Whether the child lives in a household where one, or more, of their parents smoke.
    - Whether the child lives in a household where one, or more, of their parents report that they drink too much alcohol.
    - Experience of postnatal depression.
    - Home learning environment (an index that combines how often parents read to their child, visit the library, learn the alphabet, count, nursery rhymes, paint and draw).
    - Strength and difficulties questionnaire (an index that combines each child's strength and difficulties: social, emotional, conduct, hyper-activity and peer problems).

The summary statistics for our covariates are presented in Figure A2 at the end of this document, including average values for the UK as a whole and across individual nations. In addition, Figure 3.4 shows how some key background characteristics differ across the four nations.

Panel (a) shows differences in average household incomes across nation by age of the cohort member (incomes are equivalised to account for differences in family size and structure). Household incomes are

generally highest in Scotland, closely followed by England, though these differences between England and Scotland are mostly quite small and statistically indistinguishable, with the exception of ages 11 and 14. Incomes are about 5-10 per cent lower across ages in Wales than in England, and slightly lower again in Northern Ireland, all being statistically significant at the one per cent level. Incomes are generally higher for parents with older children. This will reflect increases in parental employment as children get older and increases in earnings as parents get older and more experienced in the labour market. It will also reflect income growth and inflation across the whole economy over time.

Panel (b) shows that parents are slightly more likely to have a degree or equivalent qualification in England and Scotland (about 37 per cent) than in Wales and Northern Ireland (35 per cent). Parents in Scotland are less likely to have a GCSE-equivalent qualification as their highest education qualification. On occupational differences, parents in England and Scotland are more likely to be in managerial and professional occupations (just under 35 per cent) than in Wales and Northern Ireland (28 per cent).

Panel (c) shows differences in parental vocabulary scores (the same vocabulary test taken by cohort members). This shows higher scores in England and Scotland than in Wales and Northern Ireland, but only the difference between England and Northern Ireland is statistically significant.

The overriding message from these initial differences is that children in the MCS data seem to come from more socio-economically advantaged backgrounds in England and Scotland than in Wales and Northern Ireland. Such differences in socio-economic background are likely to affect children's cognitive skills and educational attainment.

Panel (d) shows that a much larger share of children come from White-British backgrounds in Wales, Scotland and Northern Ireland (over 97 per cent) than in England (87 per cent), statistically significant at the 1 per cent level. This is important as children from ethnic minority backgrounds tend to display different levels of educational attainment and different trajectories across ages, with children from many (but not all) ethnic minority backgrounds often starting school with lower levels of skills, before showing more rapid increases and higher levels at later ages.[8]

Panel (e) shows difference in a number of early life conditions. This shows that children across all four nations have a similar likelihood of having a low birth weight (under 2.5kg), though children in England and Scotland are slightly more likely to have a long-term health condition. One further difference is that children in Wales are more likely to have a teenage mother when they were born (11 per cent) than across the other nations (under 8 per cent), statistically significant at the one per cent level.

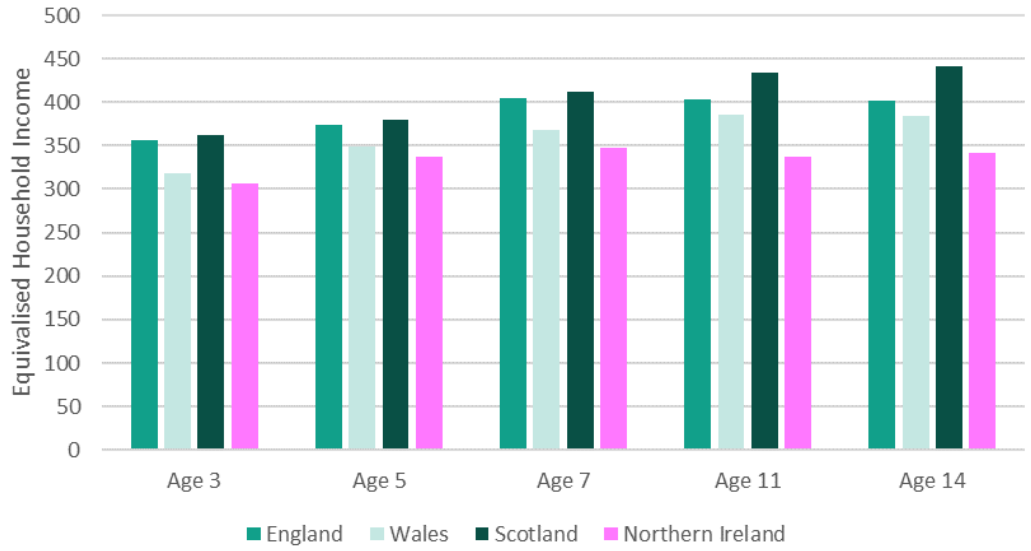
Finally, panel (f) shows differences in family size and structure. Generally speaking, differences are relatively small, though children in Northern Ireland are more likely to have two or more siblings and less likely to be an only child, these differences are statistically significant. Children in Northern Ireland are also more likely to have parents who are married and more likely to have a lone parent, with a much lower share of parents cohabiting in Northern Ireland, all statistically significant at the one per cent level.

Many of these differences in background variables are relatively large and relate to factors that are well known to shape educational attainment and recorded cognitive skills. In our main analysis, we therefore examine differences in cognitive skills by nation after controlling for differences in these and other variables listed above and in Figure A2.

[8] Wilson, Burgess and Briggs, 2011.

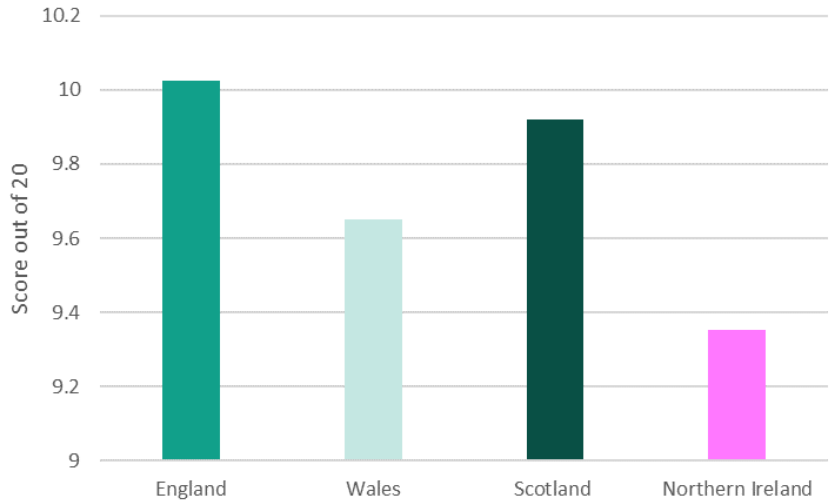
Figure 3.4 – Differences in selected background variables across nations

a) Household equivalised income

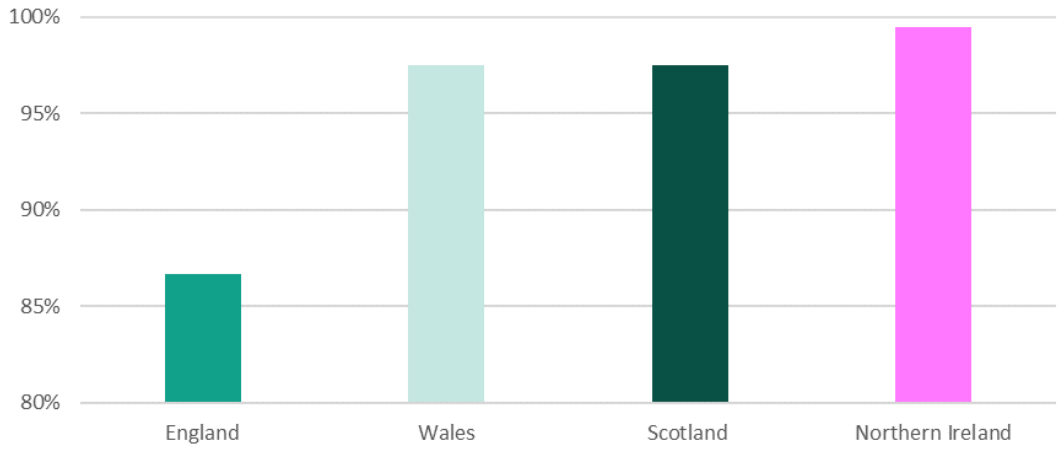


(b) Highest parental education and occupation

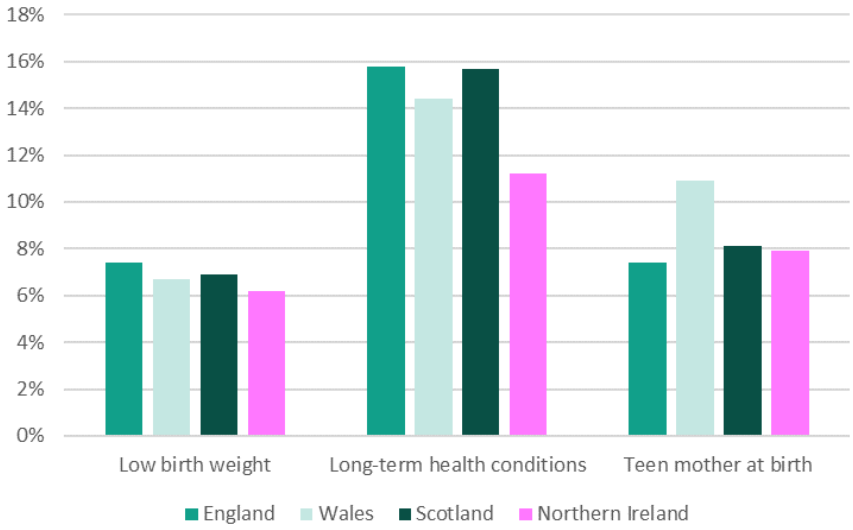
(c) Parental vocabulary scores



(d) Proportion of cohort members from a White-British background



(e) Early life conditions



(f) Family structure

Sources and notes: Authors' calculations using the Millennium Cohort Study. Relevant non-response surveys weights are always applied.

How representative is the sample?

A key question for our analysis is how representative our analysis sample in the MCS is likely to be given the sample frame, attrition from the data and our sample restrictions. This is difficult to check in practice as the MCS relates to a very specific group of families with a children born in the year 2000 or 2001. However, three comparisons are illustrative based on income data, adult qualifications and extra data about cohort members' educational qualifications at age 17.

Household incomes

Starting with income data, Households Below Average Income (HBAI) allows us to observe a similar measure of equivalised income for households with children during the late 2000s as is detailed in the MCS.[9] This won't be a perfect comparison as HBAI data covers all households with children, rather than just those with children born in the year 2000/2001. However, it is a significant improvement compared with general population data for all households. The overall patterns are reassuring:

- **Scotland** - the MCS data suggests family incomes were about 1-2 per cent higher in Scotland than in England for children aged 3-7 in the mid-2000s, whilst in HBAI, family incomes were about 1-4 per cent lower in Scotland than in England in the mid-2000s.
- **Wales** - the MCS data suggest incomes were about 9-11 per cent lower in Wales than in England for children aged 3-7, compared with about 13-18 per cent lower in Wales than in England in HBAI data.
- **Northern Ireland** – the MCS data suggest incomes were about 10-14 per cent lower than in England for children aged 3-7, compared with about 14-16 per cent lower in the HBAI data.

It would be highly unusual to get a perfect match across the data sources, particularly given sampling error from year to year. However, this comparison suggests a similar pattern across HBAI and MCS data.

Adult qualifications

There is no direct comparison for parents' qualifications in national and official data. Comparisons with overall adult qualification levels are still helpful and reassuring, though. In particular, official statistics show the share of adults aged 19-64 in each nation with qualifications at Level 4 or above over time. We focus on differences in 2010, as this is the earliest year of data currently available:[10]

- **England** – The share of adults in England with qualifications at Level 4 or above is about 37 per cent in the MCS. This compares with about 38 per cent for all adults in 2010.
- **Wales** - The share of adults in Wales with qualifications at Level 4 or above is about 35 per cent in the MCS. This compares with about 32 per cent for all adults in 2010.
- **Scotland** - The share of adults in Scotland with qualifications at Level 4 or above is about 37 per cent in the MCS, which matches the figure for all adults in 2010.
- **Northern Ireland** - The share of adults in Northern Ireland with qualifications at Level 4 or above is about 34 per cent in the MCS, which compares with 31 per cent for all adults in 2010.

[9] https://www.gov.uk/government/collections/households-below-average-income-hbai--2
[10] https://www.gov.uk/government/statistics/education-and-training-statistics-for-the-united-kingdom-2011

As with the comparisons of income, one would never expect these figures to perfectly match, particularly given that they cover different time periods, age groups and the national statistics data relates to all adults, rather than just parents of young children. Nevertheless, the similarities in the levels and overall patterns are extremely reassuring.

Cohort member qualifications

The age 17 the MCS survey also collected data on educational qualifications of cohort members, which we can compare against official statistics for individual nations. This won't be a perfect measure as it is based on individual recall of a large number of different individual qualifications (e.g. every single GCSE) and national statistics sometimes pertain to slightly different groups/definitions. However, the comparisons are still helpful, and are mostly reassuring.

Most of the MCS cohort also took their GCSE or equivalent exams in summer 2016 or summer 2017, which was a period where GCSEs were rapidly changing in England, Wales and Northern Ireland. For example, GCSEs in English and maths in England shifted to a 9-1 scale in summer 2017 from a A*-G scale. Wales and Northern Ireland maintained the A*-G scale, but moved to new specifications from summer 2017. This further complicates the comparison.

With these qualifications in mind, Figure 3.5 shows the educational qualifications (GCSE, iGCSE and National 5) of just over 8,000 cohort members from the age 17 MCS survey. In particular, for England, Wales and Northern Ireland, it shows whether respondents achieved a grade 4/C or above in maths and in English, and whether they achieved 5 or more GCSEs at A*-C (or 5 GCSEs at grade 4 or above). For Scotland, we show the share achieving a National 5 or above in maths and English (at grade A-C).

This is compared against relevant national statistics (taking age 15/16 qualifications in summer 2016 and summer 2017, which are then averaged over the 2 years given the MCS sample covers two school years). Unfortunately, data by individual subject is not available for Northern Ireland. Data for Scotland covers school leavers but excludes attainment during their final S6 year in order to match the MCS sampling frame at age 17. Population data for Scotland excludes pupils at private schools, who are also excluded from the MCS sample for Scotland in Figures 3.5 and 3.6 for comparability.

Qualifications in England and Wales

Figure 3.5 shows that respondents in our analysis sample have higher levels of attainment than their respective cohorts. 76 per cent and 77 per cent of our analysis sample in England achieved an A* to C (or 4 to 9) in maths and English compared to 65 per cent and 70 per cent of the population. A similar picture can be seen in Wales: 76 per cent of our analysis sample achieved a grade C or above in English (or Welsh as a first language), compared with 68 per cent in the population, and 73 per cent achieved a grade C or above in maths, compared to 65 per cent in the population.

In both England and Wales, the analysis sample looks more highly achieving than the population. This is visualised in Figure 3.6. Some of this is to be expected as our analysis sample focuses on individuals who completed all cognitive outcomes, and individuals with missing cognitive outcomes tend to have lower educational qualifications. Indeed, when we examine the full sample in Figure 3.5 (without sample restrictions), the MCS for England and Wales only seems to be slightly higher achieving than the full population.

Qualifications in Northern Ireland

In Northern Ireland, we can only compare the share achieving five or more GCSEs at A*-C. In our analysis sample, the share achieving this standard is about 83 per cent compared with 84 per cent in the population. In the full MCS sample, this drops to about 78 per cent. This suggest MCS cohort members in Northern Ireland are slightly *lower* achieving relative to the population. This could downwardly bias our analysis, particularly given that the MCS sample is slightly higher achieving in Wales and England relative to the population. This is slightly surprising as our later analysis shows cognitive outcomes in Northern Ireland are generally higher than the other three nations.

Qualifications in Scotland

Because of the nature of the Scottish qualification system, many young people could still be taking National 5 courses at ages 17 or 18. Indeed, partly for this reason, official statistics for Scotland look at the educational attainment of school leavers (ranging from ages 16 to 18) as opposed to 15/16-year-olds, as is the case for England, Wales and Northern Ireland. Statistics shown here, however, exclude any qualifications achieved during their final S6 year. This ensures greater comparability between national statistics and the MCS, which focuses on 17-year-olds.

These statistics for school leavers in Scotland show that 70 per cent of school leavers achieved the equivalent of a National 5 at A-C in English and 45 per cent in maths. These figures are noteworthy in themselves as they show relatively low levels of achievement in maths in Scotland. In England and Wales, young people are about 3-5 percentage points less likely to achieve a C or 4 in maths than in English. In Scotland, the equivalent difference is 15 percentage points for a National 5 at A-C in English and maths.

Looking at the MCS data for Scotland, about 57 per cent of our analysis sample have obtained an A-C in a National 5 exam in maths and 76 per cent in English (or a higher-level qualification in those subjects, such as Highers or Advanced Highers). As is the case in England and Wales, this shows that the MCS analysis sample is likely to be slightly over-achieving relative to the equivalent population in Scotland in terms of attainment in English. However, the MCS sample (both the analysis and full sample) has notably higher qualification levels in maths than is the case for the population at large. This could potentially bias up our results for Scotland, particularly in maths. This is slightly surprising, however, as the results for the sole maths outcome are lower in Scotland than other UK nations.

Figure 3.5 - Educational qualifications of MCS sample at age 17, compared with national statistics

	England (Grade C/4 or above)	Wales (Grade C or above)	Northern Ireland (Grade C or above)	Scotland (National 5 pass at A-C) *Excluding private schools*
Full sample				
Maths	72%	66%	79%	56%
English	72%	72%	83%	74%
5 GCSEs	70%	68%	78%	N/A
Analysis sample				
Maths	76%	73%	83%	57%
English	77%	76%	84%	76%
5 GCSEs	74%	72%	83%	N/A
Population				
Maths	65%	65%	N/A	45%
English	70%	68%	N/A	70%
5 GCSEs	N/A	N/A	84%	N/A

Notes and sources: Authors' calculations using the Millennium Cohort Study. Relevant non-response survey weights are always applied. In England, Wales and Northern Ireland respondents are identified as having a grade C/4 above in maths if they have obtained a grade C/4 or above in one, or more, of the following: Mathematics, Additional Mathematics, Further Mathematics, Mathematics (linear), Mathematics (numeracy) and iGCSE Mathematics. They are identified as having a grade C/4 above in English if they have obtained a grade C/4 or above in one, or more, of the following: English Language, Welsh Language (Welsh as a first language) and iGCSE English Language. We drop a small number of individuals in England, Wales and Northern Ireland who are interviewed before they have received their GCSE results (285). All other individuals we observe at age 17, and had finished year 11, we assume have not obtained a GCSE in Maths/English. In Scotland, respondents are identified as having a National 5 in mathematics/English if they have an A-C in National 5 Mathematics/English (or a Higher in those subjects). The Scottish sample excludes individuals at fee-paying independent schools in order to match national data. The analysis sample are only respondents who have no missing data at ages 11 and 14 and the full sample contains all respondents who we observe at age 17 and completed the educational attainment questionnaire. Population statistics for England are based on the average share of individuals achieving grade C or above or 4 or above in summer 2016 and summer 2017 (https://www.gov.uk/government/statistics/revised-gcse-and-equivalent-results-in-england-2016-to-2017); population statistics for Wales are based on the average share of individuals achieving grade C or above in English, or Welsh as first language, or Maths in summer 2016 and summer 2017 (https://gov.wales/examination-results-september-2016-august-2017); population statistics for Northern Ireland are based on the average share of individuals achieving 5 or more GCSEs at A*-C in summer 2016 and 2017 (https://www.education-ni.gov.uk/publications/statistical-bulletin-102017-year-12-and-14-examination-performance-post-primary-schools-northern); population statistics for Scotland are based on the share of leavers from publicly funded school who have achieved SCQF Level 5 or better in Maths and English (National 5 at A-C or higher) for 2017-18 and 2018-19, excluding attainment during their S6 year in order to match the MCS sample timing. Figures kindly supplied by the Scottish Government.

Figure 3.6 The educational attainment of the MCS analysis sample at age 17 as compared with the population in English and maths (GCSE at above C/4 or National 5 level)

Notes and sources: See Figure 3.5 for notes and sources.

4. Differences in cognitive outcomes

How do cognitive outcomes compare across the four nations and how do they evolve across different ages? In this section, we compare cognitive outcomes in the Millennium Cohort Study across England, Wales, Scotland and Northern Ireland after controlling for differences in family background and demographics observed in the previous section (using Ordinary Least Squares regression). In the following section, we consider differences within various sub-groups, such as by gender, household income and parental education.

Overall differences

Figure 4.1 shows cognitive scores in Wales, Scotland and Northern Ireland relative to England. All differences are shown in standard deviation terms to allow for a consistent comparison across ages and outcomes. The sample used is the analysis sample described in section 3 (weighted by the appropriate non-response weights). The error bars show the 95 per cent confidence intervals using robust standard errors.

Taking each country in turn, we see that average cognitive outcomes in Wales are mostly very similar to England after controlling for family background and demographics. The differences across outcomes and ages are mostly under 0.1 standard deviations and mostly not statistically significant. The main exceptions are the BAS vocabulary score at age 5 (0.1 standard deviations lower than England), BAS reading at age 7 (0.2 standard deviations lower) and the age 14 word activity (0.1 standard deviations lower). These differences are particularly noteworthy as they all relate to reading or vocabulary. This matches the lower performance of pupils in Wales on reading outcomes in PISA, though the differences in PISA were generally larger (about 0.2 standard deviations lower than in England).

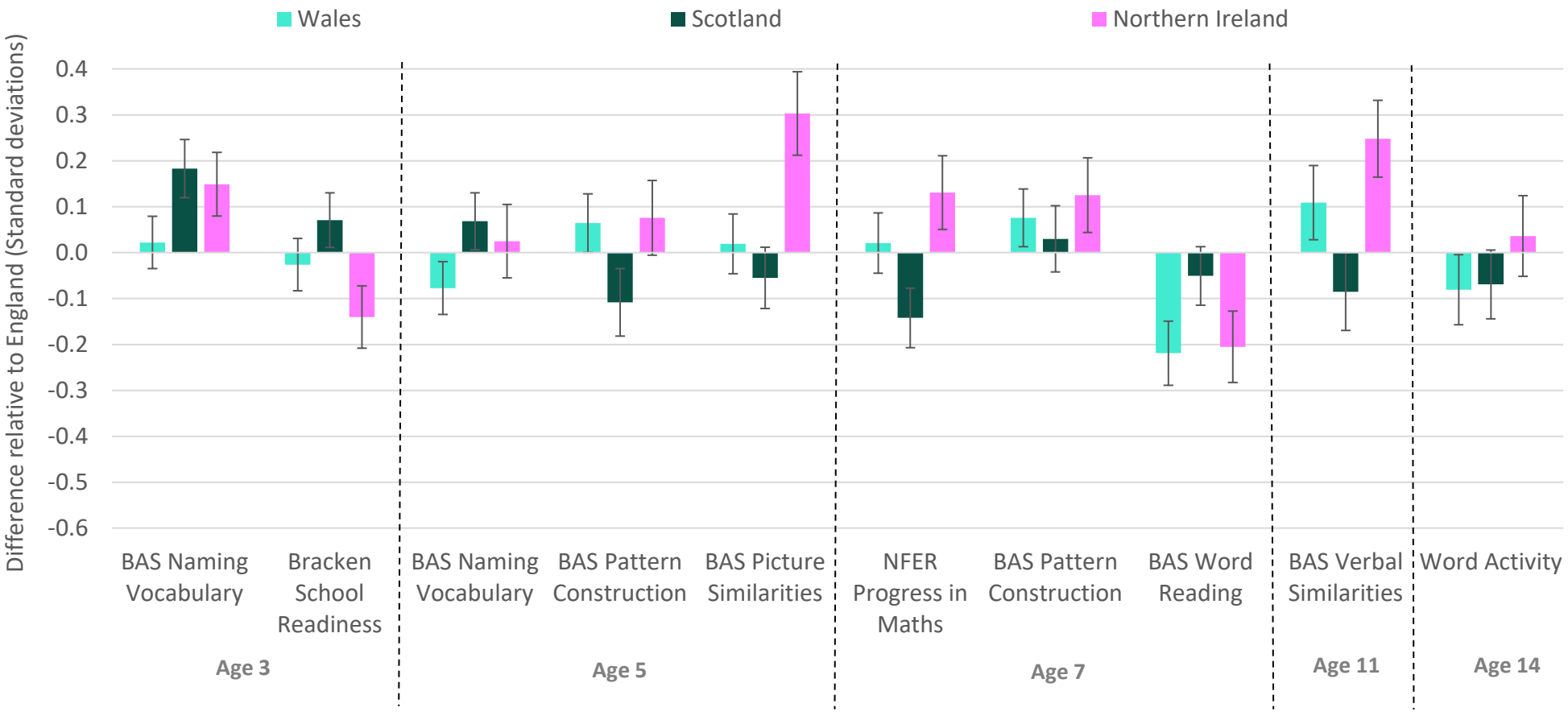
In Scotland, cognitive scores are initially higher than in England at age 3, both in terms of the BAS vocabulary score (nearly 0.2 standard deviations higher) and the Bracken school readiness score (nearly 0.1 standard deviations higher). At age 5, scores on the BAS vocabulary measure are still significantly higher, but there is also evidence of lower scores on pattern construction and picture similarities. At later ages, scores are generally below or similar to England, with lower scores on the maths measure at age 7, age 11 BAS verbal similarities and the age 14 word activity. Having been ahead of England at younger ages, Scottish children seem to be mostly behind at older ages.

This is slightly different to the picture provided by recent PISA waves, which suggests reading scores are similar for 15-year-olds in England and Scotland. However, numeracy scores were clearly lower for Scottish teenagers in the most recent PISA wave in 2018. Concerns have also been raised about the representativeness of Scottish PISA data in 2018 in particular.[11]

The picture for Northern Ireland is slightly more complicated. At age 3, children in Northern Ireland are slightly ahead of England (and similar to Scotland) on the BAS vocabulary score, but behind on the Bracken school readiness measure. At later ages, children in Northern Ireland generally score significantly higher or similar to England. Indeed, scores are highest in Northern Ireland on six out of the eight cognitive outcomes between age 5 and 14. The only exception is BAS reading at age 7 where children score about 0.2 standard deviations below England.

[11] Jerrim, 2021

Figure 4.1 – Differences in cognitive outcomes across nations after controlling for demographics and background



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response surveys weights are always applied. Error bars show the 95 per cent confidence intervals.

Value-added scores

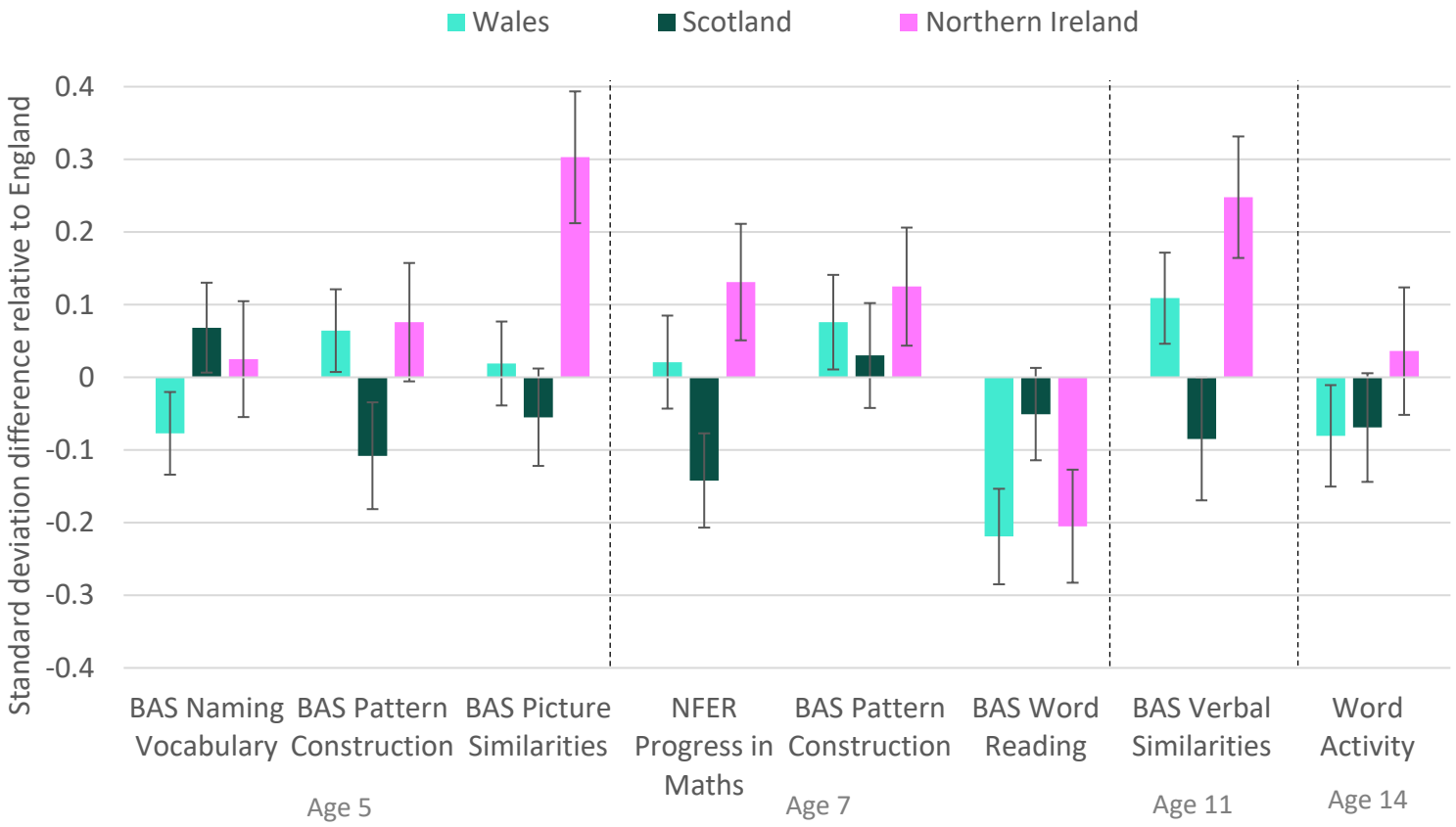
In Figure 4.2, we concentrate on cognitive scores during school ages 5 to 14, controlling for initial differences in cognitive outcomes at age 3 (BAS vocabulary and Bracken school readiness). As such, these results are more like value-added scores for children of school ages.

This confirms and accentuates many of the differences observed in Figure 4.1. In Wales, value-added scores are mostly similar to England at ages 5 to 14, generally less than a difference of 0.1 standard deviations. The only exception is BAS reading at age 7, which is 0.2 standard deviations lower.

In Scotland, value-added cognitive scores at age 5 to 14 are mostly lower than in England, the main exception being BAS vocabulary scores at age 5, which are higher than in England.

For Northern Ireland, we see a consistent picture of mostly higher scores than in the other three nations, with statistically significant larger scores than England for four out of the eight outcomes. Scores are highest in Northern Ireland for six out of the eight outcomes (though scores are not significantly higher than in England and Wales in two of these cases). The only exception is the BAS reading score at age 7, which is 0.2 standard deviations lower in Northern Ireland than in England, and of a similar level to that seen in Wales.

Figure 4.2 – Differences in cognitive outcomes across nations after controlling for demographics and parental background, value added specification



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response surveys weights are always applied. Error bars show the 95 per cent confidence intervals.

Comparisons with London

These comparisons have so far compared average outcomes across the four nations. There is significant evidence, however, of differences in outcomes within country too. For example, there is strong evidence of higher levels of educational attainment within London as compared with the rest of England.[12]

In Figure 4.3, we therefore compare average cognitive outcomes in Wales, Scotland and Northern Ireland with London and the rest of England, after controlling for family background and demographics. In particular, we treat London in the same way as Wales, Scotland and Northern Ireland, with all differences estimated relative to the rest of England (excluding London).

Starting with London, we see that outcomes in London are mostly very similar to the rest of England at ages 3 and 5. At ages 7 and 11, there is some evidence of higher outcomes in London. For example, cognitive scores are significantly higher in London in the maths test at age 7, BAS reading at age 7 and BAS verbal similarities at age 11. Scores are similar to the rest of England for BAS pattern construction at age 7 and for the age 14 word activity.

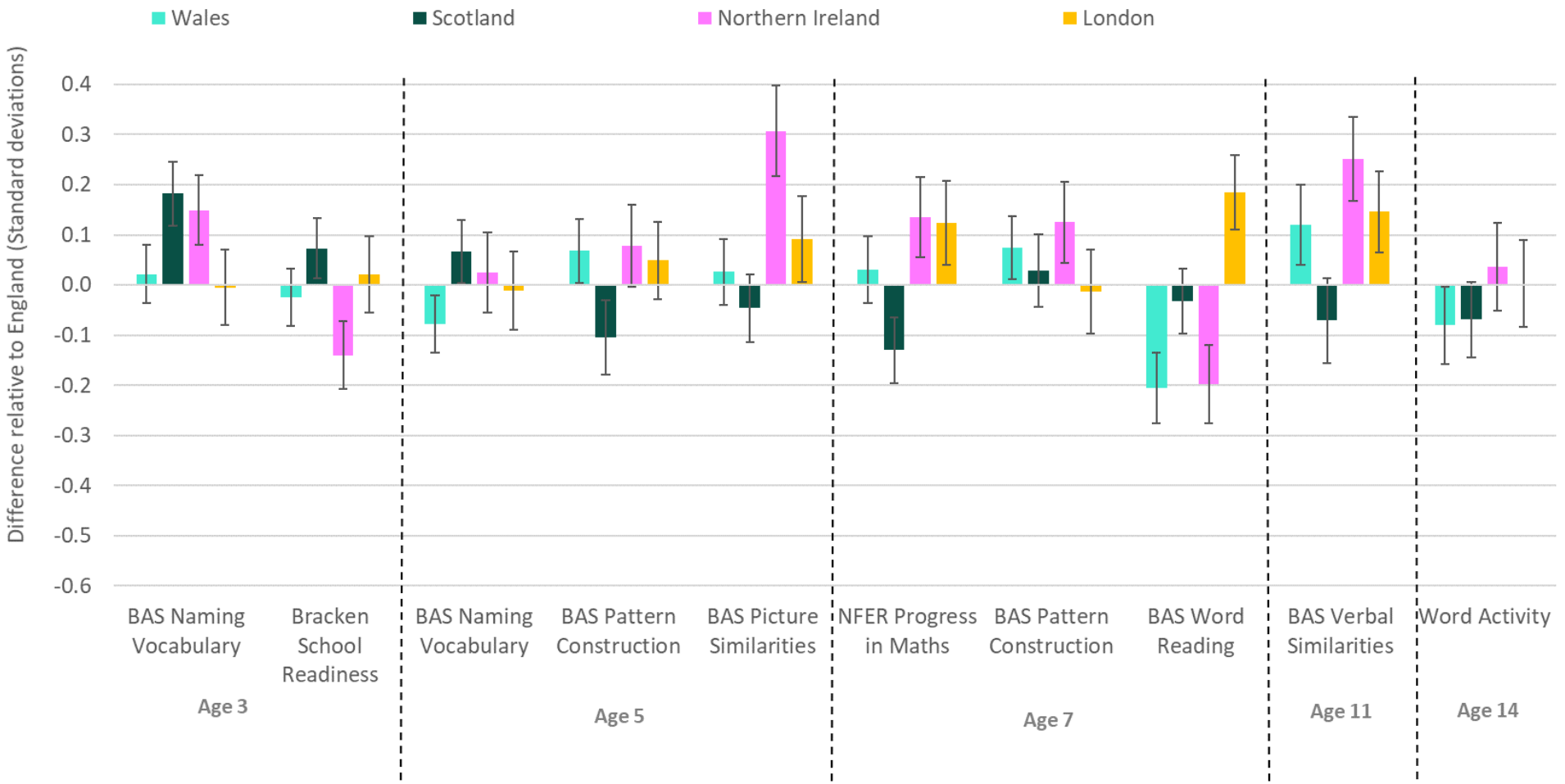
Looking again at Wales, average cognitive outcomes are mostly similar or slightly higher than in England (excluding London). In the case of BAS pattern construction ages 5 and 7, and BAS verbal similarities, average outcomes are significantly higher in Wales. However, BAS reading at age 7 remains significantly lower in Wales than in England (excluding London).

In the case of Scotland, we still see a similar picture at age 3 and 5, with higher scores than the rest of England at age 3 and age 5 BAS vocabulary. At ages 7, 11 and 14, scores are still mostly lower in Scotland, but the difference relative to the rest of England are smaller than when we look at the whole of England, and mostly not statistically significant. Indeed, we see quite clearly that part of the reason for the lower scores in Scotland can be explained by a big difference relative to London.

If we again look at Northern Ireland, a further interesting picture emerges. We still see the picture of lower school readiness and higher BAS vocabulary scores at age 3. From age 5, we then see that cognitive scores are mostly higher in Northern Ireland than in the rest of England (i.e. excluding London), often significantly higher. It is also interesting to note that average cognitive scores are mostly higher in Northern Ireland than in London too. This further emphasises the positive picture of cognitive scores in Northern Ireland as compared with the rest of the UK.

[12] Blanden et al, 2015.

Figure 4.3 – Differences in cognitive outcomes across nations after controlling for demographics and background, with separate estimates for London



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response surveys weights are always applied. Error bars show the 95 per cent confidence intervals.

Interpreting the overall differences

Care and caution are required in interpreting the differences across nations, particularly given the relatively complex patterns across different outcomes and ages. The MCS also focuses on the cognitive scores of a single cohort born around 2000/01, so can conflate age and time effects. For example, falling scores across ages could reflect an age effect or it could reflect declines over time for all cohorts.

The outcomes across different ages are also measuring slightly different domains of cognitive skills. Whilst PISA scores are much more like a measure of educational attainment and skills, a comparison between PISA and the MCS cognitive scores can still be enlightening in building a more comprehensive picture of the differences across countries. The MCS cohort will be age 15 somewhere between the PISA 2015 and 2018 cohort, so comparisons with PISA can also help consider the relative role of age and time.

Wales

For Wales, we see a mostly similar picture to England on cognitive outcomes in the MCS, particularly at younger ages. We then see bigger differences at later ages, including larger scores in Wales on the BAS pattern construction and verbal similarities scores at age 7 and 11, respectively, but notably lower scores on the BAS reading score at age 7 (0.2 standard deviations lower). The lower reading scores in Wales in the MCS at age 7 are very similar in value to those seen in PISA in 2015 and 2018. This suggests that the lower reading abilities and achievements in Wales appeared early in age for this cohort and have been quite persistent over time. Given the importance of reading for accessing other parts of the curriculum, this is clearly a concerning difference.

A particular concern for Welsh data in the MCS is the effect of language, given that many children will speak and/or be educated in Welsh. However, we partly address this issue by controlling for language spoken at home. Furthermore, one would only expect a clear problem for individuals taking the test in a different language to what are they used to. However, the data for the age 7 reading outcome (the most negative case) only reflects cases where individuals chose to take the test in English, so the negative result is amongst those taking the test in English. A small number of individuals took the assessment in Welsh, but these were not included in the main data release due to problems creating normed scores.

The only maths score in the MCS is at age 7 (measured around 2007) and appears similar in Wales to England, which is quite different to the lower numeracy scores in PISA. This picture got significantly worse in Wales between 2006 and 2012, but has since improved slightly. Nevertheless, numeracy scores in Wales were still about 0.2 standard deviations lower than in England for 15-year-olds in PISA in 2015 and 2018. The combination of MCS and PISA data suggests it is possible that numeracy and maths scores got significantly worse over time in Wales between about 2006 and 2012, but there is also the potential that the deficits in Wales emerge at later ages (i.e. after age 7). There would be significant merit in examining comparative approaches to maths and numeracy in Key Stage 2 and Key Stage 3 (i.e. between ages 7 and 14).

Scotland

The picture for Scotland in the MCS is somewhat more consistent across ages, with cognitive outcomes at age 3 being relatively high compared with England, but then lower at later ages. Part of the deficit at later ages can be explained by lower scores relative to London in particular, but scores at later ages are still lower compared with the rest of England. The biggest deficit relative to England can be seen for maths scores at age 7, which matches the falling numeracy scores for Scotland in PISA. The lower reading and more general cognitive scores in the MCS don't match with the mostly average and static position in PISA. However, it should be noted that recent evidence has raised major question marks about the

reliability of Scottish PISA results, given the number of ineligible pupils and changing age structure of participants.[13]

Further evidence from the MCS suggests the deficits for Scotland are more likely to reflect declines over time and for more recent cohorts. In particular, the parents of the MCS cohort member seem to have higher levels of education than parents in other parts of the UK (matching official statistics) and relatively high vocabulary scores themselves (see Figure 3.4). Despite this relatively advantageous position, children in Scotland seem to have the lowest scores across most cognitive outcomes from ages 5 to 14.

The lower cognitive scores in Scotland are naturally concerning, particularly the low scores in maths and the contrasting picture between children and their parents. However, it is important to remember that the children surveyed are now in their 20s and so the patterns are more likely to reflect the quality of schools and education during the 2000s. It will be important to collect and analyse future data to see if the position of Scotland has improved or got worse over time.

Northern Ireland

For Northern Ireland, cognitive outcomes in the MCS are mostly higher than England and the other nations of the UK from age 5 onwards. Indeed, often these are higher than in London, which has been frequently celebrated as having some of the best educational outcomes in England. This very positive picture in the MCS is not entirely matched in the PISA data, with reading scores close to the OECD average, numeracy scores slightly below the OECD average and both mostly static over time. There is no clear evidence from PISA that scores are significantly higher than the rest of the UK.

One clear picture from the MCS and PISA is that cognitive and educational outcomes do not appear to be significantly lower in Northern Ireland than England for school-age children, which contrasts with Wales and Scotland. Whether they are higher in Northern Ireland, as suggested by the MCS, is not clear. It is possible that the MCS sample in Northern Ireland is skewed towards more advantaged families. Whilst this is possible, it seems unlikely. Our earlier analysis showed that the GCSE achievement of children in the MCS in Northern Ireland is a good match for national statistics, whilst children in England, Wales and Scotland in the MCS seem to achieve higher GCSE or equivalent results than their cohorts in national statistics. It is also possible that the relatively strong position in Northern Ireland fades away in secondary school years, which is something that is observed in the age 14 outcome in the MCS, though this is admittedly quite a narrow outcome. Furthermore, the TIMSS data also corroborates relatively high performance in maths in Northern Ireland in primary school. Further research would be well directed at the relative performance of secondary schools in England and Northern Ireland.

Role of unobservable differences and biases

We cannot rule out the possibility that the estimated differences in cognitive outcomes across nations are driven by unobservable aspects of family background or demographics, as opposed to different school policies or institutions. For example, differences in the cost of living across nations, differences in parental investments not captured in the MCS or differences in the role of peer relationships.

It is our opinion, however, that the role of unobservables is likely to be small. First, by examining differences across nations of the UK, we are already focusing on nations with a great deal of similarity, as opposed to wider international comparisons. Second, we control for a wide range of differences likely to shape cognitive outcomes, such as socio-economic background, ethnicity and early life conditions. It is possible that policy differences across the four nations play a role in directly shaping early life parental

[13] Jerrim, 2021

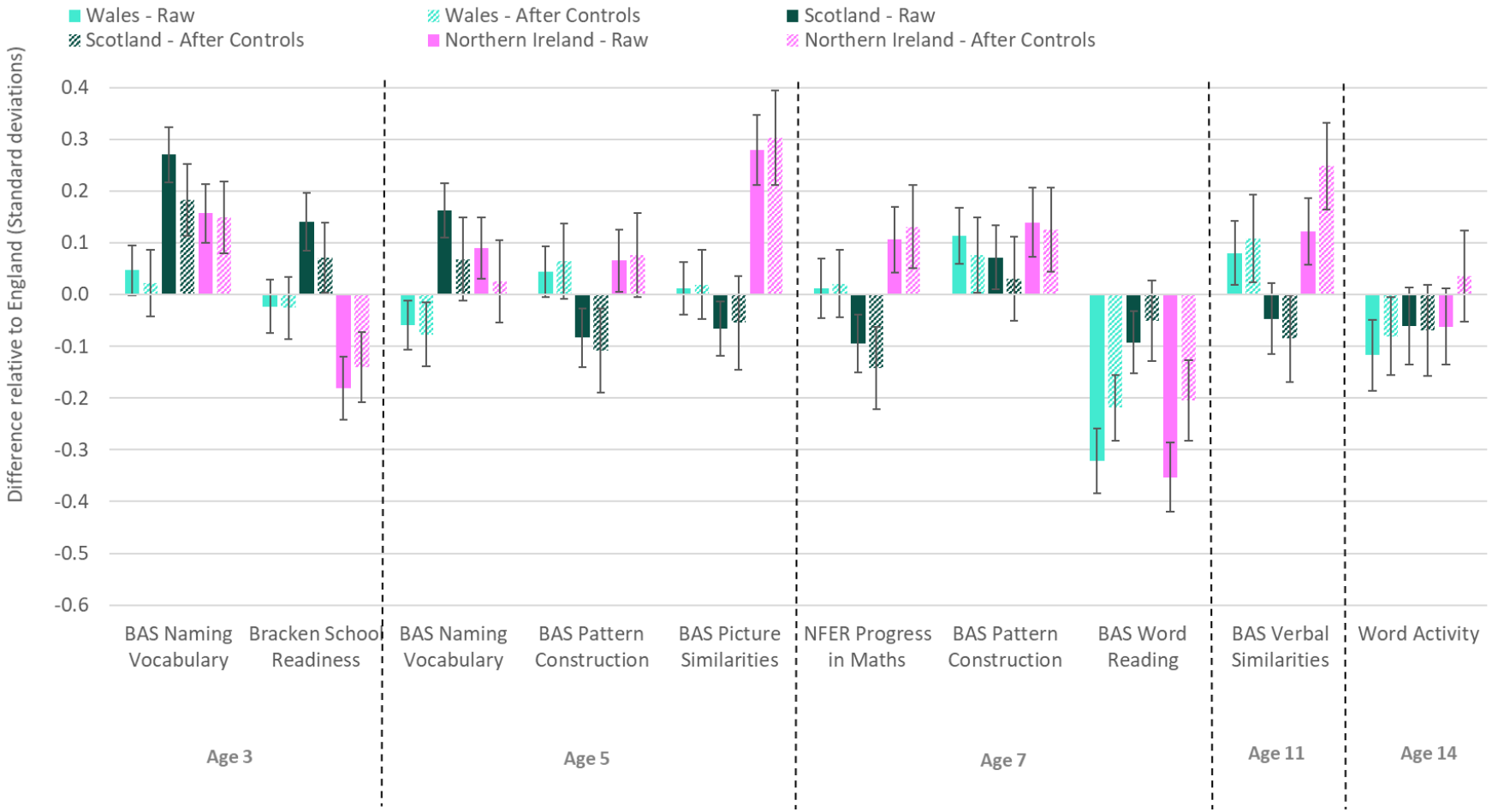
investments, such as the role of Sure Start or Flying Start. However, we performed a robustness check where we dropped controls for the early-life home-learning environment and socio-emotional development (as captured by the Strengths and Difficulties Questionnaire). Results were largely unchanged.[14]

Third, even after we control for the rich range of background characteristics, the estimated differences across nations are quite similar to the raw differences (see Figure 4.4). Whilst there are differences in the point estimates, the overall pattern of results is very similar. This suggests that the role of family background and demographics in explaining cross-nation differences in cognitive outcome is actually quite small. It is possible that unobservable factors play a much larger role, but this seems unlikely.

It is also possible that the MCS data is not representative of the UK as a whole or individual nations, possibly as a result of attrition or individuals dropping out of the sample. This is certainly a possibility. However, non-response weights provided with the dataset are supposed to address this issue for the UK as a whole and individual nations. Second, we have already seen that the full sample is relatively close to income levels, adult qualifications and young people's qualification levels at age 17. The analysis sample has higher levels of achievement, which is to be expected given that individuals with missing cognitive scores are likely to be lower achieving and this is true across nations.

[14] Precise results available on request.

Figure 4.4 Comparing cross-national differences before and after controls



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response surveys weights are always applied. Error bars show the 95 per cent confidence intervals. The raw sample uses all responses for each assessment and controls for the child's age, at time of interview, and gender. The analysis sample is restricted to those who have no missing data between the ages of 3 to 7 and 11 to 14 respectively and controls for our full list of covariates.

Role of institutions and policies

The key question is the extent to which differences in outcomes reflect the different school policies and institutions across the four nations. As we have shown in a recent report, the four nations of the UK have gradually taken very different approaches to schools since devolution in 1999.[15]

In England, there has been an increasing focus on school autonomy, a reduced role for local authorities and continued use of performance tables as part of the school accountability system. In contrast, policymakers in Wales, Scotland and Northern Ireland were quick to abolish league tables and external testing in the early 2000s. New school curriculums were established in Northern Ireland and Scotland from 2007 and 2010, respectively, which emphasised developing skills over cross-cutting areas of learning. More recently, there has been increasing divergence on approaches to GCSE and A level assessments across England, Wales and Northern Ireland, with longstanding differences in exams and assessments in Scotland. A new Curriculum for Wales is due to be introduced from 2022. Outside of schools, there are also differences in the early years offer across the four nations.

Given that we are looking at cross-national differences in cognitive outcomes for a single cohort, the data does not really allow us to look at the impact of specific policies or changes. There are, however, a number of useful insights and conclusions that we can take from the data.

First, this cohort was born around 2000/2001 so are likely to have been affected by policy changes in the early and mid-2000s, such as the abolition of league tables outside England and the ending of SATs tests in Scotland and Wales. There is therefore potential for some of the lower scores in Scotland and Wales to be driven by the abolition of league tables, with direct evidence available for Wales.[16] However, it is important to note that the highest observed outcomes are in Northern Ireland, where league tables were also abolished, so this is very unlikely to be the single, major explanation for differences.

Second, changes to the curriculum could play a role in explaining these differences. New curriculums were only introduced in Northern Ireland from 2007 and in Scotland from 2010, so could only have effects on later ages. Such changes are unlikely to explain the relatively low performance in maths of children aged 7 in Scotland or the high performance in Northern Ireland up to age 7.

Third, the differences are not the same across different cognitive outcomes, there are differences *within* country for different cognitive outcomes. For example, cognitive outcomes are mostly similar across England and Wales, with the exception of lower reading outcomes in Wales. Cognitive outcomes in Scotland are generally lower than in England, but more so for the maths outcomes than reading and literacy outcomes.

This suggests that it might be more productive for future research to examine differences in pedagogical and teaching approaches across nations. For example, how the teaching of synthetic phonics implemented and timed across nations, or how the teaching of maths in primary schools has changed. The differences across outcomes suggest this could be a fruitful area of investigation.

[15] Jerrim and Sibieta, 2021
[16] Burgess et al, 2013

5. Differences within sub-groups

In this section, we compare cognitive outcomes across England, Wales, Scotland and Northern Ireland by various subgroups, including by gender, household income, parental education and language spoken at home. As in the previous section, all differences are shown in standard deviation terms to allow for a consistent comparison across ages and outcomes. The sample used is the analysis sample described in section 3 (weighted by the appropriate non-response weights).

All differences are shown relative to the respective group England (unless otherwise stated), after controlling for differences in demographics and family background. The error bars show the 95 per cent confidence intervals based on robust standard errors. As can be seen across all the subgroup comparisons, the degree of statistical uncertainty is relatively high, so caution is required. Whilst it is not possible to reach definite conclusions, a number of noteworthy patterns do emerge.

By Gender

Figure 5.1 (a) and (b) shows the cognitive scores in Wales, Scotland and Northern Ireland relative to England for girls and boys, respectively, after controlling for demographics and family background.

Taking each country in turn, we see that the cognitive scores of girls in Wales tend to be fairly similar to girls in England, if not higher, on most outcomes. The main exceptions are the age 3 vocabulary outcome, where they score about 0.1 standard deviations below England, and the age 7 reading outcome, where they score about 0.2 of a standard deviation lower than England. We see a mostly similar picture for boys, with similar outcomes to boys in England on most outcomes. There is evidence, however, that boys in Wales score lower on reading outcomes at later ages. At age 7 and 14, they perform about 0.2 standard deviations lower than boys in England. These deficits are slightly larger than those seen for girls, with no evidence of a deficit for girls at age 14.

In Scotland girls scores are initially higher than in England at age 3, both in terms of BAS vocabulary score (about 0.2 standard deviations higher than England) and Bracken school readiness (0.1 standard deviations higher). But from the age of 5, scores are generally below or similar to England, with lower scores in age 5 pattern construction (0.1 lower) and age 7 maths (0.15 lower). A very similar picture can be seen for boys in Scotland. The only difference is that boys in Scotland have similar reading scores at age 7 to boys in England, whilst girls in Scotland are 0.1 standard deviations behind girls in England.

The picture in Northern Ireland is slightly more complicated. At age 3, boys and girls in Northern Ireland score more highly on BAS vocabulary scores than boys and girls in England, but lower on the Bracken school readiness measure (0.11 standard deviations lower). At later ages girls in Northern Ireland tend to score significantly higher, or similar to England. This is particularly striking at age 5, with BAS picture similarity scores over 0.3 standard deviations higher than for girls in England, age 7 pattern construction scores over 0.1 standard deviations higher and age 11 verbal similarities over 0.2 higher. We do, however, see that girls in Northern Ireland score about 0.3 standard deviations lower than girls in England on the age 7 reading measure.

From age 5, boys in Northern Ireland generally achieve similar or significantly higher scores than boys in England. These include age 5 picture similarities (nearly 0.3 standard deviations higher), age 7 maths (over 0.2 standard deviations) and age 11 verbal similarity score (0.2 standard deviations higher). As with girls, the only exception is age 7 reading where they score over 0.1 standard deviations lower than boys in England. Therefore, there is a mostly similar picture for girls and boys in Northern Ireland, relative to

girls and boys in England, except that boys in Northern Ireland do seem to perform relatively highly in maths.

Figure 5.1 (c) shows the differences in the cognitive scores of boys relative to girls *within* each country. At age 3 boys perform significantly worse than girls on both the BAS vocabulary scores and the Bracken school readiness measure. Whilst the gender gap is smallest in England, the difference relative to other nations is not statistically significant

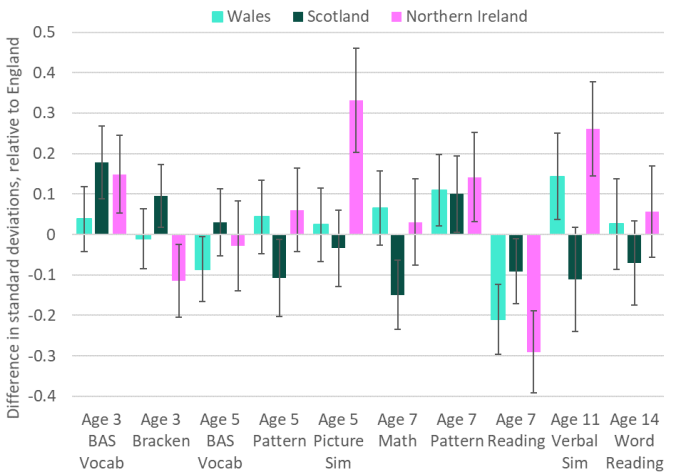
At age 5, boys perform worse relative to girls on BAS vocabulary scores (about 0.15 standard deviations across all four nations) and the BAS pattern construction score (about 0.1 standard deviations across all four nations), but perform fairly similarly on the BAS picture similarities score.

At age 7 boys seem to have higher reading scores than girls, with the exception of boys in Wales, but lower scores on the maths measure and pattern construction. Boys then score slightly higher than girls on the verbal similarity score at age 11 and mostly similar on the age 14 word reading exercise, with the exception of Wales where boys score lower.

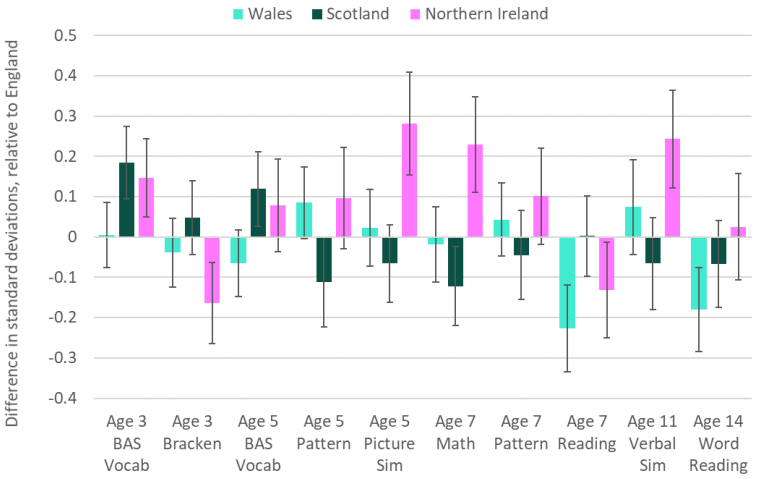
By and large, there are no clear patterns, with different gender gaps across different outcomes, ages and nations. The only clear pattern seems to be boys in Wales scoring notably lower than girls in Wales from about age 7 onwards.

Figure 5.1 Differences in cognitive scores by nation and gender, relative to England

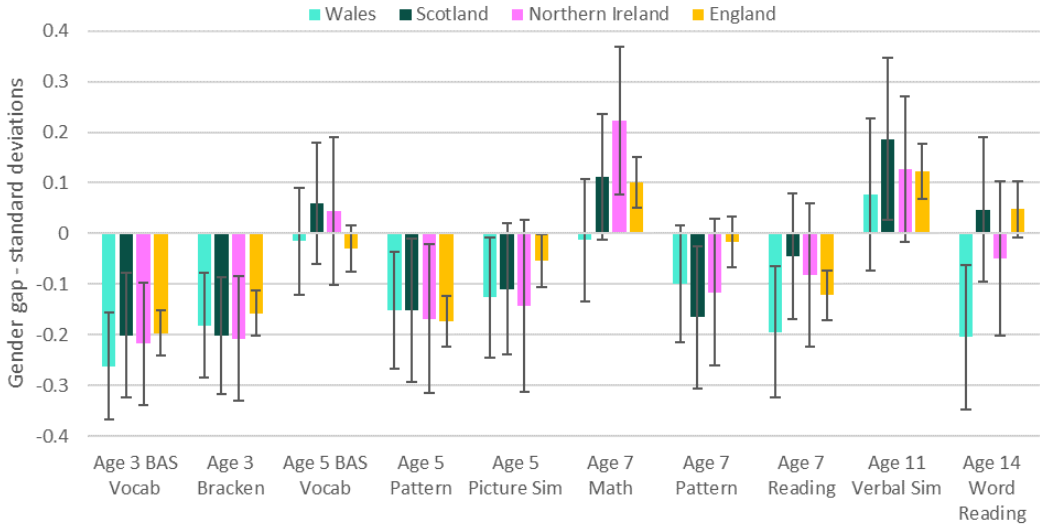
(a) Girls



b) Boys



(b) Gender gap within each country



Sources and notes: Authors' calculations using the Millennium Cohort Study. All outcomes are standardised to have mean zero and standard deviation one within the relevant sample. Relevant non-response surveys weights are always applied. Error bars show the 95 per cent confidence intervals.

It should be noted that these figures relate to the performance of girls and boys in Wales, Scotland and Northern Ireland relative to the same groups in England and estimate the differences after controlling for family background and demographics. National statistics for individual nations examine the raw gender gap within each country. For example:

- **England**: Key Stage 2 results for 2019 show that girls were about 10 percentage points more likely to achieve the expected standard in reading, writing and maths at age 11 than boys (70 per cent for girls compared with 60 per cent for boys). These gender gaps were concentrated in reading and writing, with a near zero gap in maths.[17]
- **Wales**: National Literacy and Numeracy test results for pupils in years 2-9 for 2019 show that girls outperformed boys by about 3-5 age standardised points in literacy for most years groups and that boys outperformed girls by about 1 standardised point in numeracy across most year groups. These scores are standardised within each year group to have a mean of 100 and most pupils score between 85 and 115.[18]
- **Scotland:** Girls are much more likely to achieve expected levels in reading, writing and literacy on the Curriculum for Excellence across all year groups, often being 5-10 percentage points more likely to achieve the expected levels. Girls are also more likely to achieve the expected levels in numeracy, but the difference is smaller (generally less than 5 percentage points).[19]
- **Northern Ireland:** Based on teacher assessments in 2019, girls are nearly 10 percentage points more likely than boys to be at Level 4 or above in communication at Key Stage 2 (83 per cent for girls, 74 per cent for boys). Girls are about 4 percentage points more likely than boys to be at Level 4 or above in maths (82 per cent of girls, 78 per cent of boys).[20]

These figures cannot be compared across nations as they all relate to different tests and are measured in different ways, but they are still illustrative.

By Parental Education

Figures 5.2 (a), (b) and (c) show cognitive scores in Wales, Scotland and Northern Ireland relative to England by parent(s) educational qualifications at time of birth. In this section low education refers to young people who are in households where parent(s) highest educational qualification was at Level 2 or below (i.e. GCSE equivalent or lower), medium education refers to those with educational qualifications at Level 3-5 (i.e. A level equivalent or below degree level) and high education refers to those with Level 6 or higher (i.e. degree level or above).

Taking each country in turn, we see a relatively complex picture for the low education group in Wales. Age 5 and 7 pattern construction scores are about 0.15 standard deviations higher than England, whilst reading scores at ages 5, 7 and 14 are lower (significantly so for ages 7 and 14). Turning our attention to the medium education group, children in Wales generally score similar to those in England, with the exception of age 7 reading scores (about 0.1 standard deviations lower) and age 11 verbal similarities (about 0.1 standard deviations higher). In terms of the high education group, we see lower reading or vocabulary scores than in England at ages 5, 7 and 14. We do, however, see slightly higher scores on the

[17] https://www.gov.uk/government/statistics/national-curriculum-assessments-key-stage-2-2019-revised
[18] https://gov.wales/national-reading-and-numeracy-test-results-2019
[19] https://www.gov.scot/publications/achievement-curriculum-excellence-cfe-levels-2018-19/pages/6/
[20] https://ccea.org.uk/key-stages-1-2/assessment-and-reporting/statistics/key-stages-1-2-assessment-statistics#section-5339

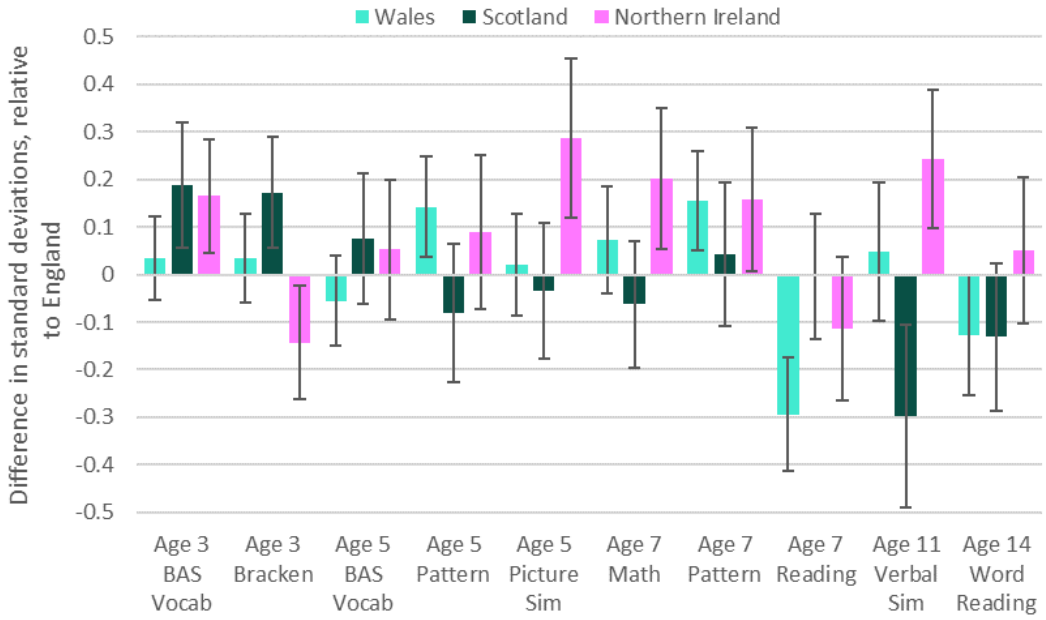
picture similarity measure at age 5 and verbal similarities at age 11 for the high education group in Wales.

In Scotland, cognitive scores for the low education group are higher than in England at age 3, almost 0.2 standard deviations higher in both BAS vocabulary and Bracken school readiness measures. From age 5 to age 7, scores are generally similar to England for the low education group, which then become lower than in England at age 11 and 14. For the medium education group, scores are again slightly higher than in England age 3, but then mostly below at ages 5 and 7. By age 11 and 14, they are similar again. Finally, looking at the high education group, age 3 scores are significantly higher than England on the BAS vocabulary measure (nearly 0.2 standard deviations higher). From age 5, cognitive scores are similar, or lower, than those in England for the high education group. It is also notable that lower maths scores in Scotland at age 7 appear to be mostly driven by the high education group.

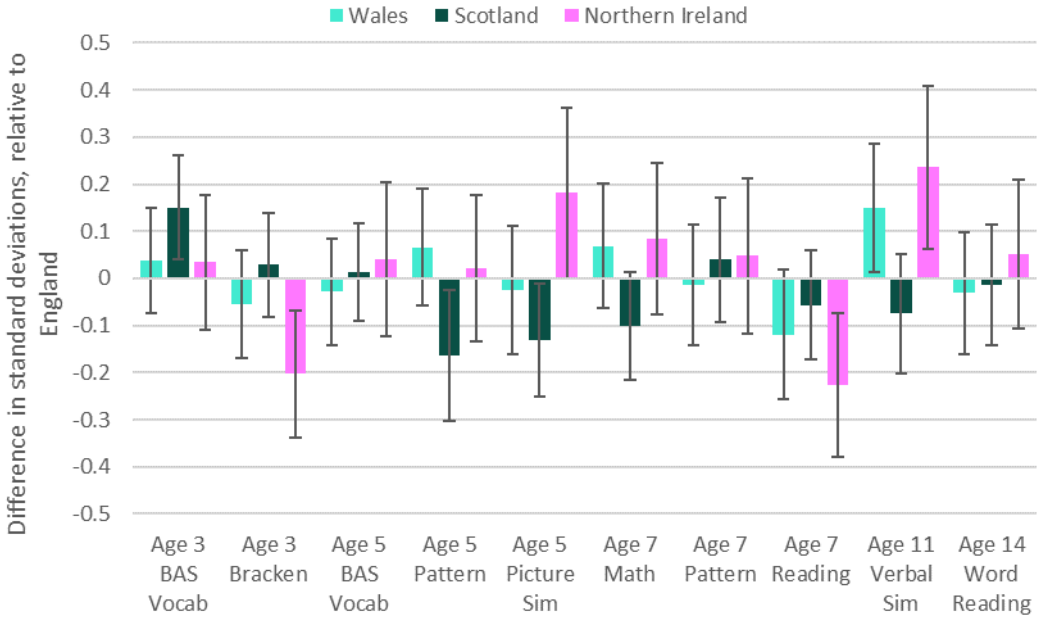
Turning to Northern Ireland, higher scores on the BAS vocabulary measure seem to be mostly driven by the high and low education groups, with lower scores on the Bracken school readiness measure driven by the low and medium education groups. At later ages, the low education group mostly scores significantly higher in Northern Ireland than in England from age 5 to 14 (scores are about 0.2 standard deviations higher on four of the eight outcomes from age 5). The medium education group has similar or higher scores than the same group in England from age 5 onwards, with the exception of lower reading scores at age 7. Finally, the high education group generally scores significantly higher in Northern Ireland from age 5, with significantly higher scores on five of the eight measures. The only exception is significantly lower reading scores at age 7.

Figure 5.2. Differences in cognitive scores by nation and parental education

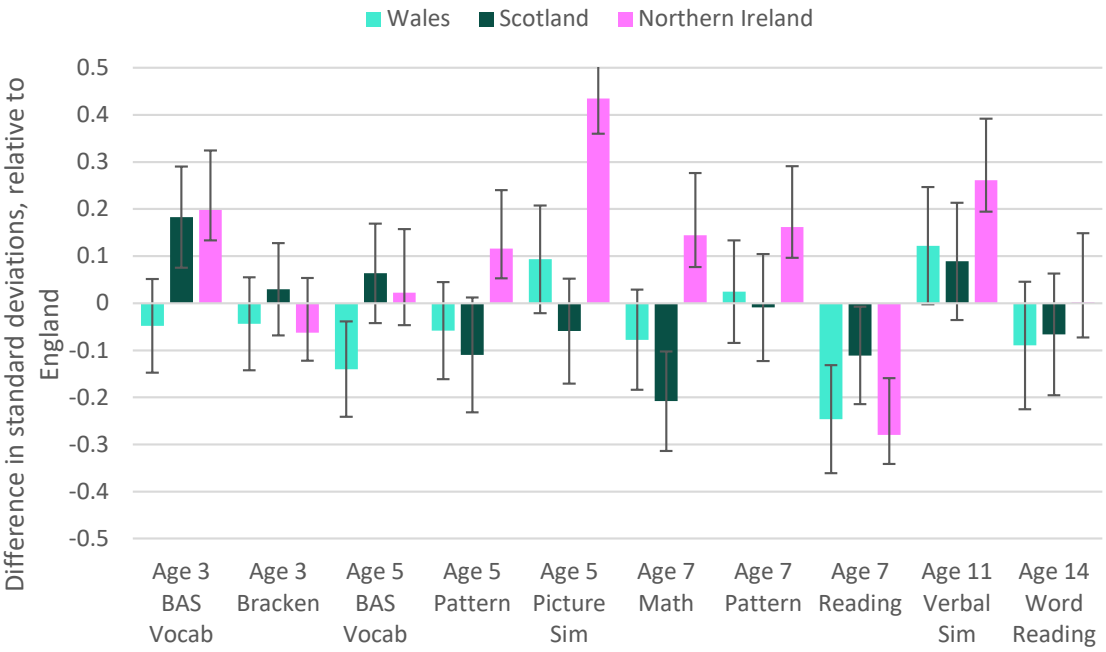
(a) Low Education



(b) Medium Education



(c) High Education



Source and notes: Authors' calculations using the Millennium Cohort Study. Low education refers to Level 2 or below (i.e. GCSE equivalent or lower), medium education refers to educational qualifications at Level 3-5 (i.e. A level equivalent or below degree level) and high education refers to Level 6 or higher (i.e. degree level or above).

By Household Income

Figures 5.3 (a), (b) and (c) show the cognitive scores in Wales, Scotland and Northern Ireland relative to England by household income at time of birth. We split the sample into approximate thirds based on their household income at time of birth (equivalized to household size using OECD equivalence scales). High income households are those in the third with the highest household income, middle income is the second third and the low income are those in the lowest third. These thirds are defined at the UK level.

Starting with Wales, we see that the low-income group in Wales tends to have similar scores to England on most outcomes, but have lower reading and vocabulary scores at ages 7 and 14. They score 0.35 standard deviations and 0.2 standard deviations lower in their age 7 reading and age 14 vocabulary outcomes, respectively. Turning our attention to the medium income group, children in Wales tend to score similar to children in England at age 3, but from age 5 they tend to have higher scores. At age 5, children in the medium income group in Wales score about 0.2 standard deviations higher on the pattern construction score and about 0.1 standard deviations higher on picture similarities score. At age 7 they score about 0.15 standard deviations higher on maths and pattern construction, and about 0.15 standard deviations higher on verbal similarities at age 11. In terms of the high-income group, and similar to the low-income group, we see that they perform similarly to England in every assessment with the exception of age 7 reading where they score about 0.2 standard deviations lower than high-income children in England.

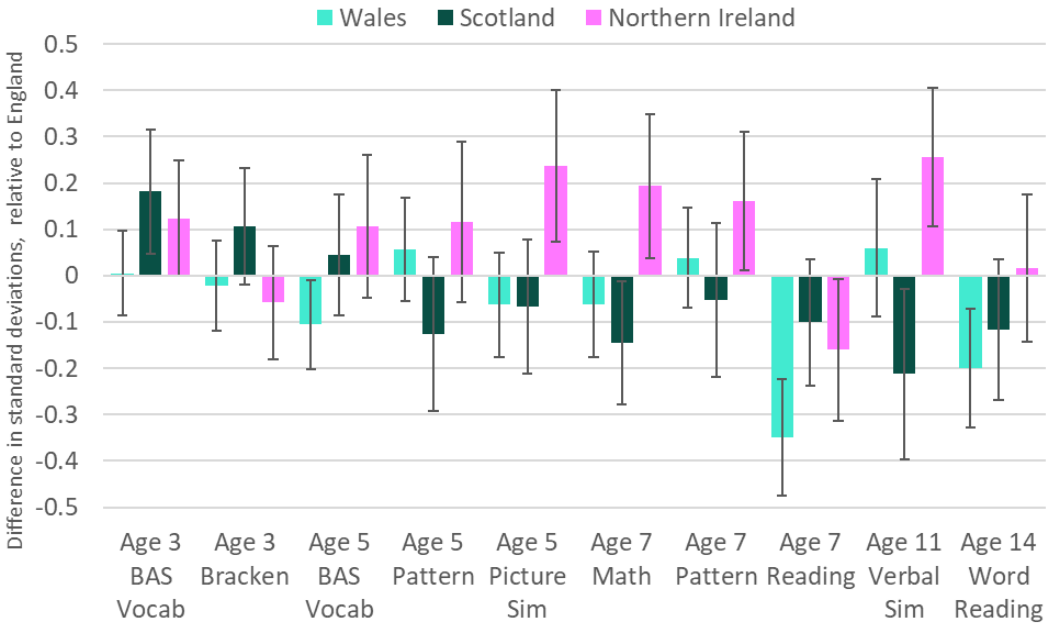
The lower reading and vocabulary scores at age 7 and 14 in Wales seem to be driven by both the low- and high-income groups, which matches the findings for parental education. It is also notable that the scores of the middle-income group partly ensure that average scores in Wales are similar to England, and not lower.

In Scotland, cognitive scores at age 3 are generally higher than in England across all income groups, but differences across income groups emerge at later ages. From age 5, scores are generally lower than in England for the low-income group, but not always significantly so. For example, age 7 maths scores are about 0.15 standard deviations lower and 0.2 standard deviations lower on the age 11 verbal similarities measure. For the middle-income group, scores are generally similar to England from age 5, with the exception of age 7 maths where they score about 0.1 standard deviations lower. Looking at the high income group, scores are generally similar to England, with the exception of the age 7 maths score (about 0.2 standard deviations lower) and age 7 reading (about 0.12 standard deviations lower). It is notable that the lower maths scores appear to be driven by all income groups.

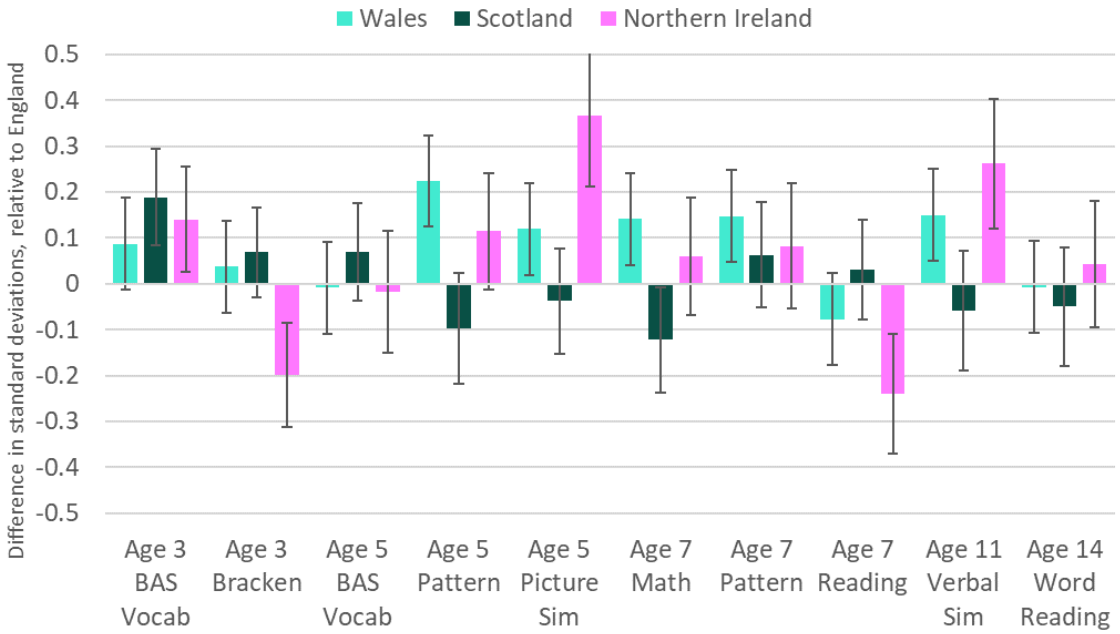
Turning to Northern Ireland, we see higher scores than in England for most outcomes amongst the low-income group – from the ages 5 to 14, the low-income group in Northern Ireland has the highest scores on seven of the eight assessments. The picture for the middle- and high-income groups is more complicated. At age 3, both groups score highly on the BAS vocabulary measure, but lower on Bracken school readiness measure. From age 5, scores are generally higher or similar to England. Scores are particularly high on the age 5 picture similarities measure and the age 11 verbal similarities measure (about 0.2 standard deviations or higher relative to England) for the medium and high-income groups in Northern Ireland. The one exception to this mostly positive picture is lower reading scores at age 7, which can be seen across all income groups.

Figure 5.3. Differences in cognitive scores by nation and household income

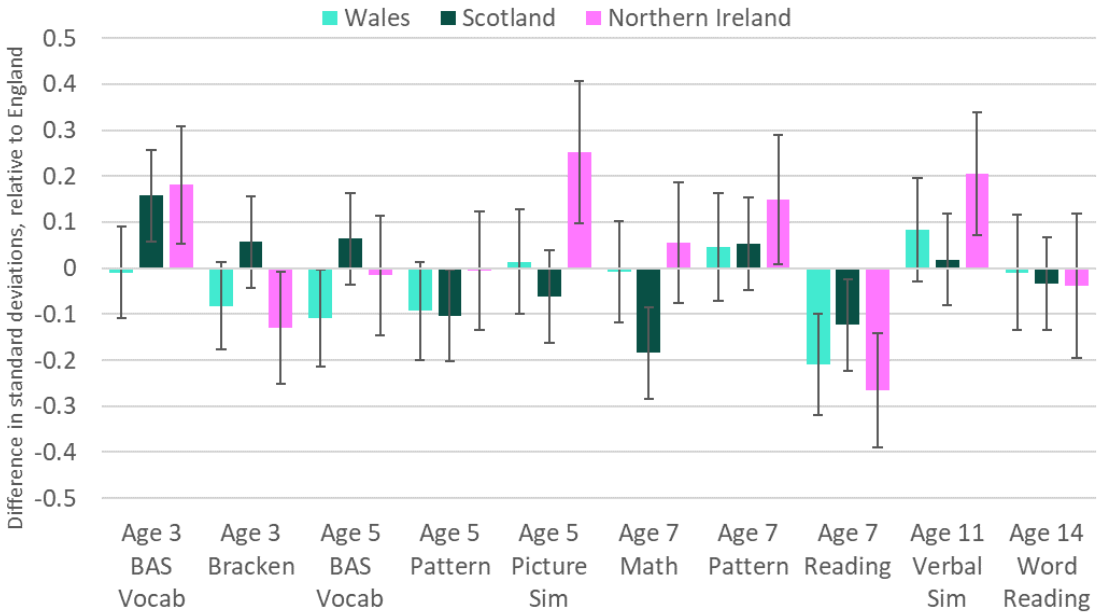
(a) Low Income



(b) Middle Income



(c) High Income



Source and notes: Authors' calculations using the Millennium Cohort Study. Low, medium and high income are defined on the basis of splitting the population into equal thirds based on household income (equivalized using the OECD equivalence scale).

By Language Spoken at Home

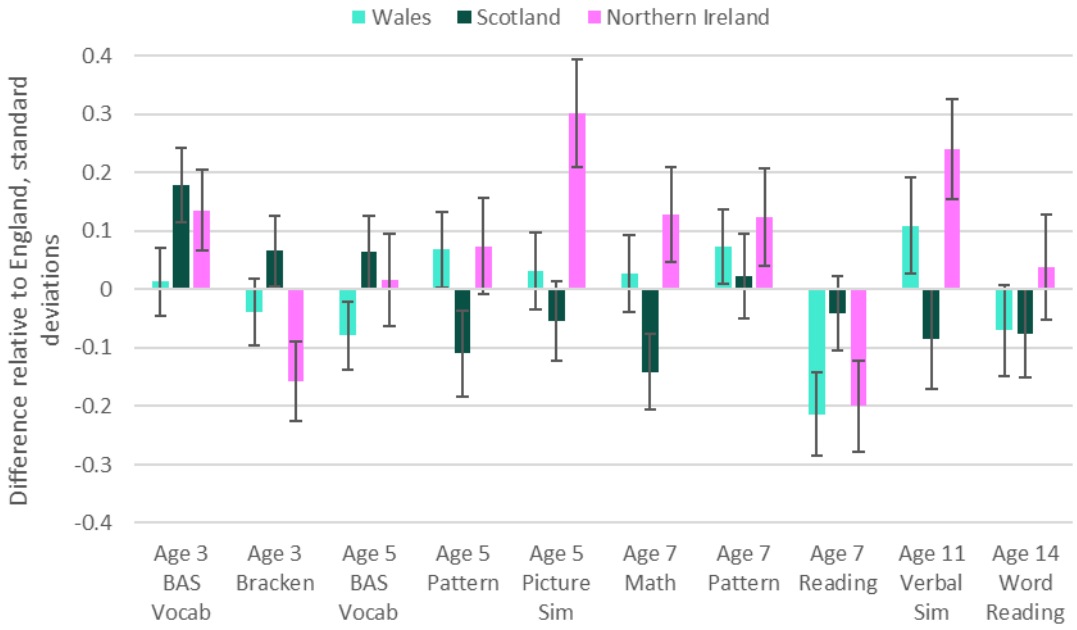
Figure 5.4 shows the cognitive scores in Wales, Scotland and Northern Ireland relative to England for those where the only language spoken at home is English. We performed similar analysis for young people who are in a household where languages other than English are spoken, but the statistical uncertainty was extremely high due to low sample sizes.

Taking each country in turn, we see that the picture for English speaking students in Wales is fairly similar to England at an early age with the exception of age 5 vocabulary scores, where they score about 0.1 standard deviations lower. At later ages they generally score similar to those in England or better, with the exception of age 7 reading, where they score about 0.2 standard deviations lower. This latter result is important as it shows that the age 7 results for Wales do not seem to be primarily driven by Welsh-speakers. The negative results are just as strong for those speaking English at home.

In Scotland, cognitive scores for the English-speaking group are higher than in England at age 3, almost 0.2 standard deviations higher in the BAS vocabulary score. From age 5 onwards, scores are similar or lower than in England – particularly in the age 7 maths score.

Turning to Northern Ireland, we observe higher scores in the BAS vocabulary measure and lower scores on the Bracken school readiness measure (over 0.1 standard deviations in both cases) at age 3. At later ages, the English speaking group mostly scores significantly higher in Northern Ireland than in England with the exception of age 7 reading where they score 0.2 of a standard deviation lower.

Figure 5.4. Differences in cognitive scores by nation for those who speak English at home, relative to England



Source and notes: Authors' calculations using the Millennium Cohort Study.

Summary

In summary, the differences by gender mostly match the overall differences by nation. There are, however, a number of interesting exceptions. Whilst boys and girls in Wales score lower on reading outcomes, these deficits appear bigger for boys, particularly at age 14. In Scotland, differences by gender also mostly match those for England, except that girls seem further behind in reading scores at age 7. This latter result is slightly surprising as national statistics show that girls are significantly ahead of boys in primary and secondary school tests in Scotland, though the large differences mostly emerge at later ages. In Northern Ireland, there is also a mostly similar picture for girls and boys as compared with England, except that boys in Northern Ireland seem to perform relatively highly in maths.

The picture by parental education level is relatively complex. For Wales, we see that lower reading scores relative to England seem to be driven by lower scores amongst the low and high education groups. In Scotland, we generally see higher scores than in England for all education groups at age 3. However, this turns into lower scores at later ages for the low and high education groups. It is also notable that lower maths scores in Scotland at age 7 appear to be mostly driven by the high education group. For Northern Ireland, we see that higher scores from age 5 onwards are generally driven by higher scores amongst both the high and low education group. The lower scores on the reading measure at age 7 appear to be driven by the medium and high education groups.

Turning our attention to the picture by household income. For Wales, we see that the low- and high-income groups both tend to have either similar or lower scores than in England across the different outcomes. The middle-income group, however, consistently has higher scores than in England, which partly accounts for why Wales scores similarly to England at the national level. The lower reading scores at age 7 appear to be driven by both the low- and high-income groups. This relatively low performance for the high and low groups, but mostly positive picture for the medium group, match the patterns by education for Wales. In Scotland, we see higher scores than England for all income groups at age 3. But this turns to lower scores at later ages, particularly for the low-income group. It is also notable that the low maths scores at age 7 can be seen across all income groups in Scotland. For Northern Ireland, we see

that, from age 5 onwards, the low-income group has consistently higher scores than in England, but scores are generally high or similar for all income groups. This high performance of the low-income groups matches the high-performance of the low-education group in Northern Ireland too. The only exception is that we see lower reading scores at age 7 for all income groups in Northern Ireland.

The overall pattern of results is mostly similar for those who speak only English at home. This is an important result in the case of Wales as it shows the negative results for reading are not primarily or exclusively driven by Welsh-speakers struggling with the assessment materials.

6. Conclusions and policy implications

As we showed in our previous report, the four UK nations have been gradually diverging on school and more general education policies since the point of devolution in 1999. Wales and Scotland were quick to abolish SATs and league tables. Both have seen a return to national testing of some form in the last ten years, though the purpose is very different now with a greater focus on using tests to understand and inform judgements of individual pupil progress. Schools in England have gained significant autonomy over the last 20 years, and to a lesser extent in Wales, whilst local and national government continue to play a very strong role in Northern Ireland and Scotland. The four nations have also diverged significantly on the curriculum, with Northern Ireland, Scotland and Wales all developing curriculums that emphasise developing skills over cross-cutting areas of learning and a strong formal role for teachers, whilst England has maintained quite specific minimum requirements. In recent years, there has been even further divergence on GCSEs and A levels, though arrangements have always been different in Scotland. Given these substantial policy and institutional differences, a key question is how children and young people compare in their levels of skills and educational performance.

This is actually quite a difficult question to answer. To date, the main source of comparable measures of skills or educational performance has come from the OECD PISA comparisons. This shows much lower scores in Wales than in other parts of the UK, particularly in reading and at the top of the distribution. Scores are more similar for the other UK nations, though numeracy scores in Scotland have been declining over time. Whilst useful, PISA is not perfect, however. It only examines 15-year-olds, so misses the evolution across ages and only takes places every 3 years.

In this report, we have used the Millennium Cohort Study to show how a range of cognitive skill measures evolve across the four nations throughout childhood from age 3 to 14, after controlling for key differences in family background. Crucially, these measures are collected consistently across the four nations and are not the focus of accountability systems, reducing the chances that high-stakes incentives could be driving differences.

Cognitive scores in Wales are mostly similar to England, on average, across most measures. This provides a much less negative picture than those based on PISA. The main exception is reading, where Wales does seem to have consistently lower scores in both the MCS and PISA data. Differences are not constant across children from different backgrounds either. Scores are generally higher or similar to England for those with medium income or education. But reading scores are more likely to be lower than England for those with high and low levels of education or income.

Children in Scotland start with relatively high scores at age 3, and parents of children in the data have relatively high vocabulary scores and education levels too. This gradually turns into lower scores at later ages, particularly in maths, which matches the patterns in PISA. Lower maths scores can be seen across all income groups. The low-income group in Scotland has particularly low scores.

In contrast to PISA, there is a more positive picture in Northern Ireland, with mostly higher scores than England and other UK nations from age 5 onwards. Indeed, scores are generally higher than those seen in London, which has been celebrated for its level of educational success. Scores are particularly strong for boys and the low-income group. The main exception is age 7 reading scores, which seem low across the board.

These comparisons are clearly informative and help move us beyond the data shown in PISA, but they do provide a relatively complicated picture. There are also a number of important qualifications. Use of survey data always prompts concerns about how representative the data is of the population. We show that comparisons of income and young people's educational qualifications between survey and national data are mostly reassuring. Children in the MCS data have slightly higher educational qualifications than their respective cohorts in national data in England, Wales and Scotland. This to be expected given how we define our sample and the picture is similar across these three nations. Educational qualifications for young people in Northern Ireland are closer to national data, which should actually create a downward bias as compared with other three nations. Yet we observe a more positive picture in Northern Ireland. There will always be a concern that unobservable differences in family background could be driving differences across nations. However, we are comparing four nations within the UK with a much greater similarity than is the case for international comparisons; we also control for a rich array of family background data and this only leads to small changes in patterns.

There is clearly a role for broad institutional changes in shaping these patterns and there is already evidence for Wales showing how the removal of league tables reduced GCSE scores. However, these comparisons of the MCS data show that comparisons of outcomes across the four nations differ by different domains of skills, with reading scores a particular problem in Wales and numeracy scores lower in Scotland. There is also a mostly positive picture in Northern Ireland, which adopted similar policy positions to Scotland and Wales. At this point, it is important to note that all but one outcome is measured between ages 3 and 11, so the results for Northern Ireland are highly unlikely to reflect the effects of grammar schools.

We conclude that fruitful future work be best directed towards analysing differences in the specific pedagogical and curriculum approaches across the four nations. For example, how the teaching of synthetic phonics implemented and timed across nations, or how the teaching of maths in primary schools has changed. The differences across outcomes suggest this could be a fruitful area of investigation. More UK-wide data is also required to better understand current and future differences in skills and educational achievement across the four nations, particularly given the large recent divergence in exams and assessments. More education-related surveys should be UK-wide or at least include comparable skill measures, rather than focused on individual countries. More use could also be made of private or internal assessment data if such assessments are common or used in similar ways across UK nations.

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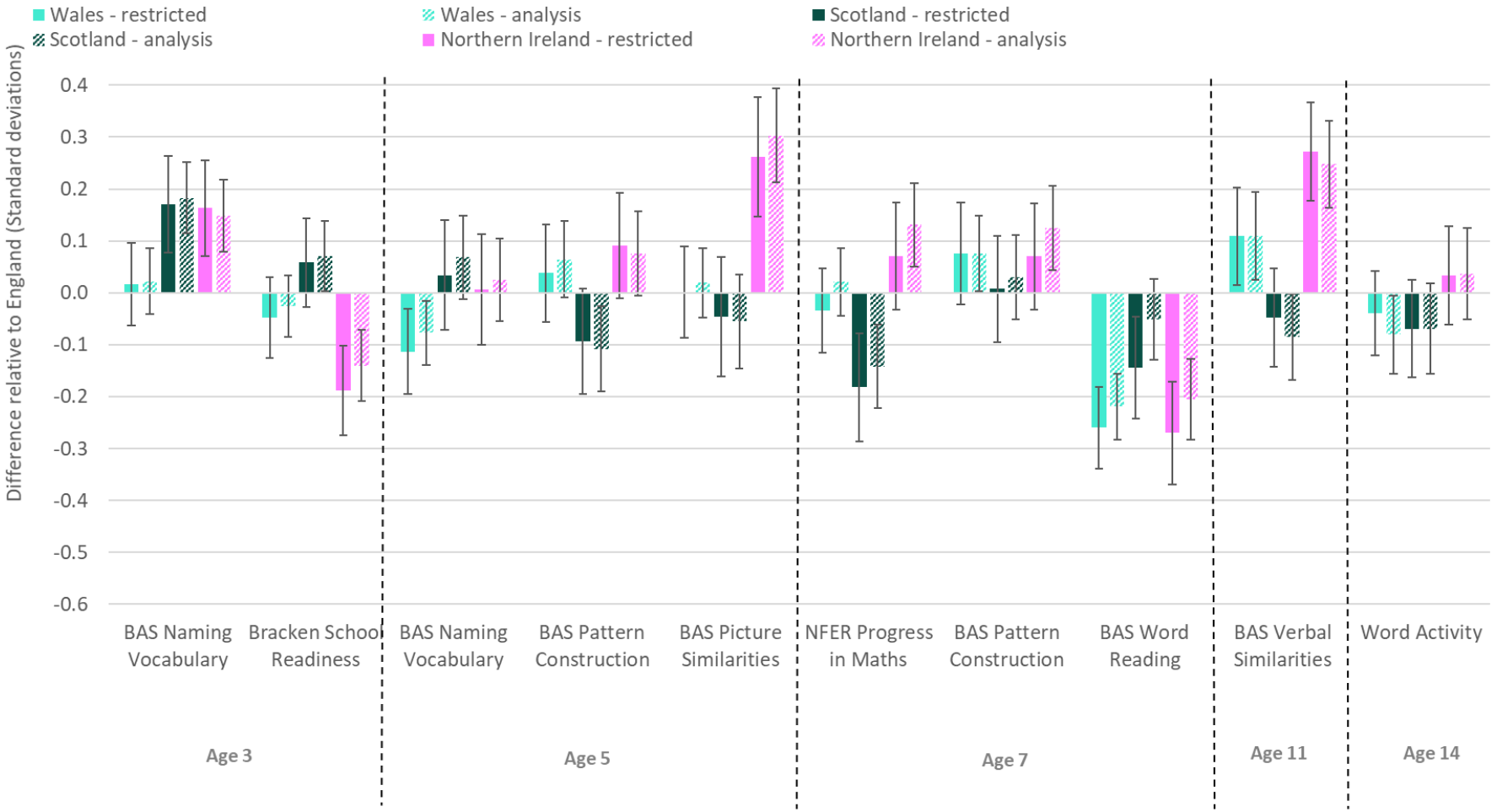
Appendix Figure A1 The effect of sample selection on outcomes, after controls



Note: The analysis sample is restricted to those who have no missing data between the ages of 3 to 7 and 11 to 14 respectively. The restricted sample drops all individuals who have any missing data. The sample sizes can be seen in Table 3.2. Authors' calculations using the Millennium Cohort Study.

Appendix Figure A2 Summary of variables based on the analysis sample

Variable	England	Wales	Scotland	Northern Ireland	UK	N
Static Covariates (at birth)						
Male Child	0.495 (0.500)	0.513 (0.500)	0.482 (0.500)	0.512 (0.500)	0.496 (0.500)	10466
Ethnicity White	0.867 (0.340)	0.975 (0.155)***	0.975 (0.155)***	0.995 (0.071)***	0.887 (0.317)	10466
Ethnicity Mixed	0.035 (0.184)	0.013 (0.113)***	0.005 (0.073)***	0.002 (0.048)***	0.030 (0.171)	10466
Ethnicity Indian	0.021 (0.142)	0.001 (0.038)***	0.005 (0.074)***	0.001 (0.022)***	0.018 (0.131)	10466
Ethnicity Pakistani	0.034 (0.180)	0.002 (0.040)***	0.004 (0.063)***	0.001 (0.031)***	0.028 (0.165)	10466
Ethnicity Bangladeshi	0.008 (0.087)	0.003 (0.052)	0.000 (0.000)**	0.000 (0.000)	0.006 (0.080)	10466
Ethnicity Black Caribbean	0.010 (0.101)	0.000 (0.000)**	0.005 (0.074)	0.000 (0.000)*	0.009 (0.094)	10466
Ethnicity Black African	0.013 (0.115)	0.002 (0.040)**	0.001 (0.036)***	0.000 (0.000)**	0.011 (0.105)	10466
Ethnicity Other	0.013 (0.113)	0.005 (0.068)	0.003 (0.055)**	0.001 (0.036)*	0.011 (0.105)	10466
Own Home	0.636 (0.481)	0.618 (0.486)	0.638 (0.481)	0.665 (0.472)	0.636 (0.481)	10466
Rent Home (Private)	0.089 (0.285)	0.074 (0.262)	0.047 (0.212)***	0.095 (0.293)	0.085 (0.279)	10466
Rent Home (Social)	0.226 (0.418)	0.256 (0.437)	0.263 (0.440)**	0.171 (0.377)**	0.228 (0.420)	10466
Other Home	0.049 (0.216)	0.051 (0.221)	0.052 (0.222)	0.070 (0.254)*	0.050 (0.219)	10466
Parental Occupation						
Managers, Directors and Senior Officials	0.218 (0.413)	0.155 (0.362)***	0.195 (0.396)	0.139 (0.346)***	0.209 (0.407)	10466
Professional Occupations	0.129 (0.336)	0.124 (0.330)	0.140 (0.347)	0.140 (0.347)	0.130 (0.337)	10466
Associate Professional Occupations	0.140 (0.347)	0.131 (0.337)	0.147 (0.354)	0.111 (0.314)	0.139 (0.346)	10466
Administrative and Secretarial Occupations	0.118 (0.322)	0.117 (0.322)	0.117 (0.321)	0.146 (0.353)	0.119 (0.323)	10466
Skilled Trades Occupations	0.106 (0.308)	0.136 (0.343)**	0.107 (0.309)	0.133 (0.339)	0.109 (0.311)	10466
Caring, Leisure and other Service Occupations	0.065 (0.247)	0.087 (0.281)*	0.075 (0.263)	0.068 (0.253)	0.067 (0.250)	10466
Sales and Customer Service Occupations	0.075 (0.263)	0.077 (0.266)	0.082 (0.274)	0.098 (0.298)	0.076 (0.266)	10466
Process, Plant and Machine Operatives	0.052 (0.221)	0.068 (0.251)	0.045 (0.207)	0.078 (0.268)**	0.053 (0.224)	10466
Elementary Occupations	0.081 (0.273)	0.094 (0.291)	0.087 (0.281)	0.068 (0.252)	0.081 (0.274)	10466

Other Occupations	0.017 (0.129)	0.013 (0.112)	0.007 (0.083)**	0.020 (0.139)	0.016 (0.125)	10466
Highest Qualifications in Household						
NQF Level 6+	0.309 (0.462)	0.305 (0.461)	0.305 (0.461)	0.282 (0.450)	0.307 (0.461)	10466
NQF Level 4 / 5	0.064 (0.246)	0.051 (0.220)	0.061 (0.239)	0.062 (0.241)	0.063 (0.244)	10466
NQF Level 3	0.185 (0.388)	0.209 (0.407)	0.278 (0.448)***	0.210 (0.407)	0.195 (0.397)	10466
NQF Level 2	0.229 (0.420)	0.214 (0.411)	0.180 (0.384)***	0.208 (0.406)	0.224 (0.417)	10466
NQF Level 1	0.056 (0.230)	0.072 (0.259)	0.032 (0.177)***	0.067 (0.251)	0.055 (0.229)	10466
NQV None	0.089 (0.285)	0.088 (0.283)	0.060 (0.238)***	0.102 (0.302)	0.087 (0.282)	10466
Language spoken in HH						
Speak English and an additional language	0.074 (0.262)	0.083 (0.275)	0.009 (0.093)***	0.010 (0.100)***	0.066 (0.249)	10466
Do not speak English	0.020 (0.141)	0.026 (0.158)	0.005 (0.070)***	0.005 (0.068)**	0.019 (0.136)	10466
Speaks Welsh	0.000 (0.000)	0.089 (0.284)***	0.000 (0.000)	0.000 (0.000)	0.005 (0.067)	10466
Home Composite Index (Age 3)	26.175 (7.803)	26.446 (7.506)	26.611 (7.374)	24.643 (8.117)***	26.167 (7.771)	10466
Index Missing	0.004 (0.063)	0.001 (0.036)	0.002 (0.044)	0.005 (0.074)	0.004 (0.061)	10466
Strengths and Weaknesses Index						
Index (Age 3)	8.940 (5.084)	8.779 (5.107)	8.613 (4.752)*	8.192 (5.045)***	8.874 (5.058)	10466
Birth Weight						
Low Birth Weight (dummy)	0.074 (0.261)	0.067 (0.250)	0.069 (0.254)	0.062 (0.242)	0.072 (0.259)	10466
Birth Weight Trimmed (kg)	3.372 (0.537)	3.400 (0.526)	3.420 (0.523)**	3.436 (0.523)**	3.380 (0.535)	10466
Birth Weight Missing	0.003 (0.051)	0.002 (0.039)	0.001 (0.038)	0.000 (0.000)	0.002 (0.049)	10466
Mother Age at Birth						
Age at Birth (Years)	28.854 (5.854)	27.878 (6.022)***	28.730 (6.065)	28.646 (5.864)	28.785 (5.885)	10466
Teen Mother (dummy)	0.074 (0.262)	0.109 (0.312)***	0.081 (0.273)	0.079 (0.270)	0.077 (0.266)	10466
Breast Feed						
Age Last Breast Feed (Trimmed)	75.897 (78.210)	55.956 (73.538)***	61.997 (76.908)***	35.111 (61.736)***	72.076 (77.843)	10466

Age Last Breast Feed Over 6 months (Dummy)	0.240 (0.427)	0.166 (0.373)***	0.197 (0.398)***	0.078 (0.268)***	0.226 (0.418)	10466
Age Last Breast Feed Missing	0.276 (0.447)	0.381 (0.486)***	0.386 (0.487)***	0.509 (0.500)***	0.300 (0.458)	10466
Household IMD Decile						
IMD 1st Decile	0.111 (0.314)	0.083 (0.276)*	0.098 (0.297)	0.091 (0.287)	0.107 (0.309)	10466
IMD 2nd Decile	0.092 (0.289)	0.122 (0.328)**	0.084 (0.278)	0.141 (0.349)***	0.095 (0.293)	10466
IMD 3rd Decile	0.099 (0.299)	0.128 (0.334)**	0.095 (0.293)	0.118 (0.323)	0.101 (0.301)	10466
IMD 4th Decile	0.082 (0.274)	0.120 (0.326)***	0.107 (0.309)**	0.096 (0.295)	0.086 (0.281)	10466
IMD 5th Decile	0.106 (0.307)	0.058 (0.234)***	0.102 (0.303)	0.076 (0.265)*	0.102 (0.302)	10466
IMD 6th Decile	0.094 (0.292)	0.066 (0.249)**	0.096 (0.294)	0.110 (0.313)	0.093 (0.291)	10466
IMD 7th Decile	0.095 (0.293)	0.078 (0.268)	0.084 (0.278)	0.070 (0.255)	0.092 (0.289)	10466
IMD 8th Decile	0.091 (0.287)	0.091 (0.288)	0.096 (0.294)	0.078 (0.269)	0.091 (0.287)	10466
IMD 9th Decile	0.088 (0.283)	0.099 (0.298)	0.119 (0.324)***	0.146 (0.353)***	0.093 (0.291)	10466
IMD 10th Decile	0.095 (0.293)	0.151 (0.359)***	0.119 (0.324)**	0.074 (0.262)	0.099 (0.299)	10466
IMD Missing	0.048 (0.214)	0.002 (0.048)***	0.000 (0.000)***	0.000 (0.000)***	0.040 (0.196)	10466
Urban Rural Index						
Urban	0.794 (0.405)	0.703 (0.457)***	0.788 (0.409)	0.470 (0.499)***	0.776 (0.417)	10466
Mixed	0.083 (0.276)	0.148 (0.356)***	0.000 (0.000)***	0.124 (0.330)***	0.081 (0.272)	10466
Rural	0.075 (0.264)	0.146 (0.354)***	0.212 (0.409)***	0.405 (0.491)***	0.104 (0.305)	10466
Urban Rural Missing	0.048 (0.214)	0.002 (0.048)***	0.000 (0.000)***	0.000 (0.000)***	0.040 (0.196)	10466
Government Office Region (At Birth)						
London	0.133 (0.339)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.109 (0.312)	10466
North East	0.046 (0.209)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.037 (0.190)	10466
North West	0.129 (0.335)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.106 (0.308)	10466
Yorkshire	0.110 (0.313)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.091 (0.287)	10466

East Midlands	0.087 (0.281)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.071 (0.257)	10466
West Midlands	0.095 (0.293)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.078 (0.268)	10466
East England	0.113 (0.317)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.093 (0.291)	10466
South East	0.187 (0.390)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.154 (0.361)	10466
South West	0.101 (0.301)	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.083 (0.276)	10466
Other Covariates						
Smoker in HH	0.438 (0.496)	0.453 (0.498)	0.426 (0.495)	0.460 (0.499)	0.439 (0.496)	10466
Parents Highest Cognitive Score in HH	10.025 (6.426)	9.652 (6.228)	9.920 (6.758)	9.352 (6.374)*	9.970 (6.445)	10466
Long Term Health Conditions (Child at Birth)	0.158 (0.365)	0.144 (0.352)	0.157 (0.364)	0.112 (0.315)**	0.156 (0.363)	10466
Dynamic Covariates						
Household Income (OECD equalized income)						
Household Income (Baseline)	356.955 (236.502)	317.736 (203.990)***	361.664 (221.724)	307.141 (185.733)***	353.408 (232.231)	10466
Household Income Missing (Baseline)	0.001 (0.037)	0.002 (0.045)	0.001 (0.029)	0.002 (0.044)	0.001 (0.037)	10466
Household Income (Wave 3)	373.488 (231.618)	348.667 (213.859)**	379.420 (221.376)	336.820 (197.111)***	371.299 (228.768)	10466
Household Income Missing (Wave 3)	0.008 (0.089)	0.007 (0.081)	0.003 (0.053)	0.006 (0.077)	0.007 (0.085)	10466
Household Income (Wave 4)	404.490 (242.335)	368.514 (221.774)***	412.522 (234.554)	348.170 (197.168)***	401.144 (239.407)	10466
Household Income Missing (Wave 4)	0.017 (0.129)	0.008 (0.092)	0.018 (0.134)	0.007 (0.086)	0.016 (0.126)	10466
Household Income (Wave 5)	403.743 (183.139)	386.211 (160.548)**	433.994 (173.452)***	337.430 (135.028)***	402.621 (180.286)	10173
Household Income Missing (Wave 5)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	10173
Household Income (Wave 6)	401.379 (183.059)	384.684 (156.486)*	441.183 (170.897)***	341.263 (135.283)***	401.353 (179.913)	10173
Household Income Missing (Wave 6)	0.001 (0.032)	0.001 (0.038)	0.001 (0.030)	0.000 (0.000)	0.001 (0.031)	10173
Siblings in Household						

At Birth						
No Siblings	0.416 (0.493)	0.426 (0.495)	0.442 (0.497)	0.392 (0.488)	0.418 (0.493)	10466
One	0.371 (0.483)	0.374 (0.484)	0.368 (0.483)	0.330 (0.471)	0.369 (0.483)	10466
Two	0.146 (0.353)	0.139 (0.346)	0.138 (0.345)	0.170 (0.376)	0.146 (0.353)	10466
Three or More	0.019 (0.137)	0.021 (0.143)	0.014 (0.119)	0.025 (0.155)	0.019 (0.137)	10466
Wave 2 (Age 3)						
No Siblings	0.250 (0.433)	0.285 (0.451)*	0.265 (0.442)	0.248 (0.432)	0.253 (0.435)	10466
One	0.479 (0.500)	0.448 (0.497)	0.491 (0.500)	0.379 (0.485)***	0.474 (0.499)	10466
Two	0.182 (0.386)	0.181 (0.385)	0.183 (0.386)	0.219 (0.414)*	0.184 (0.387)	10466
Three or More	0.089 (0.285)	0.086 (0.280)	0.061 (0.240)***	0.154 (0.361)***	0.089 (0.285)	10466
Wave 3 (Age 5)						
No Siblings	0.164 (0.370)	0.188 (0.391)	0.182 (0.386)	0.167 (0.373)	0.167 (0.373)	10466
One	0.495 (0.500)	0.478 (0.500)	0.496 (0.500)	0.401 (0.490)***	0.490 (0.500)	10466
Two	0.233 (0.423)	0.229 (0.421)	0.228 (0.420)	0.251 (0.434)	0.233 (0.423)	10466
Three or More	0.109 (0.312)	0.104 (0.306)	0.094 (0.292)	0.181 (0.385)***	0.110 (0.313)	10466
Wave 4 (Age 7)						
No Siblings	0.122 (0.327)	0.143 (0.350)	0.141 (0.349)	0.118 (0.323)	0.125 (0.330)	10466
One	0.475 (0.499)	0.458 (0.498)	0.486 (0.500)	0.381 (0.486)***	0.472 (0.499)	10466
Two	0.271 (0.445)	0.268 (0.443)	0.262 (0.440)	0.294 (0.456)	0.271 (0.444)	10466
Three or More	0.132 (0.338)	0.131 (0.337)	0.111 (0.314)	0.207 (0.405)***	0.133 (0.339)	10466
Wave 5 (Age 11)						
No Siblings	0.122 (0.327)	0.128 (0.335)	0.145 (0.352)*	0.091 (0.288)*	0.123 (0.328)	10173
One	0.430 (0.495)	0.449 (0.498)	0.484 (0.500)***	0.326 (0.469)***	0.431 (0.495)	10173
Two	0.266 (0.442)	0.261 (0.439)	0.242 (0.428)	0.339 (0.474)***	0.267 (0.442)	10173
Three or More	0.182 (0.386)	0.162 (0.368)	0.130 (0.336)***	0.243 (0.429)***	0.179 (0.384)	10173
Wave 6 (Age 14)						
No Siblings	0.142 (0.349)	0.149 (0.356)	0.156 (0.363)	0.096 (0.294)**	0.141 (0.348)	10173
One	0.434 (0.496)	0.457 (0.498)	0.483 (0.500)**	0.348 (0.477)***	0.436 (0.496)	10173

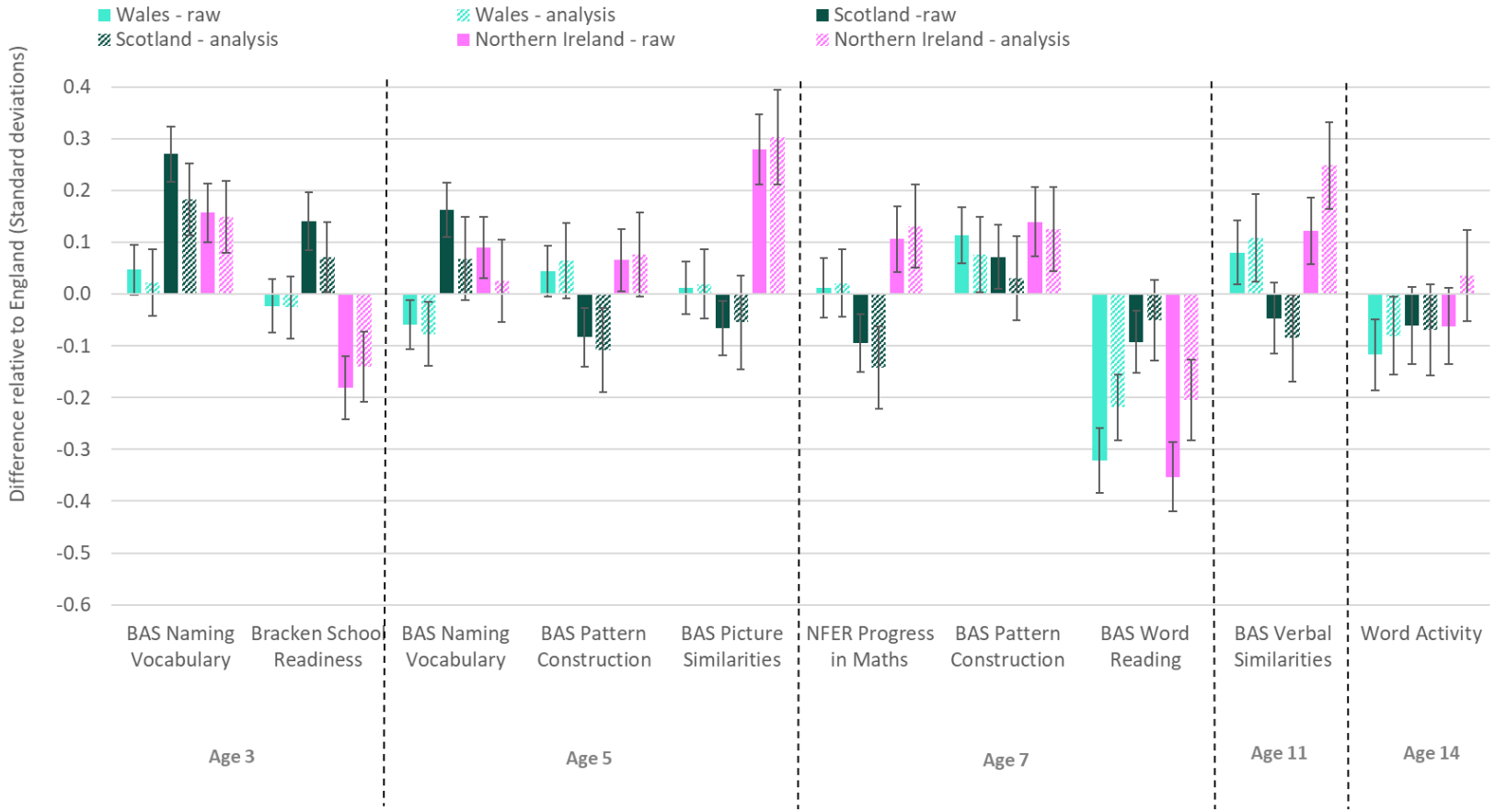
Two	0.246 (0.431)	0.239 (0.427)	0.259 (0.438)	0.310 (0.463)***	0.249 (0.433)	10173
Three or More	0.178 (0.382)	0.156 (0.363)	0.102 (0.302)***	0.246 (0.431)***	0.173 (0.379)	10173
Employment Status in HH						
Wave 2 (Age 3)						
No Employed Adult in HH	0.153 (0.360)	0.187 (0.390)**	0.127 (0.333)*	0.141 (0.348)	0.152 (0.359)	10466
Single Worker HH	0.385 (0.487)	0.319 (0.466)***	0.368 (0.482)	0.375 (0.484)	0.380 (0.485)	10466
All Parents Work in HH	0.455 (0.498)	0.491 (0.500)	0.498 (0.500)**	0.472 (0.499)	0.461 (0.498)	10466
Wave 3 (Age)						
No Employed Adult in HH	0.152 (0.359)	0.157 (0.363)	0.131 (0.337)	0.146 (0.354)	0.150 (0.357)	10466
Single Worker HH	0.366 (0.482)	0.316 (0.465)**	0.350 (0.477)	0.336 (0.473)	0.361 (0.480)	10466
All Parents Work in HH	0.482 (0.500)	0.526 (0.499)*	0.519 (0.500)*	0.518 (0.500)	0.489 (0.500)	10466
Wave 4 (Age 7)						
No Employed Adult in HH	0.141 (0.348)	0.156 (0.363)	0.119 (0.324)	0.140 (0.347)	0.140 (0.347)	10466
Single Worker HH	0.344 (0.475)	0.312 (0.464)	0.332 (0.471)	0.349 (0.477)	0.342 (0.474)	10466
All Parents Work in HH	0.515 (0.500)	0.531 (0.499)	0.549 (0.498)*	0.511 (0.500)	0.519 (0.500)	10466
Wave 5 (Age 11)						
No Employed Adult in HH	0.183 (0.386)	0.186 (0.389)	0.124 (0.330)***	0.190 (0.393)	0.178 (0.383)	10173
Single Worker HH	0.362 (0.481)	0.318 (0.466)*	0.356 (0.479)	0.335 (0.472)	0.358 (0.480)	10173
All Parents Work in HH	0.455 (0.498)	0.496 (0.500)*	0.519 (0.500)***	0.474 (0.500)	0.463 (0.499)	10173
Wave 6 (Age 14)						
No Employed Adult in HH	0.144 (0.351)	0.142 (0.349)	0.114 (0.318)**	0.178 (0.383)*	0.143 (0.350)	10173
Single Worker HH	0.370 (0.483)	0.338 (0.473)	0.328 (0.470)**	0.338 (0.473)	0.364 (0.481)	10173
All Parents Work in HH	0.485 (0.500)	0.518 (0.500)	0.557 (0.497)***	0.484 (0.500)	0.493 (0.500)	10173
Parent Relationship						
Baseline						
Married	0.579 (0.494)	0.546 (0.498)	0.591 (0.492)	0.656 (0.475)***	0.581 (0.493)	10466
Cohabitating	0.255 (0.436)	0.275 (0.447)	0.248 (0.432)	0.122 (0.327)***	0.250 (0.433)	10466
Single Parent	0.133 (0.340)	0.177 (0.382)***	0.160 (0.367)**	0.221 (0.415)***	0.141 (0.348)	10466
Missing	0.034 (0.180)	0.002 (0.049)***	0.001 (0.034)***	0.001 (0.032)***	0.028 (0.165)	10466

Wave 2 (age 3)						
Married	0.654 (0.476)	0.604 (0.489)**	0.648 (0.478)	0.717 (0.451)**	0.654 (0.476)	10466
Cohabitating	0.178 (0.383)	0.212 (0.409)*	0.200 (0.400)	0.105 (0.306)***	0.179 (0.383)	10466
Single Parent	0.164 (0.370)	0.181 (0.385)	0.152 (0.359)	0.177 (0.382)	0.164 (0.371)	10466
Wave 3 (Age 5)						
Married	0.625 (0.484)	0.606 (0.489)	0.620 (0.486)	0.693 (0.462)**	0.626 (0.484)	10466
Cohabitating	0.190 (0.393)	0.216 (0.411)	0.202 (0.402)	0.118 (0.322)***	0.190 (0.392)	10466
Single Parent	0.185 (0.388)	0.178 (0.382)	0.179 (0.383)	0.190 (0.392)	0.184 (0.388)	10466
Wave 4 (Age 7)						
Married	0.595 (0.491)	0.576 (0.494)	0.587 (0.493)	0.662 (0.473)**	0.596 (0.491)	10466
Cohabitating	0.166 (0.373)	0.193 (0.394)	0.183 (0.387)	0.111 (0.314)***	0.167 (0.373)	10466
Single Parent	0.203 (0.402)	0.201 (0.401)	0.198 (0.398)	0.210 (0.408)	0.203 (0.402)	10466
Wave 5 (Age 11)						
Married	0.532 (0.499)	0.527 (0.499)	0.554 (0.497)	0.578 (0.494)*	0.535 (0.499)	10173
Cohabitating	0.191 (0.393)	0.218 (0.413)	0.209 (0.407)	0.158 (0.365)	0.193 (0.395)	10173
Single Parent	0.276 (0.447)	0.254 (0.436)	0.236 (0.425)**	0.265 (0.441)	0.271 (0.445)	10173
Wave 6 (Age 14)						
Married	0.531 (0.499)	0.532 (0.499)	0.553 (0.497)	0.594 (0.491)**	0.536 (0.499)	10173
Cohabitating	0.179 (0.383)	0.216 (0.412)*	0.191 (0.393)	0.146 (0.353)*	0.180 (0.385)	10173
Single Parent	0.289 (0.454)	0.252 (0.434)*	0.256 (0.437)*	0.261 (0.439)	0.284 (0.451)	10173
Country Different that Country of Birth						
Wave 2 (Age 3)	0.006 (0.075)	0.021 (0.143)***	0.022 (0.145)***	0.004 (0.065)	0.008 (0.088)	10466
Wave 3 (Age 5)	0.008 (0.090)	0.032 (0.175)***	0.025 (0.157)***	0.005 (0.068)	0.011 (0.103)	10466
Wave 4 (Age 7)	0.008 (0.091)	0.044 (0.206)***	0.029 (0.167)***	0.006 (0.076)	0.012 (0.108)	10466
Wave 5 (Age 11)	0.011 (0.103)	0.051 (0.220)***	0.039 (0.193)***	0.012 (0.108)	0.015 (0.121)	10173
Wave 6 (Age 14)	0.011 (0.106)	0.057 (0.232)***	0.034 (0.181)***	0.014 (0.116)	0.016 (0.124)	10173
Age at time of interview						
Wave 2 (Age 3) in months	38.004 (2.321)	38.175 (2.550)	38.387 (2.587)***	38.335 (1.599)***	38.059 (2.337)	10466

Wave 3 (Age 5) in months	63.209 (2.876)	64.449 (3.098)***	64.168 (3.020)***	62.746 (2.350)***	63.338 (2.908)	10466
Wave 4 (Age 7) in months	86.710 (2.931)	87.311 (3.051)***	87.156 (3.025)***	85.562 (1.992)***	86.735 (2.930)	10466
Wave 5 (Age 11) in years	11.103 (0.336)	11.201 (0.354)***	11.185 (0.276)***	11.029 (0.208)***	11.112 (0.330)	9249
Wave 6 (Age 14) in years	13.771 (0.445)	13.774 (0.472)	13.880 (0.346)***	13.707 (0.457)**	13.778 (0.441)	8480

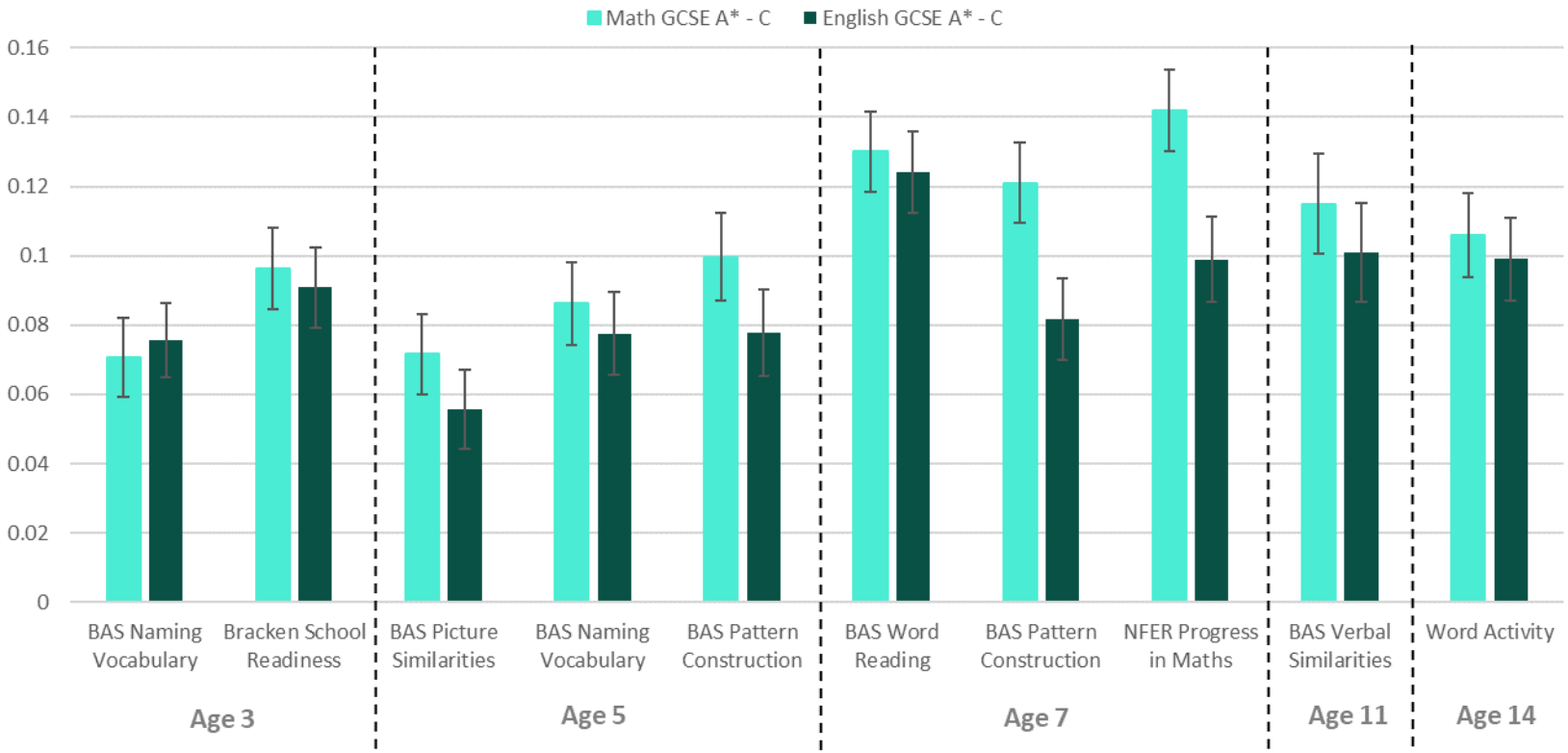
Note: mean coefficients; sd in parentheses. Stars indicate statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Appendix Figure A3 The effect of sample selection on outcomes



Note: The raw sample uses all responses for each assessment and controls for the child's age, at time of interview, and gender. The analysis sample is restricted to those who have no missing data between the ages of 3 to 7 and 11 to 14 respectively and controls for our full list of covariates.

Appendix Figure A4 - The relationship between cognitive scores and age 17 attainment



Note: The dependent variable is a 1/0 dummy that indicates if the respondent has achieved a GCSE A*-C by age 17 in math and English respectively (and National 5 in Scotland). The independent variable is the cognitive score. The sample used in this figure is our analysis sample (those who have no missing data between the ages of 3 to 7 and 11 to 14 respectively) with the added restriction that they have taken part in the age 17 interviews and they were not taking their GCSE qualifications for the first time. Cognitive scores are standardised to have mean zero and standard deviation one. Therefore each bar represents the relationship between having higher cognitive scores and achieving a GCSE at age 17 – specifically how a one standard deviation increase in cognitive scores affects the probability (percentage point) that a young person will achieve an A* to C in their GCSEs.