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What Determines the Range of Reading Attainment in a Country?

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Introduction

The Progress in International Reading Literacy Study (PIRLS), which reported in April 2003, is the largest and most rigorous study ever undertaken of young children's reading skills. The study was conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), the organisation also responsible for the international surveys of achievement in mathematics and science (TIMSS). It involved 150,000 children aged 9-10 years old in 35 countries (listed in Table 1) and is described fully in Mullis *et al* (2003a). The analysis of the data for England from which the present paper arises is presented in Twist *et al* (2003).

Table 1: PIRLS 2001 participating countries

Argentina	Germany	Kuwait	Romania
Belize	Greece	Latvia	Russian Fed.
Bulgaria	Hong Kong, SAR	Lithuania	Scotland
Canada (Ontario/Quebec)		Macedonia	Singapore
Colombia	Hungary	Moldova	Slovak Republic
Cyprus	Iceland	Morocco	Slovenia
Czech Republic	Iran, Islamic Rep.	Netherlands	Sweden
England	Israel	New Zealand	Turkey
France	Italy	Norway	United States

The sampling, development of the assessment instruments, translation, data capture and analysis were conducted by an international consortium led by Boston College and rigorous targets had to be met at each stage to ensure that the results could be compared from country to country.

Sampling was supervised, and in most cases conducted by, Statistics Canada. It was carried out on a probability proportional to size basis, ensuring that larger schools were drawn in appropriate proportions. A key requirement was the proportion of selected schools which agree to participate. In order for their results to be reported countries had to meet a criterion of 85 per cent of selected schools plus a high

proportion of pupils tested. For some countries, this was straightforward. For others, it represented a major challenge. In England, many schools felt that they had too many demands on their time and were not always willing to get involved.

The reading literacy tests were developed by the National Foundation for Educational Research, drawing on advice and reviews from all participating countries. The tests were a mixture of multiple choice and constructed response items, with both narrative (story) and information blocks. Although the texts often originated in other languages, they were developed in English, and so they were translated for use in most countries. This was a demanding task, requiring independent verification to ensure that the translated tests remained valid versions of the originals whilst also providing good models of the language in which the children were being tested.

Each country's overall achievement score was calculated, along with average scores on narrative and information scales. Scales were also constructed showing the performance of boys and girls.

In addition to achievement data, a series of questionnaires were completed, generating a rich data set about, for example, how reading is taught in the participating countries, children's pre-school literacy experiences, and children's reading habits and their attitudes. This data can all be linked back to the achievement scores.

In this paper, both the achievement data and some of the data collected in the teacher questionnaires are explored in an investigation of patterns in performance between subgroups of countries.

Results

Figure 1 presents the distribution of student achievement in reading for the 35 countries that participated in PIRLS 2001. The countries are shown in order of average (mean) scale score. The scores range from 561 for Sweden down to 327 for Belize. The international average is 500. PIRLS 2001 used Item Response Theory (IRT) to summarise the results on a scale with a mean of 500 and a standard deviation of 100. Pupils' responses have been summarised on a common metric even though individual children responded for different items in the reading test.

Twenty-three countries were significantly above the international average and ten significantly below this average. Many of those above average were European countries, or those with developed economies. Those below the international average were largely outside Europe and with developing economies.

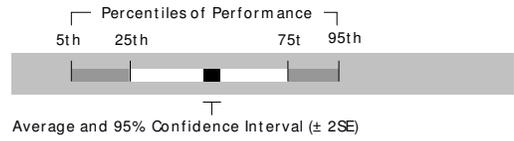
Figure 1: Distribution of Reading Achievement



SOURCE: IEA Progress in International Reading Literacy Study (PIRLS) 2001.

* Ontario (Canada)		548 (3.3)
* Quebec (Canada)		537 (3.0)

200 300 400 500 600 700 800



Sweden and The Netherlands were ranked highest overall in terms of the Reading Achievement scale score, with England placed third. Other English-speaking countries (who took substantially the same test) were above the international average but with lower scores than England: United States, New Zealand¹, Scotland and Singapore. Canada (Ontario), testing largely in English, was also well above the international average. Scores for the major European countries (Germany, Italy and France) were above the international average.

PIRLS 2001 devoted considerable effort to maximising comparability across the ages and grades tested. However, because education systems are so different, there are many school starting ages, leading to different lengths of schooling. Most countries tested children after four years of formal schooling² but for England, New Zealand and Scotland, pupils were tested after five years of schooling

Figure 1 also indicates information about the range of scores in each country and the confidence interval for the main score. The dark boxes in the centre of each country's bar show the 95 per cent confidence interval around the average achievement of each country. The start and end of the bars show the 5th and 95th percentiles for student achievement in each country. Hence the length of the bar indicates the range of achievement in that country. The 25th and 75th percentiles are also shown. Each percentile point indicates the percentage of children performing below and above that point on the scale. For example, 25 per cent of pupils in each country performed below the 25th percentile of that country and 75 per cent performed above it. The range between the 25th and 75th represents performance by the middle half of the pupils. In most countries, the range of performance for the middle group was around 100 scale points.

¹ New Zealand also tested a small proportion of students in Maori (2.8% of sample).

² The length of formal schooling has been determined by the International Study Center from information provided by each country. It does not correspond exactly to years of compulsory schooling.

Table 2: Percentiles of Achievement in Reading

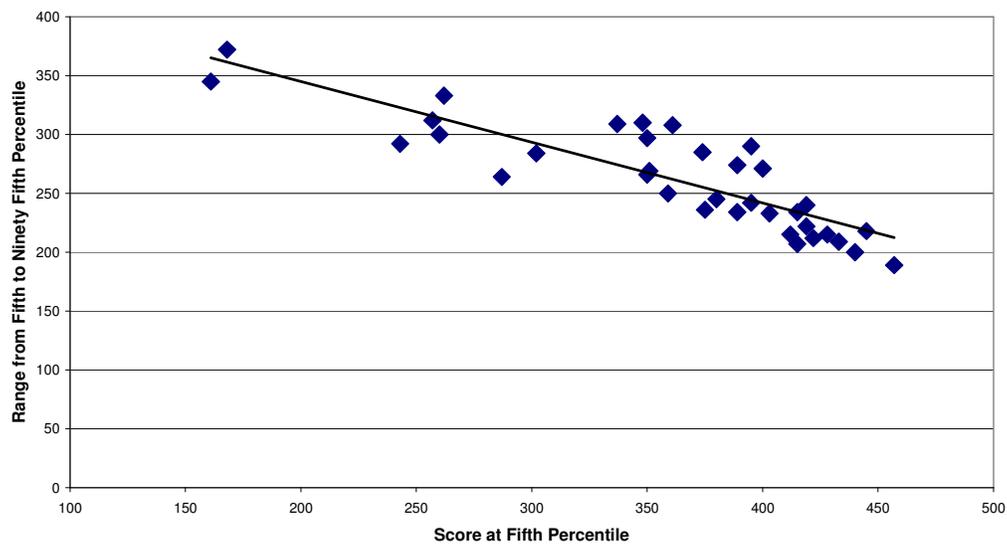
Countries	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Argentina	257 (6.7)	353 (8.7)	424 (6.7)	487 (6.5)	571 (7.7)
Belize	161 (3.4)	251 (5.7)	322 (4.8)	401 (5.9)	506 (5.3)
Bulgaria	400 (11.9)	502 (4.5)	559 (3.7)	607 (2.1)	671 (3.8)
Canada (O,Q)	419 (4.4)	498 (2.7)	547 (2.6)	594 (5.1)	658 (2.3)
Colombia	287 (8.6)	368 (5.9)	424 (5.1)	479 (6.4)	551 (6.9)
Cyprus	352 (4.3)	441 (3.1)	500 (3.2)	551 (4.7)	619 (5.0)
Czech Republic	421 (5.2)	496 (1.9)	542 (2.7)	582 (3.0)	634 (4.7)
England	395 (6.3)	501 (4.4)	559 (4.6)	612 (4.5)	685 (5.3)
France	403 (5.2)	481 (2.8)	528 (2.1)	573 (1.8)	636 (4.5)
Germany	419 (3.9)	497 (3.1)	544 (2.6)	586 (1.9)	640 (1.9)
Greece	396 (4.0)	477 (5.3)	528 (4.5)	576 (3.1)	636 (4.1)
Hong Kong, SAR	415 (6.4)	491 (5.0)	533 (3.9)	571 (4.0)	622 (3.2)
Hungary	428 (4.4)	502 (2.4)	548 (3.8)	589 (2.9)	643 (3.8)
Iceland	380 (3.3)	466 (2.8)	517 (1.9)	564 (2.3)	629 (5.4)
Iran, Islamic Rep. of	260 (3.5)	348 (6.0)	416 (6.7)	482 (4.7)	560 (4.7)
Israel	338 (7.0)	450 (3.9)	520 (2.8)	575 (3.8)	646 (4.2)
Italy	415 (6.5)	496 (3.2)	546 (2.2)	590 (3.1)	649 (2.7)
Kuwait	244 (7.6)	335 (5.5)	401 (5.0)	461 (3.9)	535 (5.3)
Latvia	440 (4.9)	505 (3.3)	548 (2.7)	586 (2.4)	640 (3.4)
Lithuania	433 (4.4)	502 (4.0)	547 (3.6)	589 (2.3)	642 (3.6)
Macedonia, Rep. of	262 (8.3)	368 (11.4)	451 (5.5)	520 (4.2)	595 (2.5)
Moldova, Rep. of	359 (5.0)	445 (6.2)	495 (5.0)	544 (4.3)	609 (6.4)
Morocco	168 (8.7)	266 (8.7)	346 (11.0)	428 (9.9)	540 (21.2)
Netherlands	458 (4.1)	517 (3.8)	556 (2.5)	593 (2.9)	645 (3.6)
New Zealand	360 (4.7)	472 (5.9)	537 (3.6)	593 (4.5)	668 (5.1)
Norway	351 (5.0)	450 (4.1)	507 (2.5)	556 (2.8)	620 (6.0)
Romania	351 (13.4)	456 (4.4)	520 (3.6)	574 (6.4)	647 (4.4)
Russian Federation	412 (12.9)	488 (5.1)	533 (3.4)	574 (4.6)	627 (4.0)
Scotland	378 (5.1)	476 (6.0)	534 (3.4)	586 (2.7)	658 (6.1)
Singapore	348 (10.6)	479 (7.2)	540 (4.6)	592 (4.6)	658 (5.4)
Slovak Republic	389 (9.7)	477 (2.7)	525 (2.2)	566 (1.8)	623 (3.9)
Slovenia	373 (6.4)	456 (2.8)	506 (2.5)	551 (2.7)	611 (3.0)
Sweden	445 (4.5)	521 (4.7)	565 (2.4)	605 (1.7)	663 (2.1)
Turkey	302 (3.9)	392 (4.0)	452 (3.8)	510 (4.1)	586 (6.0)
United States	389 (8.9)	492 (4.7)	551 (2.8)	601 (4.2)	663 (2.8)

SOURCE: IEA Progress in International Reading Literacy Study (PIRLS) 2001.

() Standard errors appear in parentheses. Because results are rounded to the nearest whole number,

Table 2 shows the percentiles of achievement in reading for all the countries participating in PIRLS 2001. The countries with the widest range tend to be those with low average scores (Morocco, Belize, Macedonia). Indeed there is a high negative correlation between scores at the 5th percentile and the range, that is countries with a wide range of achievement tend to have low scores for their lowest performing pupils. The correlation was -0.83. This high correlation may indicate a slight ceiling effect (a bunching of scores at the upper end) in the tests for countries with overall high levels of achievement. This relationship is shown graphically in Figure 2.

Figure 2: Relationship of Low Scores to Range

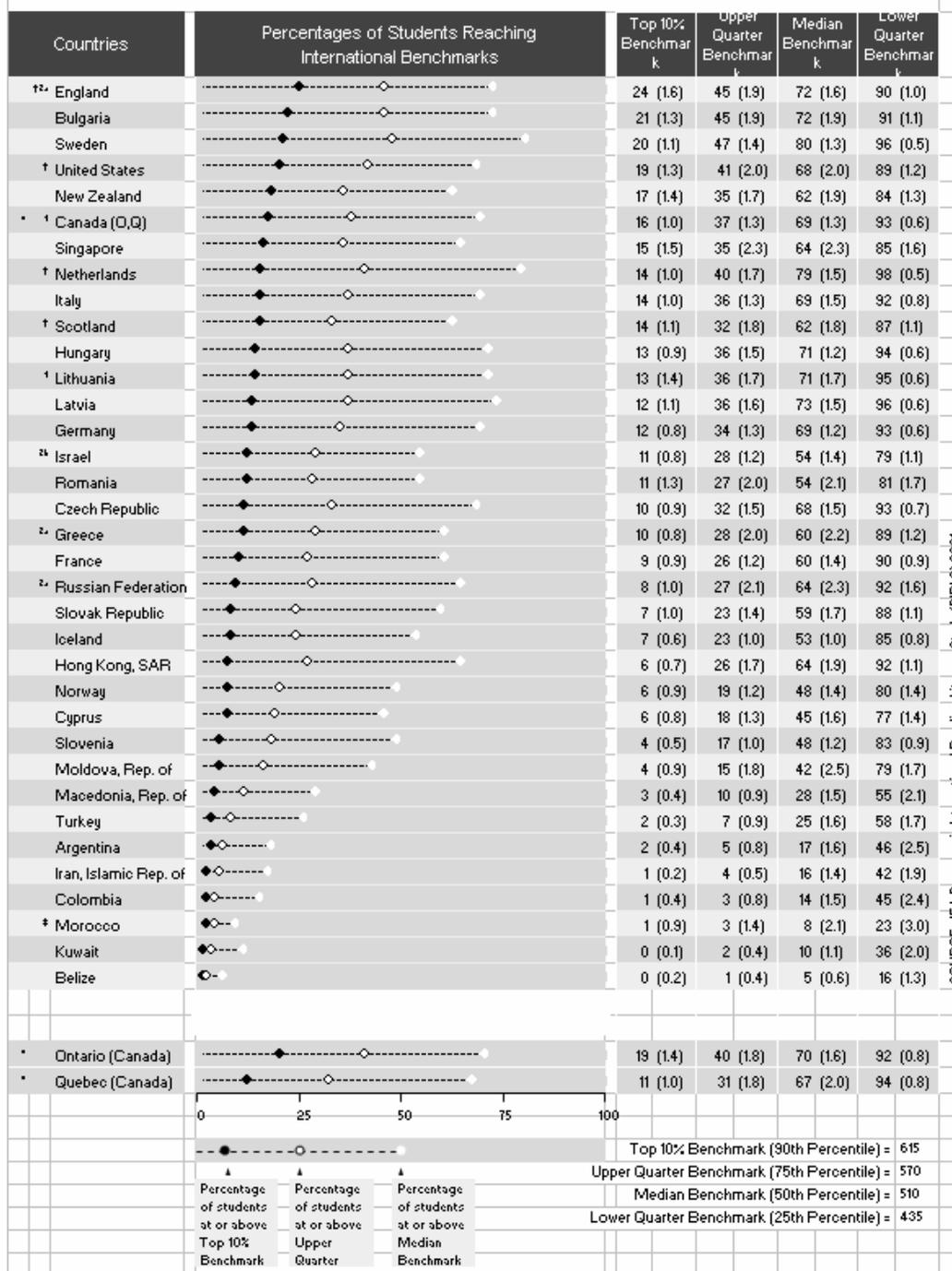


Some countries with wide ranges, such as Singapore, have a large proportion of pupils who are being educated and tested in a language other than that they speak at home. However, several developed English-speaking countries (New Zealand, England, Scotland and the United States) also tend to have a wide range of achievement. This contrasts with such European countries as Italy, France, Germany, Sweden and The Netherlands, which all have fairly narrow ranges of achievement. In particular The Netherlands forms a strong contrast with England, in that both have a very high average score, but The Netherlands has a range of 187 scale points from the 5th to 95th percentile, the smallest of all countries, whereas England has a range of 290 scale points.

An alternative manner of approaching this data is provided by Figure 3. This shows the percentages of pupils reaching three international benchmarks for PIRLS 2001. These are the top 10 per cent, the top 25 per cent (upper quartile) and the top 50 per cent (median) benchmarks. The figure is ordered in terms of the percentages of pupils at the top 10 per cent benchmark. On this measure, England has the highest proportion of pupils in the top 10 per cent internationally. Similarly it has the second highest proportion in the top 25 per cent internationally, and the third highest proportion in the top 50 per cent internationally. All of this data indicates that the top performing pupils in England are among the best in the world. They surpass the performance of other English-speaking countries and of the larger European countries, being matched or surpassed only by the children of Sweden, and perhaps The Netherlands.

However the reading performance of lower scoring pupils in England is not as good. This is indicated by the large range of scores for England, referred to above. It can also be shown by expressing the data from Table 2 graphically.

Figure 3: Percentages of Students Reaching PIRLS International Benchmarks in Reading Achievement



SOURCE: IEA Progress in International Reading Literacy Study (PIRLS) 2001.

Figure 4 shows the standardised results³ of the large European countries. This illustrates that England has the highest scoring pupils at the 95th and 75th percentiles, but slips markedly at the 25th percentile and declines further at the 5th percentile. In contrast, Sweden maintains a high position throughout the ability range. The Netherlands has a high average position and improves this for its low achieving pupils. Two other large European countries (France and Germany) tend to show a slight improvement for their lower achieving pupils. Pupils in Italy tend to have an even performance at all of the percentiles.

Figure 4: Standardised Deviation from Average of All Countries for European Countries

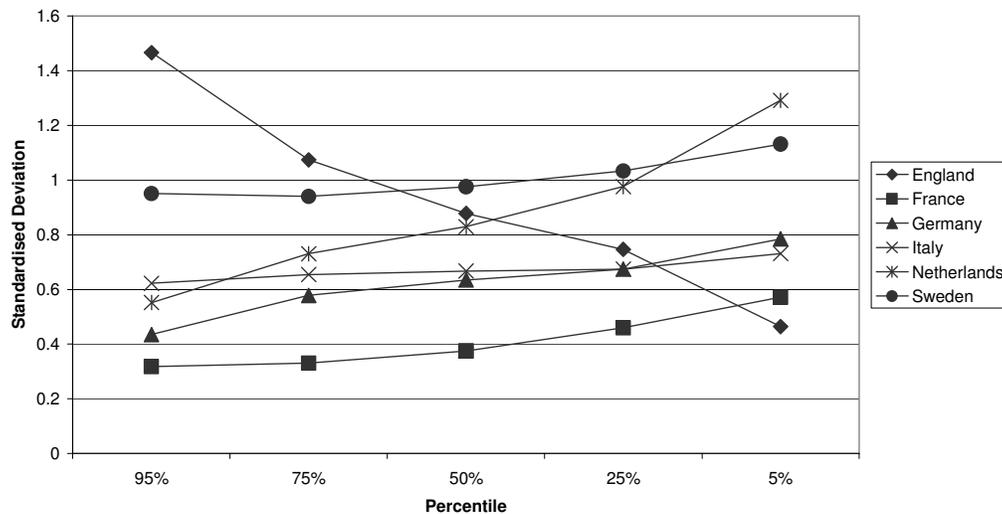
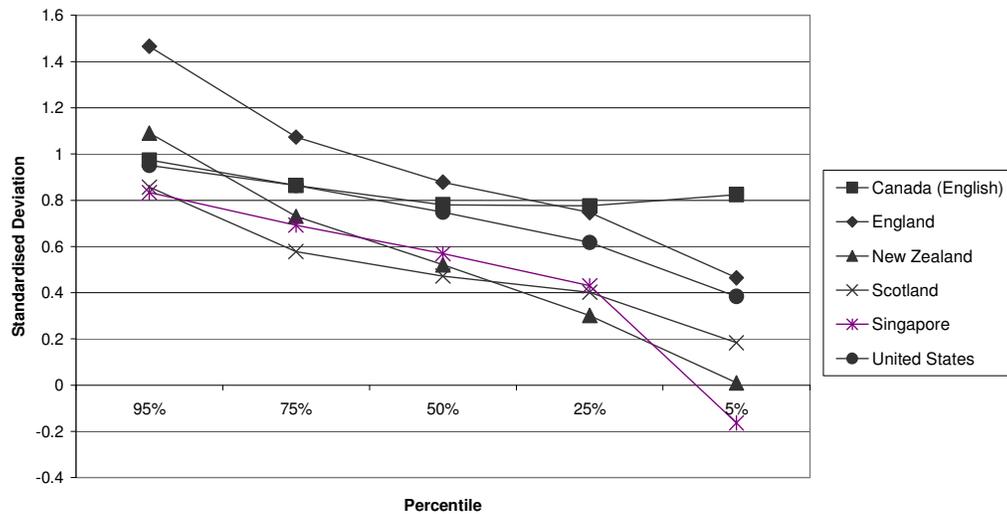


Figure 5 has the same form and shows the data for English-speaking (or testing) countries. This illustrates that the trend shown for England, of a decline in standing across the achievement range, is a fairly general one. Although starting from a lower base New Zealand and Singapore show the greatest decline; New Zealand being among the top five countries at the 95th percentile but with very low performance at the 5th percentile. Singapore falls from among the top ten countries at the 95th percentile to among the lowest ranked ten at the 5th percentile, but this is perhaps

³ For this purpose, standardised results have been calculated separately for each of the percentiles shown. This has been done by finding the mean and standard deviation in achievement scores across all the countries, then expressing each country's score as a proportion of the standard deviation above (positive figures) or below (negative) the international mean.

understandable in that the language of instruction and testing is not the home language for the great majority of pupils. The United States and Scotland show the same general pattern. The slight exception is Canada – English only (Ontario and Quebec), for which the decline in the lower percentiles is not as marked. It is interesting to note that when the complete results for Canada, incorporating students tested in both English and French are included, this pattern is not present.

Figure 5: Standardised Deviation from Average of All Countries for Countries Testing in English



Discussion

The reasons for this difference between European countries with lower ranges of attainment and the maintenance of position for their low achieving children, and English-speaking countries with larger ranges of performance and worse performance at the lower percentiles need further exploration. They may derive from educational factors, such as curriculum and pedagogic practice, or from social factors in the countries related to cohesion or inclusiveness. Finally, they may also derive from the nature of the languages tested. English has many orthographic inconsistencies, and a richness deriving from its many linguistic roots. It is possible that these factors mean it is more difficult for low achieving pupils than more regular languages.

The school and classroom context

It might be hypothesised that the range in pupils' performance in reading increases during schooling. One factor common to three of the English-speaking countries is a relatively early start to compulsory schooling. In England, New Zealand and Scotland, compulsory primary schooling starts at age 5 with widespread pre-school provision.

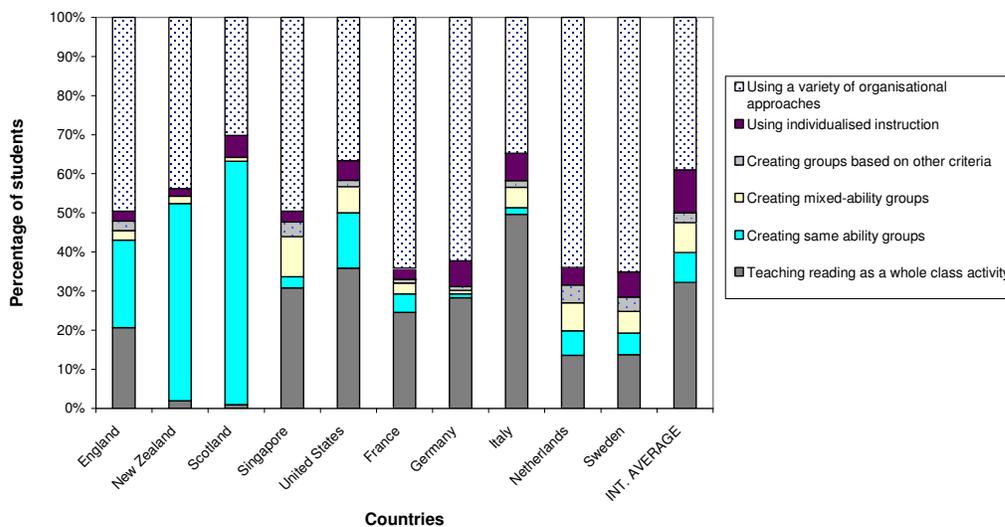
In the United States and Singapore, whilst compulsory schooling starts at 6, kindergarten provision ensures that a majority of children are in pre-school at age 5. The situation in Singapore and the United States is typical of many participating countries in PIRLS, where widespread pre-school provision, sometimes combined with local variation, means that it is difficult to establish a very clear view of when ‘formal’, as opposed to ‘compulsory’, schooling starts.

However, any straightforward relationship between the extent of compulsory schooling and the range of achievement in PIRLS is called into question by the results from The Netherlands. Here, compulsory primary education starts at age 5, although in practice nearly all children start at age 4 (Mullis *et al*, 2002) but the range of achievement in PIRLS is the narrowest of all 35 countries.

Data is available from PIRLS questionnaires about the teaching of reading in schools, including how classes are organised and how materials are used to support the teaching of reading.

How teachers organise their students for the teaching of reading may also be a factor which influences the range of achievement. Figure 6 shows how teachers reported their classrooms were organised in the English-speaking and major European countries. The questionnaire asked teachers to identify how they ‘always’ or ‘almost always’ organised their classes for the teaching of reading.

Figure 6: Classroom organisation for the teaching of reading (percentage of students taught by teachers who ‘always’ or ‘almost always’ use these organisational approaches)



It is clear from Figure 6 that same ability grouping is a feature of some English-speaking countries, particularly New Zealand and Scotland, with at least half the

pupils in schools where this is the predominant form of organisation for the teaching of reading. Conversely, teaching reading as a whole class activity is uncommon in New Zealand and Scotland but a feature in Singapore, the United States and Italy in particular. Unsurprisingly, in many countries, teachers were using a variety of methods and did not identify one organisational approach as being much more commonly used than another.

Related to how pupils are grouped for the teaching of reading is the selection of teaching materials. The PIRLS data confirmed that teachers deployed teaching materials in a variety of ways in their classes. The main distinction was between whether teachers used the same materials with all students working at different rates, or whether they used different materials for students working at different levels.

Figure 7 shows the use of instructional materials in the selected countries.

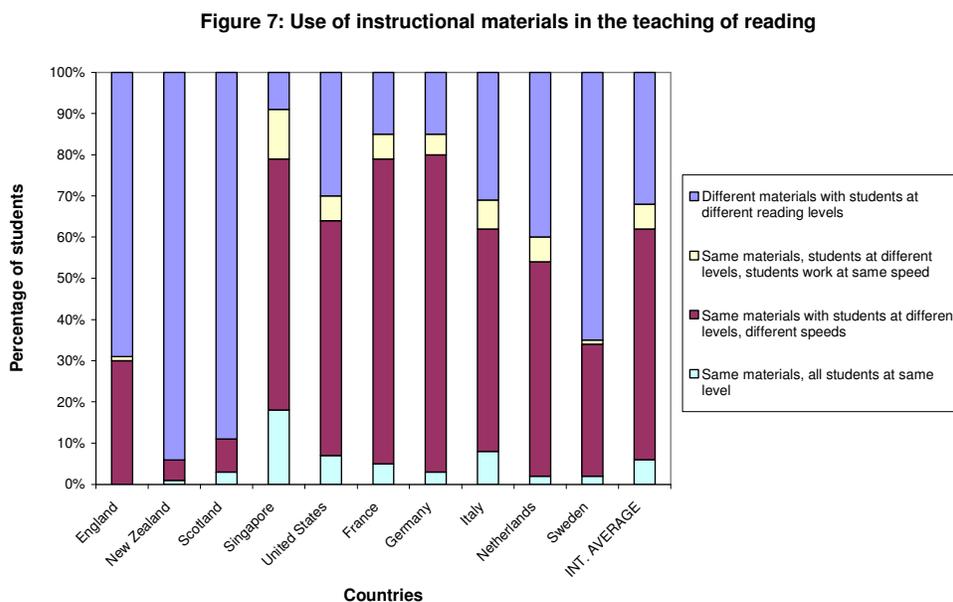
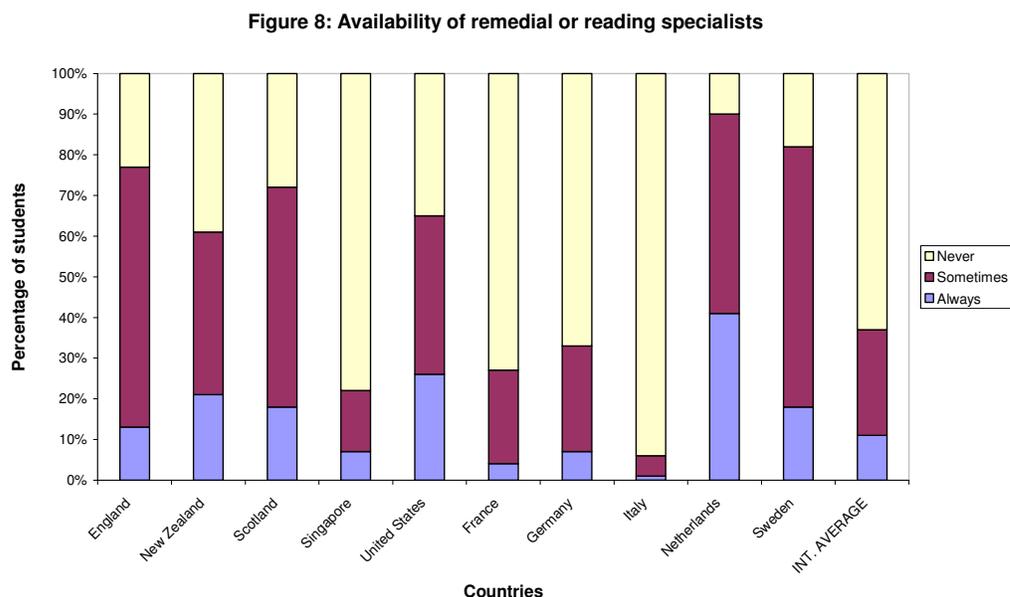


Figure 7 shows how, within New Zealand and Scotland, and to a slightly lesser extent England and Sweden, teachers tend to work with highly differentiated teaching materials. This may be related to the emphasis on ability grouping reported in New Zealand and Scotland.

Another factor which may influence the range of student achievement is the resources available to teachers to support students who are experiencing difficulties in learning to read. Inadequate remediation may lead to an increasing gap between the weakest and the strongest readers. Responses from the PIRLS questionnaires (Mullis *et al*,

2003) and detail in the PIRLS Encyclopedia (Mullis *et al*, 2002) give some insight into how weaker readers are supported at grade 4.

Figure 8 show the variation in the availability of specialist teaching across the participating countries.



Within the English-speaking countries, specialist support was available in the classrooms of the majority of students for at least some of the time. It was available all of the time in the classrooms of between 13 percent of students (England) and 26 percent (United States). This fairly consistent pattern contrasts with a much more diverse picture seen in the European countries. In The Netherlands, the country with the narrowest range of attainment in PIRLS, over 40 percent of students were in classrooms where a reading specialist was available all the time, and just 10 percent of students were in classrooms where a reading specialist was ‘never available’. In contrast, in France, Germany and Italy, a specialist teacher was never available in the classrooms of well over half of the students. In summary, very varied levels of support are available for students experiencing difficulties. The Netherlands and Sweden, with their narrow ranges of achievement, provide high levels of support, as do four of the five English-testing countries, all of which show a wide range of overall achievement.

The data from the PIRLS teachers’ questionnaire describes a complex situation. A high level of differentiation is reported in New Zealand and Scotland, to a lesser extent in England but not in the other two English-testing countries.

What the data cannot show is if this more differentiated style of teaching has evolved in some countries in order to cope with the range of performance seen in the classroom, if these teaching strategies contribute to the range, or if these factors interact.

In summary, this brief exploration of factors in school organisation has not identified any particular practice in classrooms in English-speaking countries which is not present in some other countries and could lead to the wide ranges of attainment identified.

The nature of the language

A recent article in the psychological literature explored the possibility that the acquisition of reading may vary between languages because of the nature and structure of those languages (Seymour *et al*, 2003). This work arose from a collaboration of researchers across 15 European countries.

This article advanced the view that reading acquisition may vary between languages because of differences in “orthographic depth”. In this analysis, English is regarded as a deep orthography containing many inconsistencies and complexities. This is contrasted with some other European languages which have shallow orthographies with consistent grapheme-phoneme correspondences. Examples of shallow orthographies are Finnish, Greek, Italian, Spanish and German. Deeper orthographies characterise English, Danish, French and Portuguese. A review was undertaken which examined the characteristics of European orthographies which were likely to affect reading acquisition. This proposed two dimensions: first of syllabic complexity, and, second, of orthographic depth. In terms of syllabic complexity, romance languages tend to have more open structures with consonants followed by vowels. There are few consonant clusters at the beginning or end of words. Germanic languages have many closed consonant-vowel-consonant structures with clusters of consonants at both the beginning and end of words. The orthographic depth dimension contrasts writing systems which have a consistent and direct mapping between letters and phonemes, and those like English or French with inconsistencies and complexities.

This work led to the classification of languages shown in Table 3. The expectation is that the difficulty in acquiring literacy will increase as one moves from simple to complex syllabic structures, and from shallow to deep orthographies.

Table 3: Classification of Languages in terms of syllabic complexity and orthographic depth.

Orthographic Depth					
	Shallow				Deep
Simple Syllabic Structure	Finnish	Greek Italian Spanish	Portuguese	French	
Complex Syllabic Structure		German Norwegian Icelandic	Dutch Swedish	Danish	English

Seymour *et al* (2003) report a series of experiments in which children in different countries read lists of letters, familiar words and simple non-words in their own languages. They concluded that the time needed to establish Foundation literacy varies between languages, taking longer in Portuguese, French and Danish, and much longer in English. They attributed this to more complex languages requiring learners to operate a dual process system with an alphabetic process and a logographic process both operating. (A logographic process requires the storage and identification of familiar words.) In simpler orthographies a single alphabetic process is sufficient.

This work relates to the acquisition of reading by young children. Does it have anything to say about the later reading ability of children who have moved on to the stages of understanding the deeper meanings of text? In particular, does the orthographic depth of English lead to the wide ranges of achievement found in the PIRLS study and to the characteristic pattern of English-testing countries in the analysis of percentiles? Could it be the case that children of low ability find the complexities of English such that they are unable to progress to gaining a full understanding, whereas children with higher abilities move beyond the difficulties, and perhaps even revel in the linguistic complexity?

In order to examine these questions, the cells of the classification grid (Table 3) were allocated numerical values reflecting the orthographic complexity of the languages. This is shown in Table 4. Also in the Table have been inserted the countries in PIRLS testing in the relevant languages of each cell

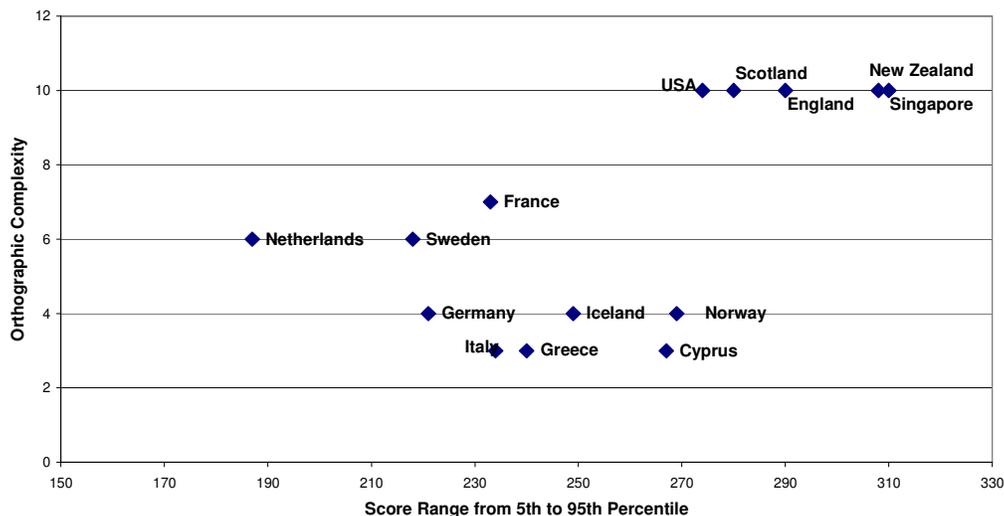
Table 4: Numerical values attached to orthographic depth and syllabic structure.

Orthographic Depth					
	Shallow			Deep	
Simple Syllabic Structure	1	3 Greece Cyprus Italy	5	7 France	9
Complex Syllabic Structure	2	4 Germany Iceland Norway	6 Netherlands Sweden	8	10 England Scotland USA New Zealand Singapore

These values are of course somewhat arbitrary since they are little more than an ordinal scale. Nevertheless they allow some preliminary analysis of the relationships with scores on the PIRLS test to be made. The initial hypothesis examined was that there would be a relationship with the range of scores from the 5th to 95th percentile for the relevant countries. In fact, the correlation was 0.60, a fairly substantial positive correlation, lending credence to the idea that the range of scores is related to the orthographic complexity of the language.

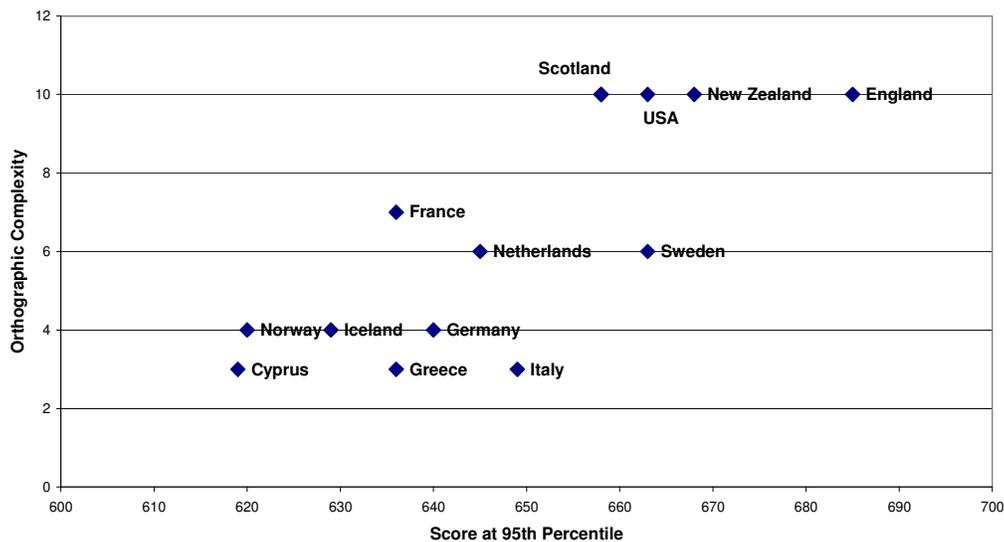
The relationship is shown in Figure 9. This shows that the English-testing countries do have a greater range of scores. However, the overall relationship is by no means linear. In fact, it is very unstable. This is illustrated by removing Singapore. Initially this was done on the grounds that most pupils there were not being tested in their home language. Going further and removing all the countries testing in English produces an extremely substantial negative correlation of -0.56 between orthographic complexity and range of scores, that is the more complex the language, the lower the range of scores.

Figure 9: Relationship of Score Range to Orthographic Complexity of Language of Testing



Examining the correlations between orthographic complexity and various percentile values led to interesting differences. For the 50th percentile, effectively the average performance of each country, the correlation was around 0.45. This remained at this level both with and without the inclusion of the English-testing countries. The strongest relationship though was with scores at the 95th percentile. With all countries included, the correlation of score with orthographic complexity was 0.78. This again falls when the English-testing countries are removed but only to 0.42. The relationship is shown in Figure 10.

Figure 10: Relationship of Orthographic Complexity and Score at 95th Percentile



This investigation began as an exploration of the similar patterns of the percentile scores of the English-testing countries with good performance of their high achievers but a wide range of attainment. It was hypothesised that the complexity of English meant that low ability students found it difficult to function in a language with a high degree of orthographic complexity. This hypothesis has not really been supported by this investigation, *if all languages are considered*. In fact the data equally support a conclusion that the complexity of English is such that it allows high ability pupils to achieve most and that languages with great orthographic complexity lead to better performance of the most able. However, it is apparent that any relationships with orthographic complexity are overturned for the English-testing countries.

In conclusion, it does seem that there is some evidence that the orthographic complexity of languages is related in some way to the attainment outcomes of students in this international comparison of reading attainment. The relationship is not a straightforward one, and it does seem that English is something of an outlier in its complexity and the results. There are other caveats. There are only a few countries and fewer languages involved in this analysis. All are European languages in origin, although now occur in other parts of the world. All of the countries involved are developed western-style states. There are therefore not necessarily any similar relationships in other language groups or other parts of the world.

A troubling possibility remains that one of the determinants of scores in international comparisons of reading ability may be the language of testing. Those involved in such studies go to extreme lengths to attempt to ensure that passages are equalised in difficulty for different cultures and that passages and questions are carefully refereed in all the various translations. However, it may be that efforts to have high-quality translations and to verify these in order to provide comparable assessments are doomed to failure in a reading test. This would not necessarily carry over into curriculum tests of mathematics or science. Nor would it necessarily be the case for literacy levels of older students, since the influence of orthographic complexity may be greatest at the time of learning to read. But, for tests of literacy or reading for young children, it is a possibility that some aspects of scores in international comparisons are determined not by educational or social factors, but by features of the language of testing.

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