Interrelationships among Reading Achievement, Grade level, and Age in PIRLS 2006

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Abstract

This study uses PIRLS 2006 reading achievement results for fourth grade students in 40 countries to show how countries' policies on age of school entry and promotion/retention affect students' age within grade and result in a range of average ages for the PIRLS countries. In addition, the relationship between age within grade and achievement is complicated by the flexibility of school entry policies as well as policies regarding promotion/retention. Although in some countries older fourth grade students have higher achievement than younger students, older students do not necessarily perform better. Many countries have a significant proportion of older students in the fourth grade (students whose age suggests they belong in a higher grade) and these older students have significantly lower achievement than their younger classmates. The many different configurations of age-within-grade and reading achievement makes statistical adjustment of countries' average reading achievement for differences in age problematic.

Keywords: *school entry policies, promotion/retention, age and grade level, reading achievement, regression discontinuity design*

Introduction

IEA's TIMSS and PIRLS assessments are grade-based assessments, that is, the target population is all the students at a particular grade level, because assessing students by grade rather than age provides greater opportunity to link educational achievement to policies, curriculum, and instructional practices. Because most educational initiatives are implemented at particular grade levels, TIMSS and PIRLS data can more easily be used as a basis for implementing educational reform and improving student achievement. Also, amount of instruction, not maturation is the greater determinant of educational achievement. Students learn mathematics, science, and reading through instruction, rather than just by getting older.

For IEA's major purpose of improving educational achievement, amount of schooling provides a better basis for comparison than age. Consequently, PIRLS targets students after

four years of formal schooling (the fourth grade) and TIMSS targets students after four and eight years of schooling (fourth and eighth grades). However, using grade (determined by years of formal schooling) as the basis of comparison does make the age of the students an important contextual factor. Participants in IEA's TIMSS and PIRLS studies often express interest in examining the relationship between students' age structure and achievement. The purpose of this paper is to explore the distribution of student ages in the countries participating in PIRLS 2006 and how the distribution of age within grade relates to achievement.

It is fundamental to recognize that students' age within grade can be manipulated by policy decisions. In particular, policies on age of entry to school and policies on promotion and retention can impact the average age within a grade. Because the 40 countries that participated in PIRLS 2006 represent a wide range of policy approaches, an analysis of the age distribution within grade in terms of the different entry and promotion policies can be used to demonstrate the relationship between these policies and the distribution of students' age within grade. Educational decision makers can use the results of such an analysis to understand the effects of students starting school at younger or older ages, and the likely effects of various promotion and retention policies.

The PIRLS 2006 international database (Foy & Kennedy, Eds., 2008) containing reading achievement results for fourth-grade students in 40 countries is used in this study to examine the distributions of students by birth-month. Also included in the analyses are five Canadian provinces that participated in PIRLS 2006. Age distributions are considered in the light of countries' reports in the *PIRLS 2006 Encyclopedia* (Kennedy, Mullis, Martin, & Trong, 2007) about their policies and practices on ages of entry to primary school and policies on promotion and retention, and augmented by more recent information from the *TIMSS 2007 Encyclopedia* (Mullis, Martin, Olson, Berger, Milne, & Stanco, 2008). Then, various patterns of distribution by birth-month are related to reading achievement in each of the countries.

Distribution of Student Ages in the PIRLS 2006 Target Grade

As described in the *PIRLS 2006 Encyclopedia*, countries' admission policies generally provide for children to begin primary school when they are six or seven years old. How this is implemented varies from country to country, however, contributing to the variety of age distributions across participating countries. To provide a perspective on how students' ages are distributed across the PIRLS 2006 countries and benchmarking entities, Exhibit 1 depicts, for each PIRLS 2006 participant, the percentage of students at each month of birth. This presentation groups together PIRLS participants with similar age distributions, while also revealing the effects of school admission policies and promotion and retention through the

grades on the distribution of student age at the fourth grade.

[insert Exhibit 1 about here]

Common sense would suggest that an age of entry policy based on students' date of birth would result in an equal proportion of students in each birth-month. That is, a full cohort of students would contain an equal percentage of students born in January, February, March, and so on. Since there are 12 months in a year, there would be approximately 8 percent of students in each birth month. Such a pattern could be expected in countries with strict policies on age of entry and automatic promotion from grade to grade. However, countries with more flexible practices on age of entry can have different age distributions within a grade, as can countries with promotion policies based on examination results, or retention or acceleration practices based on school or teacher recommendations.

Exhibit 1 presents a series of bar charts depicting the percentage of students at each month of birth for each of the PIRLS 2006 participants. The 12 adjacent months that include the greatest percentage of students are highlighted for each participant to identify its predominant age cohort for the grade (i.e., the 12 adjacent months that define the greatest percentage of students). Some participants have all of their students within this 12-month interval, while others have more widespread distributions, in some cases spanning several years. The PIRLS participants are shown in decreasing order by predominant age cohort, with countries where students were older, on average, at the top and those where students were younger at the bottom.

Since PIRLS compares reading achievement after four years of formal schooling, the target grade in most countries is the fourth grade of primary school. However, in PIRLS 2006 two countries assessed students at fifth grade: South Africa because the PIRLS assessment was judged to be too demanding for their fourth grade students, and Luxembourg because fourth grade students had only three years of instruction in the language of the assessment (German). As a result, these countries are a special case, and their students were older, on average, than students in other countries. In South Africa, the predominant age cohort for the fifth grade was students born in the 1994 calendar year, but there also were considerable percentages of students born in the previous years (1992 and 1993). In Luxembourg, the predominant age cohort extended from September 1994 through August 1995, and again there was a substantial percentage in the previous year.

Following South Africa and Luxembourg in Exhibit 1 is a block of countries where the predominant cohort was the students born in the 1995 calendar year. Included in this group

were Denmark, Bulgaria, Latvia, Lithuania, Moldova, Romania, the Russian Federation, Singapore, and Sweden. With the exception of Singapore, these countries have the policy that students begin primary school in the calendar year in which they turn seven. Consequently, students in these countries were among the oldest in the PIRLS 2006 assessment, approximately 10.8 years, on average. Singapore, like New Zealand and South Africa, begins the school year in March and conducted the PIRLS testing in November. Therefore, although the predominant cohort in Singapore was students born in the 1995 calendar year, the average age of Singaporean students tested in PIRLS 2006 (10.4 years) was less than that of northern hemisphere students born in the same year. In Singapore, children must be six years old in the calendar year they begin school.

Among this group of countries, the predominant age cohort included practically all students at fourth grade in Singapore, and Sweden, with very few younger or older students. However, the other countries in this group (Denmark, Bulgaria, Latvia, Lithuania, Moldova, Romania, and the Russian Federation) had a noticeable percentage of older, and in some cases, younger students (see Exhibit 2 for exact percentages).

Following the countries in Exhibit 1 with the predominant cohort born in 1995 is a set of countries where the predominant cohort was not confined to a single calendar year, but spanned two years. In Hungary, where children normally must be six years old by May 31 in order to begin school in September, the predominant cohort extended from March 1995 through February 1996, as also was the case for Macedonia. Both countries also had substantial percentages of older and younger students in the fourth grade. In New Zealand, where children may begin school as soon as they turn five years old, the predominant age cohort extended from May 1995 through April 1996, with a number of older and younger students also in the grade. Children in Germany must be six years old by the end of June to begin school in September. Germany's predominant age cohort reflected this policy, spanning July 1995 through June 1996. However, Germany also had many older (15%) and younger (8%) students in the fourth grade (Exhibit 2).

Next in Exhibit 1 comes a group of countries where the practice is to admit children who have reached their sixth birthday by the beginning of September, when the school year begins. In these countries, which include Austria, Chinese Taipei, England, the Slovak Republic, and the United States, the predominant age cohort extended from September 1995 through August 1996. In Austria, Chinese Taipei, and the Slovak, children must be six years old on September 1st to begin primary school. Children in England must begin school at the start of the term following their fifth birthday. Age of entry policy and practice in the United States

varies from state to state, but judging by its age distribution, it is common practice to admit children to school on the basis of their age at the beginning of September. Almost all of the fourth grade students in Chinese Taipei and England were included in the predominant age cohort, whereas in Austria, the Slovak Republic, and the United States, about 15 percent of the fourth grade students were older than the predominant age cohort, and in the United States there is also a group that was younger (8%).

Exhibit 1 next has a group, which includes the Canadian provinces of Nova Scotia and Quebec as well as Iran and the Netherlands, where the predominant age cohort extended from October 1995 through September 1996. In Nova Scotia, Quebec, and Iran, children must be six years old by the end of September to begin school, whereas in the Netherlands, children begin school the month after their fifth birthday. Nova Scotia and Quebec each had more than 90 percent of their fourth grade students in the predominant age cohort, but Iran and the Netherlands had many older students (18% and 21%, respectively).

In Georgia and Indonesia, the predominant age cohort spanned November 1995 through October 1996, although there were many older and younger students also: 42 percent older and 8 percent younger in Indonesia and 18 percent older and 6 percent younger in Georgia. In Israel, the predominant age cohort extended from December 1995 through November 1996, with 8 percent of older students and 3 percent of younger students also in the fourth grade.

The most common age of entry practice appears to be to admit children to primary school in the calendar year in which they turn six. As shown in Exhibit 1, there were 15 PIRLS 2006 participants where the predominant age cohort coincided with the 1996 calendar year. These included both the Flemish and French parts of Belgium and the Canadian provinces of Alberta, British Columbia, and Ontario, as well as France, Hong Kong SAR, Iceland, Italy, Morocco, Norway, Poland, Slovenia, Spain, and Trinidad and Tobago. These, as well as Kuwait, Qatar, and Scotland, where the predominant age cohort extends from March 1996 through February 1997, were among the youngest of the PIRLS 2006 participants. Several PIRLS participants in this group had almost all of their fourth grade students in the predominant age group, including British Columbia, Ontario, Iceland, Italy, Norway, Poland, Slovenia, and Spain. Others, including the two parts of Belgium, France, Hong Kong SAR, had substantial percentages of older students (about 15%) in the fourth grade, and Morocco and Trinidad and Tobago had 50 percent and 33 percent of fourth grade students older than their predominant age cohort, as well as 4 and 8 percent of younger students, respectively.

Complementing the information displayed in Exhibit 1, Exhibit 2 presents, for each PIRLS 2006 participant, the percentage of students in the PIRLS target grade that was

included in the predominant age cohort, together with the percentage of older and younger students. The average age of all students at that grade also is shown. Exhibit 2 is organized in decreasing order by percentage of students in the predominant age cohort, with PIRLS participants in the upper part of the table having all or practically all of their students included in a single 12-month period and those in the lower part having substantial percentages of older students and also some younger students.

[Insert Exhibit 2 about here]

As shown in Exhibit 2, there were 10 participants with almost all of the students in the grade tested (95% or more) in the predominant age cohort. These included Iceland (100%); Norway and England (99%); Poland (98%); Chinese Taipei, British Columbia, and Singapore (97%); Ontario and Slovenia (96%); and Sweden (95%). In each case, the practice on age of entry was to admit an entire age cohort (i.e., students born in a single 12-month period) and to have automatic promotion from grade to grade, at least in the grades preceding the fourth grade. Since the grade population tested is very similar to, if not identical with, the predominant age cohort, it is not surprising that the average age of these two groups are almost exactly the same.

However as described earlier, many participants have distributions that do not fit this pattern, and instead have age distributions with a long tail of older students as well as some percentage of younger students. More than half the PIRLS participants had more than 10 percent of students in the grade tested older than the students in the predominant age cohort. The most extreme examples in Exhibit 2 are Trinidad and Tobago, South Africa, Indonesia, and Morocco, where between one-third and one-half of the students were older than the predominant age cohort and between four and eight percent of the students were younger.

Reading Achievement and Student Age

If, as seems intuitive to many people, older students at a grade level have higher reading achievement than younger students at that grade, then it might be expected that countries with older students on average should have higher achievement than countries with younger students. As a result of the variations in age of entry and promotion and retention practices described above, the average age of students in the PIRLS 2006 countries and benchmarking participants ranged from 9.7 years (Italy) to 11.0 (Latvia) among countries that tested at the fourth grade. Including Luxembourg and South Africa, which tested at fifth grade, extends the upper age to 11.9. If being older automatically conveyed an advantage in reading literacy, then the PIRLS data should show higher average reading achievement for the countries with the

older students and lower achievement for countries with younger students, on average. However, this does not appear to be the case. Exhibit 3 plots average reading achievement for each PIRLS 2006 participant against its students' average age. Across all participants there is no evidence of a positive relationship between average age and average reading achievement. Indeed, the Pearson correlation between age and achievement for the 45 PIRLS participants shown in the graph is negative: -0.15. Excluding Luxembourg and South Africa changes the correlation to 0.06, which is very close to zero.

[Insert Exhibit 3 about here]

Age within Grade and Student Reading Achievement

There are many factors other than average age that can influence a country's average reading achievement, and consequently many possible explanations for why a simple plot of countries' average achievement against average age might not show an expected positive relationship. Economic development and the investment in education that this makes possible, for example, may have a more fundamental effect on literacy levels than average age of students at a grade level. However, even if there is an underlying maturational effect, i.e., that older students could be expected to be more able, it is possible that the combined effect of a country's policy and practice on age of entry to primary school together with its promotion and retention policies could disrupt this expected positive relationship between age and achievement.

Exhibit 1 shows many examples of countries with sizeable percentages of students in the fourth grade older than the predominant age cohort. In a country where children are not obliged to begin school strictly on the basis of age, there may be a tendency for parents to hold back for another year those children they consider not quite ready for the rigors of schooling. In such countries, this can result in a build up of older, less able students at a grade level. Similarly, in a country where students have to demonstrate adequate progress in order to be promoted to the next grade, the weaker students who have to repeat a grade will be older, on average, than the students in that grade for the first time. These factors, operating separately or in combination, can create a situation in which the older students in a grade level are also among the academically less able, and, if sufficiently large numbers are involved, can affect the relationship between age and achievement within the grade.

The first part of this study has shown that the way students' ages are distributed within fourth grade varied very widely across the PIRLS 2006 participants, with many societal and systemic factors coming into play. With so many factors influencing the within-grade age distribution, it

seemed unlikely that the relationship within the fourth grade between students' age and their reading achievement would be the same for all PIRLS participants. In order to explore this issue, this study examined how average reading achievement varied within the predominant age cohort by month of birth for each PIRLS participant, paying attention also to average achievement of students older or younger than the main cohort. As expected, the relationship between age-within-grade and average reading achievement was not constant across participants, but varied in ways that were at least partly associated with age of entry and promotion/retention practices. Some of these results are presented in this paper, but much remains to be done to provide a fuller picture.

Although the age distributions of the PIRLS participants varied in many ways, it was possible to identify a number of countries where the policy appeared to be to admit children to school solely on the basis of their chronological age, and to automatically promote this cohort through the grades, at least as far as fourth grade. If there was an underlying "natural" or maturational relationship between age and achievement, then it might be most apparent in such countries, where all the students in the grade come form a single one-year age cohort and there has been no grade repetition for weaker students or promotion for high-performing students. From several countries with age distributions meeting these criteria, Iceland, Norway, and England were chosen to explore this issue. These countries had the greatest percentage of target-grade students (essentially all students) in the predominant age cohort and in all three countries, primary school students are promoted automatically from one grade to the next. Exhibit 4 presents the percentage of students at each birth month of the predominant age cohort for these three countries, together with average reading achievement for each month.

[Insert Exhibit 4 about here]

As shown in Exhibit 4, each country has an approximately uniform distribution of students across the 12 months of the predominant age cohort and very few younger or older students (labeled "Yng" and "Old," respectively). For students in the predominant age cohort, the exhibit shows the month of birth (e.g., "9612" refers to December 1996). Reading across this exhibit, the younger students are to the left and older students to the right. Accompanying the percentage of students at each birth month, the exhibit also shows average reading achievement for the students at each birth month, expressed as a difference from the overall mean for the country. For all three countries, the achievement pattern is the same: average reading achievement is lowest among the younger students and gradually increases as students get older. There are very few students younger or older than the predominant age cohort, so

these have little impact on the age-achievement relationship.

By way of contrast, Exhibit 5 presents a similar display for three countries, Austria, Germany, and the United States, where approximately 15 percent of the grade tested consisted of students older than the predominant age country. Additionally, in Germany and the United States, 8 percent of the students were younger that the predominant cohort and in Austria, 2 percent. In all three countries, the older students had average achievement well below the students in the predominant age cohort, and the younger students had achievement above them, at least in Austria and Germany. Furthermore, the achievement pattern that could be seen in Exhibit 4, i.e., that achievement was higher among the older students in the predominant age cohort, is not so much in evidence in Exhibit 5. It appears that, in countries such as these, the combined effect of entry and promotion/retention practices is to produce a predominant age cohort with uniform reading achievement, together with an older group with lower achievement and a (smaller) younger group with higher achievement. Note that the regression lines in Exhibit 5 were based on students in the predominant age cohort only. Including the younger and older students would have altered the age-achievement relationship even more.

[Insert Exhibit 5 about here]

Considering the information presented in Exhibits 4 and 5, it is clear that there is no simple, consistent relationship within a grade level between student age and reading achievement at the fourth grade. This implies that any attempt to make a statistical adjustment to countries' average achievement to account for differences in average age will be problematic.

Growth in Reading Achievement from Fourth to Fifth Grade

To give an indication of how much student reading achievement increased from one year to the next, two of the countries from Exhibit 4, Iceland and Norway, administered the PIRLS 2006 assessment at the fifth grade as well as at the fourth grade. Although the fifth grade samples were somewhat smaller than the fourth grade samples reported internationally for PIRLS, the fifth grade samples were nationally representative, and provided an opportunity to examine the relationship between age, grade, and reading achievement, at least in these two countries (information on the fifth grade samples may be found in Martin, Mullis, & Kennedy, 2007).

Exhibit 6 summarizes the results of a series of regression analyses used to model the relationship between age within grade (represented by birth month) and reading achievement for Iceland and Norway. Model 1 shows the regression coefficients resulting from fitting

separate equations to the fourth and fifth grade data in each country. From this analysis, it can be seen that the slopes of the regression lines for fourth and fifth grades are approximately parallel (2.5 and 2.2, respectively, for Iceland and 2.1 and 2.9, respectively, for Norway). Accordingly, for this exploratory analysis it was decided to fit parallel slopes for the next step, as shown in Model 2.

[Insert Exhibit 6 about here]

Exhibit 7 shows average reading achievement by birth month together with the fitted regression lines for fourth and fifth grades for Iceland and Norway. Fitting separate lines with common slopes to fourth and fifth grade (2.3 for Iceland and 2.5 for Norway) provides estimates of the average difference in reading achievement between the two grades. These are 38.3 score points for Iceland and 42.3 points for Norway (see Exhibit 6, Model 2). Put another way, fifth grade students in Iceland scored 38.2 points higher, on average, than fourth grade students on the PIRLS 2006 assessment, and fifth grade students in Norway 42.3 points higher than fourth grade students.

[Insert Exhibit 7 about here]

The approximately 40-point difference in the reading achievement of fourth and fifth grade students reflects the average growth in achievement that could be expected in these countries as students work from fourth grade through fifth grade. This growth in reading achievement reflects the effects of an extra year of schooling, but also other learning experiences in the home and the community as the students became a year older. These factors are inextricably interwoven, since all the students attended school for a year and at the same time all the students grew older. Therefore, it is not possible from data such as these to say with any certainty how much of the 40-point growth from fourth grade to fifth grade in Iceland and Norway can be attributable to the effects of a year of schooling and how much can be attributed to other, incidental maturational factors. However, it is possible to capitalize on the positive relationship between age within grade and reading achievement to make an estimate of the effect of schooling in these countries.

The predominant age cohort for the PIRLS 2006 fourth grade students in Iceland and Norway was the cohort of children born between January 1 and December 31, 1996, and the corresponding cohort for the fifth grade students, those students born between January 1 and December 31, 1995. As shown in Exhibit 7, at fourth grade there was a steady increase in average reading achievement from the youngest students (those born in December 1996) to the oldest students (those born in January 1996) and also at the fifth grade from the youngest

students (those born in December 1995) to the oldest students (those born in January 1995). Because the regression lines for fourth and fifth grades were parallel, the increases from month to month at fourth grade were the same and the increases from month to month at fifth grade were the same.

Exhibit 8 depicts average achievement for fourth and fifth grades along a continuous two-year birth month continuum, beginning on the left with those born in December 1996 (the youngest fourth grade students), and extending on the right to those born in January 1995 (the oldest fifth grade students). The cutoff between fourth and fifth grade is between January 1996 and December 1995. A discontinuity in the regression lines at this point would indicate an achievement difference associated with a change from fourth grade to fifth grade, whereas a continuous straight line would imply no discernable grade effect. For both Iceland and Norway, Exhibit 8 shows a discontinuity in the fitted regression line, with higher achievement associated with fifth grade in both countries. For Iceland, the grade effect, adjusted for birth month, was 10.3 score points, and for Norway 12.1 points (see Table 1, Analysis 3). One interpretation of this could be that, in Iceland, a hypothetical fifth grade student born in a particular birth month would be expected to have a 10.3 point advantage over a hypothetical fourth grade student born in the same birth month. Similarly, a hypothetical fifth grade Norwegian student could expect a 12.1 point advantage over a hypothetical fourth grade student born in the same month.

[Insert Exhibit 8 about here]

The foregoing analysis implies that the 38.3-point difference between fourth and fifth grade average reading achievement in Iceland could be separated into a 10.3-point grade effect and a 28-point age-within-grade effect, and similarly the 42.3-point difference in Norway into a 12.1-point grade effect and a 30.2 age-within-grade effect. It should be noted, however, that the relative sizes of the grade and age-within-grade effects are determined by the slope of the age-within-grade regression lines, which in Iceland and Norway both are positive. Indeed, the steeper the slopes of the regression lines for each grade, the more the lines come into alignment across the grades and the smaller the grade effect. The implication here is that if fifth grade data also had been available for countries like Germany, Austria, and the United States, with less steep regression lines, the estimated grade effect would have been quite different. Preliminary exploratory work with TIMSS 1995 data, where all countries had both third and fourth grades, seems to confirm this.

Conclusion

The interrelationships among achievement, grade, and age vary from country and often are extremely complicated. They are rooted in countries' policies on age of school entry, promotion, and retention and how these policies are actually implemented in practice according to the economic, social, and cultural contexts of the country. The PIRLS 2006 data demonstrate that it is not necessarily the older students that have the higher achievement, and provide a basis for a careful and informed analysis of the relationship between students' ages and their reading achievement.

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Exhibit 1: PIRLS 2006 Percentage of Students by Month of Birth

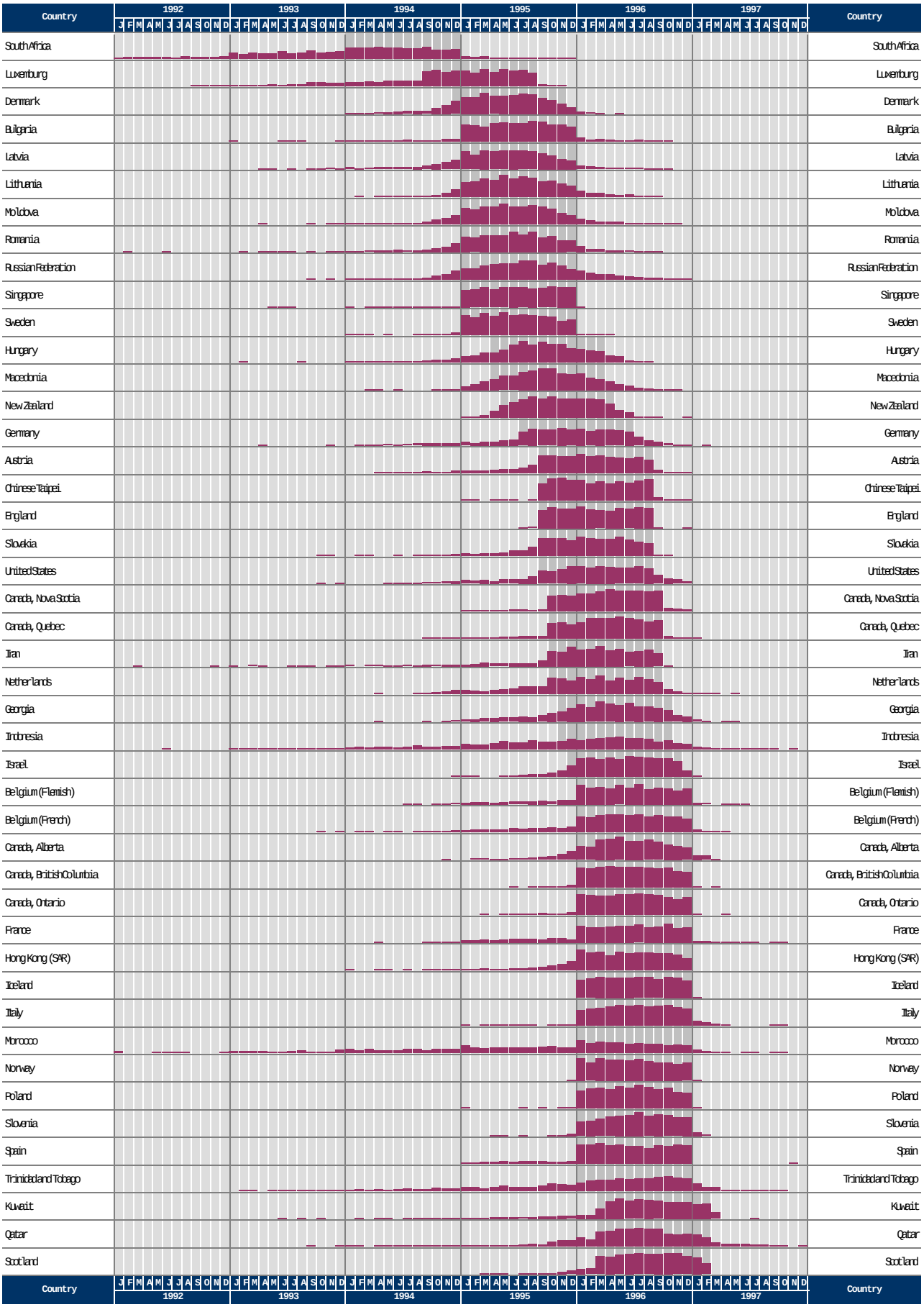

Exhibit 2: PIRLS 2006 Average Student Age and Age Cohorts

Country	Average Age in Entire Grade	Percentage of Students		
		Older than the Predominant Age Cohort	In the Predominant Age Cohort	Younger than the Predominant Age Cohort
Iceland	9,8 (0,00)	0 (0,1)	100 (0,1)	0 (0,1)
Norway	9,8 (0,01)	0 (0,1)	99 (0,2)	0 (0,1)
England	10,3 (0,01)	1 (0,1)	99 (0,4)	1 (0,4)
Poland	9,9 (0,00)	1 (0,2)	98 (0,3)	1 (0,1)
Chinese Taipei	10,1 (0,01)	1 (0,2)	97 (0,3)	2 (0,2)
Canada, British Columbia	9,8 (0,01)	3 (0,3)	97 (0,4)	0 (0,1)
Singapore	10,4 (0,01)	3 (0,2)	97 (0,2)	0 (0,1)
Canada, Ontario	9,8 (0,01)	3 (0,4)	96 (0,5)	0 (0,1)
Slovenia	9,9 (0,00)	2 (0,2)	96 (0,3)	2 (0,2)
Sweden	10,9 (0,01)	3 (0,4)	95 (0,5)	2 (0,3)
Canada, Nova Scotia	10,0 (0,01)	4 (0,4)	94 (0,5)	3 (0,3)
Italy	9,7 (0,01)	3 (0,4)	93 (0,6)	4 (0,6)
Scotland	9,9 (0,01)	7 (1,0)	93 (1,0)	0 (0,1)
Canada, Quebec	10,1 (0,01)	7 (0,7)	92 (0,8)	2 (0,3)
Spain	9,9 (0,01)	8 (0,7)	91 (0,8)	1 (0,2)
New Zealand	10,0 (0,01)	5 (0,4)	89 (0,6)	6 (0,6)
Israel	10,1 (0,01)	8 (0,6)	89 (0,6)	3 (0,2)
Bulgaria	10,9 (0,01)	7 (0,9)	88 (1,1)	5 (0,6)
Canada, Alberta	9,9 (0,01)	10 (0,7)	86 (0,6)	4 (0,4)
Hong Kong (SAR)	10,0 (0,02)	15 (1,1)	85 (1,1)	0 (0,0)
Belgium (Flemish)	10,0 (0,01)	14 (0,9)	85 (0,9)	2 (0,2)
Kuwait	9,8 (0,01)	13 (0,7)	84 (0,7)	3 (0,3)
Denmark	10,9 (0,01)	12 (0,6)	84 (0,7)	4 (0,4)
Lithuania	10,7 (0,01)	7 (0,5)	84 (0,7)	9 (0,5)
Slovakia	10,4 (0,01)	15 (0,8)	84 (0,8)	1 (0,1)
Austria	10,3 (0,01)	16 (0,7)	82 (0,7)	2 (0,3)
Iran	10,2 (0,02)	18 (1,2)	82 (1,2)	0 (0,1)
France	10,0 (0,02)	16 (1,0)	81 (1,0)	2 (0,3)
Macedonia	10,6 (0,01)	9 (0,7)	80 (0,9)	10 (0,7)
Moldova	10,9 (0,01)	13 (0,8)	80 (0,9)	7 (0,7)
Belgium (French)	9,9 (0,01)	18 (0,9)	80 (1,0)	2 (0,3)
Romania	10,9 (0,02)	14 (0,9)	79 (1,2)	7 (1,1)
Latvia	11,0 (0,01)	16 (0,8)	79 (1,2)	5 (1,0)
Hungary	10,7 (0,01)	17 (1,0)	77 (1,0)	6 (0,5)
United States	10,1 (0,03)	15 (1,3)	77 (1,2)	8 (0,7)
Germany	10,5 (0,02)	15 (1,3)	77 (1,2)	8 (0,5)
Georgia	10,1 (0,02)	18 (1,1)	76 (1,0)	6 (0,6)
Netherlands	10,3 (0,02)	21 (1,5)	75 (1,4)	4 (0,4)
Luxemburg	11,4 (0,01)	24 (0,6)	75 (0,6)	1 (0,2)
Qatar	9,8 (0,01)	21 (0,5)	74 (0,5)	6 (0,3)
Russian Federation	10,8 (0,01)	11 (0,6)	73 (1,1)	16 (1,0)
Trinidad and Tobago	10,1 (0,03)	33 (1,5)	60 (1,4)	8 (0,7)
South Africa	11,9 (0,03)	42 (1,2)	53 (1,2)	5 (0,5)
Indonesia	10,4 (0,04)	42 (1,9)	50 (1,7)	8 (0,5)
Morocco	10,8 (0,04)	50 (1,4)	46 (1,3)	4 (0,4)

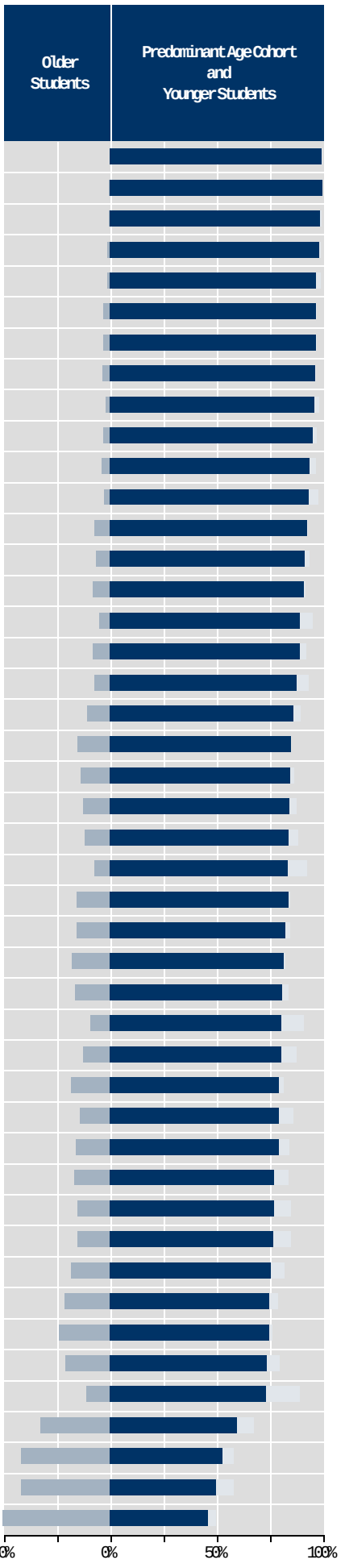

Exhibit 3: PIRLS 2006 Fourth-Grade Average Reading Achievement by Average Age

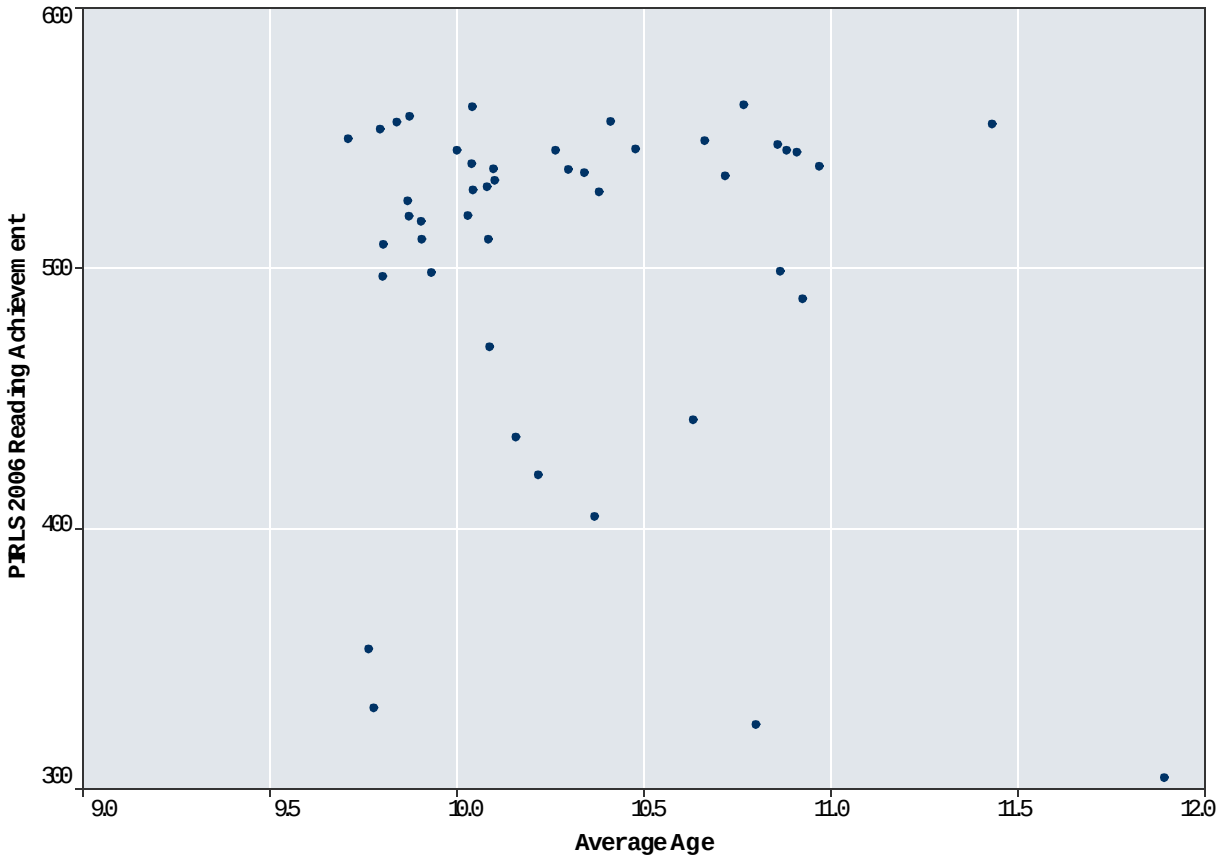

Exhibit 4: Example Countries with All or Almost All Students in the Predominant Age Cohort - Iceland, Norway, and England

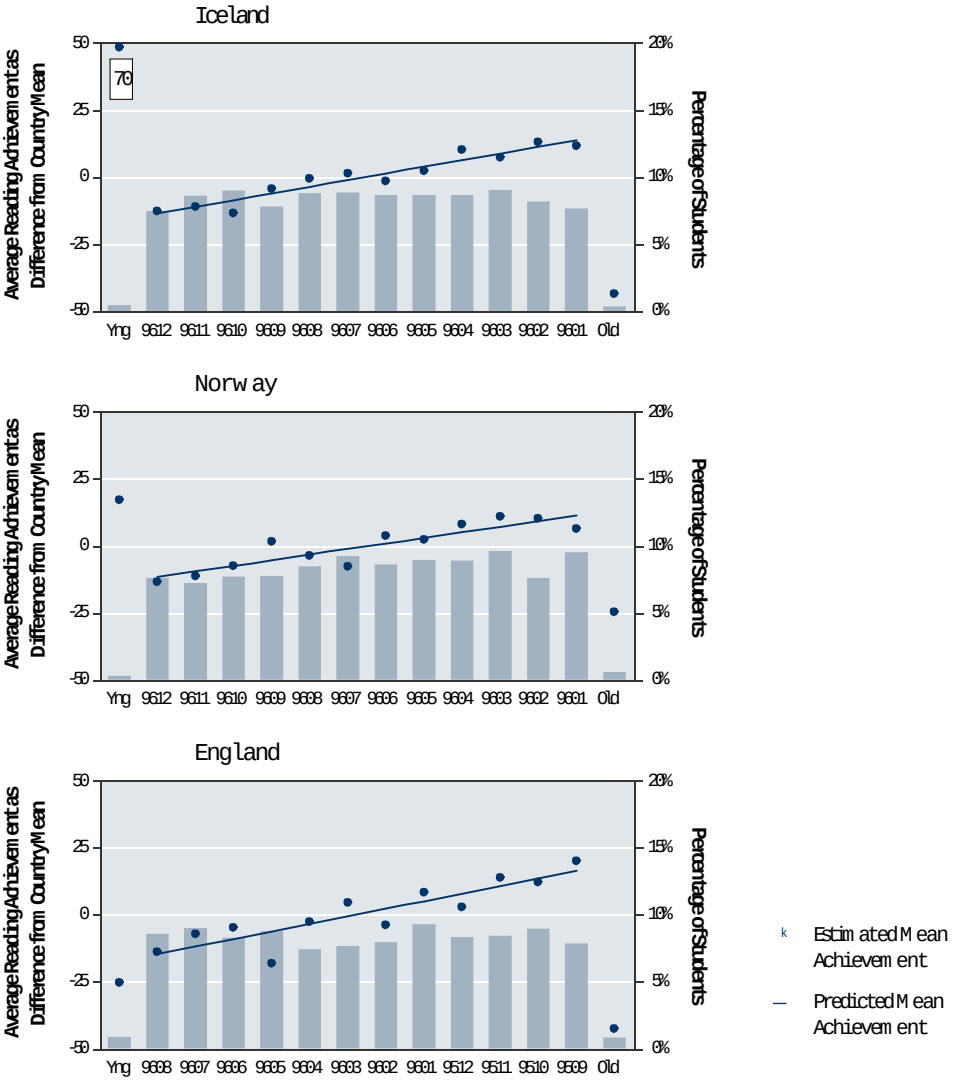

Exhibit 5: Example Countries with Students Older or Younger than the Predominant Age Cohort - Germany, United States, and Austria

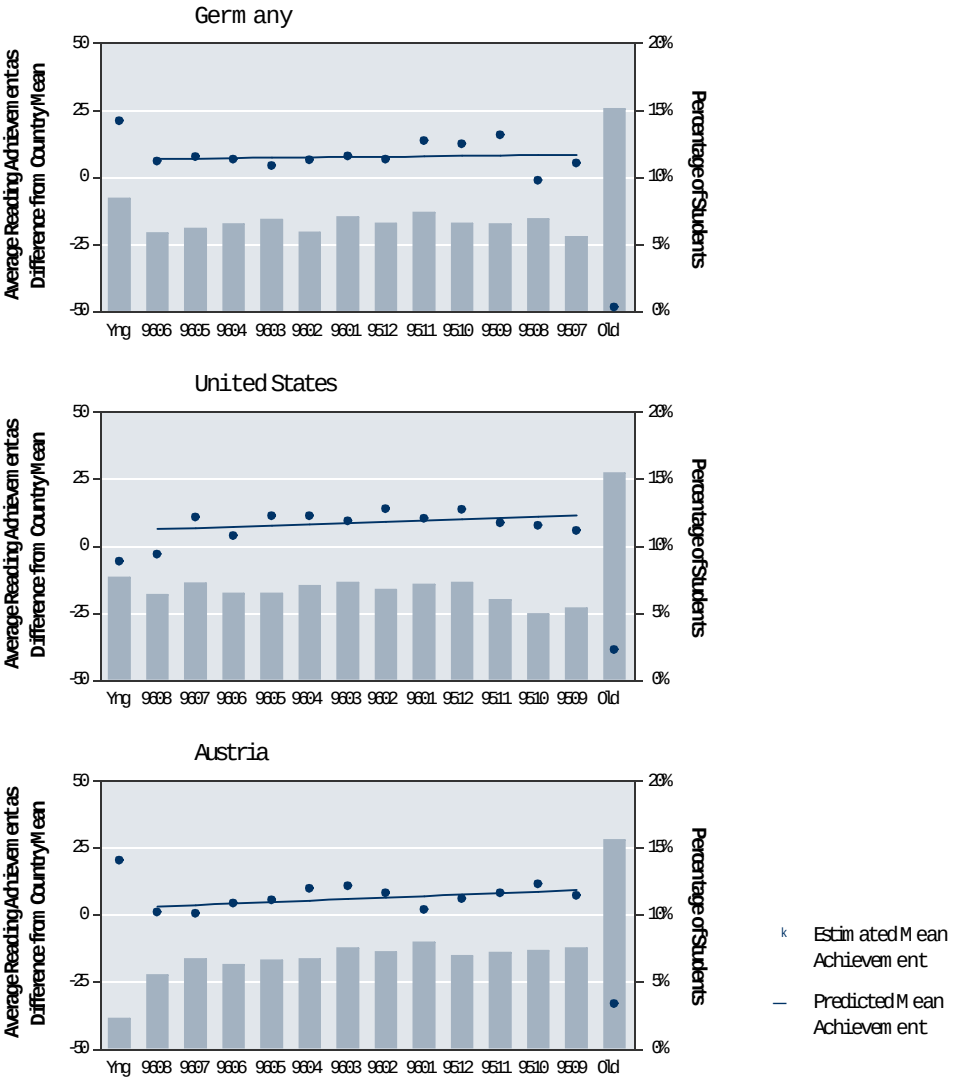

Exhibit 6: PIRLS 2006 Reading Achievement as a Function of Birth Month Within Grade

Model 1: Reading Achievement by Birth Month - Separate Models by Grade

Country	Grade	Intercept	Slope
Iceland	4th	496,8 (2,09)	2,5 (0,33)
	5th	536,8 (5,21)	2,2 (0,59)
Norway	4th	486,2 (3,59)	2,1 (0,43)
	5th	523,6 (7,48)	2,9 (1,32)

Model 2: Reading Achievement by Birth Month - Parallel Regression Lines

Country	Intercept	Grade	Slope
Iceland	497,6 (2,06)	38,3 (3,69)	2,3 (0,33)
Norway	483,7 (4,69)	42,3 (4,23)	2,5 (0,71)

Model 3: Reading Achievement by Birth Month - Extended Regression Lines

Country	Intercept	Grade	Slope
Iceland	497,6 (2,06)	10,3 (5,81)	2,3 (0,33)
Norway	483,7 (4,69)	12,1 (9,10)	2,5 (0,71)

Exhibit 7: PIRLS 2006 Reading Achievement as a Function of Birth Month at Fourth and Fifth Grades - Iceland and Norway

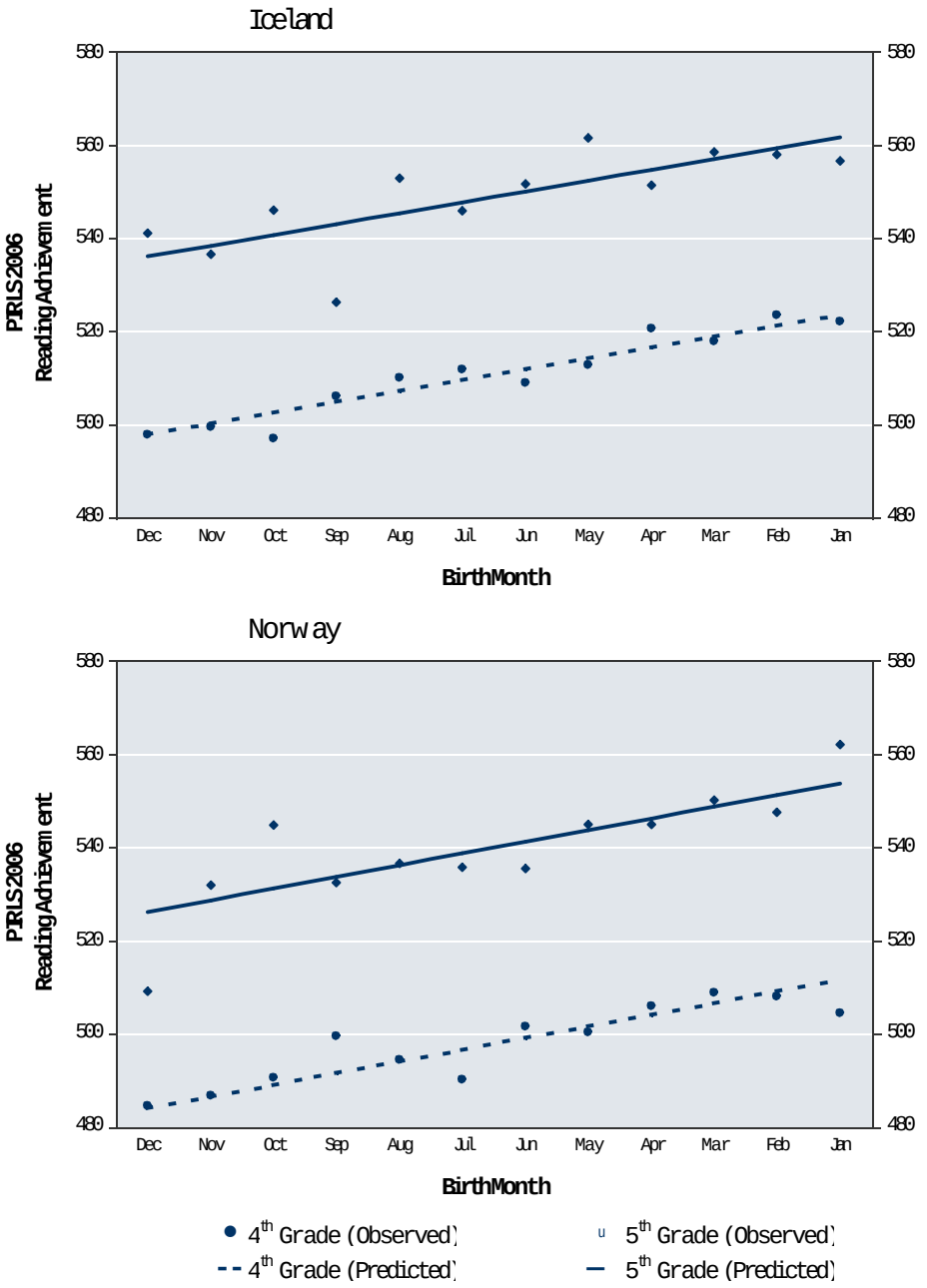

Exhibit 8: PIRLS 2006 Reading Achievement as a Function of Birth Month across Fourth and Fifth Grades Consecutively - Iceland and Norway