

# Age, maturation and school performance

Júlíus K. Björnsson

Educational Testing Institute



# Overview

- The differentiation between children based on their absolute age, leading to different teaching methods (individualized teaching) is perhaps not nearly enough in today's schools, in other words: differences due to maturation and readiness to learn within each school year are not well enough recognized.
- Current data shows that small differences in age can be associated with relatively large differences in performance.
- The PIRLS (**P**rogress in **I**nternational **R**eading **L**iteracy **S**tudy) and results from the Icelandic national tests will be used to illuminate the issue.

# Problems with international comparisons of school performance?

- When results from the PIRLS 2001 reading study were presented in 2002, some countries experienced difficulties interpreting the results, primarily because of the age differences of participants in different countries.
- The study was criticized for not dealing adequately with age and it was maintained by some that up to 40% of the between-country variation could be explained by age alone.

# PIRLS Reading 9/10 year olds

- In the documentation for the PIRLS 2001 study (PIRLS 2001 User Guide for the International Database) it is clearly stated that the choice of participants is based on choosing the upper of the two grades with the most 9-year olds at the time of testing (Conzales and Kennedy, 2003).
- This definition led to the fact that some countries chose to base the study on a grade where a minority of the nine year olds were, although this grade consisted of a small number of nine-year olds, thus leading to an average age well above 10 years.

# PIRLS

- In the PIRLS 2006 study however, the definition of the sample changed and was based on the number of formal school years.
- The class participating should be one who had gotten 4 years of formal schooling.
- This was a definition which allowed the 2001 PIRLS participants to do their sampling in the same way as in the earlier study, as the focus was not any more on age, but on the number of years of formal schooling.

# Why is this important

- 3 reasons:
  - International comparisons can be biased or plainly wrong if age is not a part of the sampling methodology.
  - The importance of age and maturation when assessing school performance is greater the younger the children are.
  - This should perhaps have implications for teaching.
- And last but not least:
  - Resources in the education system are often allocated after international comparisons are done.

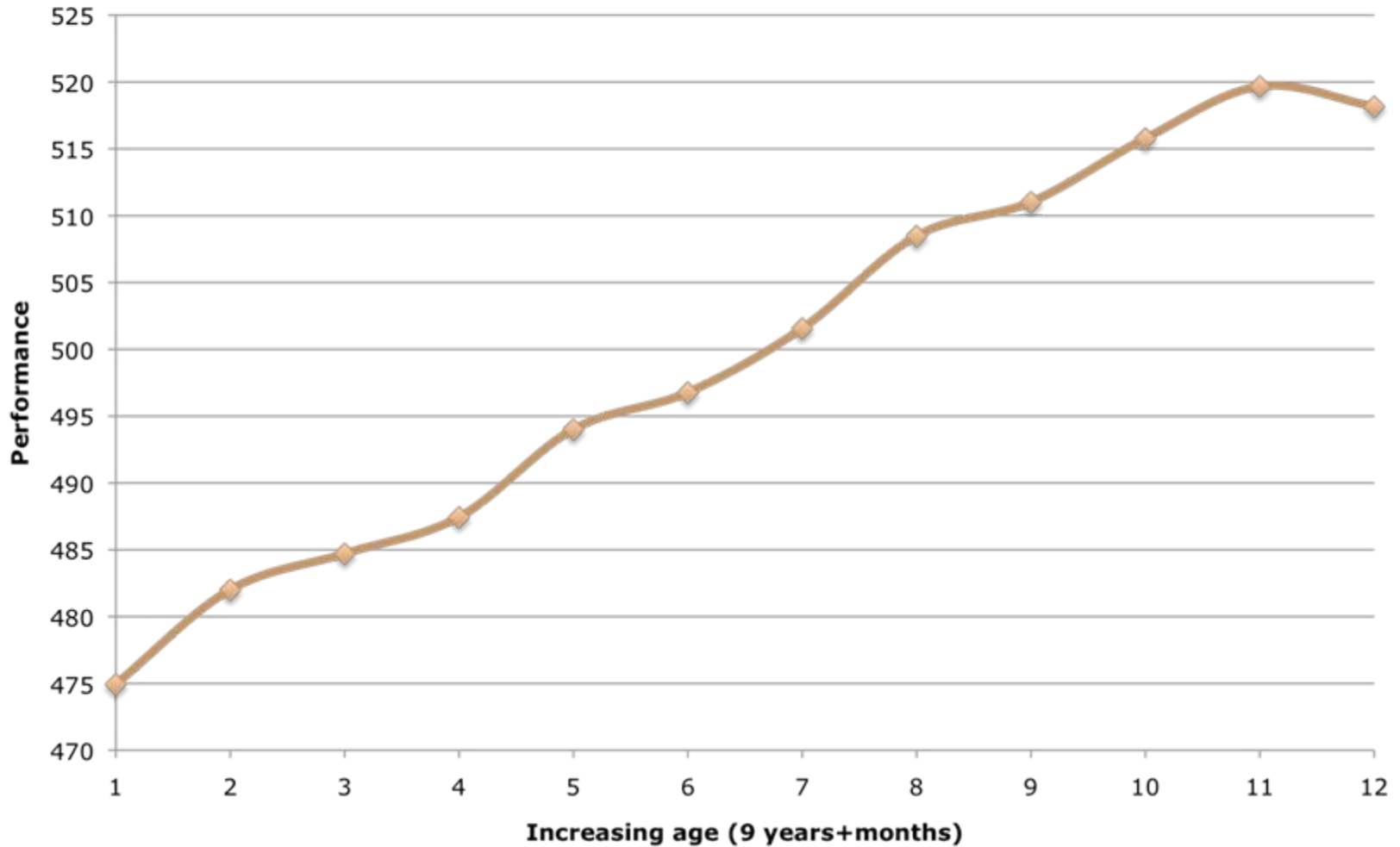
# *The age effect in Iceland*

- This relationship between performance and age in the Icelandic national tests is very prominent. These national tests are held every autumn and are obligatory for all pupils in the fourth grade (nine year olds).
- When their performance is examined according to month of birth, the relationship shown in the figure on the next slide emerges. The figure is based on data from the fourth grade national tests in Icelandic/reading in the period from 1997 until 2004, i.e. based on 8 years of testing. (approximately 33.000).
- All are born in the same year.

# *The age effect in Iceland*

- Grades on the test are here converted to a scale with a mean of 500 and a standard deviation of 100, which is comparable to the PIRLS scale.
- The performance difference between children born in January and those born in December is around 45 points, i.e. almost half a standard deviation.

# *The age effect in Iceland*



# *The age effect in Iceland*

- The increasing performance in the fourth grade according to age is highly significant.
- The same can be seen in the 7<sup>th</sup> grade (12 year olds), but the differences are only significant between those born in jan-feb-mar and those born in oct-nov-dec.
- In the tenth grade (15 year olds) the relationship between performance and age has largely disappeared, but there is at that age still a significant difference between students born in December and January.

# Consequences for PIRLS

- When preparing for the PIRLS 2006 study it was therefore decided both in Iceland and Norway (which uses the same school intake methods as Iceland and has no grade repetition) to add an extra sample of pupils from the 5th grade, in order to be able to do an age independent comparison of the results, or in other words to be able to compare the results with students from different countries at the same age.

# The countries compared:

- Austria,
- Denmark
- France
- Germany
- Luxembourg
- The Netherlands
- Russia
- Spain
- Sweden
- England and Scotland
- Fourth and fifth grades in Norway and Iceland

# Different age-school start

- In some countries (e.g. Sweden and Denmark) formal schooling begins at the age of seven but not at six as in Iceland and Norway.
- In many countries (e.g. Luxembourg and Germany) it is common practice for children to repeat a grade if they do not achieve a minimum proficiency in reading at the end of each school year.
- The method of admitting children to formal schooling also varies widely between countries, and even if children start school at the same age there can be an age difference in the PIRLS study according to which rule of entering school the countries use.

# Mean age and variability

Country	Mean	N	SD
Austria	10,34	5067	0,46
Denmark	10,90	4001	0,38
France	10,01	4402	0,50
Germany	10,46	7899	0,51
Iceland-grade 4	9,79	3673	0,29
Luxembourg	11,43	5101	0,60
Netherlands	10,23	4156	0,49
Norway grade 4	9,78	3837	0,29
Russia	10,77	4718	0,50
Spain	9,88	4091	0,42
Sweden	10,84	4394	0,33
England	10,28	4034	0,31
Scotland	9,84	3775	0,32
Iceland grade 5	10,79	1379	0,28
Norway grade 5	10,79	1808	0,28
Total	10,38	67525	0,64

# Student birth year

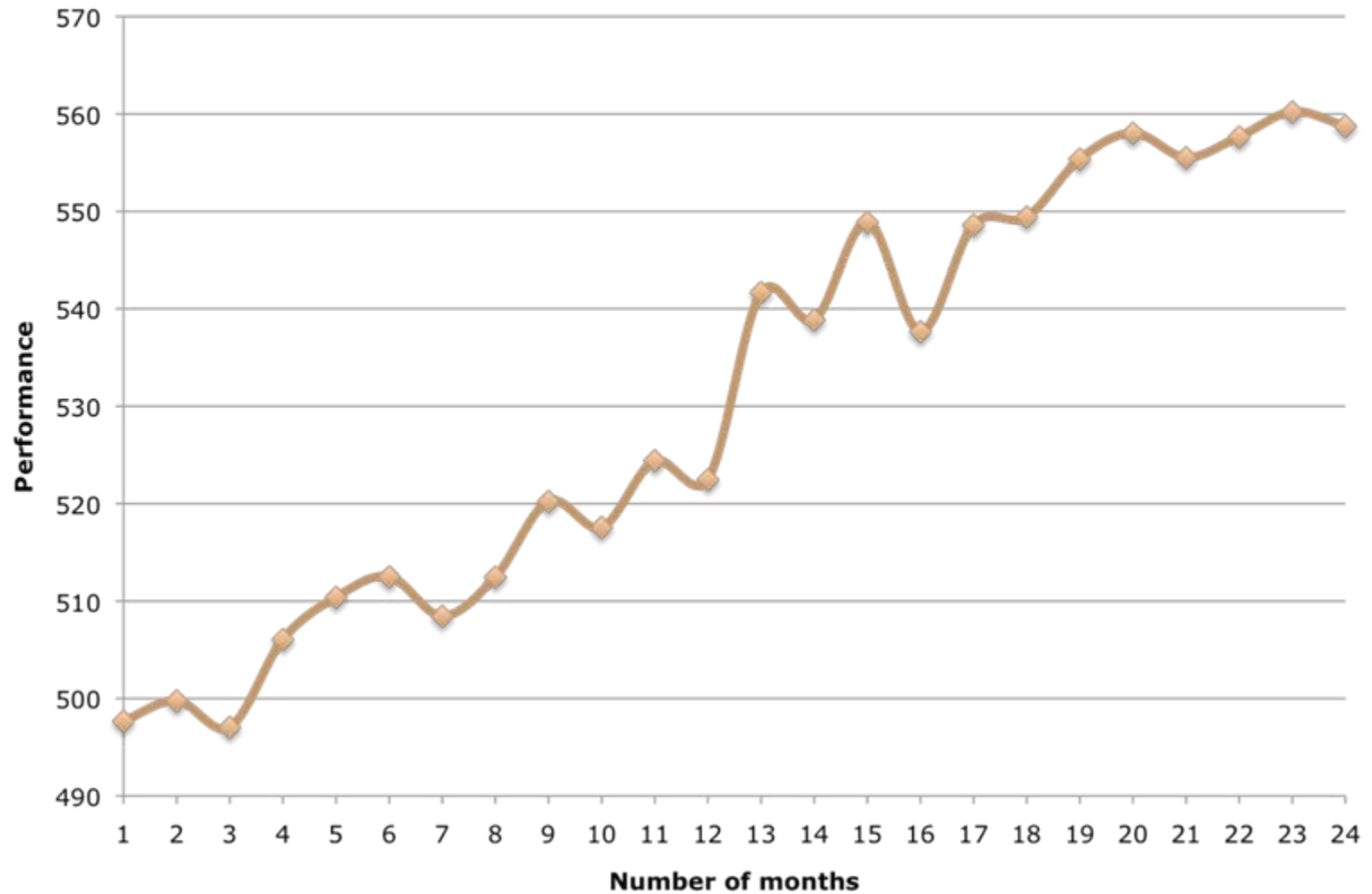
	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Austria	0	0	9	176	2116	2765	1	0	0	5067
Denmark	0	0	12	662	3264	63	0	0	0	4001
France	0	0	2	49	638	3600	111	2	0	4402
Germany	0	0	30	400	3797	3628	42	1	1	7899
Iceland grade 4	0	0	0	0	6	3658	9	0	0	3673
Luxembourg	4	36	459	1996	2601	5	0	0	0	5101
Netherlands	0	0	2	113	1485	2519	34	2	1	4156
Norway grade 4	0	0	0	0	18	3812	7	0	0	3837
Russia	2	11	27	464	3530	676	5	3	0	4718
Spain	0	0	0	3	289	3771	16	2	13	4094
Sweden	0	0	1	123	4191	78	1	0	0	4394
England	0	0	3	0	1340	2683	7	1	0	4034
Scotland	0	0	0	1	99	3222	452	1	0	3775
Iceland grade 5	0	0	0	0	1375	4	0	0	0	1379
Norway grade 5	0	0	0	7	1796	5	0	0	0	1808
Total	6	47	561	4154	28348	33684	699	14	15	67528

# Mean performance by year of birth

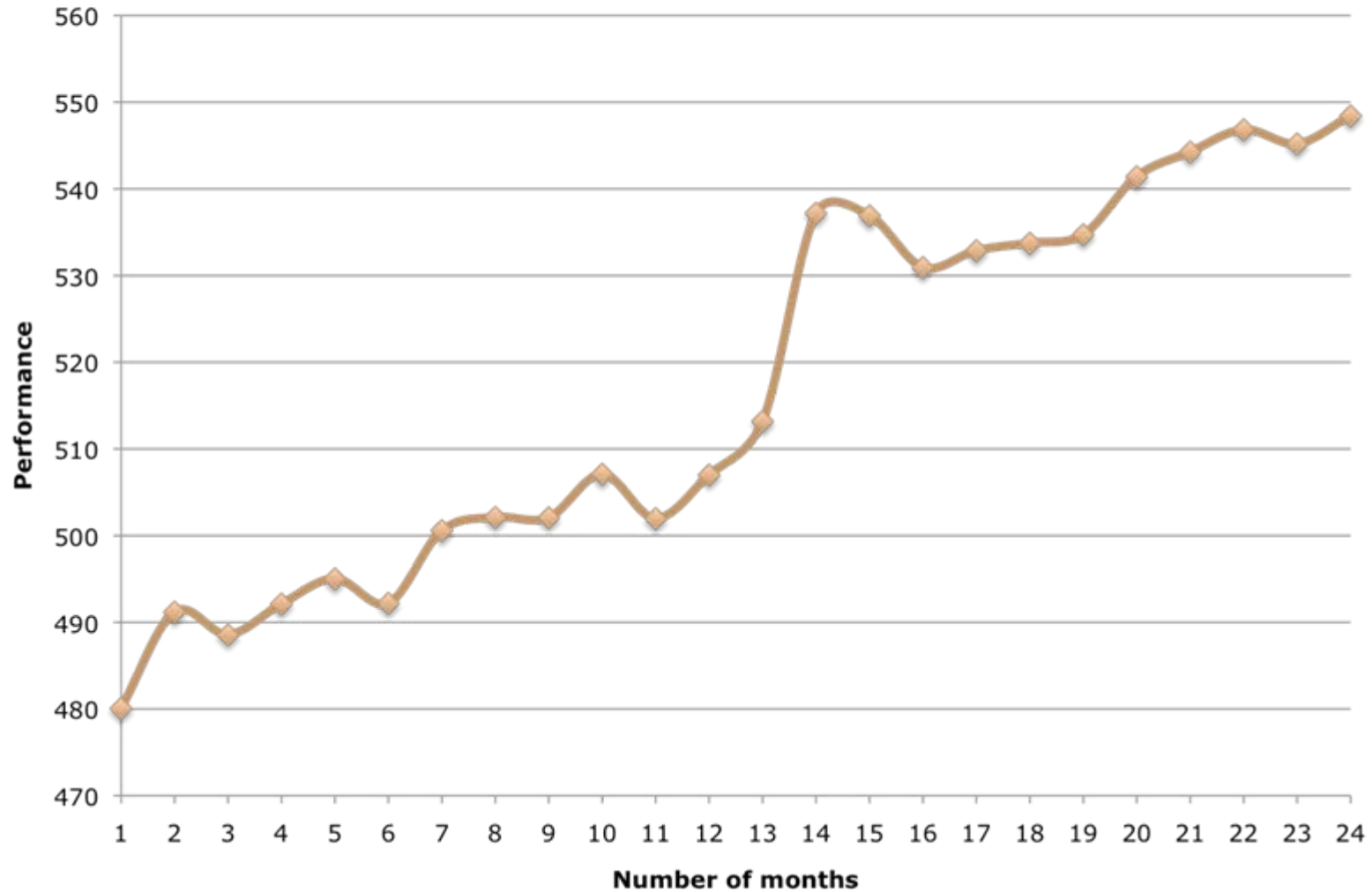
	1995	N	1996	N
Austria	534	2116	543	2765
Denmark	553	3264	568	63
France	464	638	531	3600
Germany	546	3797	554	3628
Iceland grade 4	467	6	510	3658
Luxembourg	570	2601	594	5
Netherlands	542	1485	557	2519
Norway grade 4	470	18	497	3812
Russia	573	3530	557	676
Spain	455	289	521	3771
Sweden	551	4191	543	78
England	548	1340	530	2683
Scotland	508	99	533	3222
Iceland grade 5	551	1375	580	4
Norway grade 5	537	1796	557	5

In most of the European countries the performance of the students born in 1995 is worse than the performance of those a year younger, i.e. those born in 1996

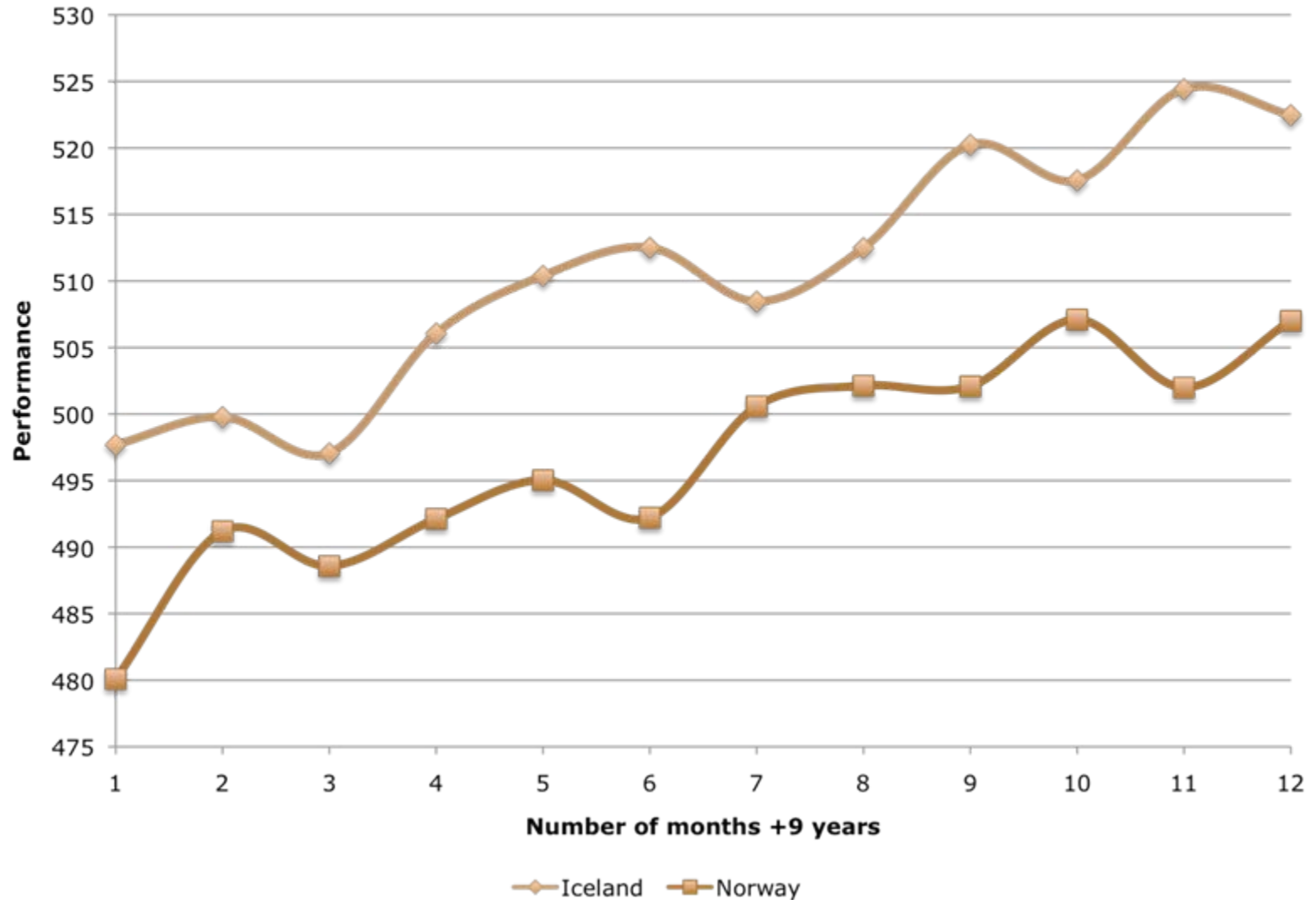
# PIRLS performance by age (Iceland)



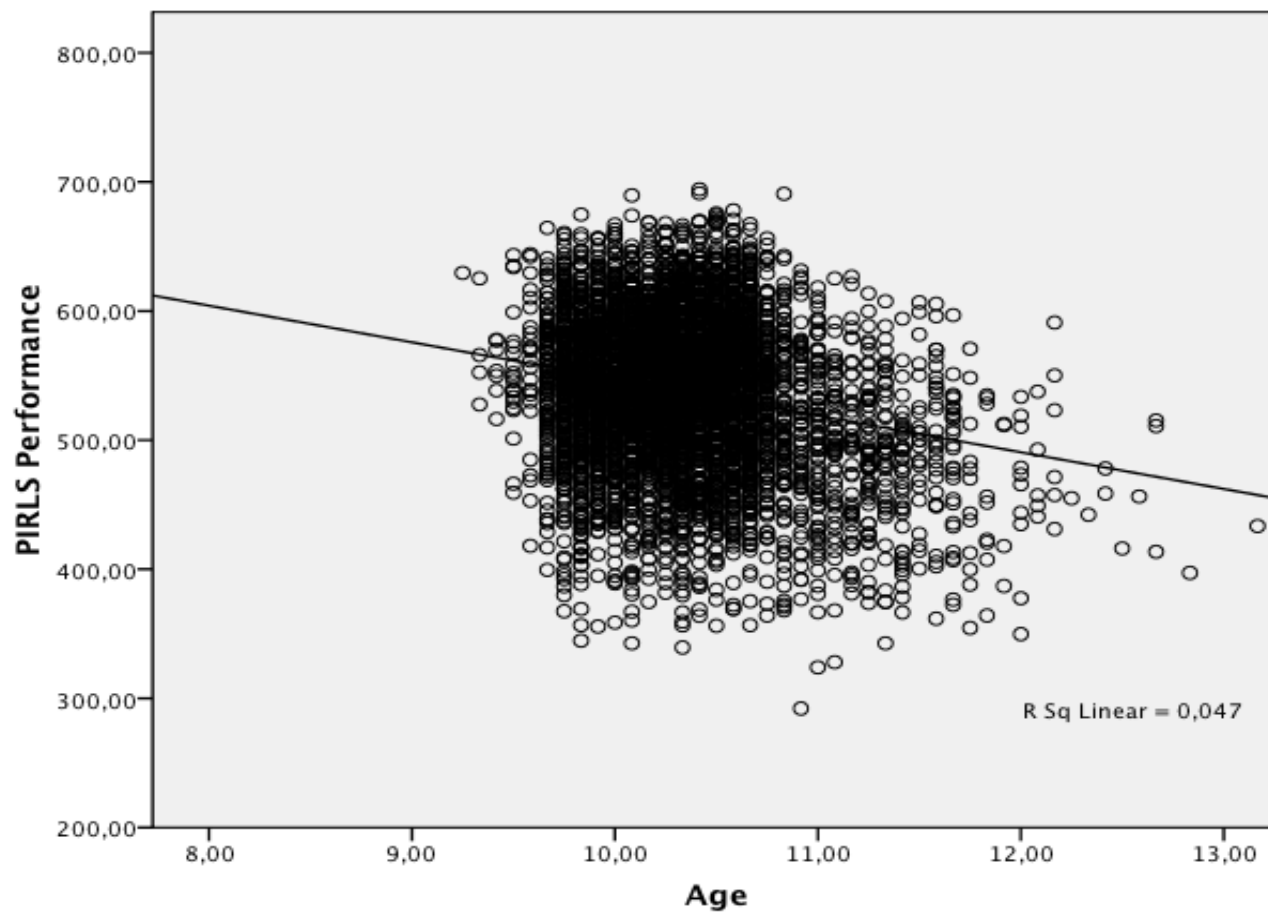
# PIRLS performance by age (Norway)



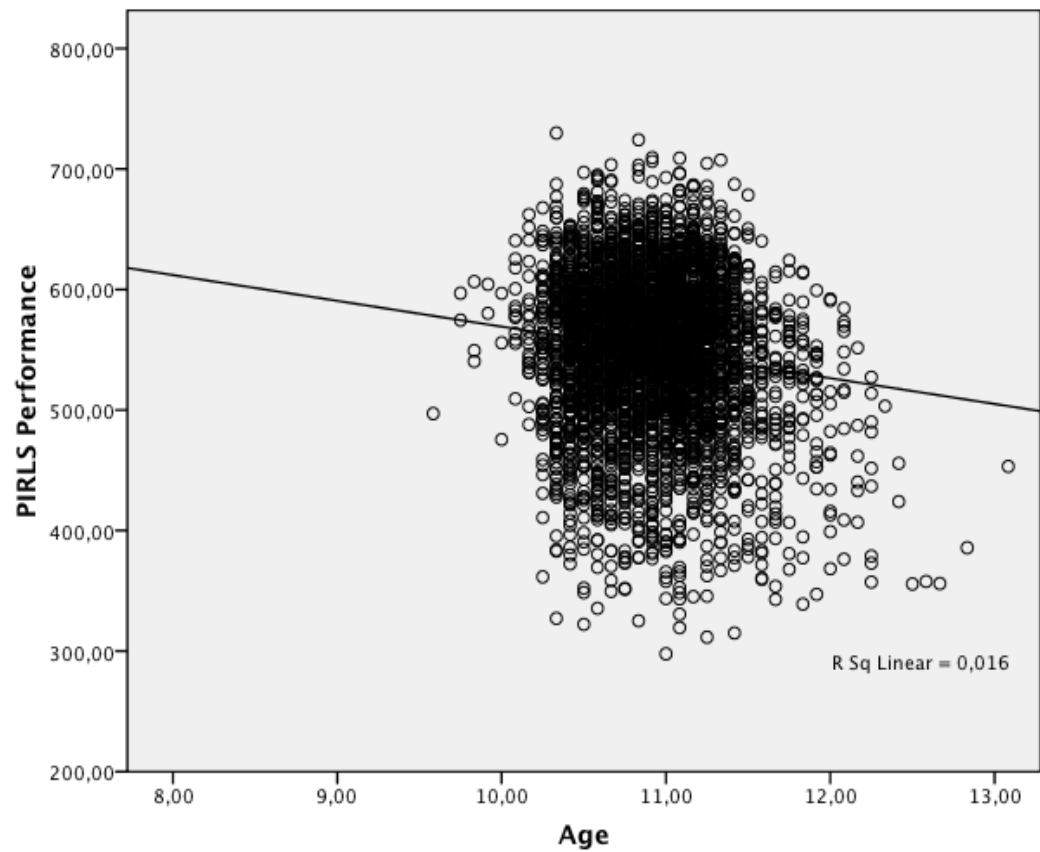
# Only 4<sup>th</sup> grade



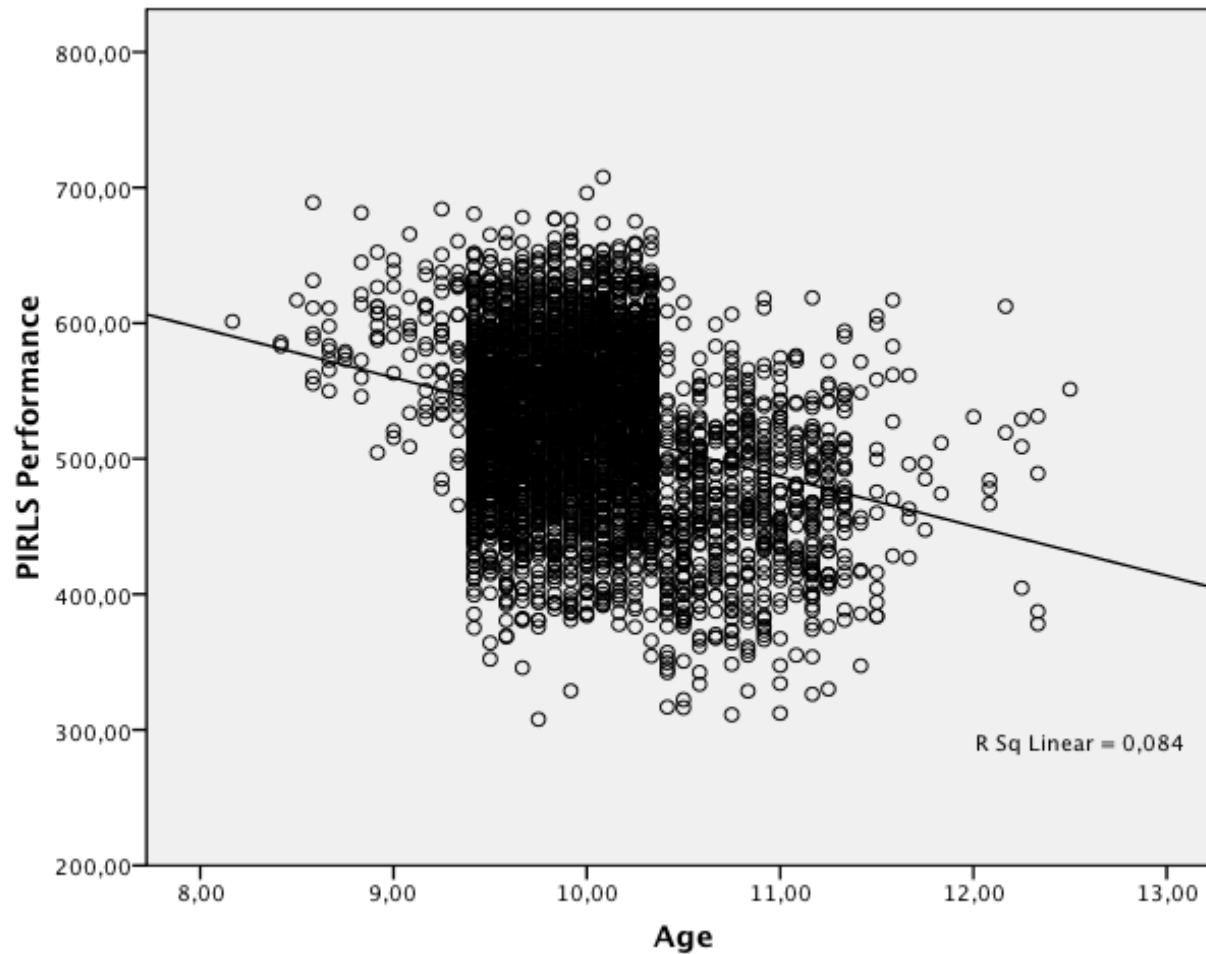
# Austria



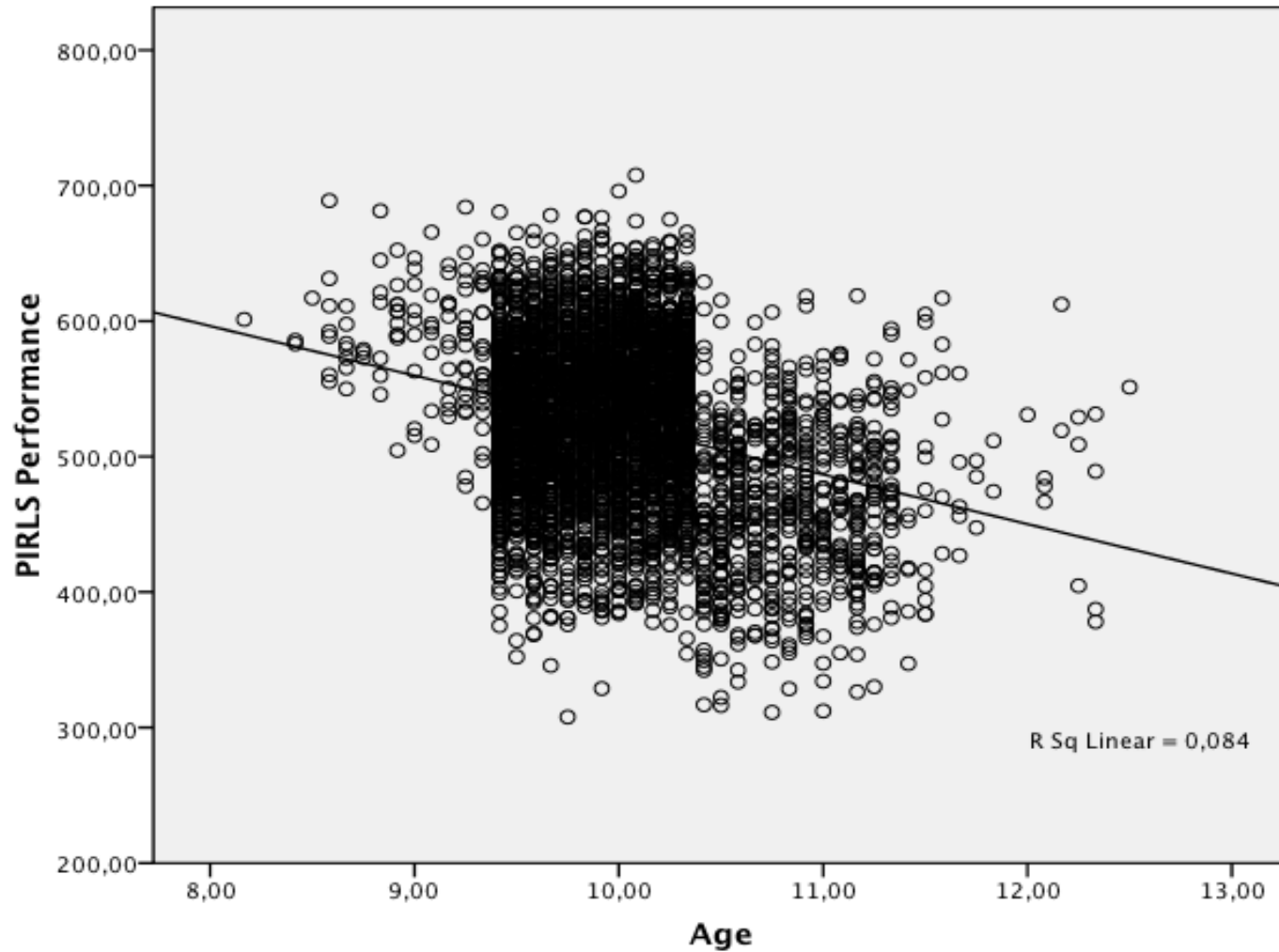
# Denmark



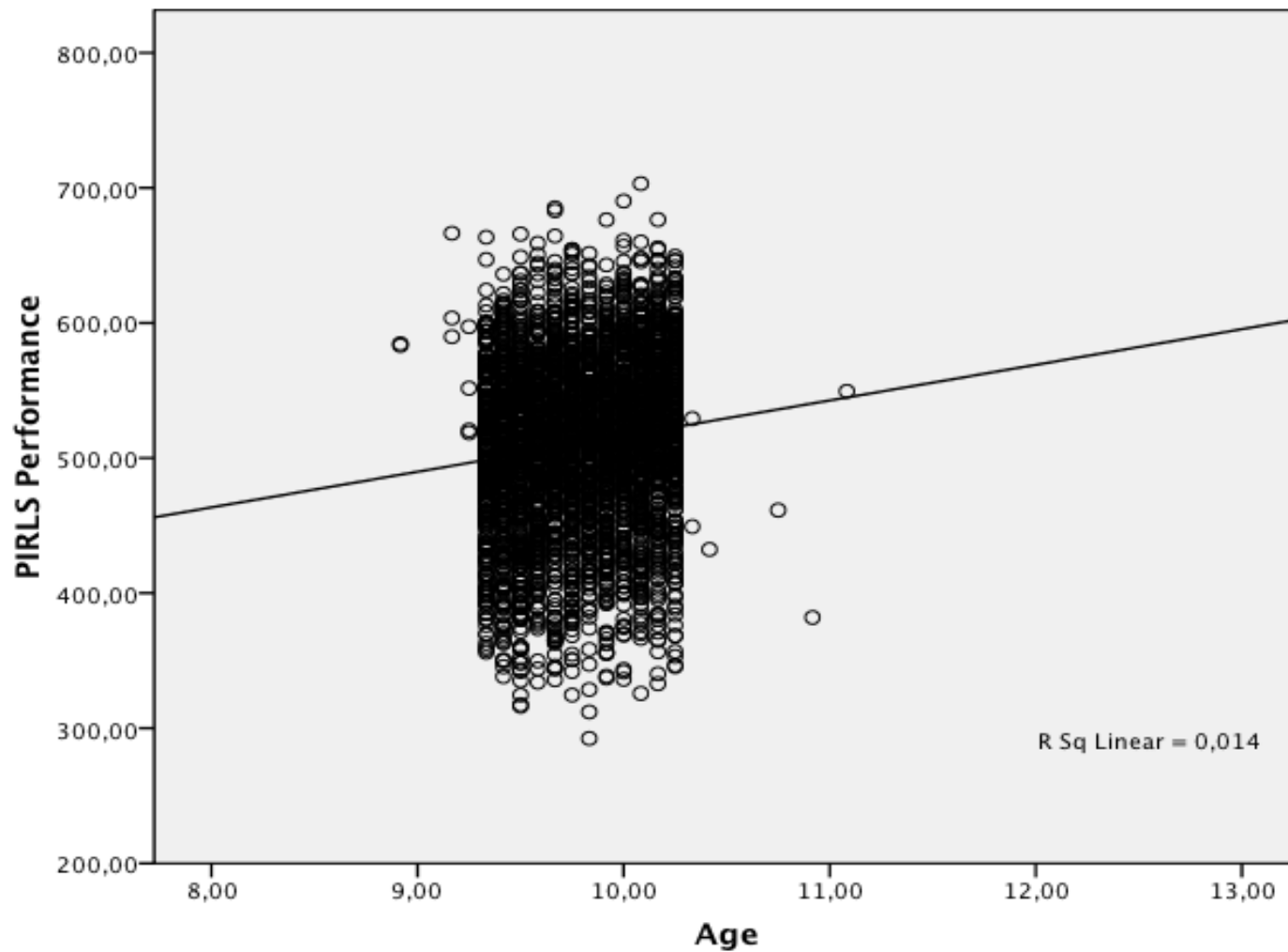
# France



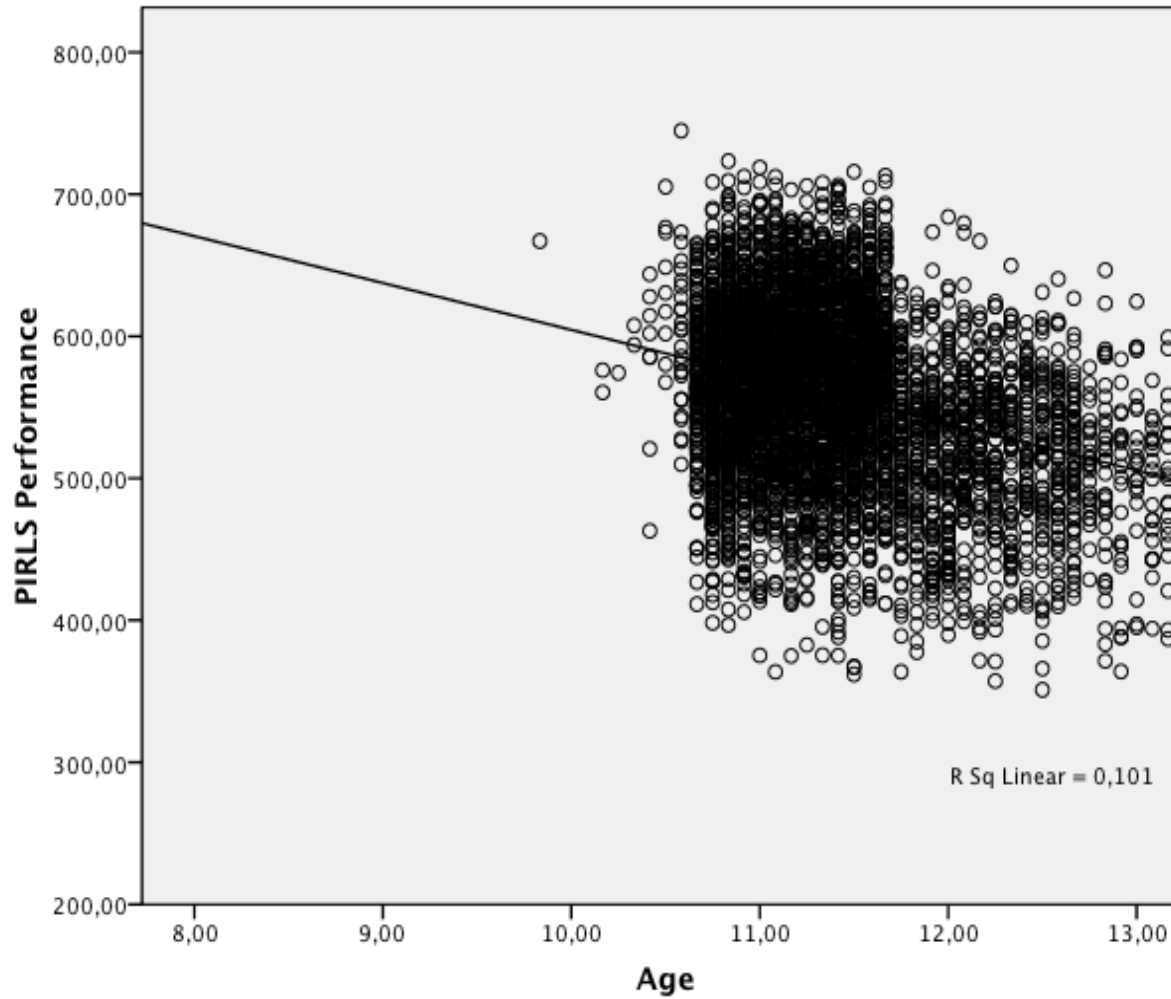
# Germany



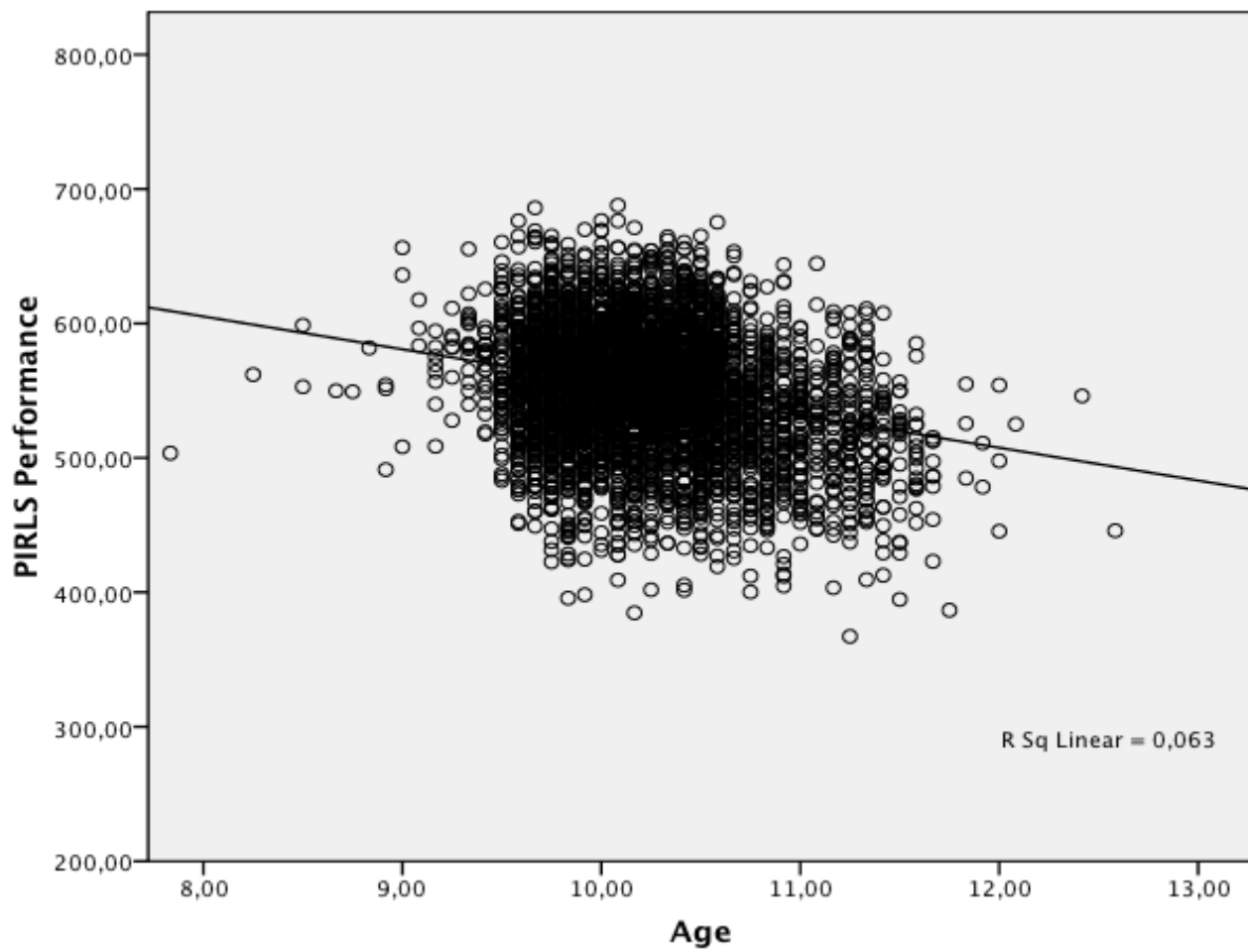
# Iceland grade 4



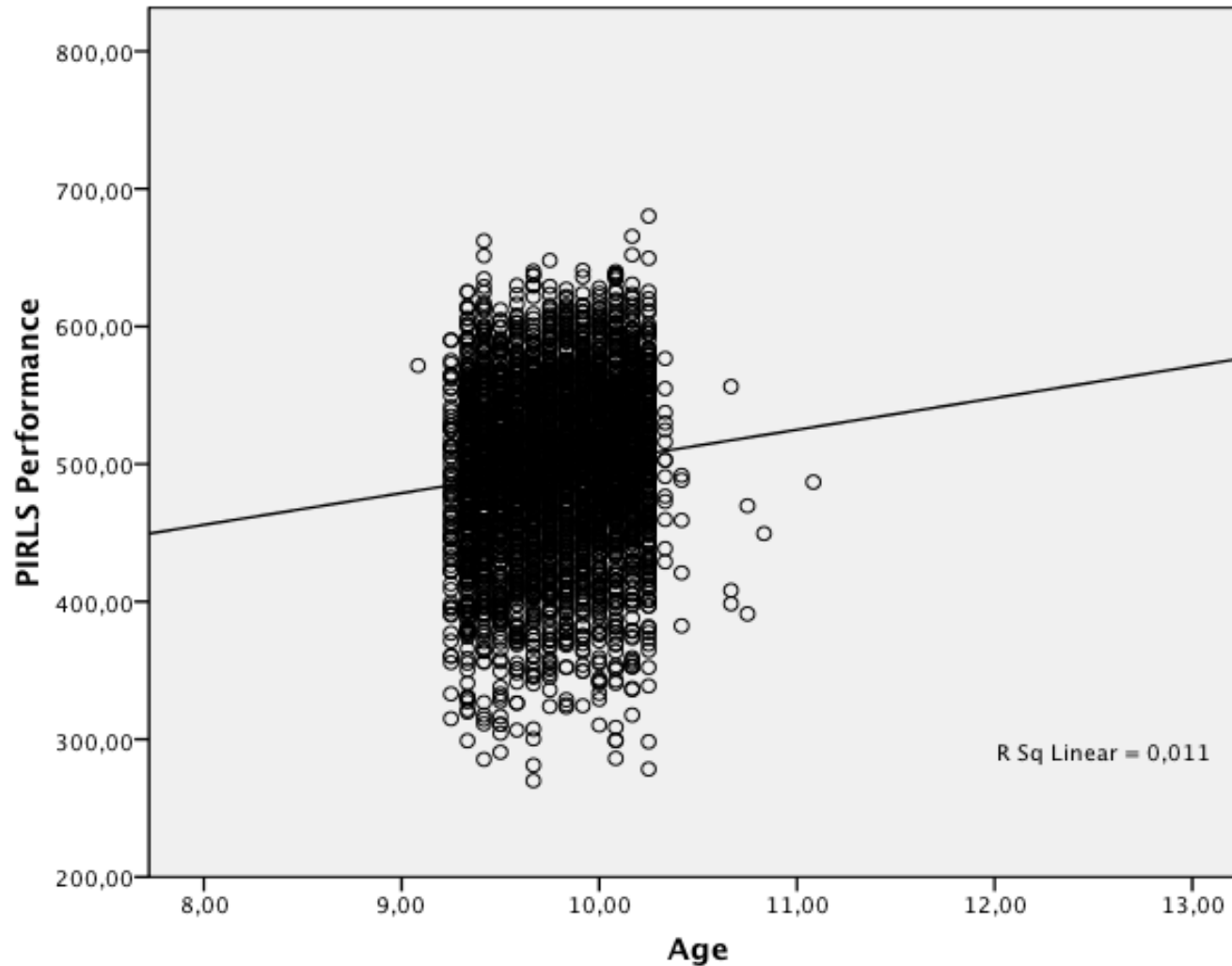
# Luxembourg



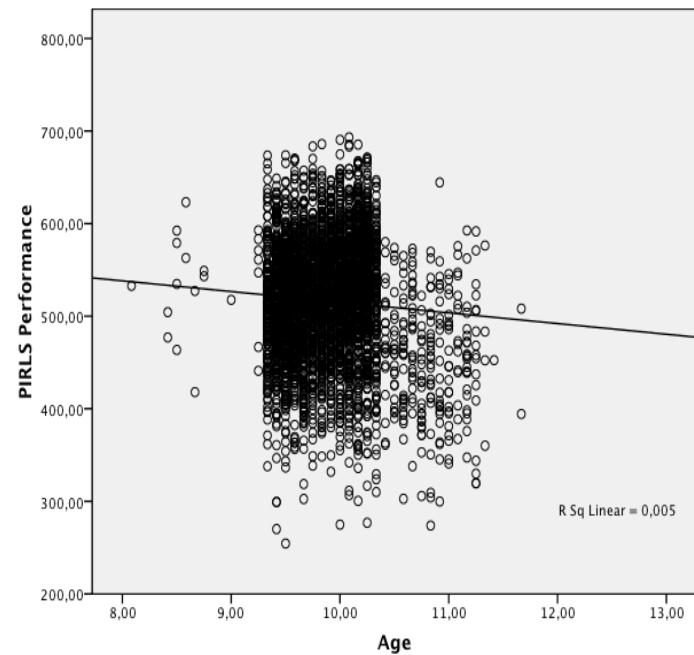
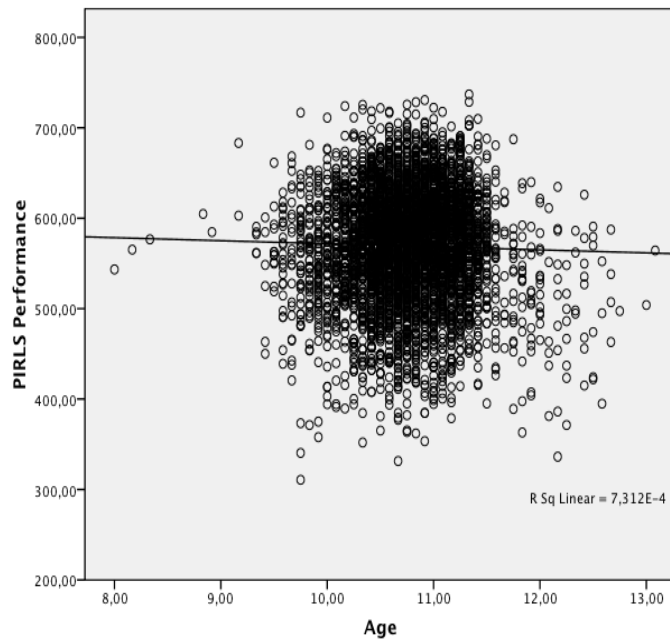
# Netherlands



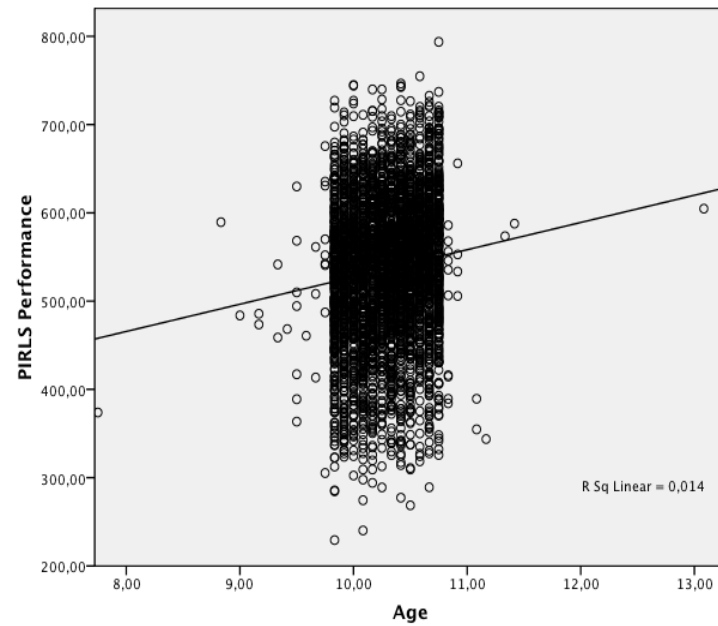
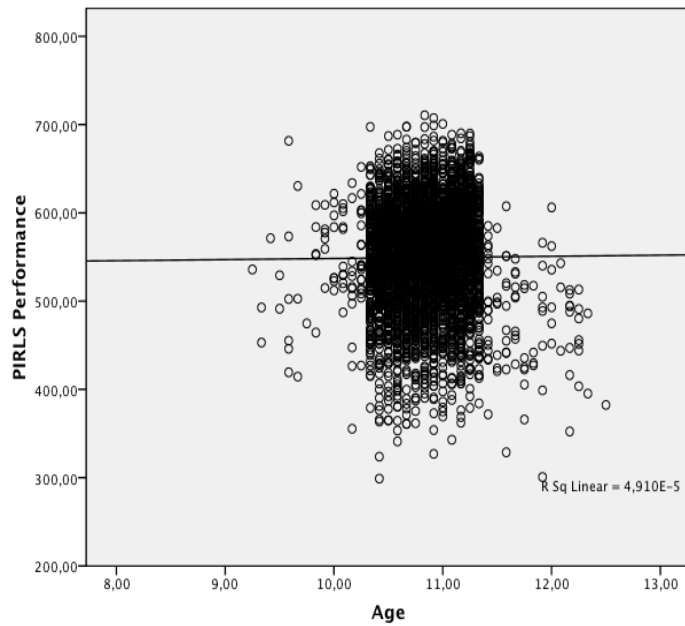
# Norway grade 4



# Russia and Spain



# Sweden and England



# What does this tell us?

- Given the differences shown in the scatterplots, one can speculate on the appropriateness of comparing these countries directly, without controlling for the variable that shows the greatest variation, i.e. age. (approx. 40% of the differences between countries can be explained by age).
- A correlation was performed for each country between age and performance and for most of them a zero correlation or a negative one emerged.
- In Iceland and Norway both age groups had however a positive correlation and the only other country with such a significant relationship was England.

# Age and Performance

Country	Correlation
Austria	-0,28
Denmark	-0,12
France	-0,28
Germany	-0,23
Iceland grade 4	0,11
Luxembourg	-0,32
Netherlands	-0,25
Norway	0,10
Russia	-0,02 ns
Spain	-0,07
Sweden	0,00 ns
England	0,11
Scotland	0,09
Iceland grade 5	0,10
Norway grade 5	0,11

# What did we learn?

- The main conclusion from this examination is therefore, that a comparison between Norwegian and Icelandic students on the one hand with most of the North-European countries examined here on the other, needs to take into account the age differences after four years of formal schooling, the different methods of intake into primary schools practiced in different countries leading to age differences, and other important variables such as the methods used for determining whether a grade should be repeated or not.

# What did we learn?

- The differences within one year are highly significant and should be taken into account when organizing learning and teaching in the youngest age groups.
- If these differences are not taken account of when doing international comparisons, those same comparisons are going to be wrong.
- Should we here in Iceland for example conclude that our 4<sup>th</sup> graders are about average, or that our kids are among the best when the comparison takes age into account and controls for intake methods and other variables?

# In conclusion

- Absolute age and therefore maturation are highly important variables which can influence school performance to a great extent, although the effect is largely invisible in most countries because of different intake methods and often a system of repeating grades.
- Even a difference of one or two months in age corresponds (explains) to a significant difference in reading performance.
- This is a variable the school system tends to ignore after the children have been grouped into classes, irrespective of which intake method is used.
- This therefore once again, underlines and emphasizes the importance of individualized teaching, based on knowledge about different individual needs.