

Are girls becoming better in mathematics or better students?

A new perspective for understanding gender gaps in maths and reading.

Joel Rapp

National Institute for Testing and Evaluation

**The 45th International Association for
Educational Assessment Annual Conference
Baku, Azerbaijan, Sep. 2019**

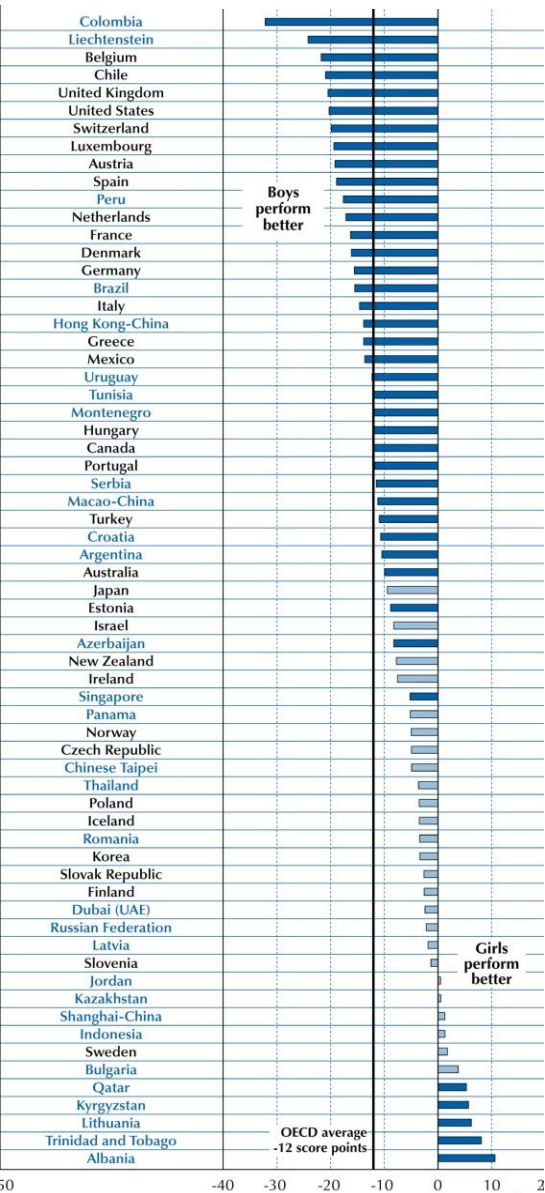
Background

The gender gap in mathematics

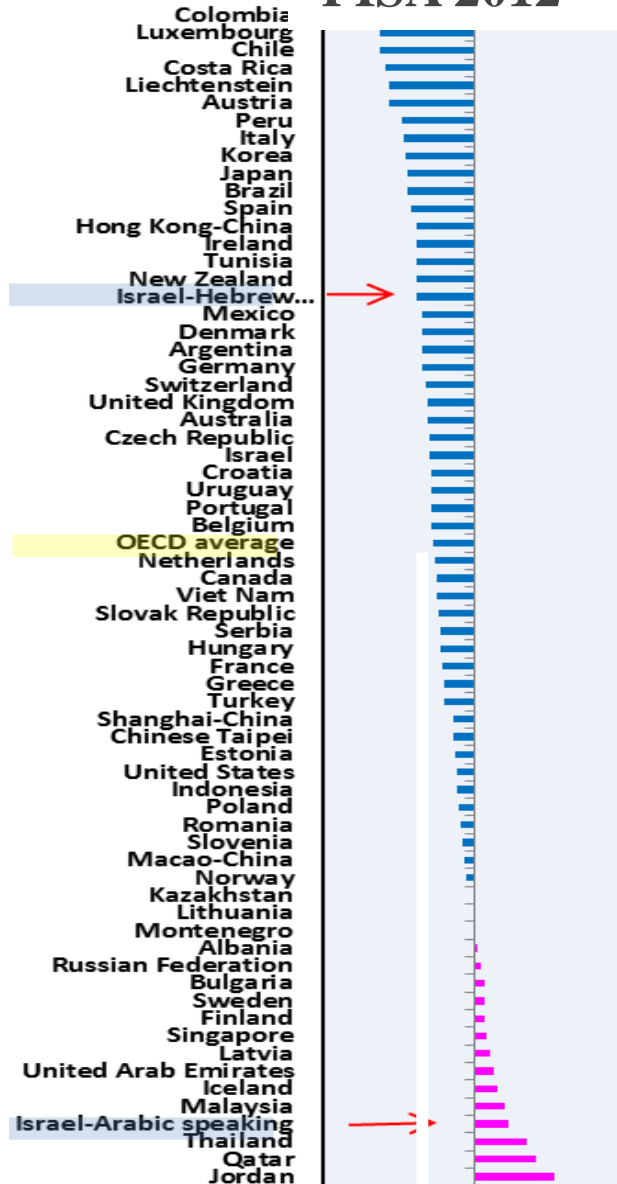
- **Historically, males outperformed females in math, especially at the higher levels of the achievement distribution.**
- **For decades, researchers tried to find out if a gender gap in mathematics really exists, and if so, what are its origins.**
- **Along the last decades gender gap between girls and boys in maths is getting narrower and in some countries and cultures - girls outperform boys in maths (Hyde, Lindberg, Linn, Ellis, & Williams, 2008; Voyer & Voyer, 2014).**

The gender gap in maths across countries

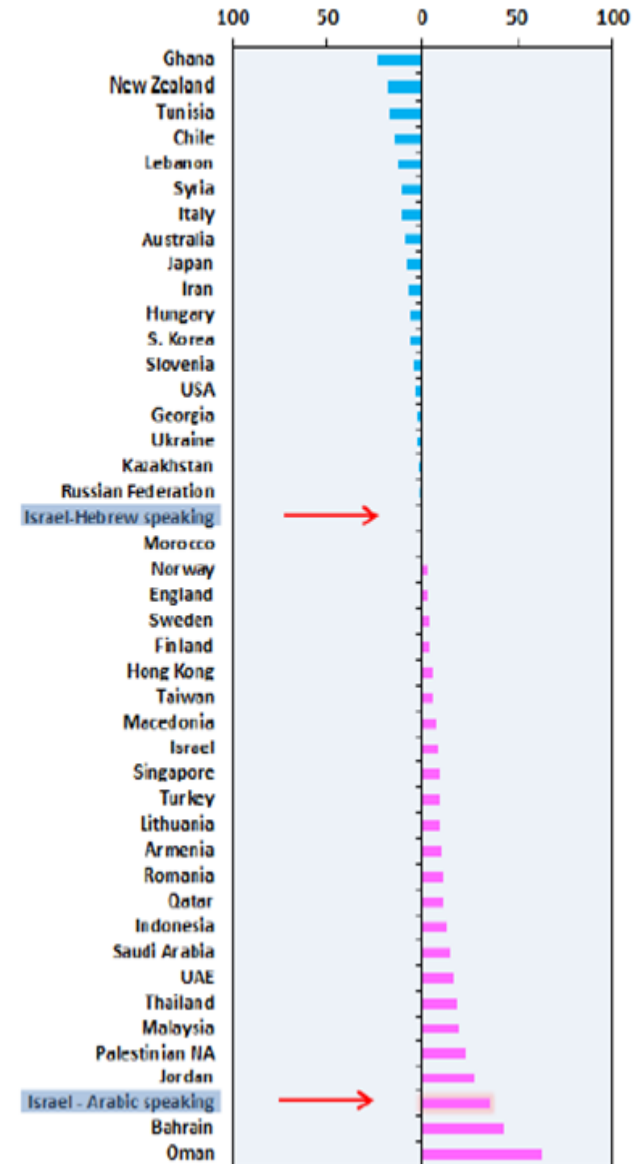
PISA 2009



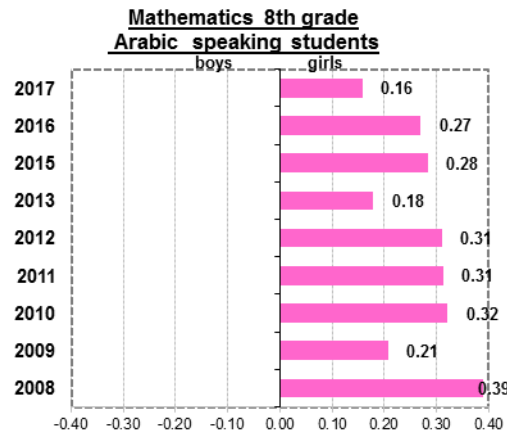
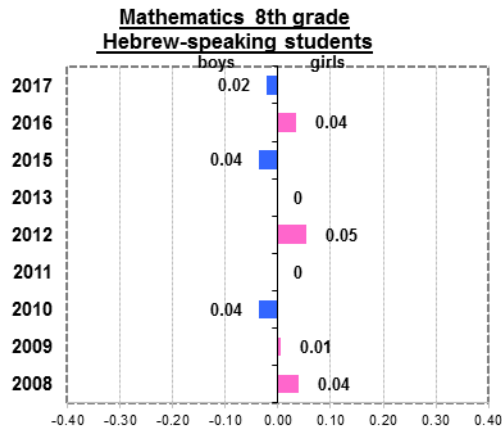
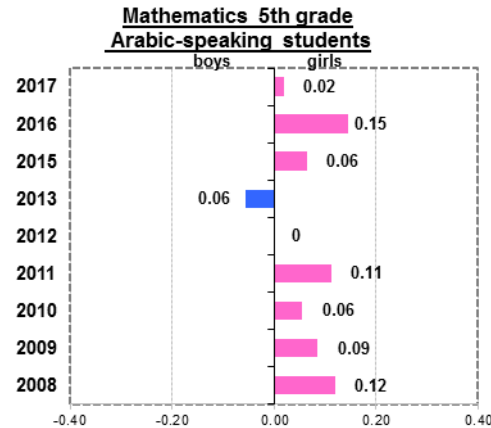
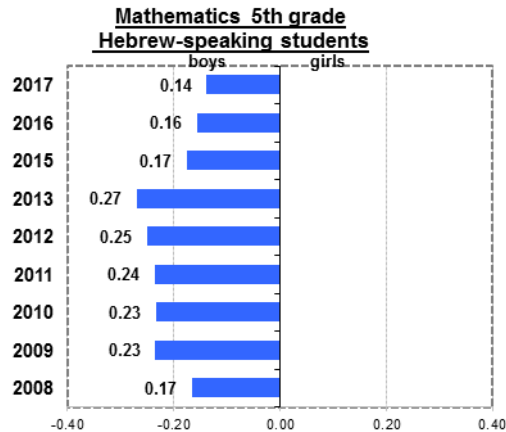
PISA 2012



TIMSS 2011



The gender gap on MEITSAV in mathematics, in Israel



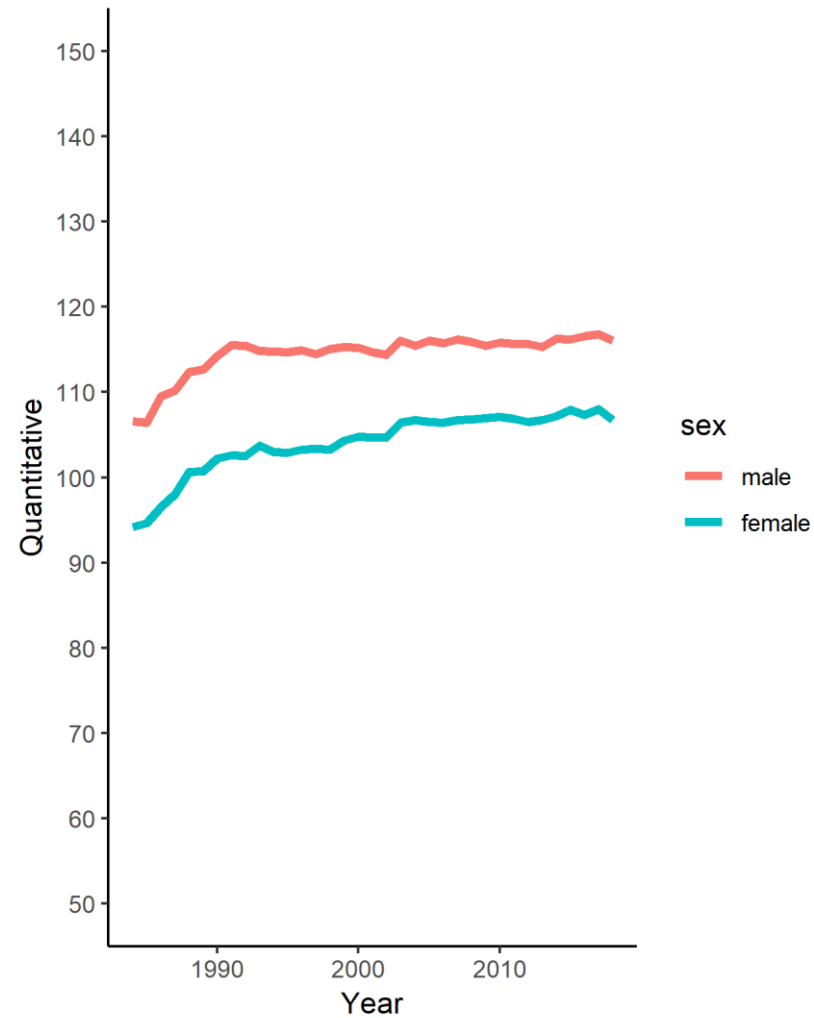
grade 5

grade 8

Hebrew

Arabic

The gender gap on PET in quantitative reasoning, in Israel 1984-2018

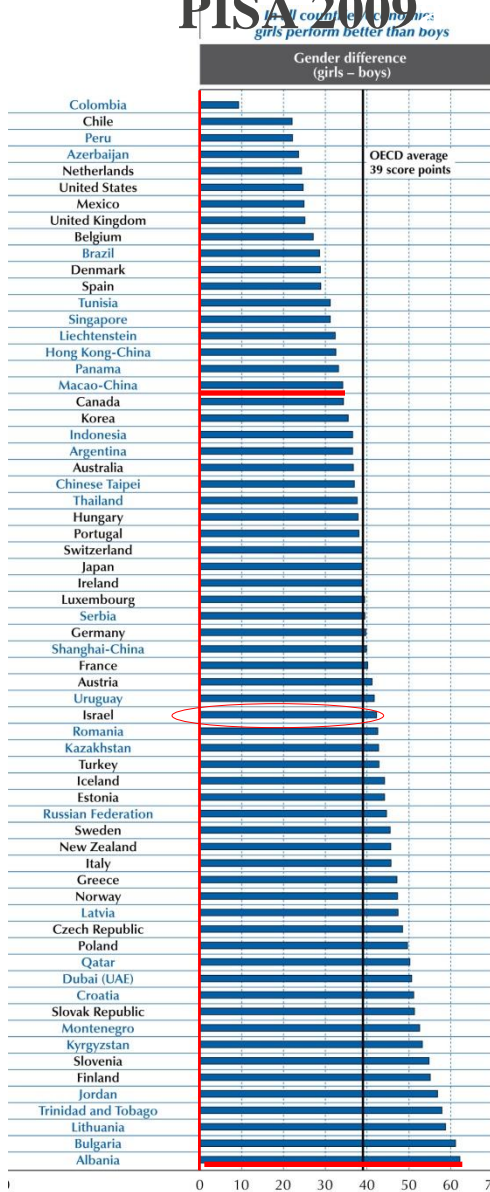


The gender gap in reading

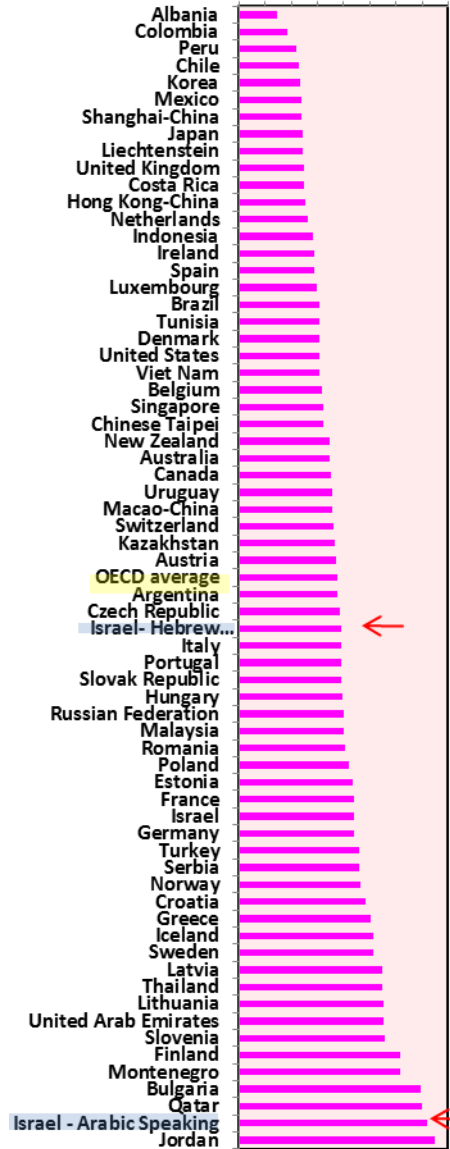
- From some reason, there is less interest in gender gap in reading than in mathematics.
- Girls tends to do better than boys in reading and they have better general verbal competences than boys.
- This gender gap in favor of girls is consistent across countries, cultures, ages and different types of tests and measurement approaches (Cole, 1997; Lietz, 2006; Maccoby & Jacklin, 1974).

The gender gap in reading across countries

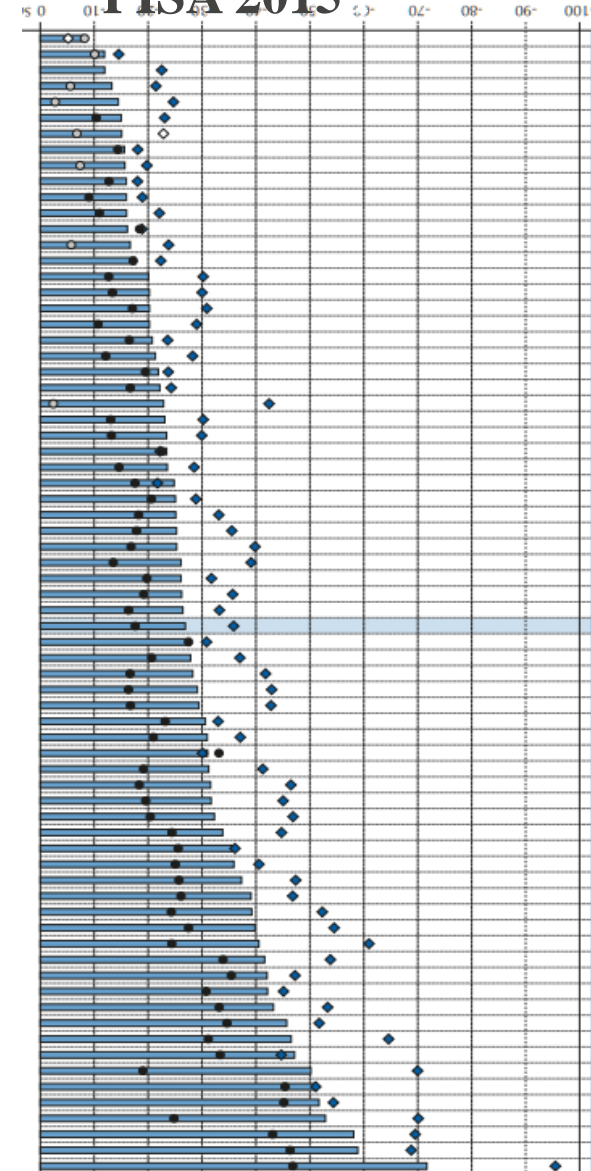
PISA 2009



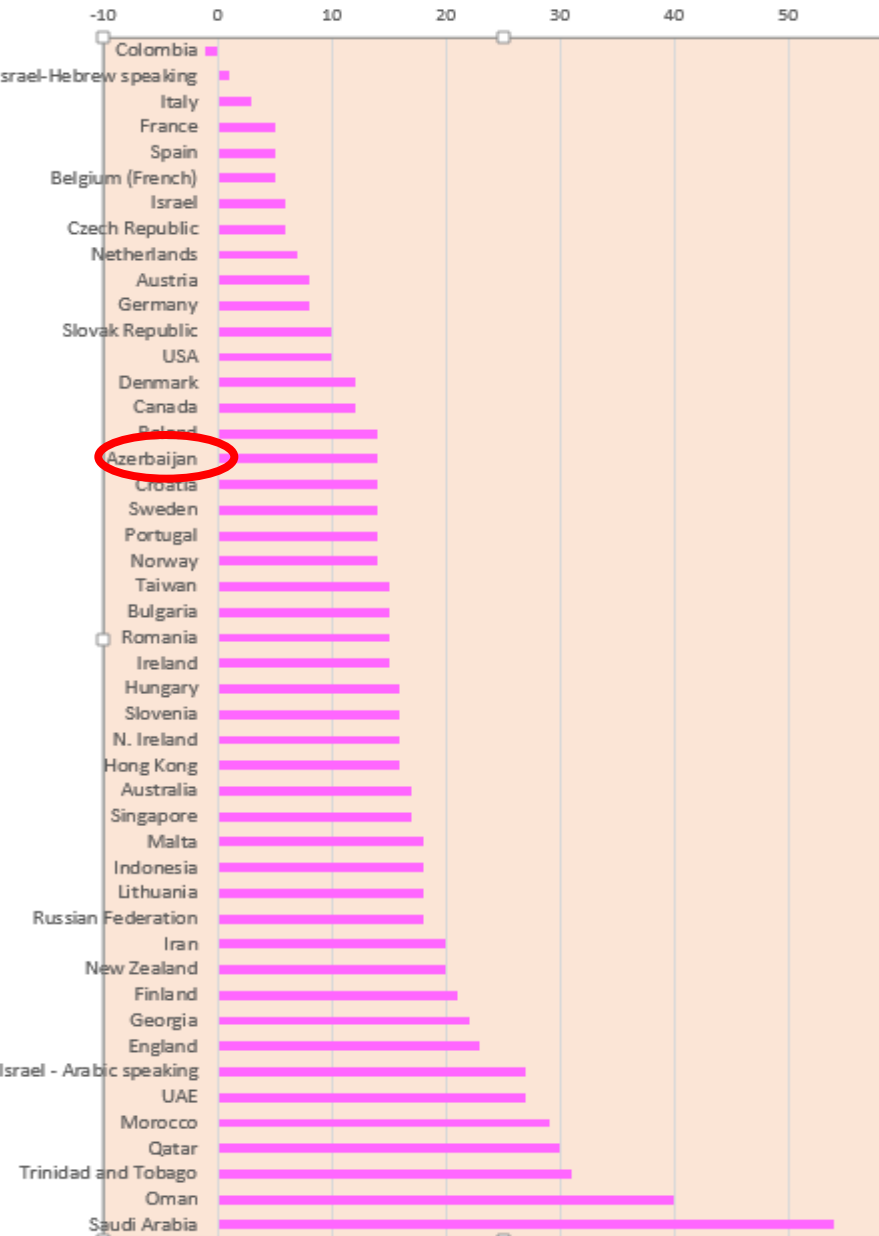
PISA 2012



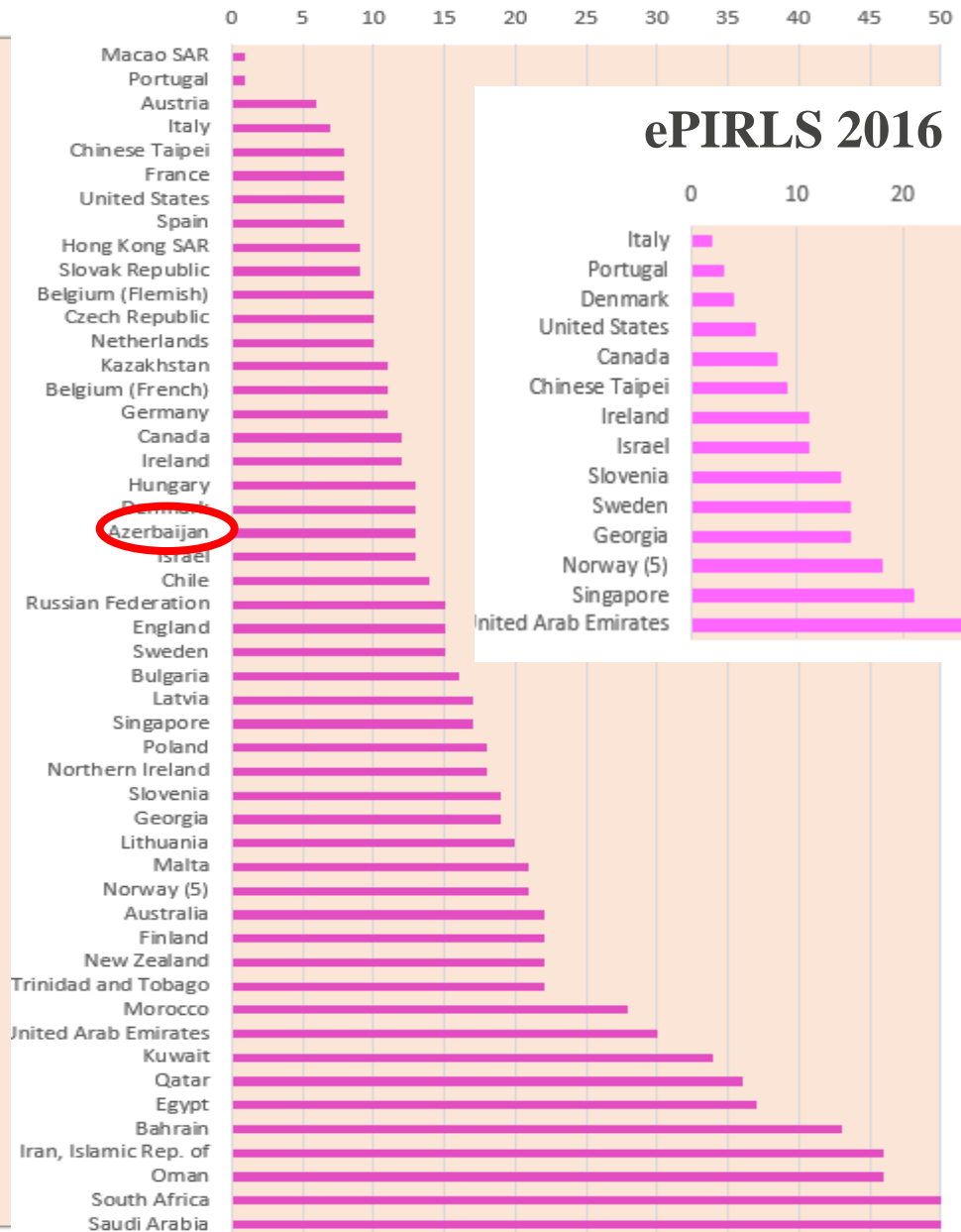
PISA 2015



PIRLS 2011

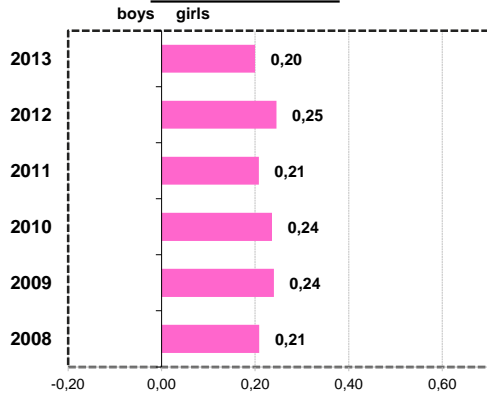


PIRLS 2016

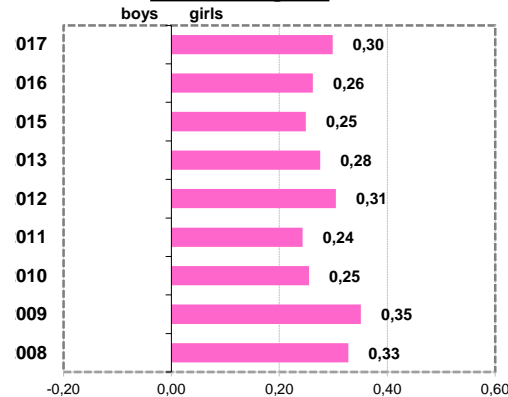


The gender gap on MEITSAV in language in Israel

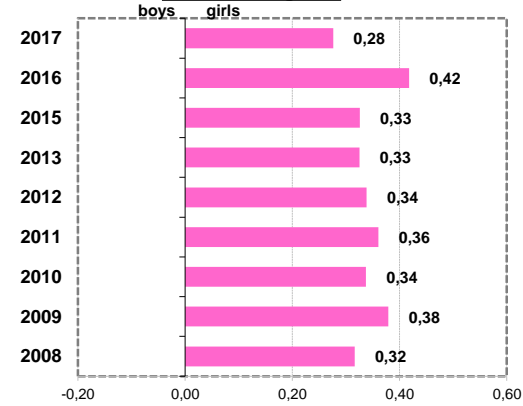
Hebrew 2nd Grade



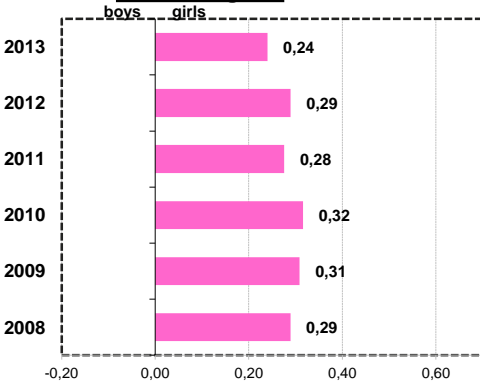
Hebrew 5th grade



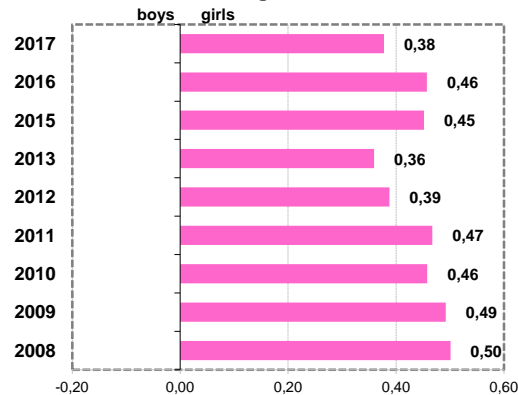
Hebrew 8th grade



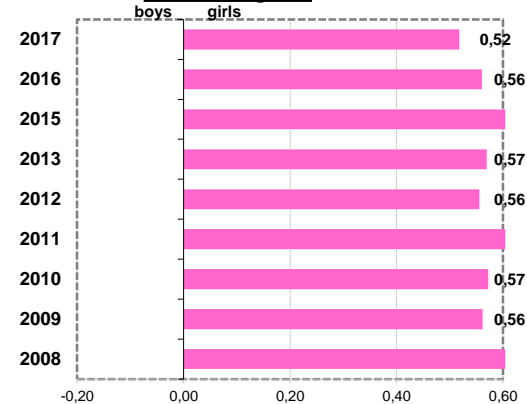
Arabic 2th grade



Arabic 5th grade



Arabic 8th grade



Hebrew

Arabic

grade 2

grade 5

grade 8

The mutuality between the gender gaps in maths and reading

Why should we inspect gender gaps in maths and reading concurrently ?

- **With a few exceptions, gender gap in math and in reading have been reported and investigated as separate issues.**
- **However, they are learned by the same students in the same context, in the same schools and years, and in many cases the performance in both subjects is measured by the same test system and with the same metrics.**

The relation between the gender gap in maths and in reading

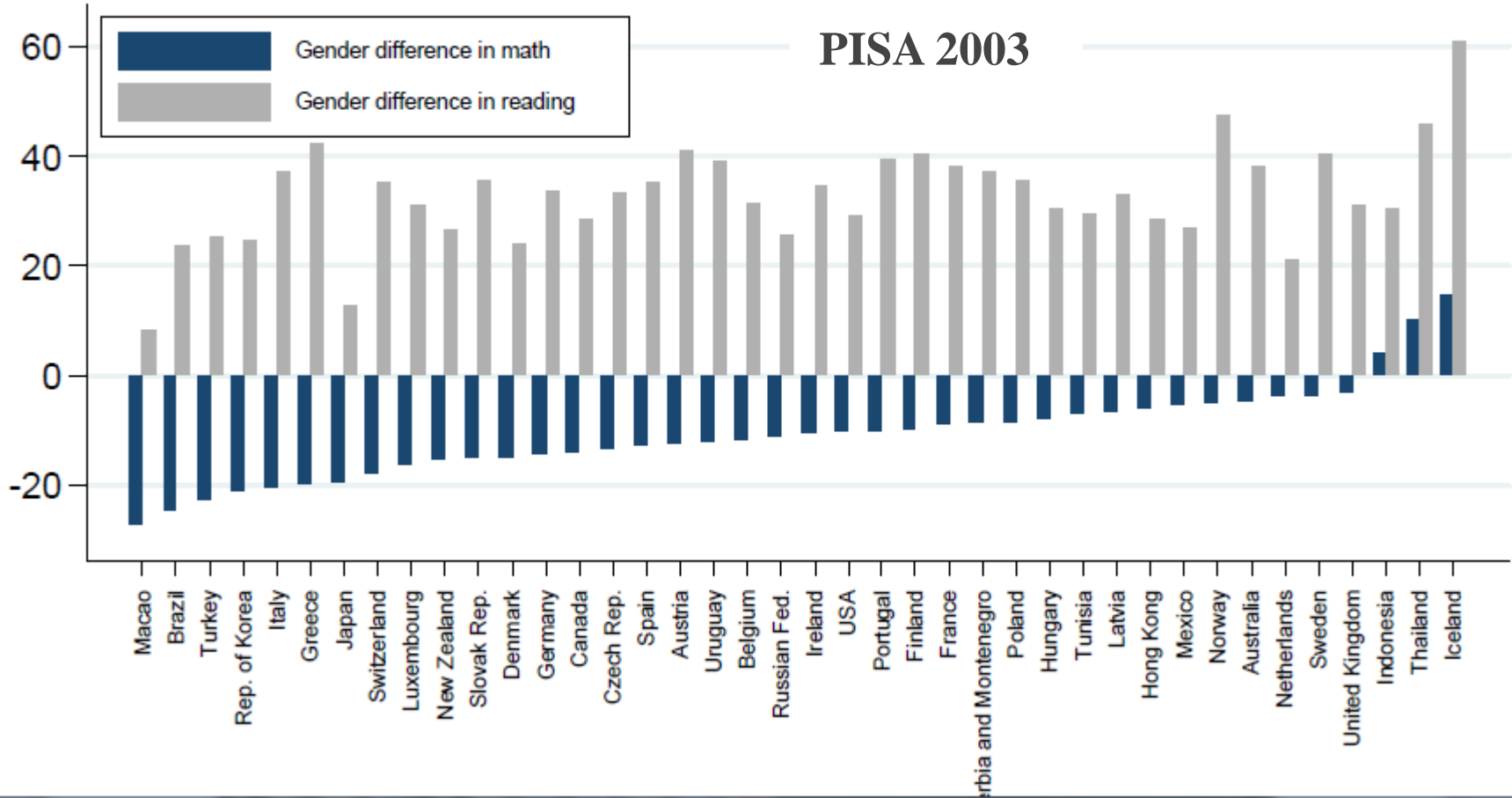
Findings that have not received enough attention in the literature:

- 1. There is a high correlation and a synchronicity between gender gaps in reading and in maths across countries and time.**
- 2. There is a constant order among the gender gap size: reading-science-math.**
- 3. Boys do better in maths than girls of the same level of reading proficiency.**

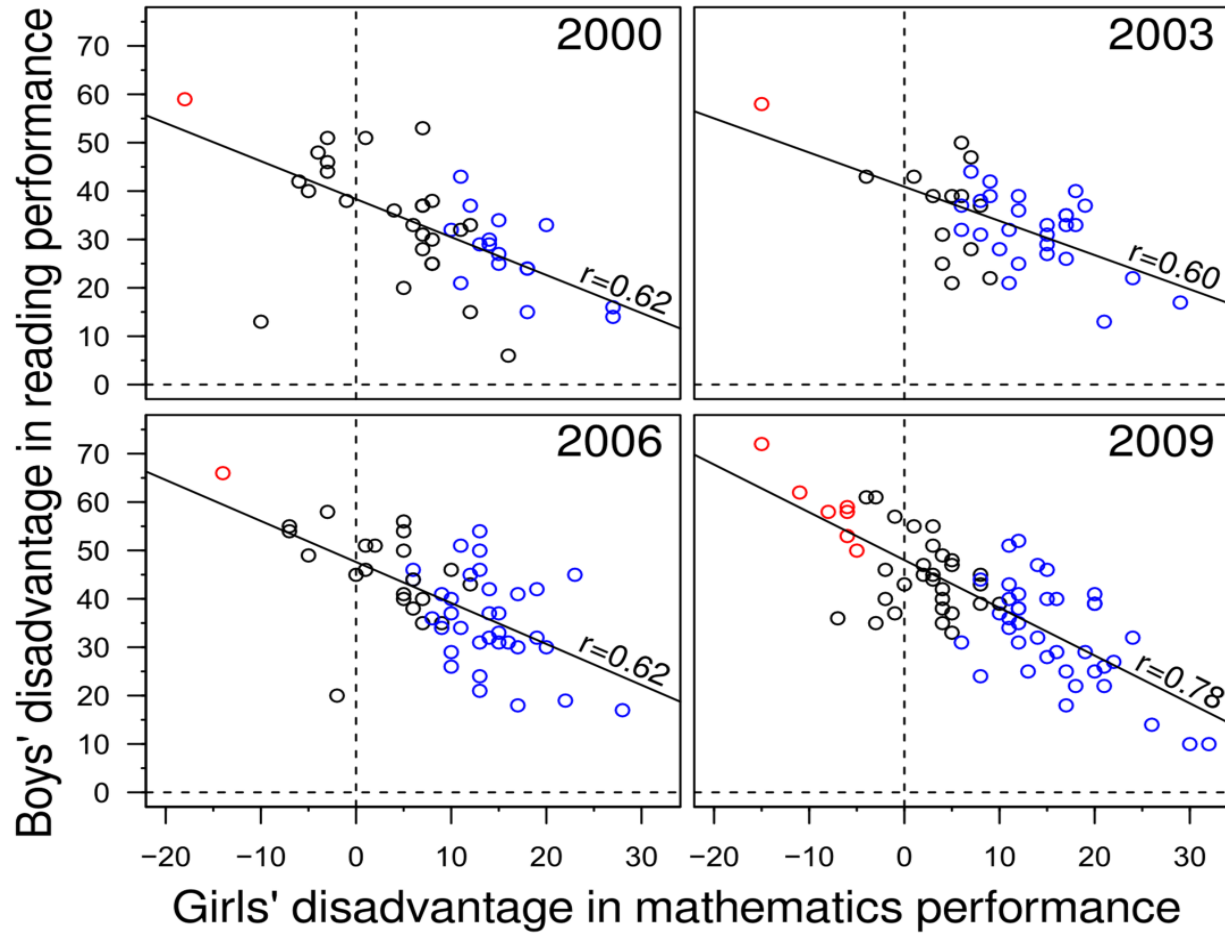
1

There is a high correlation and synchronicity between gender gaps in reading in math across countries and time. (Guiso et al., 2008; Marks, 2008; OECD, 2012, 2015; Stoet & Geary, 2013, 2015, 2018; Rapp, 2015, Rapp & Borgonovi, 2019).

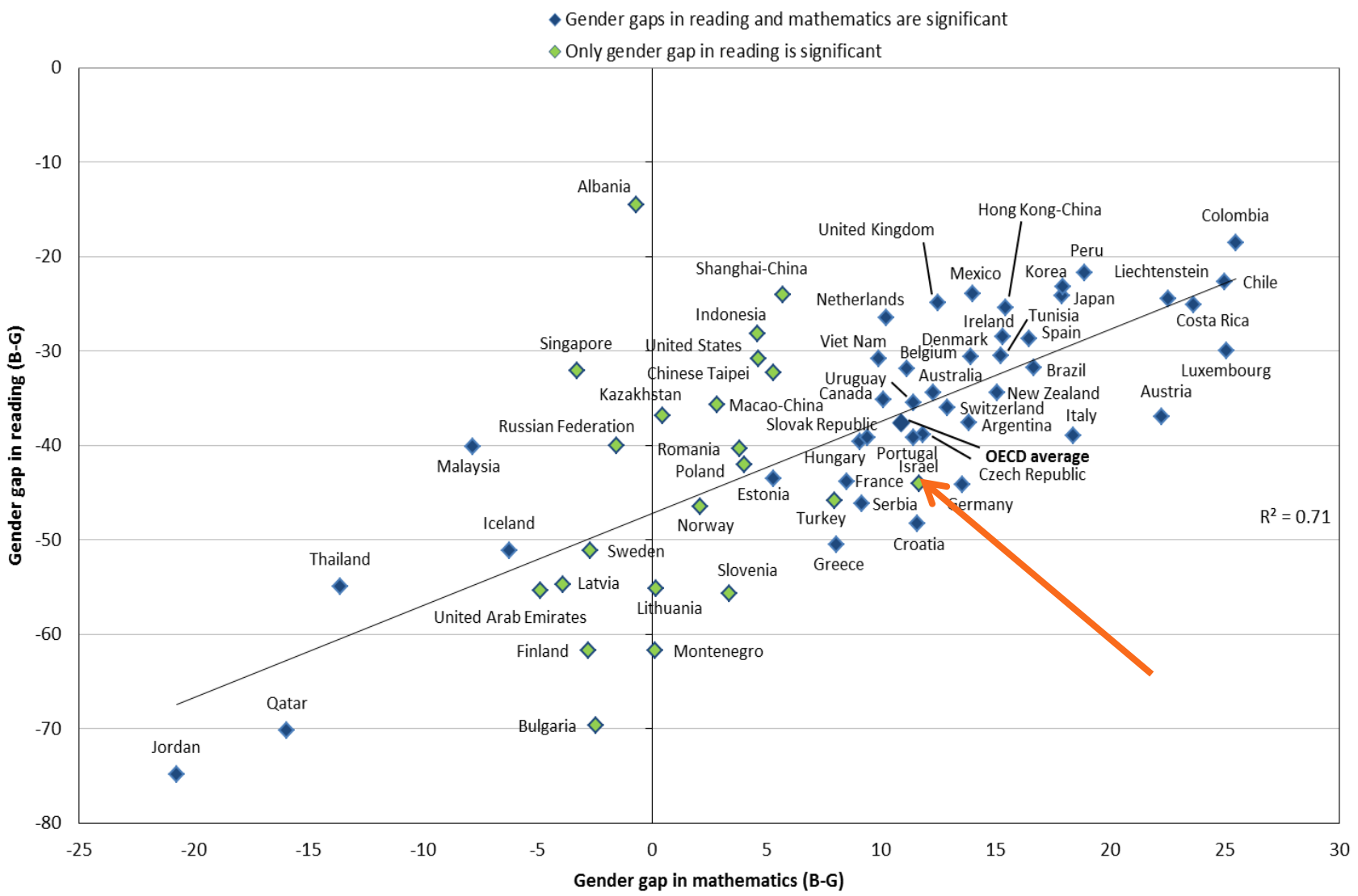
Guiso et. al. (Science, 2008)



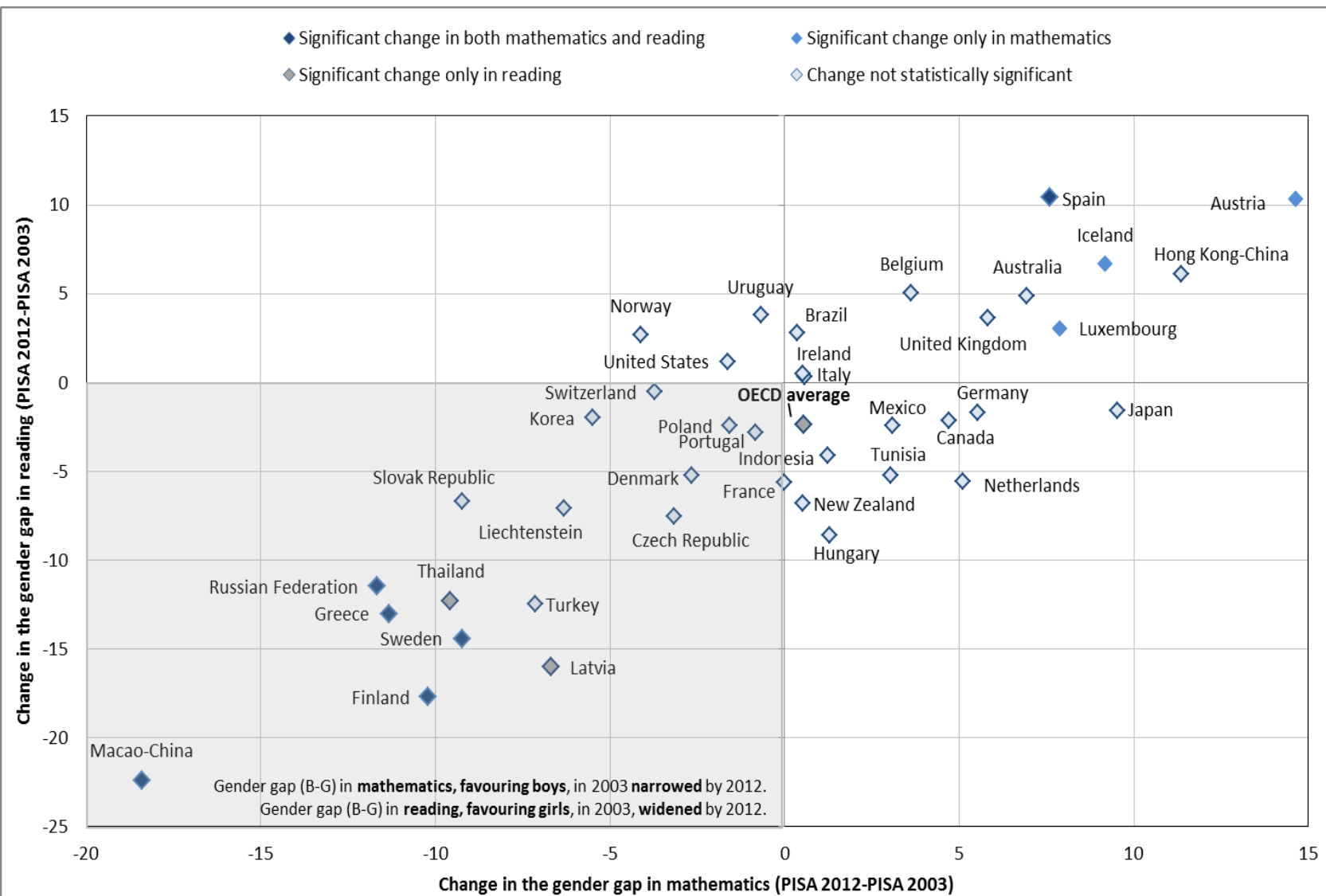
Stoet and Geary , 2014 , PISA data



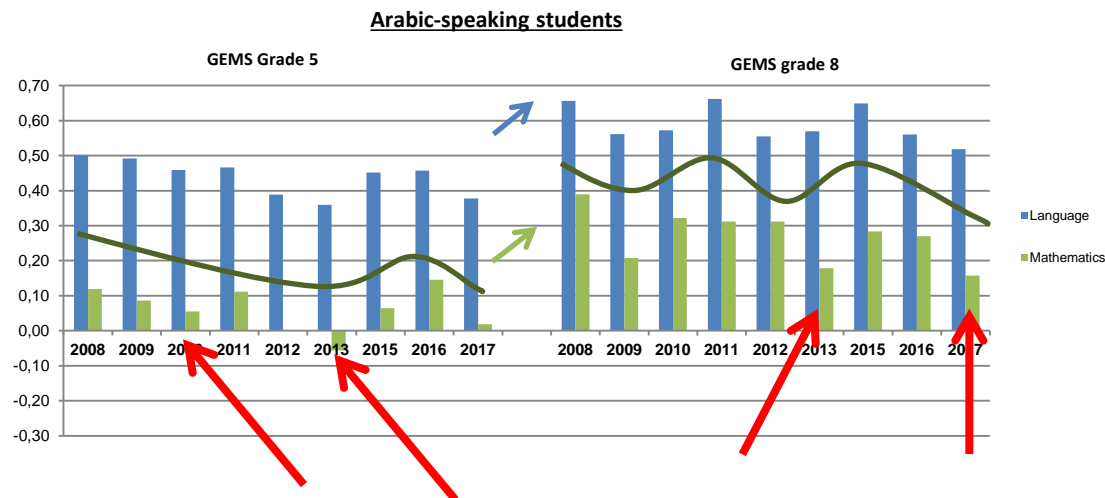
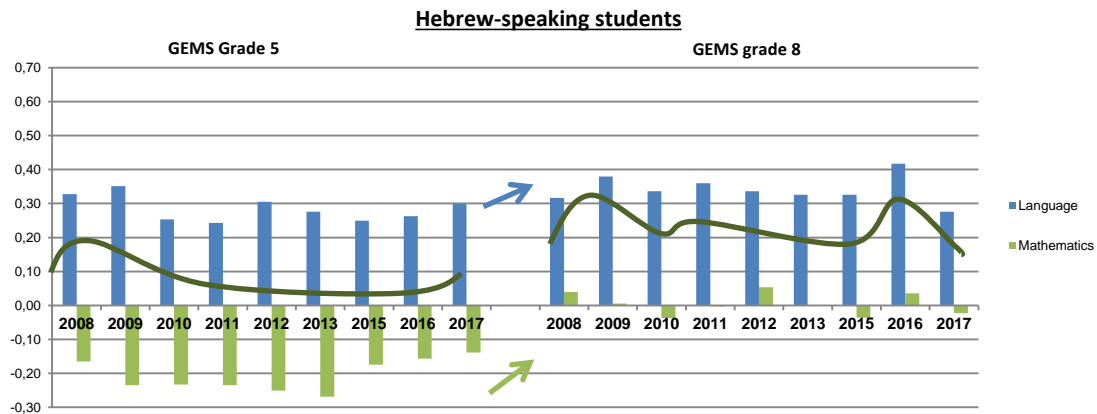
Cross-country variation in gender gaps in reading and mathematics in PISA 2012 (OECD, 2015)



Trends in gender gaps in reading and mathematics between PISA 2003 and 2012



Trends in gender gaps in reading and maths in MEITZAV 2008-2017



The gender gaps in maths and reading

- This correlation is due to the fact that the achievement level in maths and reading is correlated at the student level. **e.g. on PISA, the correlation between math and reading scores is about 0.85**

Why is there a relation?

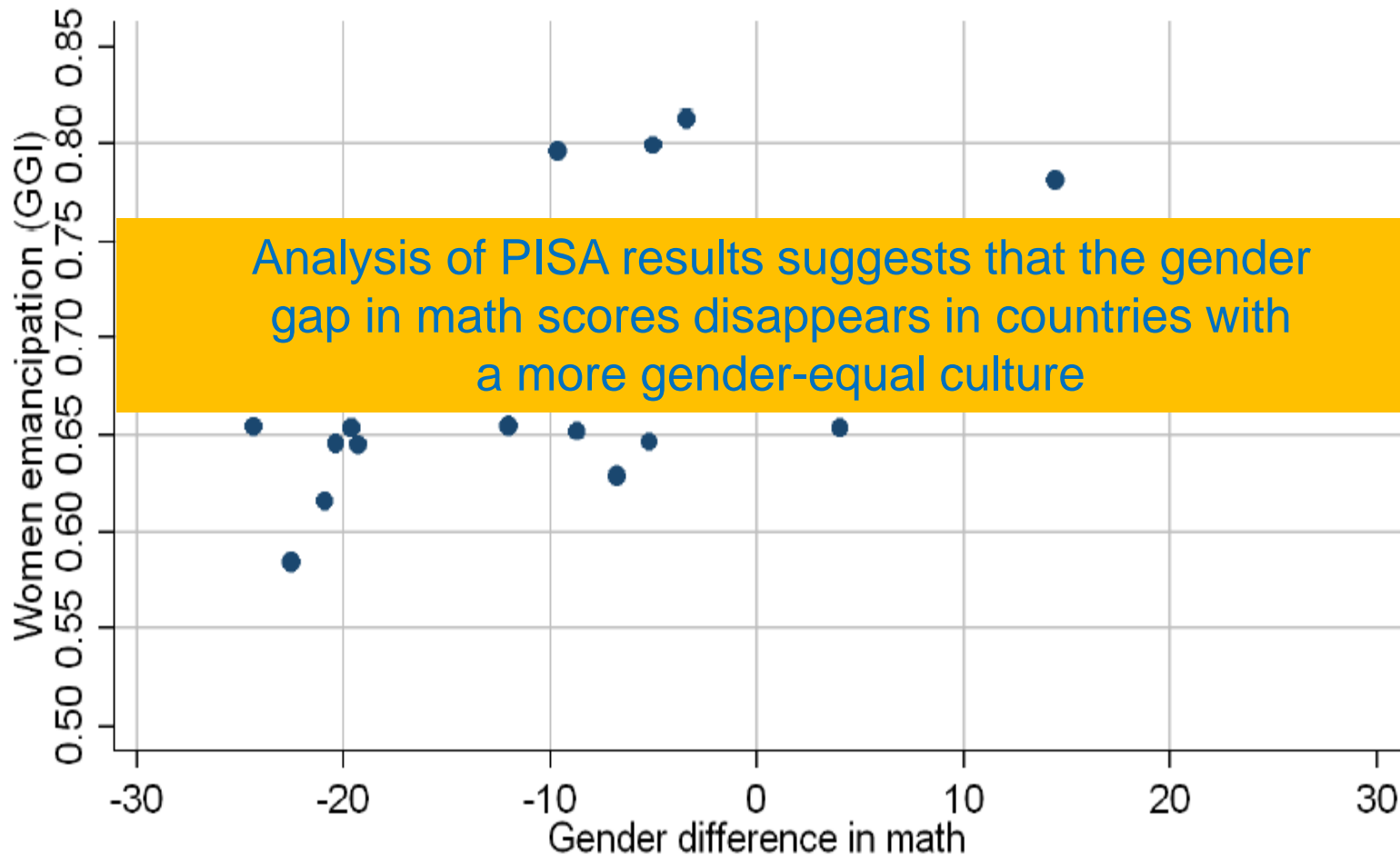
- From the perspective of the individual student - it would mean that as much one improves in maths, he/she usually also improve in reading (and other subjects as well) or vice versa. It is a result of becoming a better student in general.

- **From the perspective of the gender groups, it implies that when the traditional observed gap in maths toward boys decreases or even completely vanishes, it is usually associated with an increase in the gender gap in reading toward girls (OECD 2014, Rapp and Borgonovi 2019).**
- **Hence, it can be claimed that the reason the gender gap in maths is getting closed or reversed is that girls become relatively better students than boys at school in general, not particularly in mathematics.**

Variability in gender gap in math

- **Much of the gender gap literature tried to explain the variability in the gender gap in maths across countries by social factors.**
 - **General level of equality in the society (Gender stratified hypothesis)**
 - **How much society holds gender stereotype**
 - **Single-sex schooling**
 - **Gender stratified hypothesis**
- **However, any explanation could explain the variability in gender gap in reading insofar as in gender gap in maths.**

Guiso et.al. (2008): gender gap math and gender equity measures



What have we learned till here?

Nothing is special about mathematics.

We have to redefined our knowledge.

Instead of thinking that -

“in more gender-equal societies girls are doing better in math”

We have to realise that -

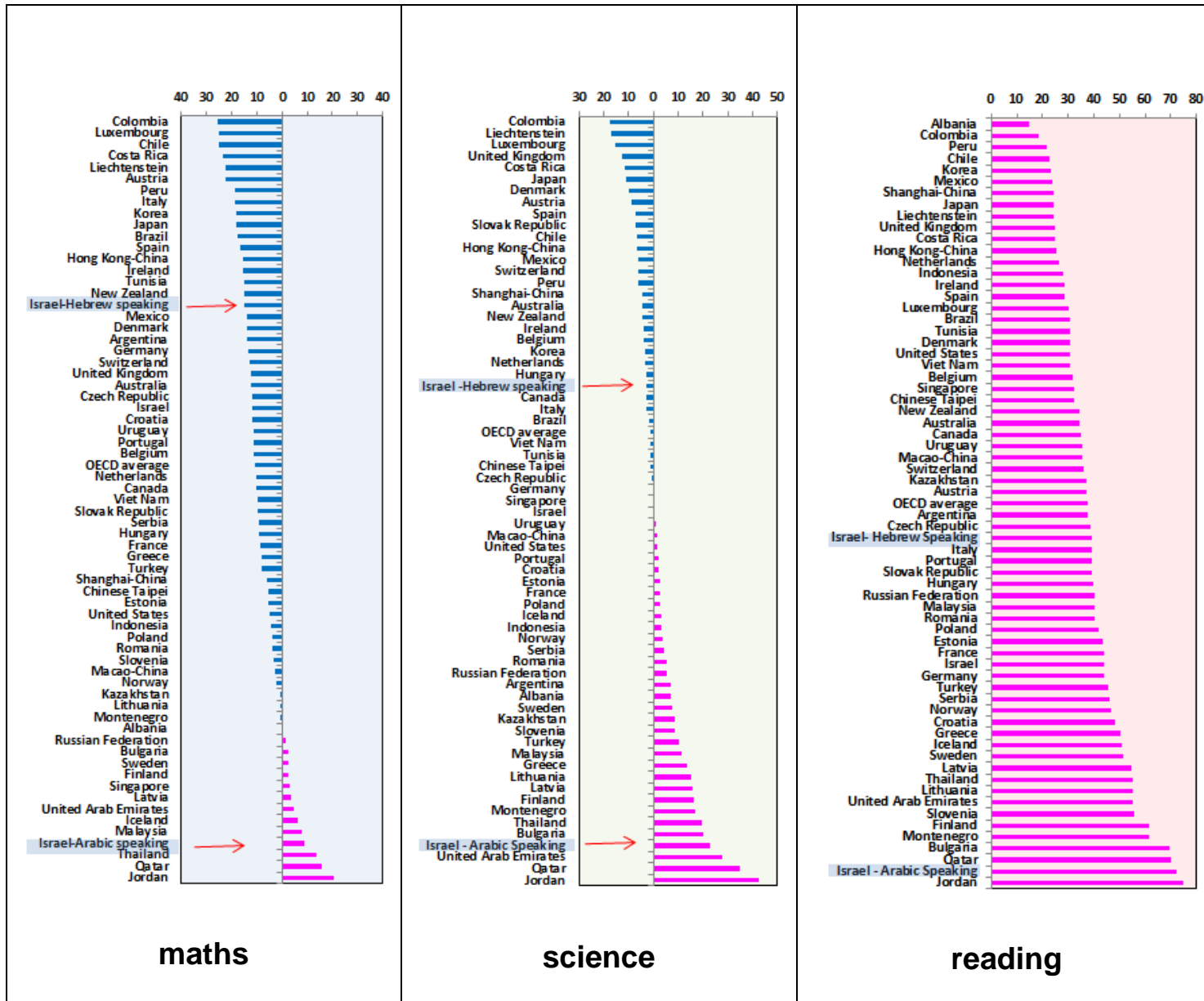
“in more gender-equal societies girls are doing better at school [Including, but not exclusively, in maths.]” !!!!

2

There is a constant order between the gender gap size:

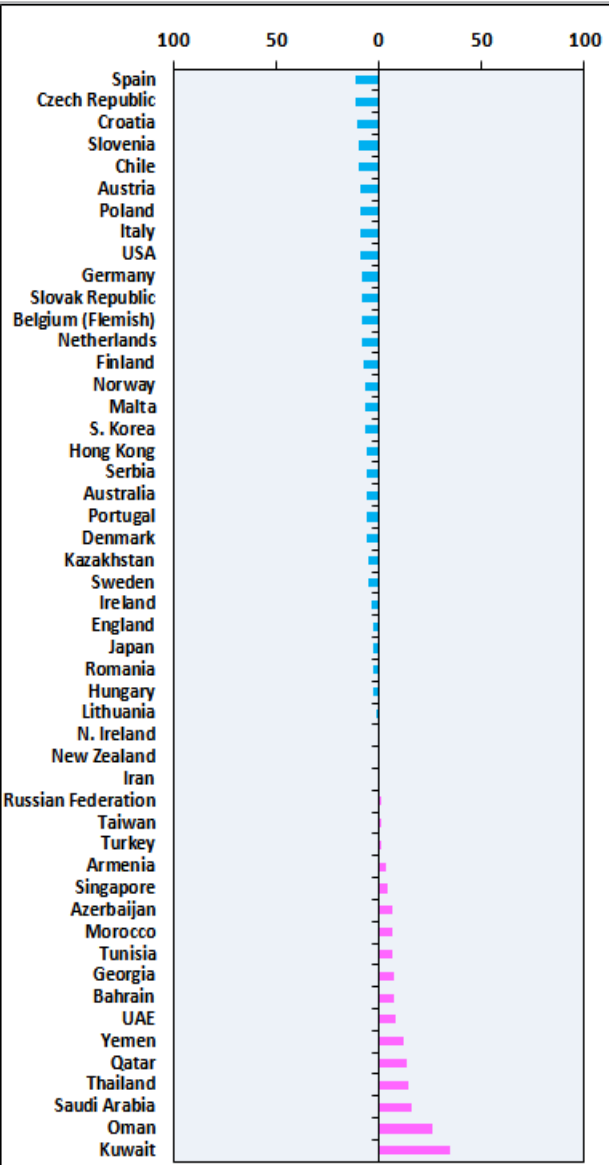
maths → science → reading

gender differences in PISA 2012



Gender differences in TIMSS 2011 grade 4 and PIRLS 2011

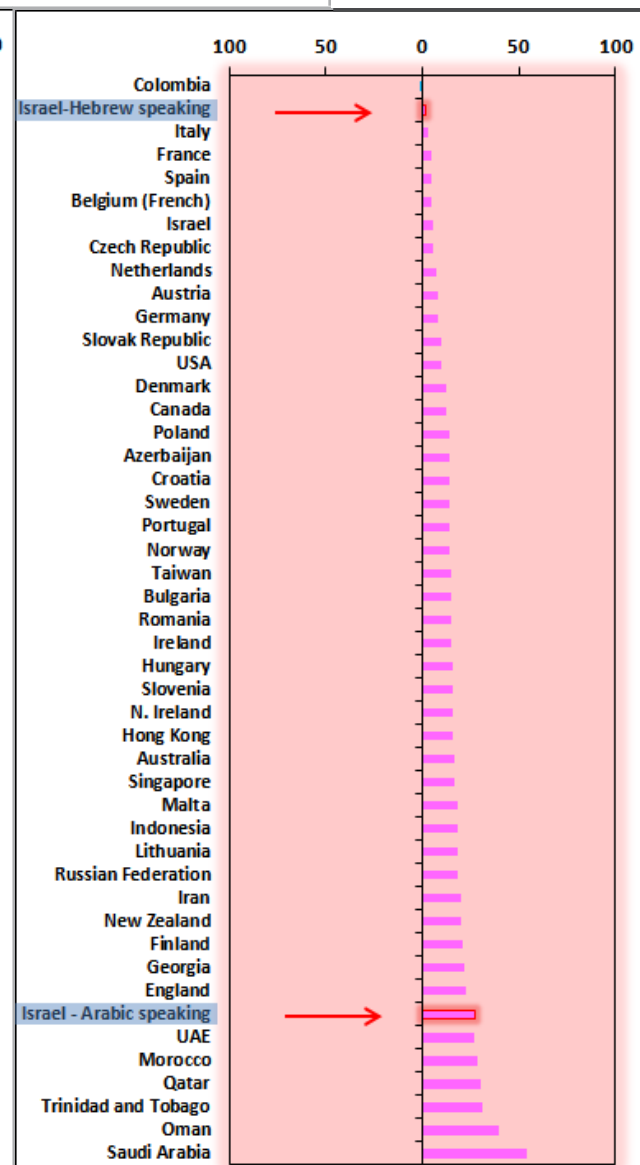
maths



science

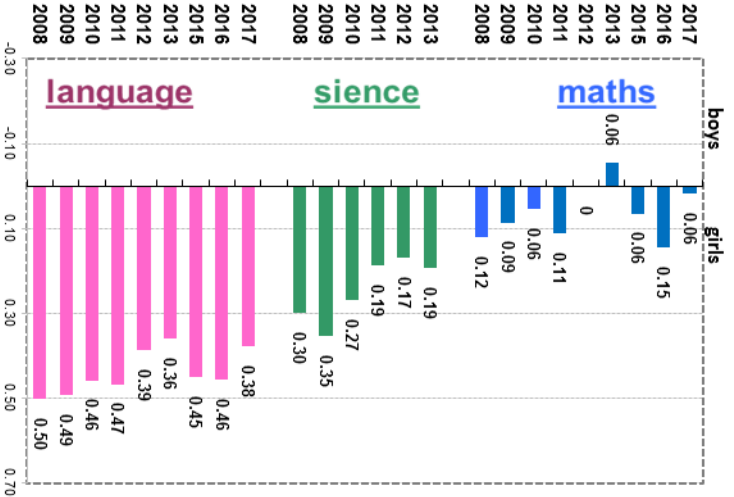


reading

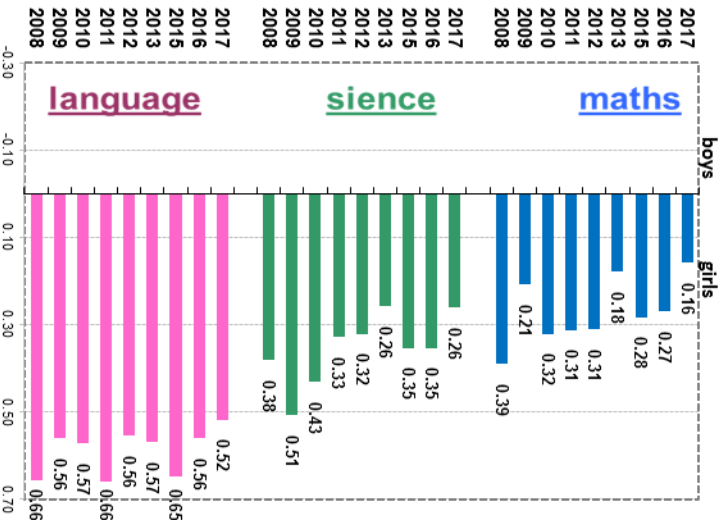


Gender differences on MEITSAV grade 5 & 8

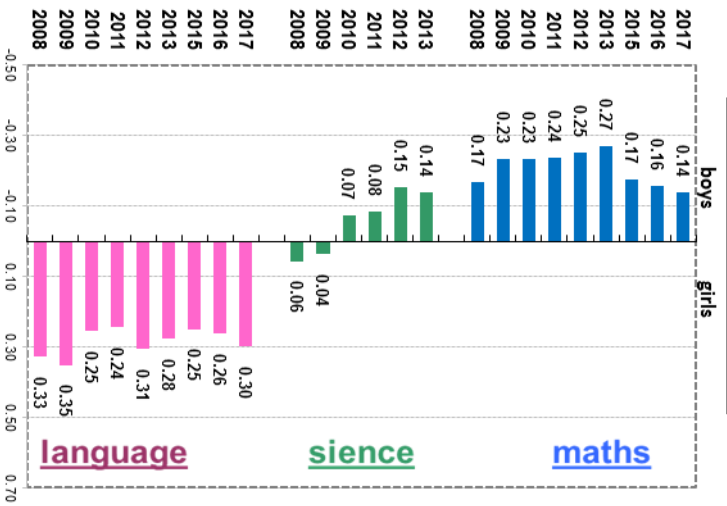
5th grade
Arabic-speaking students



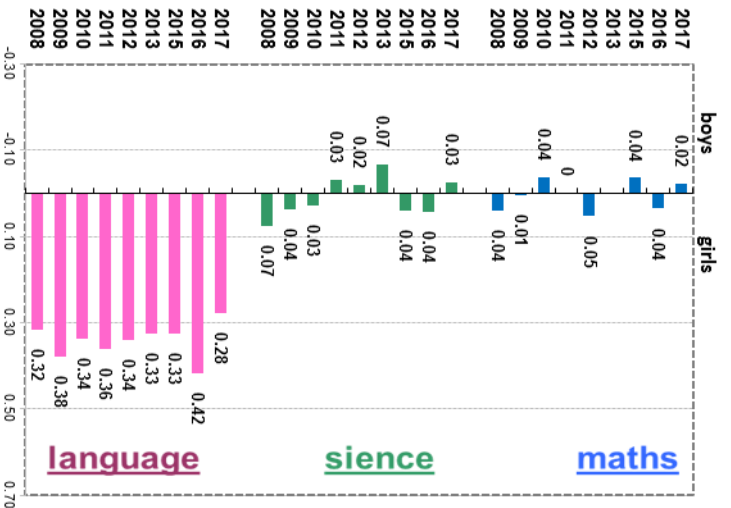
8th grade
Arabic-speaking students



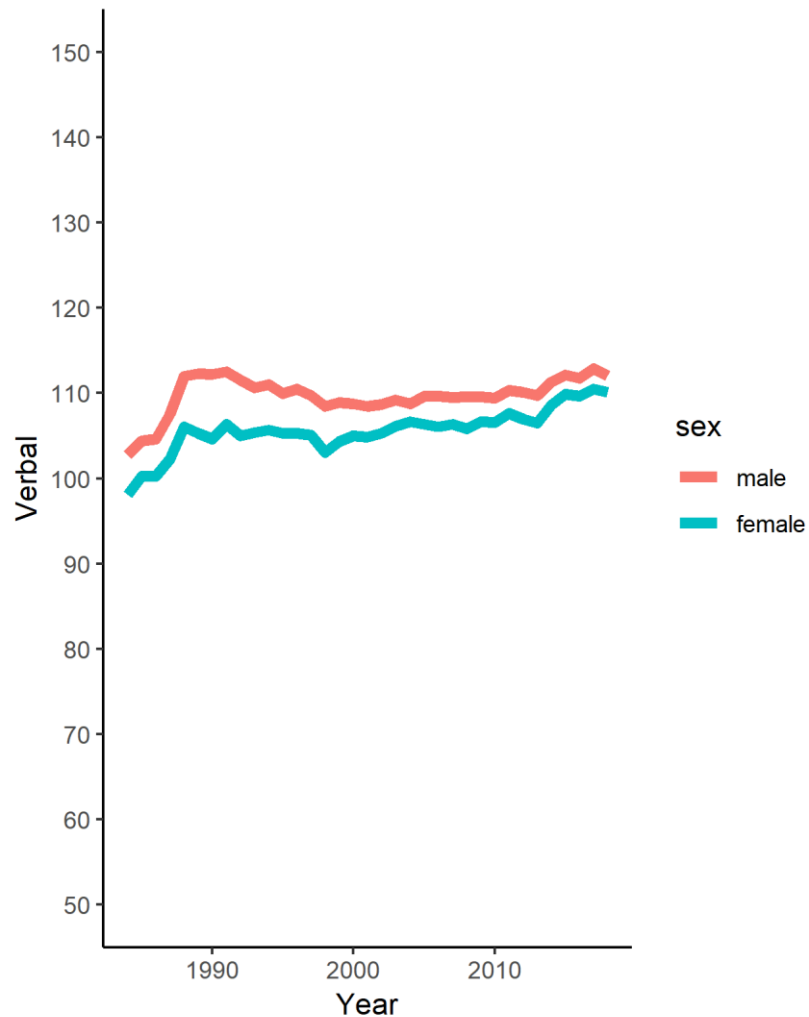
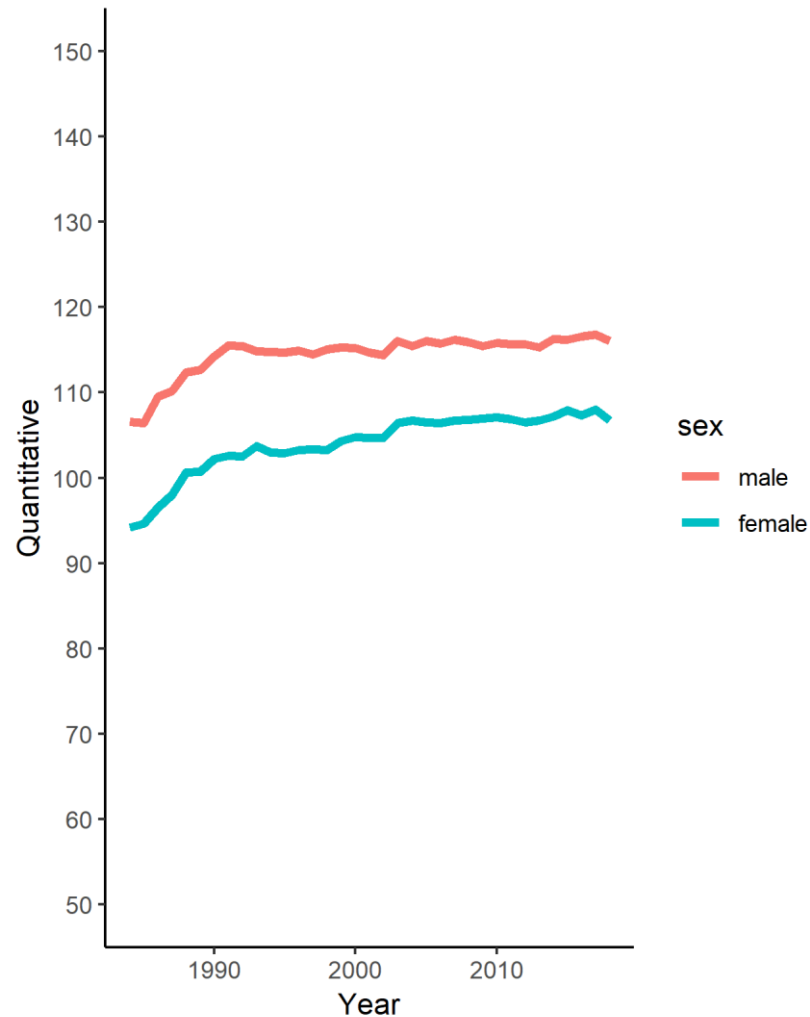
5th grade
Hebrew-speaking students



8th grade
Hebrew-speaking students



Trends in gender gaps in verbal and quantitative reasoning in PET 1984-2018



Data reveal a typical pattern among the three subjects regarding the gender gap;

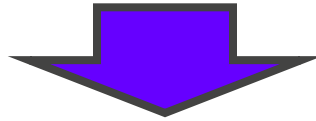
Reading: the widest gap favoring girls

Science: low gap or no gap at all (balanced gap)

Maths: gap favoring boys or the lowest gap favoring girls

Israeli and international large scale test data reveals a regularity:

While girls enjoy the strongest advantage in reading with respect to boys, in math they exhibit a disadvantage (or the smallest advantage).



Boys tend to have better scores in mathematics than in reading.

Girls tend to have better scores in mathematics than in reading.

This is true across countries and cultures

Rapp and Borgonovi, 2019

If you are a boy, you have higher chances to perform better in maths than in reading

If you are a girl, you have higher chances to perform better in reading than in maths.

The within student difference between performance in math vs. reading is mainly explained by gender (being a girl or a boy) and only slightly explained by factors such as student and school background.

Conclusions and implications

Conclusions and implications

- **In light of these evidences it can be claimed that the improvement of girls in maths at school, documented in the recent decades, is not specific to mathematics but rather part of a more general phenomenon of improvement of girls at schools.**
- **These are really good news but not good enough news to create a change in the maths self concept of girls.**

Conclusions and implications

- **Because girls, even when they outperform their boys' schoolmates in maths, continue to experience mathematics as their weakest school subject while boys, continue to experience maths as one of their most successful and rewarding subject matter at school.**
- **According to the Dimensional Comparison Theory (Marsh, 1986, 1989, 2007; Möller & Marsh, 2013) that postulates that students' self-concepts are formed by internal dimensional comparison processes - girls tend to develop a higher self concept in verbal competences than in maths and boys a higher self concept in maths than in**

Conclusions and implications

- This can be a reason why although mathematics achievement today is characterized by a high degree of gender similarity - school girls still tend to consider themselves less competent in mathematics (OECD 2015, Niepel, Stadler, & Greiff, 2019).
- In addition, the stereotype of boys being better than girls in mathematics still **persists** (Else-Quest, Hyde, & Linn, 2010, Lindberg, Hyde, Petersen, & Linn, 2010, Miller, Eagly, & Linn, 2015).

The gender gap in mathematics

- **This is extremely problematic because one's representation of one's mathematics ability influences his/her later academic careers and job preferences** (Guo, Parker, Marsh, & Morin, 2015; Marsh, 2006; Eccles et al., 2004; Nagy et al., 2006; Park et al., 2007; Parker et al., 2012, 2014).
- **This can explain the under representation of girls in STEM fields.**

What could be done?

- **Emphasizing only the improvement of girls performance in maths is not enough to enhance equality.**
- **A more balanced perspective is needed.**
- **Both boys and girls need a more balanced experience, one that will change the way they perceive themselves as well as the way they are perceived by others.**

What could be done?

- **For more equality at school and beyond school we have to target efforts to close gender gaps favouring either boys or girls in both domains, quantitative or literal**
- **Educators and policy makers have to search for policies that will enhance exclusively girls maths skills but at the same time enhance exclusively language skills for boys.**

Thank
You !