Gender and Physics?

Tomas Brage
Professor and Director of Education in Physics
Lund university, Sweden

Physics and Gender?

Physics is considered to be objective – not affected by the sex or gender or … of the people involved (researcher, teacher, student …)

… but ….

Physics class-rooms, labs, history are extremely affected by sex or gender – almost always dominated by men

… seems like a contradiction …

Physics and Gender?

The Physicist looks out in the universe and wonders why there is only matter and no antimatter.

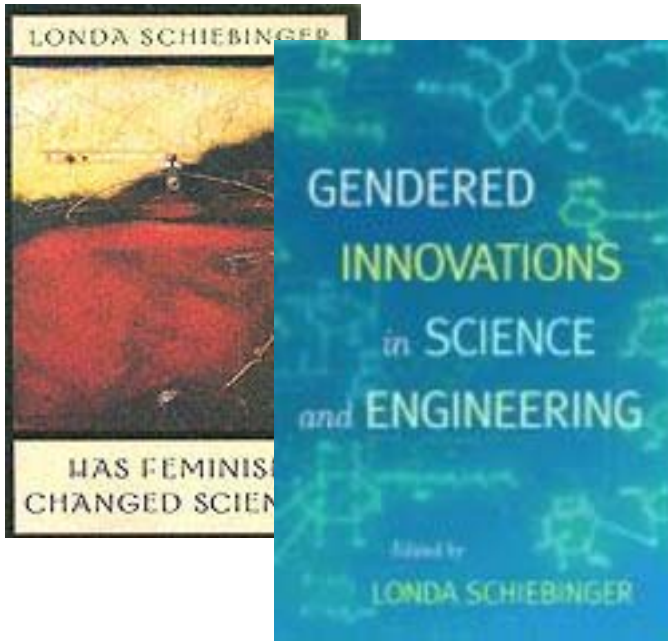
Where did the antimatter go? Is one of the most prestigious questions in Physics and the subject of thorough research.

The Physicist looks out over the classroom or lab and notes that it is dominated by men.

Where did the women go? Is often a non-question for Physicists and sometimes answered without scientific discussion or method.

Basic model – Levels of Change

Londa Schiebinger, Stanford University



1. Numbers

2. Culture

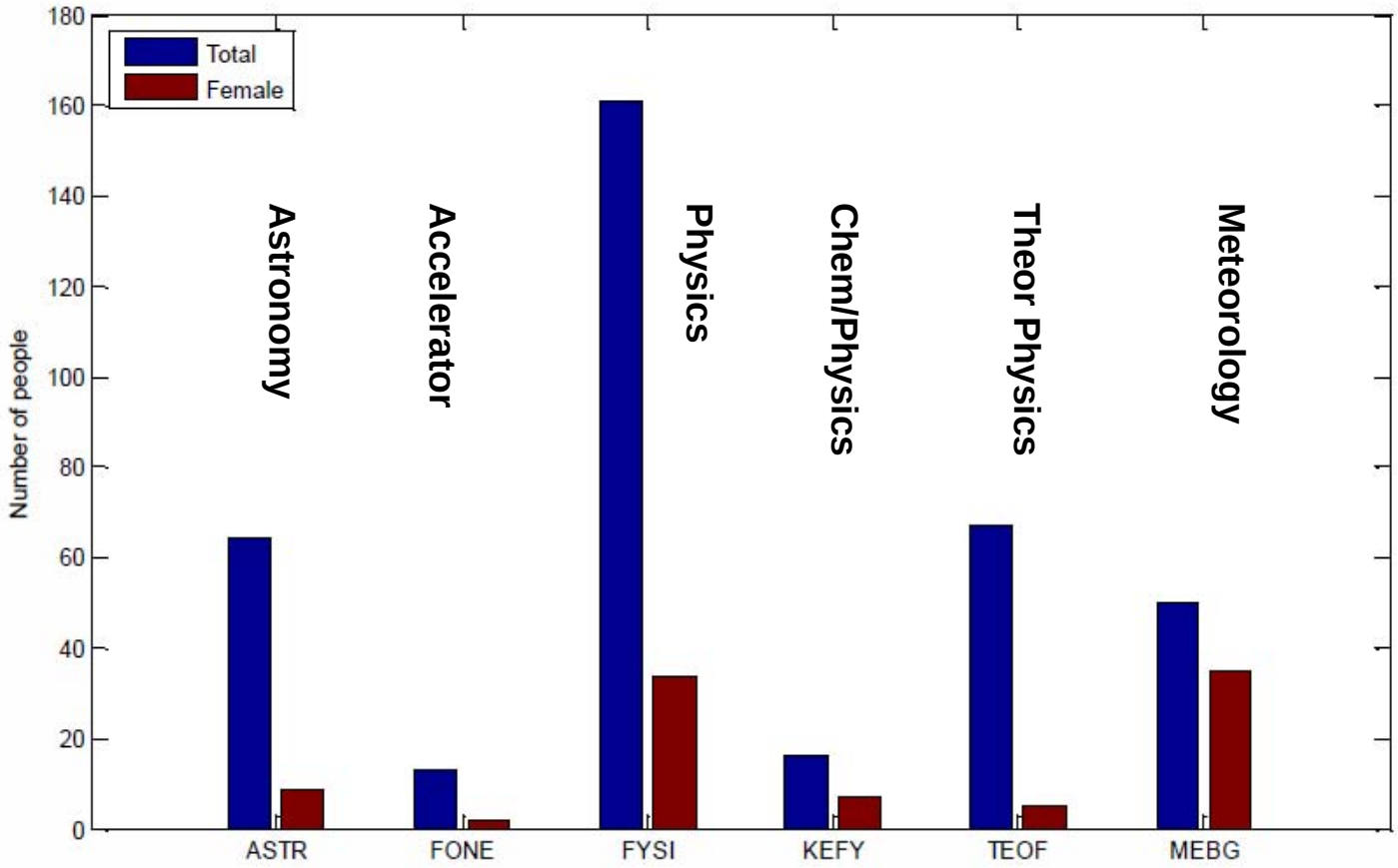
   Gender awareness

3. Subject

   Gender perspective

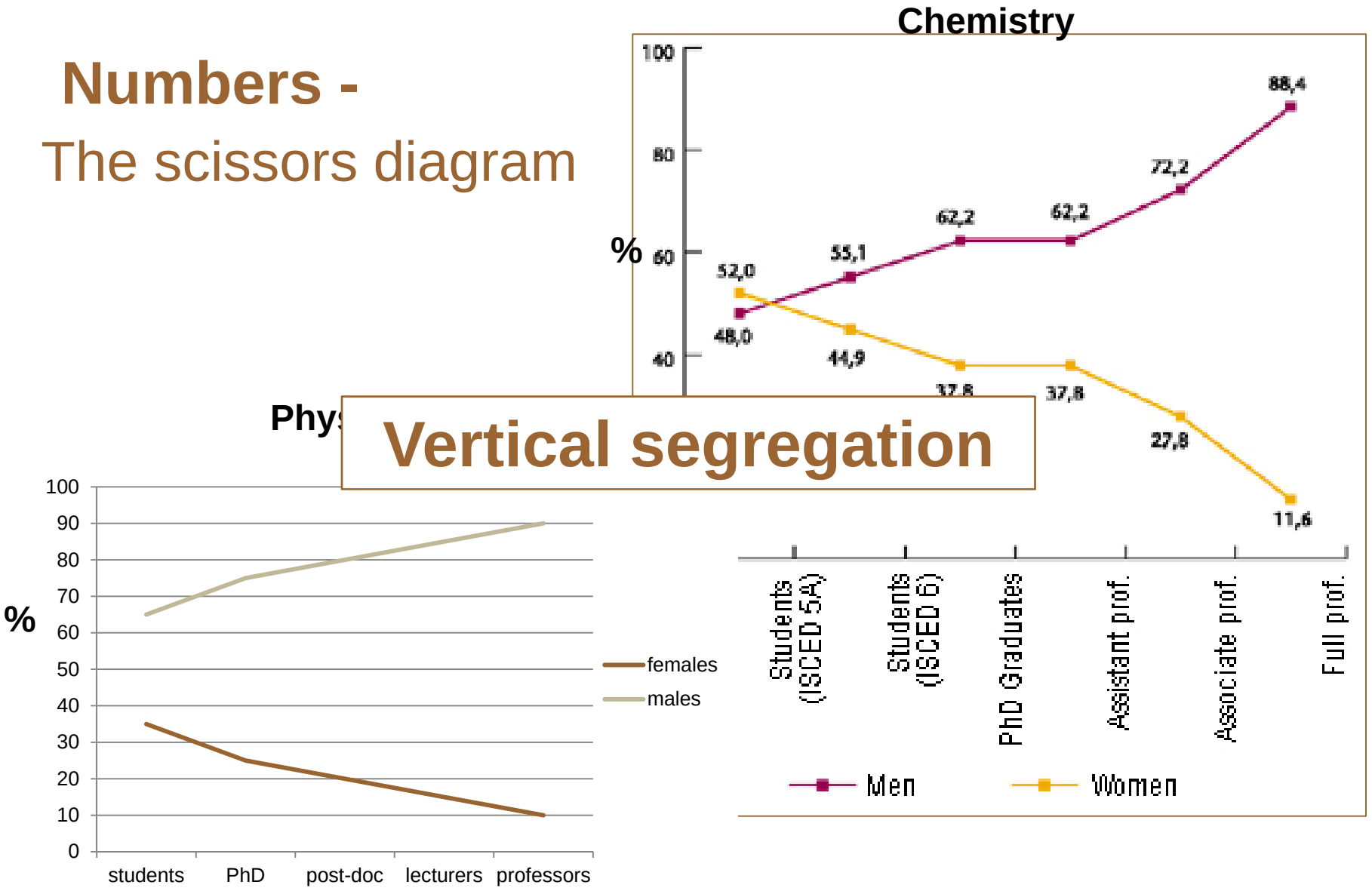
Level 1: Numbers

Numbers – Horisontal segregation of Physics in Lund



Numbers -

The scissors diagram



Vertical segregation

Numbers – vertical segregation

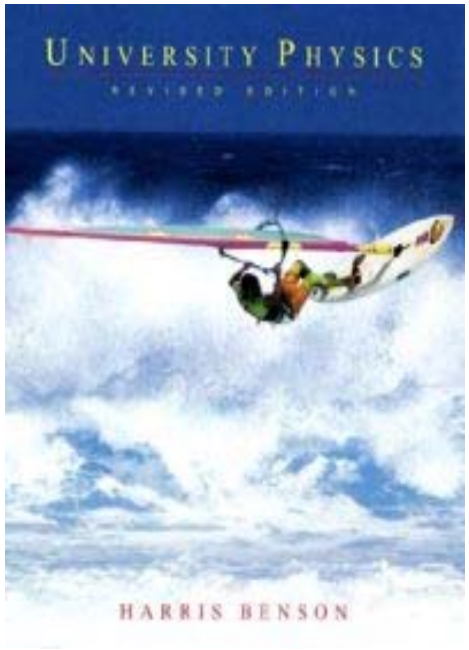
From the leaky pipeline …

…. to the vanishing box

Etzkowitz and Ranga 2011 *Gender Dynamics in Science and Technology ...,* Brussels Economic Review

Level 2: ”Culture”

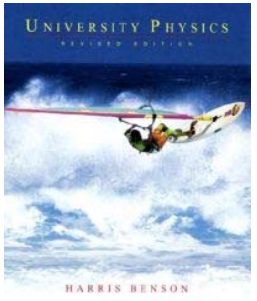
Culture – visual presentations in textbooks



Calculus based, introductory books

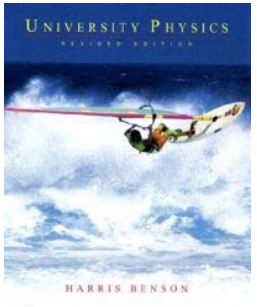
- Benson, University Physics
  - Traditional book

Culture – visual presentations



Benson

Culture – visual presentations



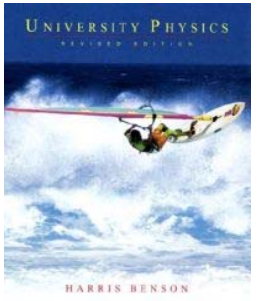
Benson

23. What arrangement of mirrors would produce the multiple images of Ann Margaret shown in Fig. 35.51?

FIGURE 35.51

Culture – visual presentations

Pictures of women



Benson

What do you notice about the front wheel?

The net work done on the javelin is equal to the change in its kinetic energy.

During a grand jeté, a ballet dancer appears briefly to "float in air". However, the center of mass still follows a parabolic path.

Elizabeth Manley controls her angular speed by varying her moment of inertia.

Culture – visual presentations

Pictures of men

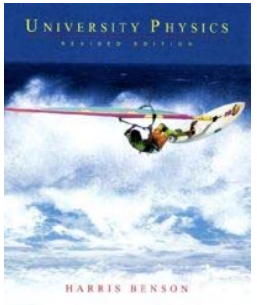


FIGURE 1.8 Johannes Kepler (1571–1630).

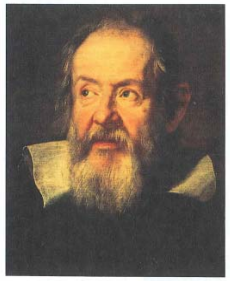


FIGURE 1.9 Galileo Galilei (1564–1642).

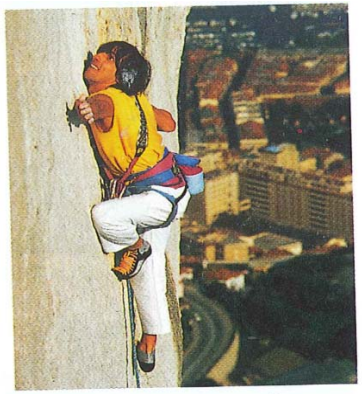
FIGURE 5.1 Sir Isaac Newton (1642–1727).

FIGURE 8.2 Gottfried W. Leibniz (1646–1716).

(b)

Although the mass of Edwin Aldrin, Jr., had not changed, his weight on the moon was roughly one-sixth his weight on earth.

A weightlifter does work to lift weights but not to hold them at rest.



The climber has done work to increase his potential energy.

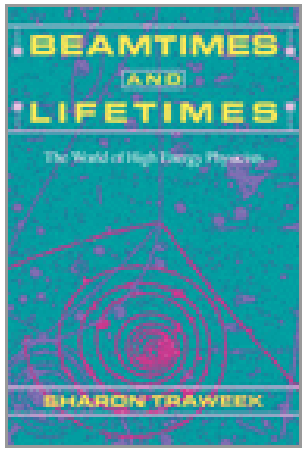
Culture – history of Physics

- Often incorrectly described in books

"The Development of Quantum Physics, in Historic Accounts, Textbooks and Classrooms"

Reidun Renstrøm, Agder Universitet in Norway

A classic about culture of Physics – Anthropology



Sharon*Traweek – Beamtimes and Lifetimes*

Physicists assume that we have a culture without culture

Investigations of SLAC (USA) and KEK (Japan)

Different definition of excellence and leadarship

....but what is male, defines excellence

Culture - Sociology:

Hasse and Trentemoller: UPGEM-project (2008)

UPGEM
Understanding Puzzles in the Gendered European Map

What is the percentage of women among Physics professors?
Denmark, Estonia, Finland, Italy, Poland

Which has the largest percentage?

Which has the smallest percentage?

Culture - Sociology:

Hasse and Trentemoller: UPGEM-project (2008)

UPGEM
Understanding Puzzles in the Gendered European Map

What is the percentage of women among Physics professors?
Denmark, Estonia, Finland, Italy, Poland

Denmark – 3%
Estonia – 11%
Finland – 12%
Poland – 14%
Italy – 23%

UPGEM
Understanding Puzzles in the Gendered European Map

Is it Physics in culture?

Using ”Culture Contrasts” to understand:

Is it Physics in Culture – outside Physics?

1. The Classically schooled Physicist
2. Family culture
   a) Parenthood contra motherhood
   b) Child care contra nannies
   c) Nuclear contra extended family
   d) Strong border between family and work?

      What about flexibility?
3. Religion

Denmark – 3%
Estonia – 11%
Finland – 12%
Poland – 14%
Italy – 23%

... Or is it Physics as culture?

Three cultures ”discovered”:

1. Hercules-culture – the fighter’s culture
2. Care taker-culture – the social culture
3. Working bee-culture – the industrious culture

Denmark – 3%
Estonia – 11%
Finland – 12%
Poland – 14%
Italy – 23%

Hercules:

Oh yes, there is a lot of competition. This whole process is extremely competitive. The case that the department needs to make to the university is that I am not only good enough for the job, but I am the best person in the world for this job.

Care-taker:

There's always a team behind a genius. (...) Good teamwork always brings the best results, but of course, not everyone is lucky enough to find a good group to work with. Sometimes when there are very competitive people, it is difficult to form a group..

Working bee:

But in this respect, for us not to show ourselves too much and do no crazy things, we had to sit quiet and pretend we were not there

UPGEM
Understanding Puzzles in the Gendered European Map

Investigation of five countries:

Denmark, Finland, Estonia, Poland and Italy

What culture defines Physics departments in the different countries?

Denmark – 3% - Hercules

Estonia – 11% - Working bee

Poland – 14% - Working bee

Italy – 23% - Care-taker

Finland –12% - not a clear culture

Remember: It is the perception of the culture, but

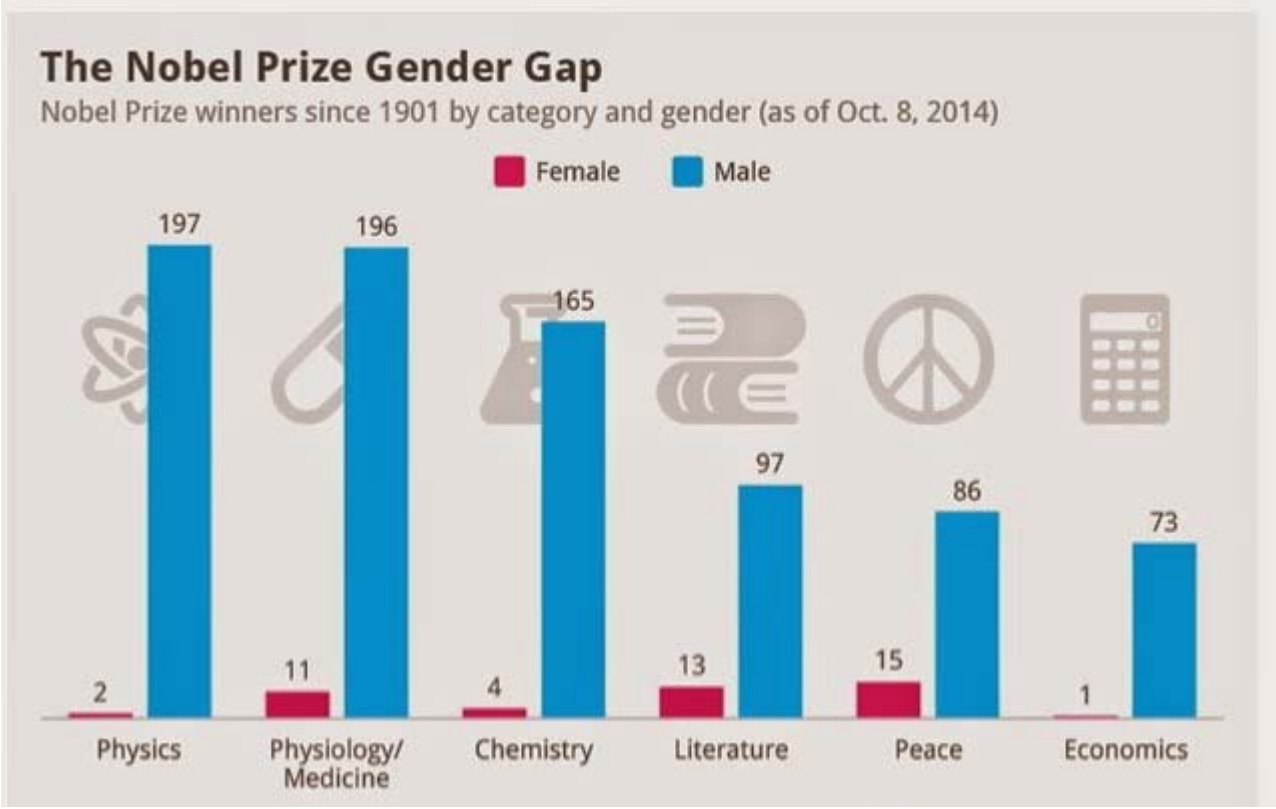
..... is it really the culture of Physics?

..... and what do they say to their students?

Bias

Level 1: Numbers

Vertical Segregation – even higher



Courtesy www.statista.com

.. No women in Physics?

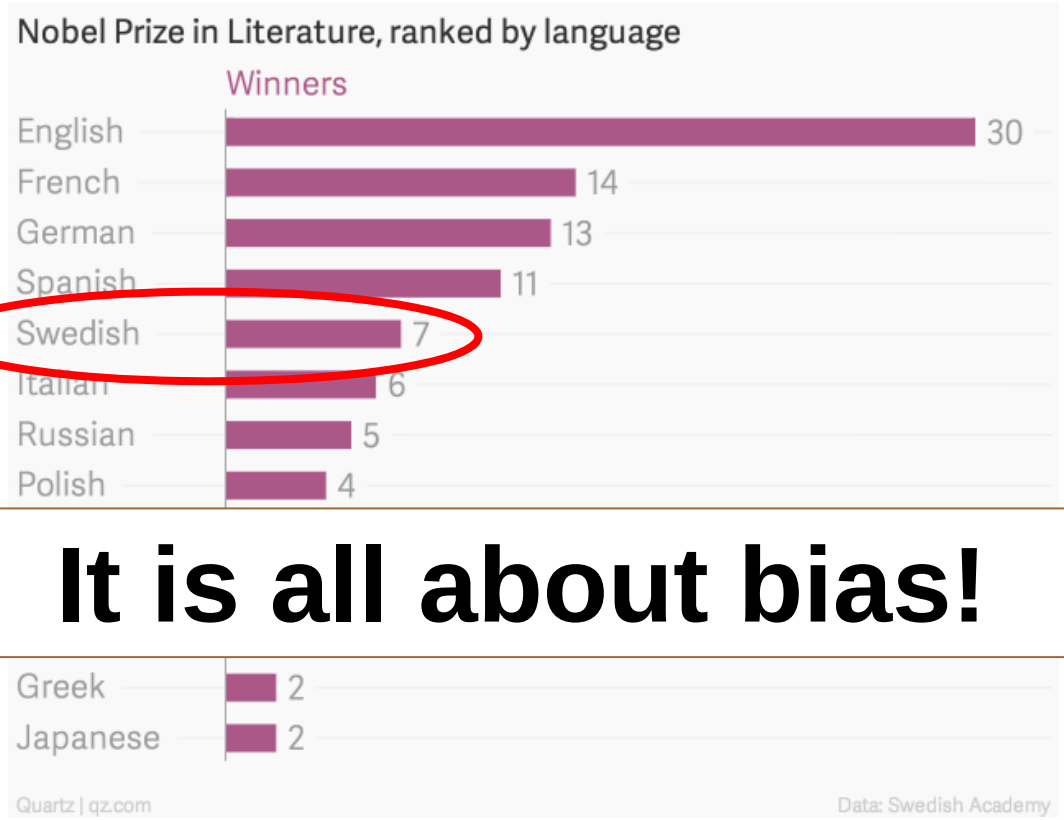
Marie Curie 1903 (och 1911)

Maria Goeppert-Mayer 1963

Lise Meitner (not 1944!!)

Jocelyn Bell (not 1974!!)

Noble Prizes are based on Merits … right?



It is all about bias!

Is Swedish really the fifth language?

Level 2: Culture

What about bias?

Traditional results – repeated many times:

Judge identical texts, grade 1 (lowest) – 5 (highest):

	Men about		Women about	
	Ingvar (Male)	Ingvor (Female)	Ingvar (Male)	Ingvor (Female)
Credible	4.9	3.4	4.5	3.5
Nonchalant	2.6	2.4	2.7	2.3
Humane	2.9	2.7	3.2	3.8
Competent	4.3	3.0	3.7	3.3

Meritocracy?

*Nielsen (2015) Nature **525** 427 – Studie vid Aarhus universitet 2004-2013*

Appointment of Professors and Lecturers:

- 20% closed (30% later years)
- 40% only one applicant

Women part of appointed professors:

- Closed: 12%
- Open: 23%

Similar results from Netherlands and Finland

Van den Brink (2010) and Husu (2000)

Meritocracy and Equality?

*Nielsen (2015) Nature **525** 427 – Studie vid Aarhus universitet 2004-2013*

We know we are affected by bias:

This combined with the

Myth of Meritocracy

Creates arguments against change

There is an persistant idea that equal opportunity is contradictory to or counteracts meritocracy

”The university is a realm of the *justly unequal*”

So – what can we do?

- **Education**, information, infiltration
- **Gender mainstreaming**
  through e.g. gender integrated leadership education
- **Bias observers**
- Not only **affirm women**, but also **confine men**
  – but do get involved
- **Counterspaces** (see Maria Ong et al.)
- **Awards**/Certification for best practices (e.g. Athena Swan or Gender certification)

Con

Conclusions – Gender and Science

- It is important to move beyond numbers and work on changing the culture of Physics (and the culture Physics is in, of course)
- We are all bias – and in Science it works against women.
- One example: Bias is a threat to true meritocracy.
- Thanks to the research of humanists and social scientists we are getting closer to an understanding of the segregation and therefore what to do about it.
- An active,exciting and important field of research.

It is not easy...

Thank you for your attention!

References

- Banaji et al, *Project implicit,* https://implicit.harvard.edu
- Barad 2007, *Meeting the universe halfway,* Duke university press
- Brage and Lövkrona 2016, *Core values work in academia – with experiences from lund univeristy,* Lund University
- Conell 2014, *Gender,* Springer Fachmedien, Wiesbaden
- Eagly 1987, *Sex differences in social behavior: A social-role interpretation,* Hillsdal, N.J.
- Hasse and Trentemöller 2008*, Break the Pattern!,* UPGEM-project report, Tartu University Press
- MacNell et al 2014*, What's in a Name: Exposing Gender Bias in Student Ratings of Teaching,* Innov High Educ, Springer Verlag.
- Nielsen 2015, *Nature* **525** 427
- Rosser 1995*, Teaching the Majority,* Teacher's college press
- Rosser 2012*, Breaking into the Lab,* New York University Press
- Schiebinger (ed) 2008, *Gendered Innovations in Science and Engieering,* Stanford University Press
- Schiebinger et al*: https://genderedinnovations.stanford.edu/*