

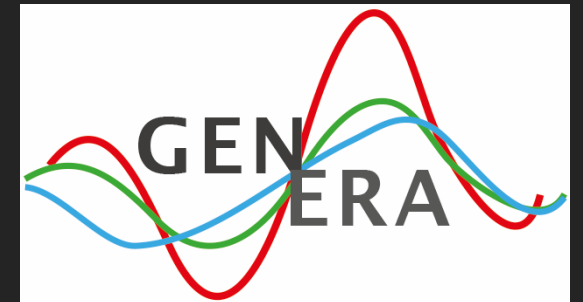
What does Gender have to do with Physics?

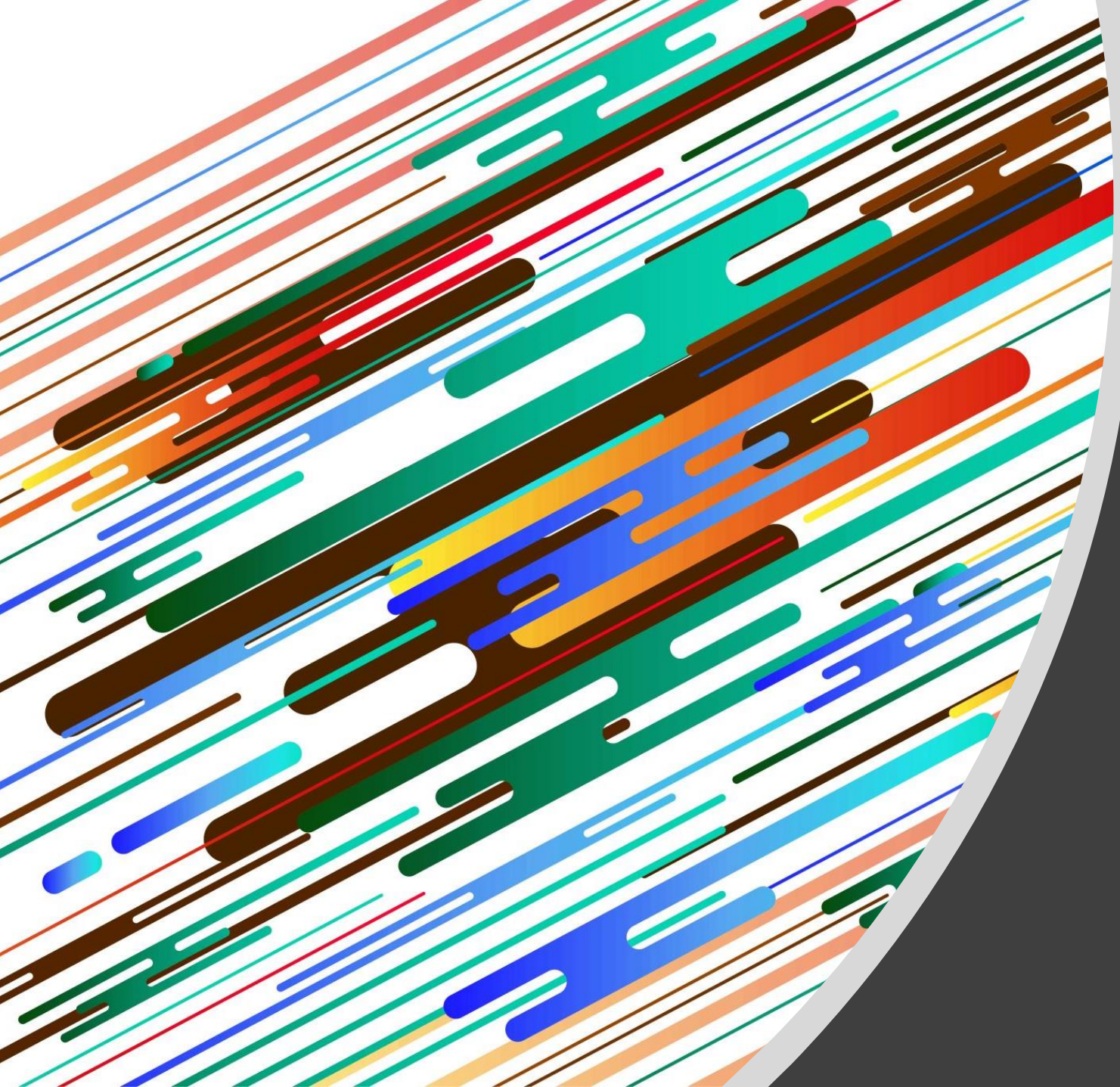
Tomas Brage
Professor

Division of Mathematical Physics
Lund University
Sweden



PUSHING
THE FRONTIERS
OF INNOVATIVE
RESEARCH





... or
Gender dimensions in
Physics
– always there, often
forgotten!

Disclaimer

- We should use evidence and gender research
- ... but here, I will only be able to describe it briefly.
- I will use it to illustrate useful concepts,
- ... but for full understanding and critical evaluation – go to original work.

~~Taxonomy~~ of Change

Londa Schiebinger, Stanford University

1. Fix the number



Fix the women

Indicator

Trap!

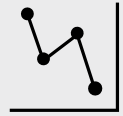
2. Fix the institutions – Culture

3. Fix the knowledge – Subject



Focus!

Different approaches



Numbers and statistics



Culture – Myths



Culture – Bias



Knowledge



The background consists of a dense field of 3D-rendered numbers from 0 to 9. The numbers are arranged in a somewhat chaotic but rhythmic pattern, with some appearing in a light grey color and others in a vibrant orange. The perspective is from a slightly elevated angle, giving the numbers a sense of depth and volume. The lighting creates soft shadows, enhancing the three-dimensional effect.

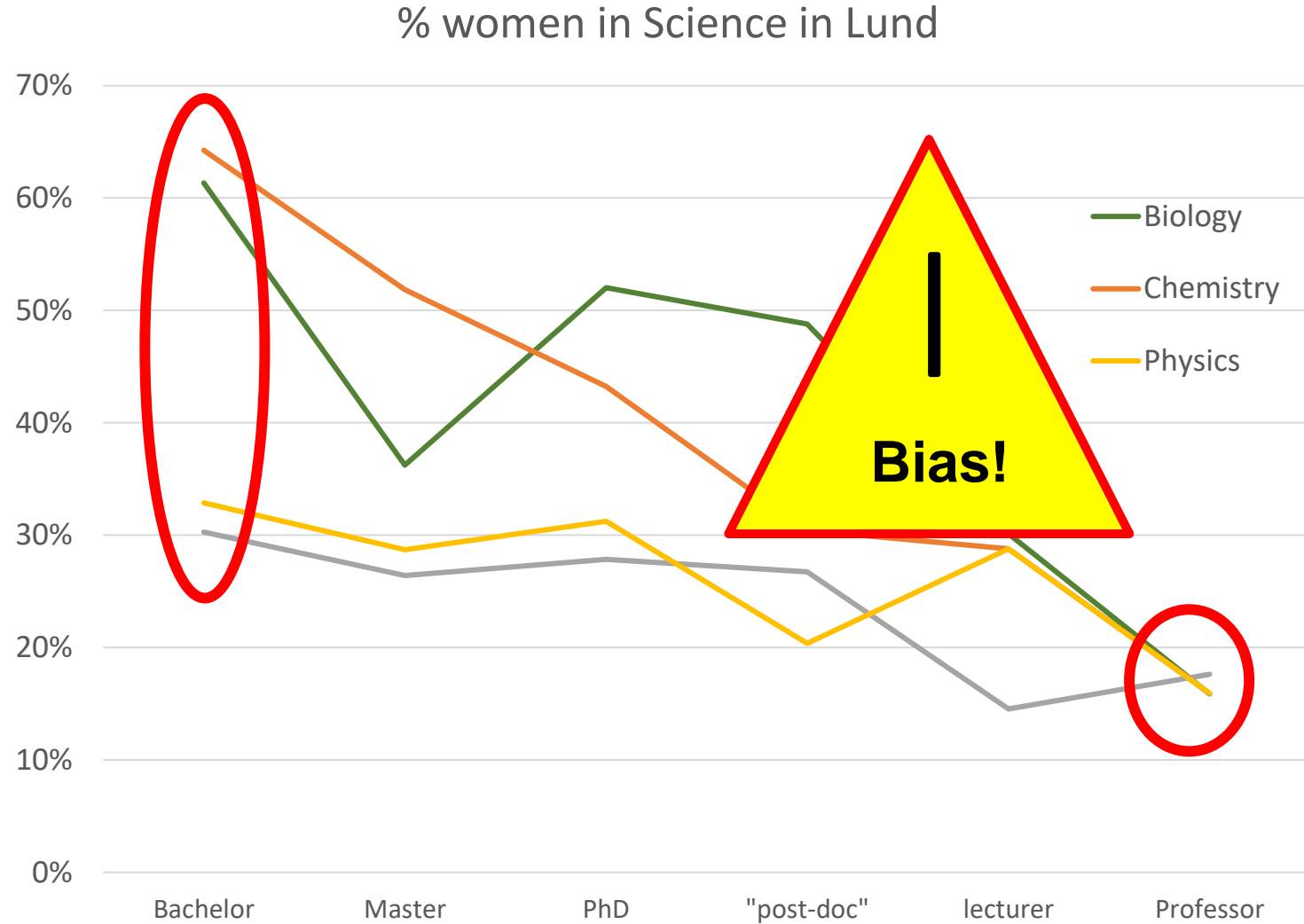
Level 1: What about numbers?

Vertical segregation – Science in Lund

Career paths in a typical Science faculty.

Many different curves – but the same outcome

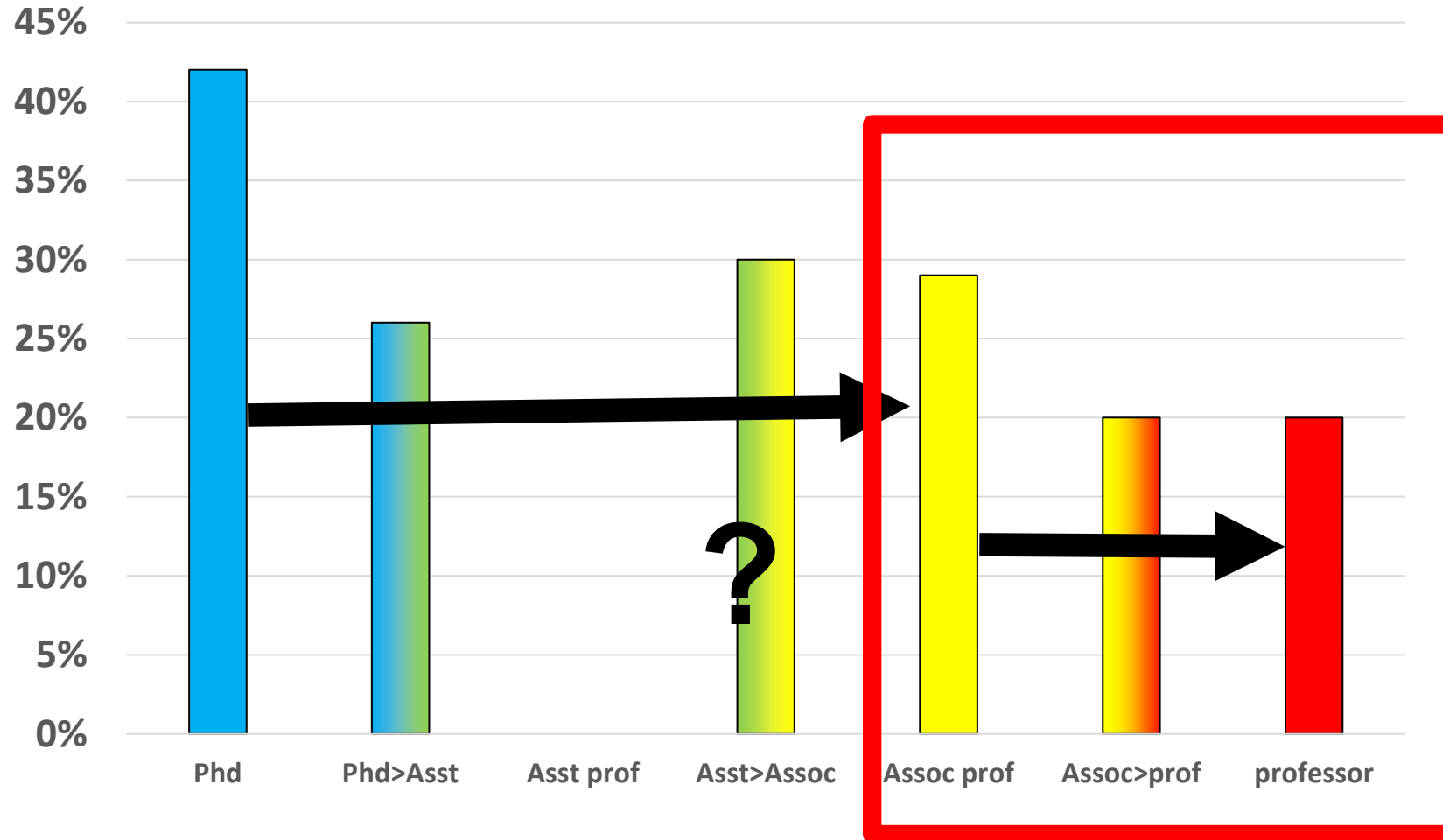
Weak dependence on input!



Flexible cascade model

- Science Faculty in Lund – some time ago...

% women



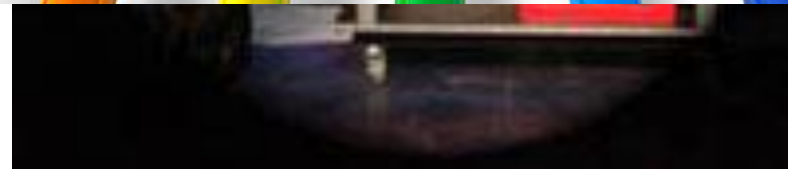
Vertical segregering

Explanations

Från the "leaky pipeline"...

.... to the "vanish box"

... or "diverse pipelines"



Etzkowitz and Ranga 2011

Ong et al 2017 and the Harvard project



Level 2: Culture of Science

Myths in Science that affect knowledge production:

- Culture without culture (Beamtimes & Lifetimes)
- Priesthood/Toolmaker/Indiana Jones
- Hercules culture (UPGEM project)
- Myth of effortless success (Physics Education and Gender)
- Nerd culture of cosmopolitans (CERN study)

Culture with no Culture

Antropological study of Physics labs (SLAC and KEK)

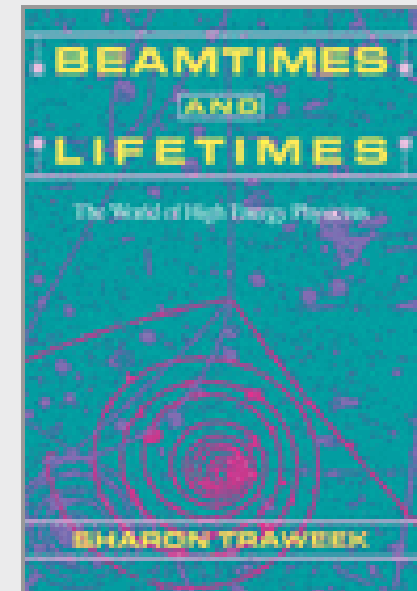
- Culture with no culture – “longing” for objectivity
- What is excellent is perceived as male – universally
- Relationship to machines and nature (gendered)
- Grooming of new generations

... Later research: The stronger the myth of objectivity

- the more subjective we get

Castilla and Benard 2010

*Traweek:
Beamtimes and Lifetimes*



Hercules

(Hasse and Trentemöller 2008)

Trying to explain different percentage of women among Physics professors in five countries:

Denmark, Estonia, Finland, Italy, Poland

Which one do you think had the highest %?

... and the lowest?

UPGEM
Understanding Puzzles in the
Gendered European Map

Hercules

Results (women among Physics Profs):

Denmark – 3%

Estonia – 11%

Finland – 12%

Poland – 14%

Italy – 23%

Why? Many thoughts on outside Academia – but no complete correlation (e.g. work-life balance, Classically schooled Physicist, Religion)

– but a new dimension turned up - Culture within Physics!

Cultures within Physics

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

Hercules

Denmark – 3% - Hercules

Estonia – 11% - Working bee

Poland – 14% - Working bee

Italy – 23% - Care-taker

Finland – 12% - not a clear culture

But perception of culture! What does it do to the minorities, how does it affect "feeling of non-belonging"?

Allison J. Gonsalves
Anna T. Danielsson Editors

Physics Education and Gender

Identity as an Analytic Lens for Research

Myth of effort-less success

Boys and girls in school are

- Equally interested in method of Physics
- But in different applications

A recognized myth is

- *Successful Scientists are doing Science effortlessly.*

But correct and inclusive idea is “it is hard work”.

Effort-less comes from background, familiarity of examples, metaphors, culture, family background.

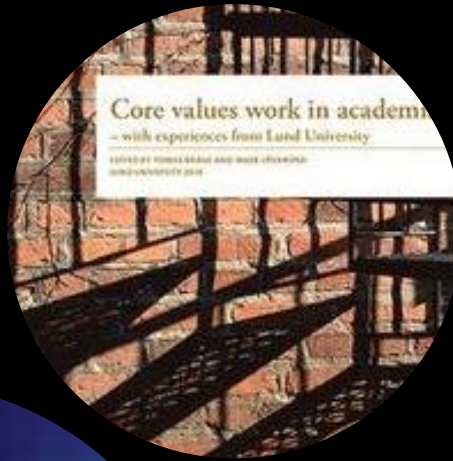
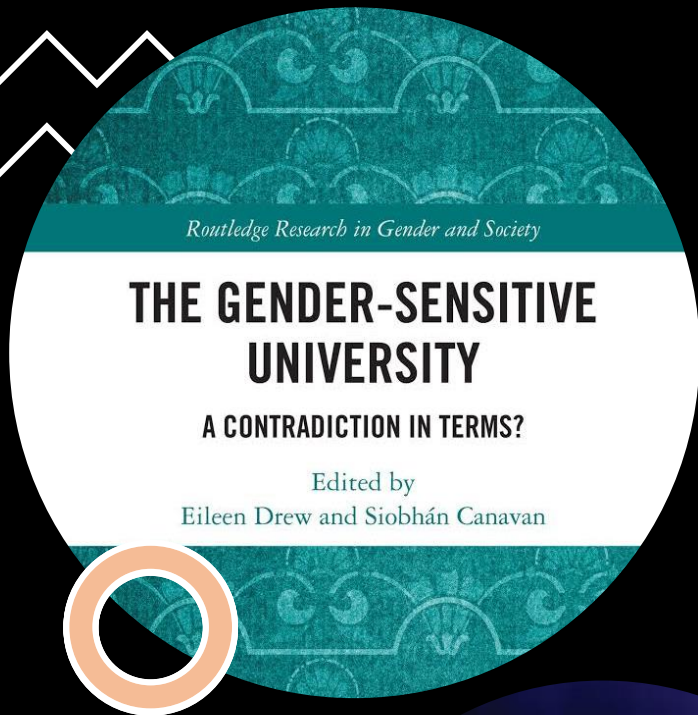
Non-belonging



Many students have a feeling of non-belonging, for many reasons.

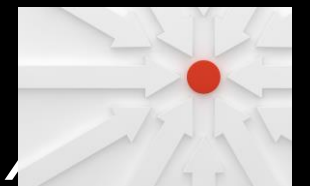
Reactive first step – let them know it is common!

Pro-active second step – change culture, representation



More about these topics

- *Stewart and Valian 2018, Inclusive Academy*
- *Drew and Caravan 2021, Gender-Sensitive ...*
- *Brage and Lövkrona 2016, Core values ...*



Level 3. Gender in knowledge



The screenshot shows the homepage of the Gendered Innovations website. The header is dark red with the text "GENDERED INNOVATIONS in Science, Medicine & Engineering". Navigation links include "Home", "People", "How To Use The Site", and "Contact Us". A search bar is located in the top right. Below the header, there are four main navigation buttons: "The Big Picture", "Fix The Numbers", "Fix The Knowledge", and "Fix The Numbers". The main content area features a large image of a person wearing a yellow safety vest, with the text "Answering the Question: How to design gender analysis into basic and applied research?". Below this, there are three smaller sections for "Science", "Medicine", and "Engineering", each with a representative image and a brief description. A sidebar on the left lists various resources: Case Studies, Tools, Terminology, Policy, Curriculum, Checklist, and Videos. At the bottom left, there is a call to action: "GENDERED INNOVATIONS MEANS EMPLOYING GENDER AS A RESOURCE TO CREATE NEW KNOWLEDGE & STIMULATE NOVEL DESIGN. LEARN MORE". The URL <http://genderedinnovations.stanford.edu/> is displayed at the bottom center.



The graphic depicts a hand holding a glowing sphere composed of interconnected nodes and lines, symbolizing a network or data. The background is a gradient of green and yellow, with a bright light source creating a lens flare effect. The text "GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation" is written in orange on the right side. Below this, the text "Policy Review" is written in white. At the bottom right, the text "Genderedinnovation 2" is written in white.

Gender in the knowledge

Sometimes it is "obvious" (but often forgotten):

- Sex and/or gender in the topic you research: Medicine, Biology, Organic Chemistry, Biophysics. [Example Animal research](#)
- Or it is applied: Meteorology, Engineering, Climatology. [Example Transport system.](#)
- There is always the sex of the researcher! [Example.](#)
- But, what about when it is not? Are you immune?



Not obvious?

- Where sex and gender is not a part of what is studied,
- or what it is applied to ...
- Where there is a strong resistance against a gender perspective
- Where there is an idea of “Culture with no culture”
- Where the Positivistic Paradox prevails...

The Positivist Paradox in Physics:

Physics is considered to be objective

– not affected by the sex or gender or ... of the people involved (researcher, teacher, student ...)

... *but*

Culture of physics is affected by sex, gender, ...

- Class-rooms, labs, history, board rooms are almost always dominated by white men

... seems like a **contradiction** ...




Resistance 1: The God Trick

- *I study electrons or stars – they don't have a sex!*
- *I study differential equations – their solutions do not depend on gender/sex!*

This is a version of the “God Trick” – we pretend we have an objective and transcendent sight or we are situated were we have an objective view. (Harraway)

From a sociology of science point of view we have to go further ...

Resistance 2: Curiosity



- *“I am involved in curiosity-driven science”*
- But who’s curiosity is driving Science and who decides what and how things should be researched? ... and how is that shaping the science of the future?

Subjectivity

There is a meaningful relationship between the questions we ask, who scientists are, and what we come to know.

Prescod-Weinstein, 2020, p. 439
Associate Professor of Physics
University of New Hampshire

Image source: University of New Hampshire

•



Conclusion

The only useful definition:

Science is what Scientists do! (“Doing Science, Doing Gender”)

.. and we do a lot of gendered things:

- We use metaphors, similes, clichés, analoges
- We choose examples
- We name things –machines, labs, particles, equations, properties
- We represent science with labels, pictures, ...
- We use role models
- We build our science on an epistemology.
- **We choose methods, teams, collaborations, what to research**
- **We do th full research wheel!**

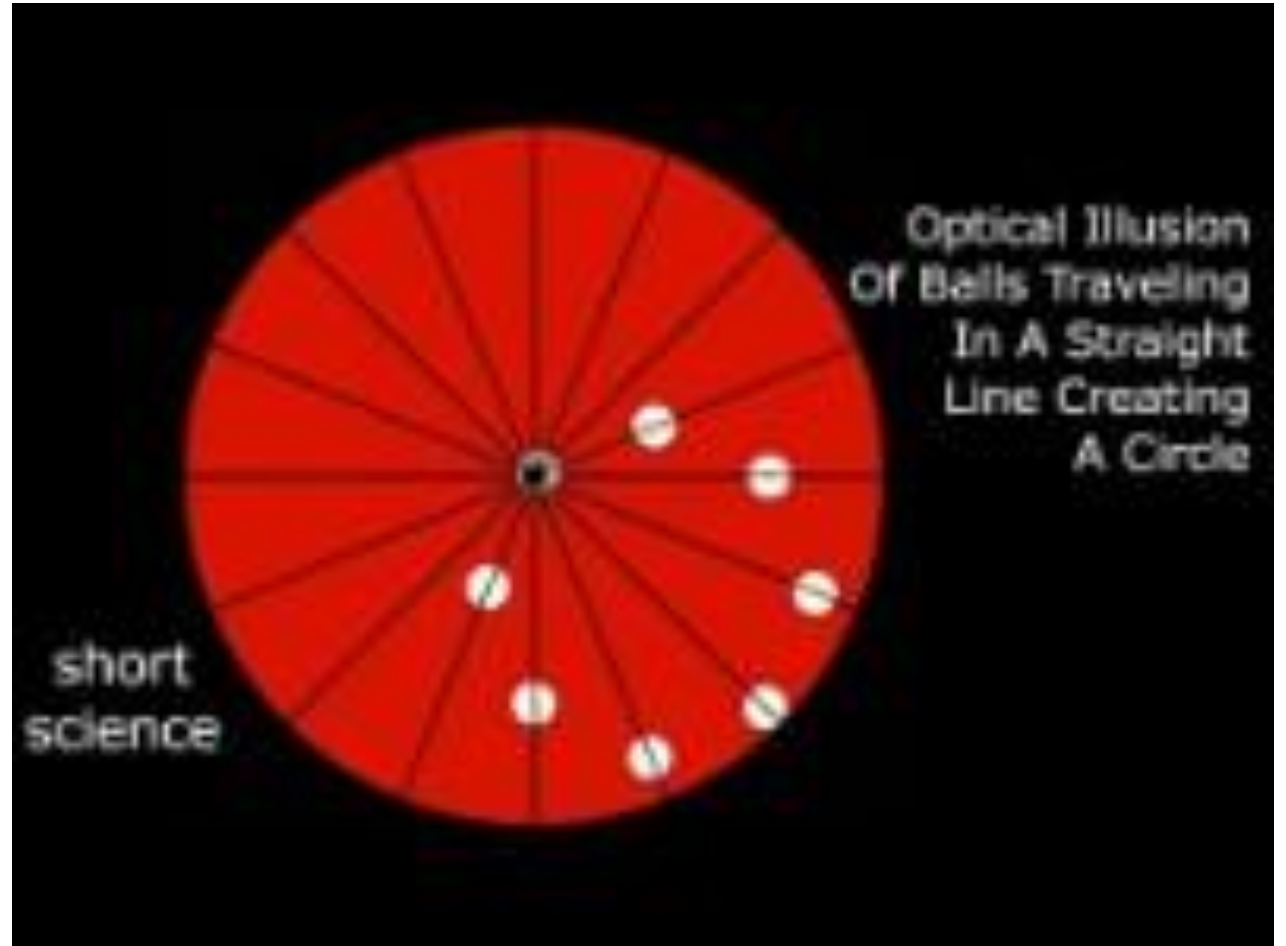




Level 2: "Culture":
- bias and meritocracy

Bias and illusions

For how many balls do you see a collective motion?



Test your own bias with IAT-test.

Test of your own bias.

Banaji et al, *Project implicit*,
<https://implicit.harvard.edu>

[Watch it in the movie *Picture a Scientist* at 50:30 minutes](#)



Project Implicit®

Bias-experiment: IAT-test

You can test it yourself:

Implicit Association Test (IAT)

<https://implicit.harvard.edu/implicit>

M. Banaji (Harvard University), T. Greenwald (U of Washington) and B. Nosek (U of Virginia)

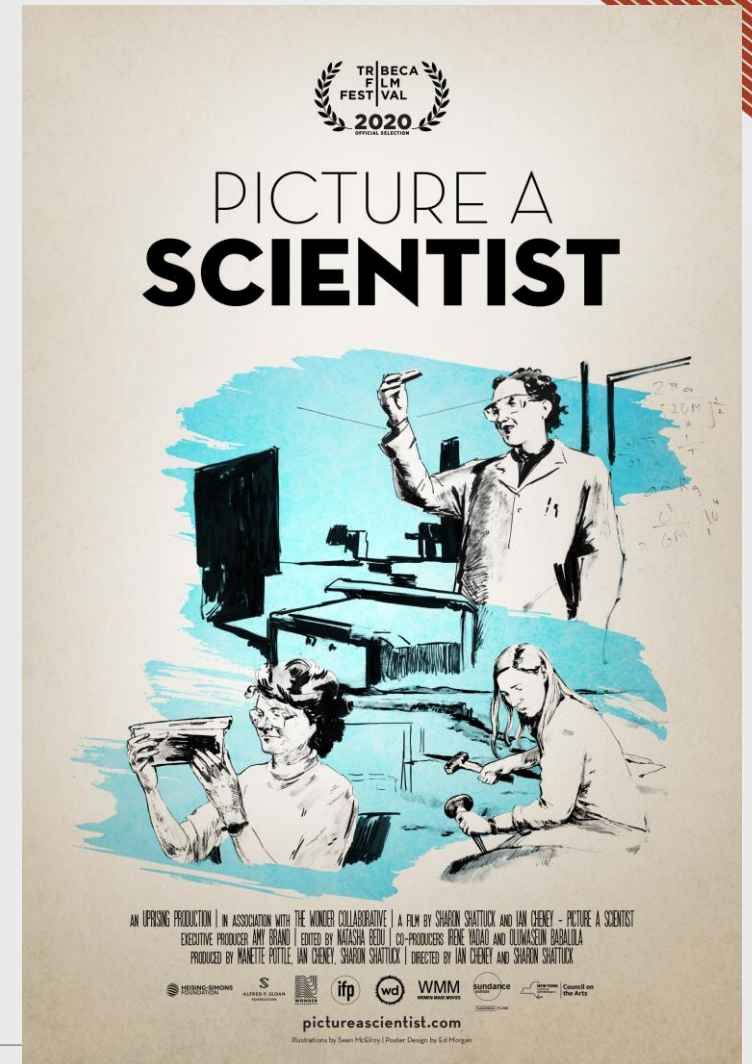
Picture a Scientist 50:30 minutes



Bias in the movies

Evaluations of candidates to a position in a lab.

John and Jenny by Moss-Racusin:
Picture a Scientist 47.30 minutes



Systemic bias

1: "Decoupling"

Saying one thing, doing another e.g.

One says: *"We only look at qualifications and merits – it is all about the best candidate"*

... but one does, e.g.

- Tailor-made advertisements
- Hand-picked experts
- Lack of openness

2. Standardisation

Pretending there are objective measures e.g. excellent journals and h-index.

Or using point systems with weak justification

See DORA association (sfdora.org)

*Nielsen (2015) Nature 525 427 – Studie vid Aarhus universitet 2004-2013
similar results from Netherlands (van den Brink 2010) and Finland (Husu 2000)*



Systemic bias

3. Symbolic boundary work

Justifying through stereotypes, e.g.

Sexism

- Old sexism: “*Women are not fit to or it is dangerous for them to ...*”
- New sexism: “*Women do not want to do, or someone else is against it ...*”

Cloudy ideas of “*risk-taking*” and “*caring vs competition*”



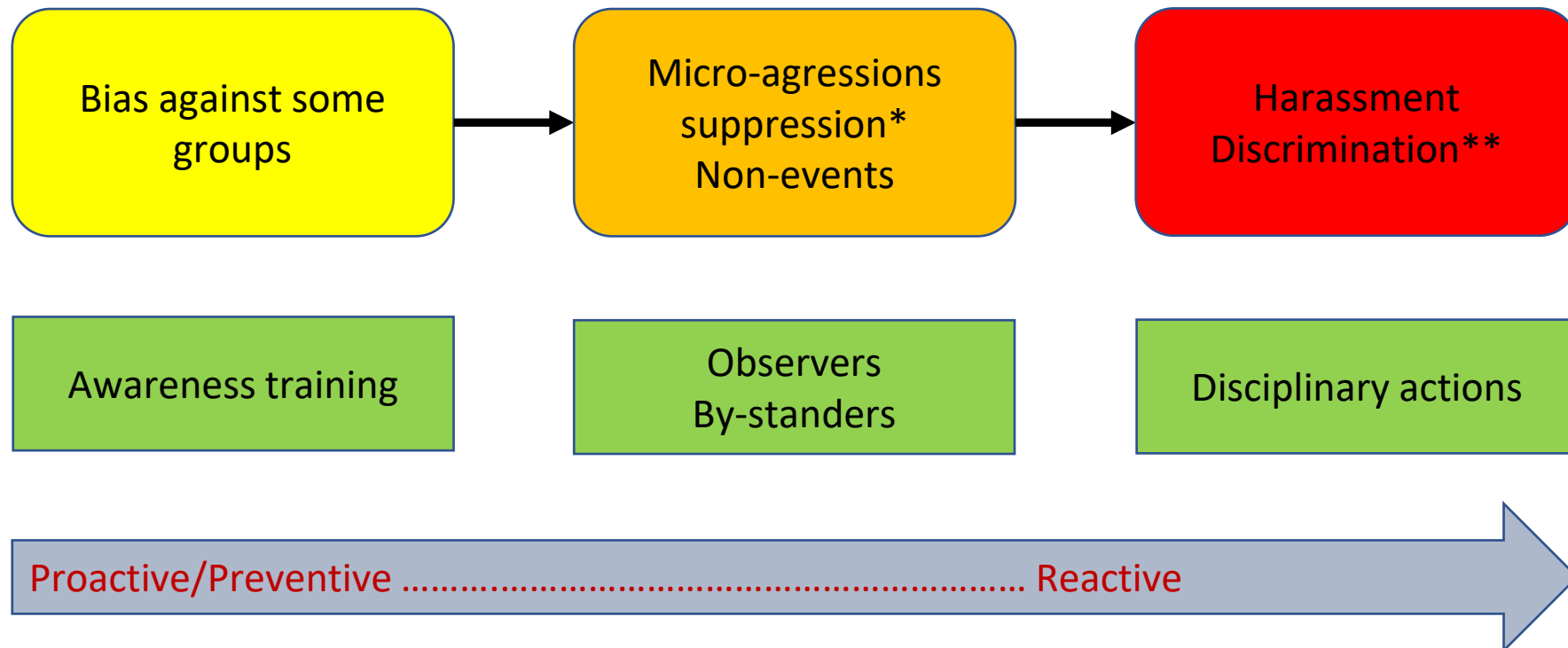


What can bias lead to?

Effects on recruitment, micro-aggressions and discrimination.

Bias and harassment

Actions will be harder the further it gets in this process.



One note on harassment/bullying and excellence

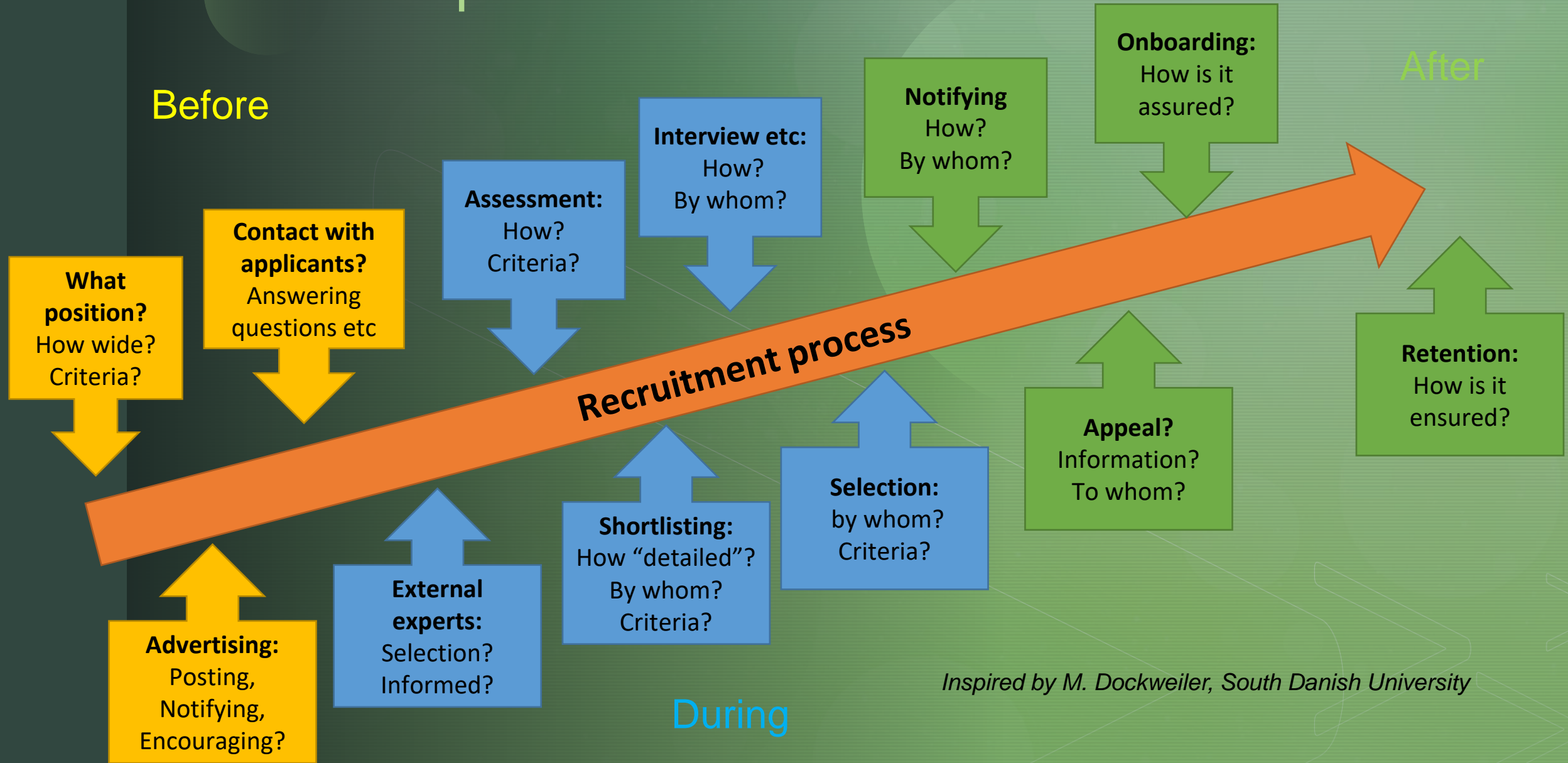
What is true?

- Some are bullies in spite of being excellent.
- Some are bullies because they are excellent.
- Some are bullies because they are not excellent – a career move for a mediocre.

Täuber and Mahmoudi 2022, How bullying becomes a career tool, Nature Humane Behaviour 6 475



Recruitment processes – a minefield of bias



LERU advice paper on bias – full process

1. **Monitor and follow up** careers and assign **accountability**.
2. Offer **training** to understand and mitigate bias.
3. Use **bias observers** in recruitment and funding processes.
4. Evaluate the **language** in recommendations etc
5. Eliminate **pay gaps**
6. Evaluate **quality**; Compensate for **care leave**.
7. Monitor **precarious contracts** and part-time positions.
8. Use **positive actions** against vertical segregation.

Implicit bias in academia:

A challenge to the meritocratic principle and to women's careers –
And what to do about it





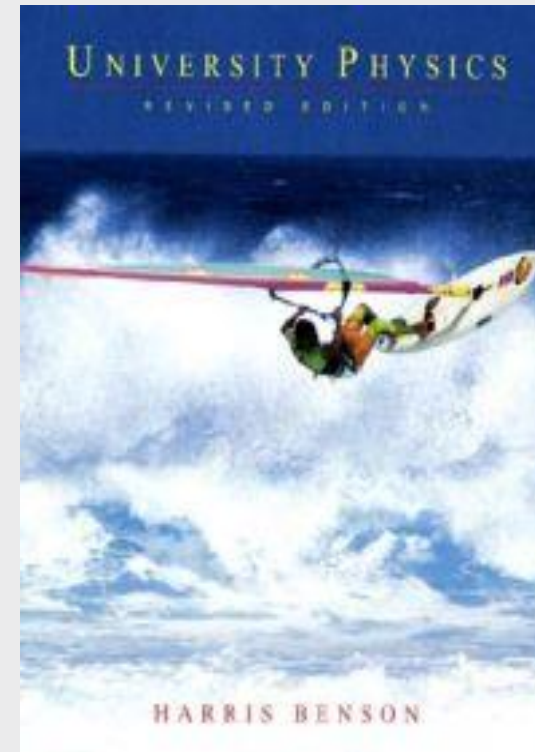
Some examples

Ex: Visual representation

A Standard first year Physics book.

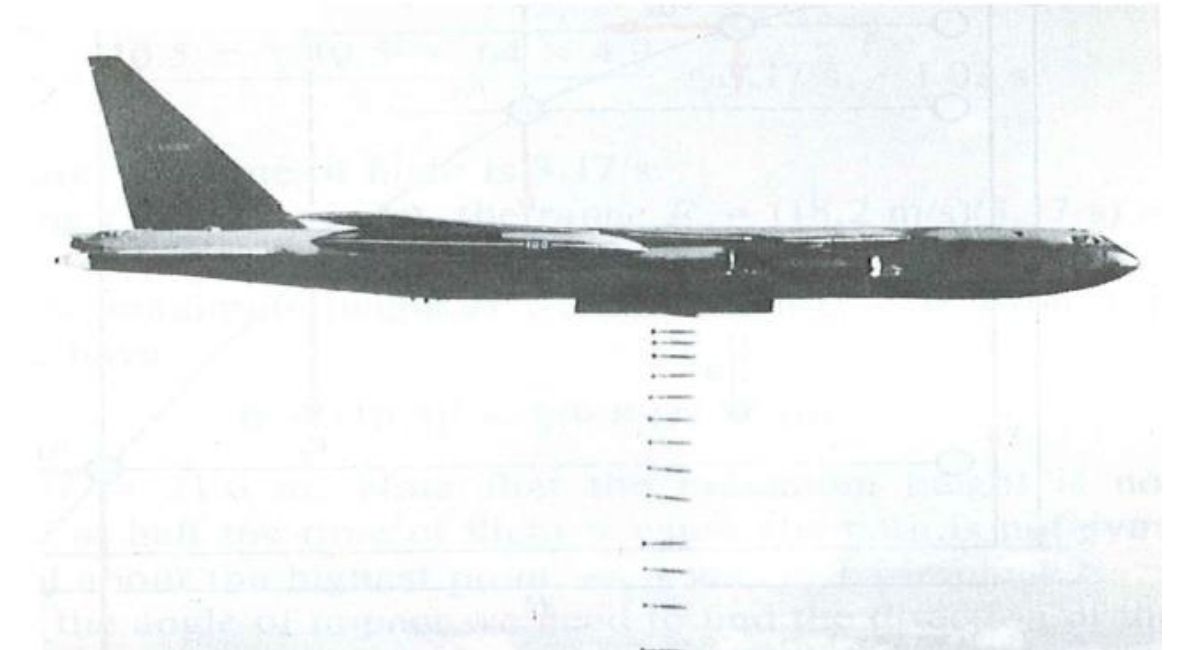
Benson: University Physics.

Reported to be sexist!



Visual representation

We should have been suspicious – first picture:



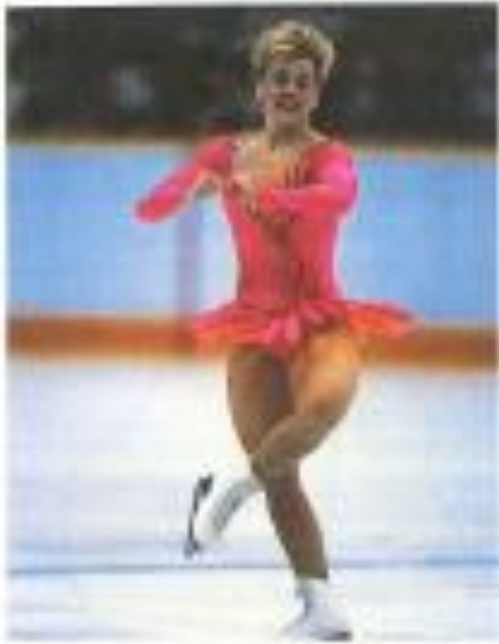
If you have lived here,
it means something different to you ...

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



Sexist?

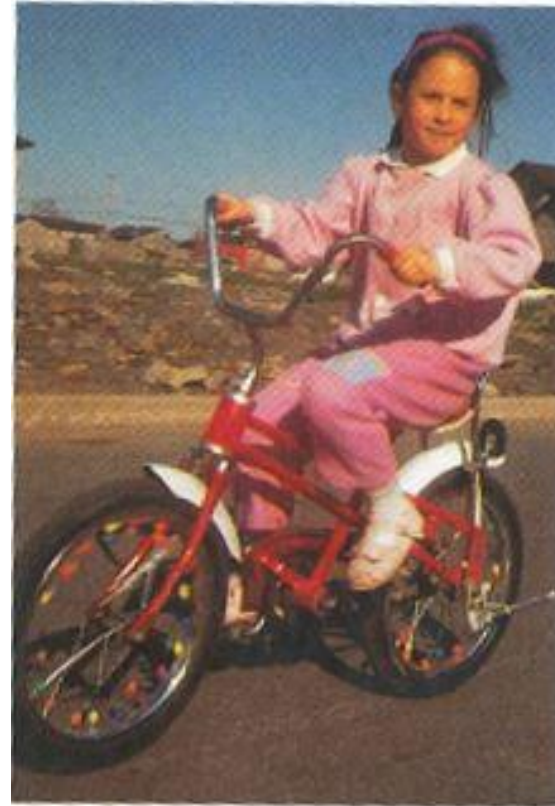
If you have experienced sexual harassment,
It means something different to you



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



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



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

Pictures of women

Pictures of men



FIGURE 9.1 René Descartes (1596–1650).



(b)



FIGURE 9.1 Sir Isaac Newton (1642–1727).



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



FIGURE 1.8 Johannes Kepler (1571–1630).

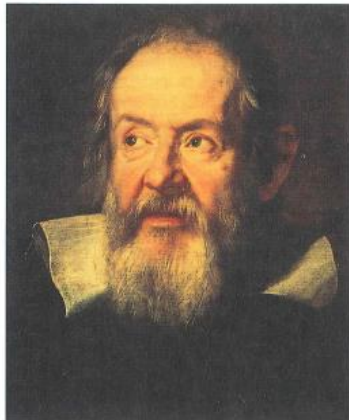


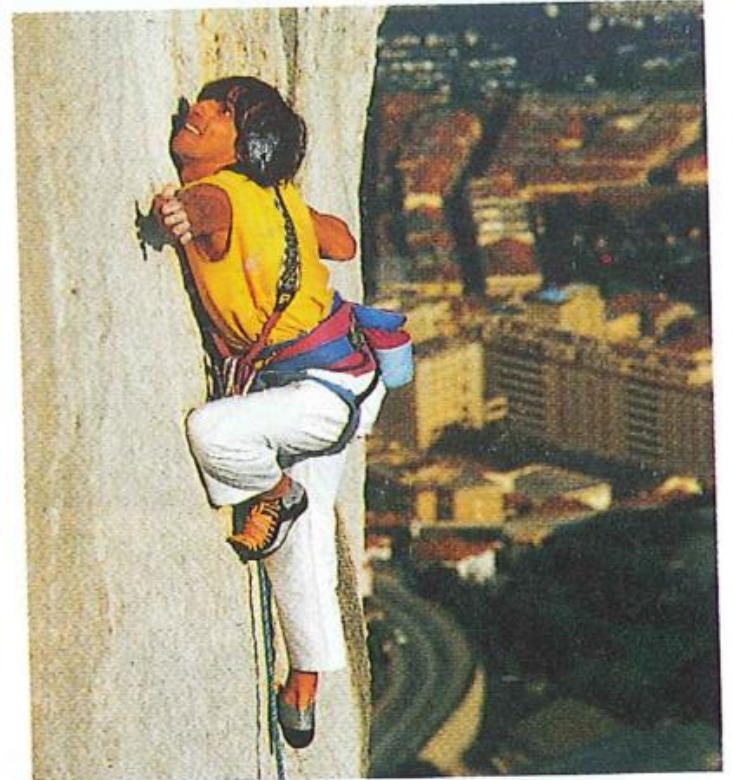
FIGURE 1.9 Galileo Galilei (1564–1642).



FIGURE 9.1 Gottfried W. Leibniz (1646–1716).



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



The climber has done work to increase his potential energy.

Conclusion



- Culture and Subject are intertwined – can't be separated.
- Ex: Culture is breeding certain leaders, who makes priorities that shape Science.
- Culture creates an “image” of Science (and the Scientist), which affects knowledge production and sense of belonging.
- To understand the Knowledge production, we need to understand the Culture.

Toolboxes from LERU

[Publications | LERU](#)

www.leru.org/publications

LE
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ADVICE PAPER
No.18 - SEPTEMBER 2015

GENDERED RESEARCH AND INNOVATION:

INTEGRATING SEX AND GENDER ANALYSIS
INTO THE RESEARCH PROCESS

LEAGUE OF EUROPEAN RESEARCH UNIVERSITIES

LE
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PUSHING
THE FRONTIERS
OF INNOVATIVE
RESEARCH

ADVICE PAPER
NO.23 - JANUARY 2018

Implicit bias in academia:

A challenge to the meritocratic
principle and to women's careers –
And what to do about it



Equality, diversity and inclusion at universities: the power of a systemic approach

LERU position paper
September 2019

GeDiMIRT conference in Lund, June 2022

GENERA conference on

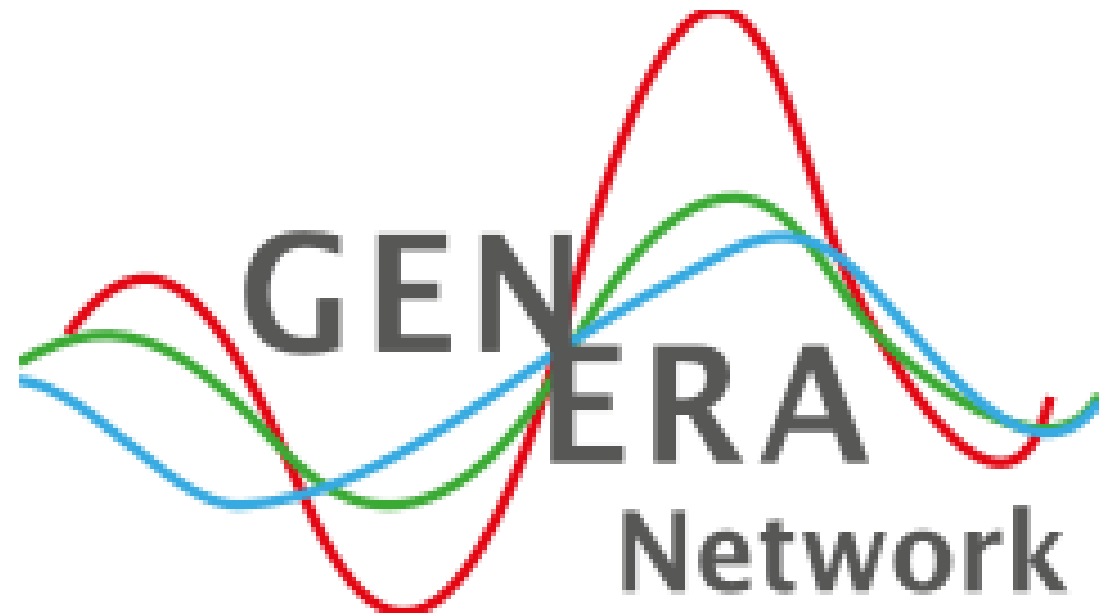
GeDiMIRT :

*“Gender Dimensions in Physics and other
Math-intensive Research and Teaching”*

Playlist of talks on youtube:

<https://www.youtube.com/playlist?list=PLXGHXpAti7oG5QJHfT9qt-rPGrcPAT0ji>

www.genera-network.eu





GENDER FOR EXCELLENCE IN RESEARCH

The GenderEX project

- Horizon 2020 project on Gender for Excellence in research.
- Homepage: Genderex.eu
- Conferences, courses for young reserachers.



It is not
easy...





Thank you for your attention!

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