
History's Lessons:

Opportunities and Challenges for Women in Physics Today

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@alrightPET

Defining the problem

So much progress....

- Access to higher education, further training and senior ranks of professions
- Widespread acceptance of women working outside of the home – 60% of lone mothers and 72% of married or cohabiting mothers are in paid work (2013 UK statistics)
- Control over reproductive capacity (since ~1960)
- Workers' rights extended to include right not to be sexually harrassed or discriminated against on basis of gender or marital status, and the right to request flexible/part-time working and this be granted unless genuinely unfeasible (since 1975, revised 2010)
- Equal pay for equal work (since 1970)

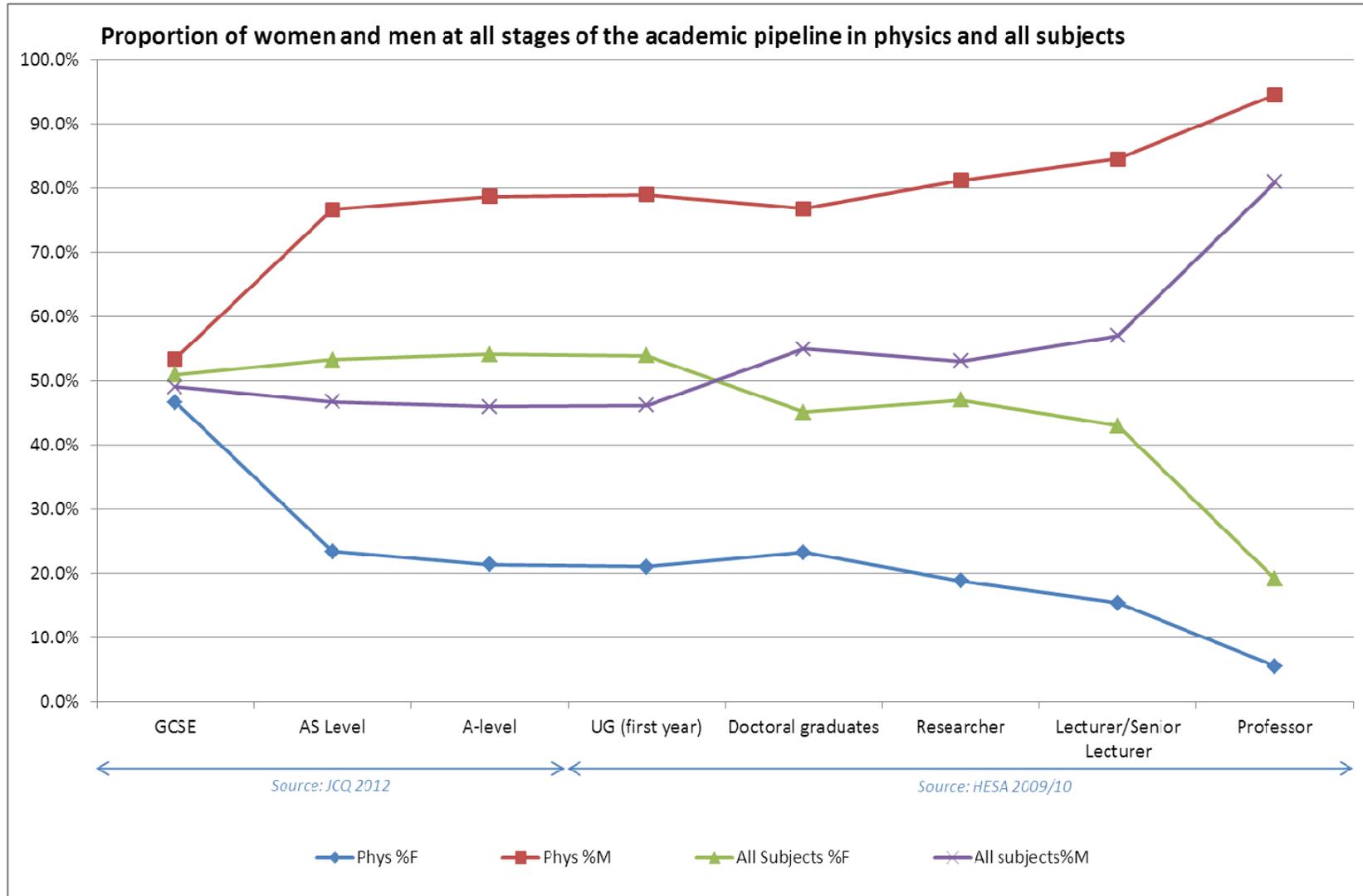
So what's the problem?

	<i>undergraduate</i>	<i>PhD</i>	<i>"academic"</i>
<i>Albania*</i>	~50%		
<i>Argentina</i>	27% enrolled 34% graduated	33%	22% research
<i>Australia</i>	21%		21% uni staff
<i>Austria*</i>	20%	20%	
<i>Bangladesh</i>	30%		
<i>Belarus</i>	33%	50%	
<i>Bulgaria</i>	42%	45%	33% post doc students
<i>Burkina Faso</i>	23%	2%	
<i>Cameroon</i>	16%		
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<i>South Africa</i>	23%		23% all levels
<i>Spain</i>	31%	26%	8%
<i>Turkey</i>			50%
<i>Uruguay*</i>		42%	
<i>Yemen</i>	50%		

A culture-specific problem

Data from IUPAP ICWIP 2011 conference in Stellenbosch, South Africa, and Waterloo 2014 abstracts, courtesy of Gillian Butcher

Female representation in UK academia



Issues affecting female professionals (not just physics)

- Persistent gender expectations with regard to child-rearing and housework
- Lack of affordable childcare / flexible working arrangements
- Progression based on ‘unbroken track record’
- Job insecurity
- ‘Two body’ problem
- Unconscious bias

Unconscious bias

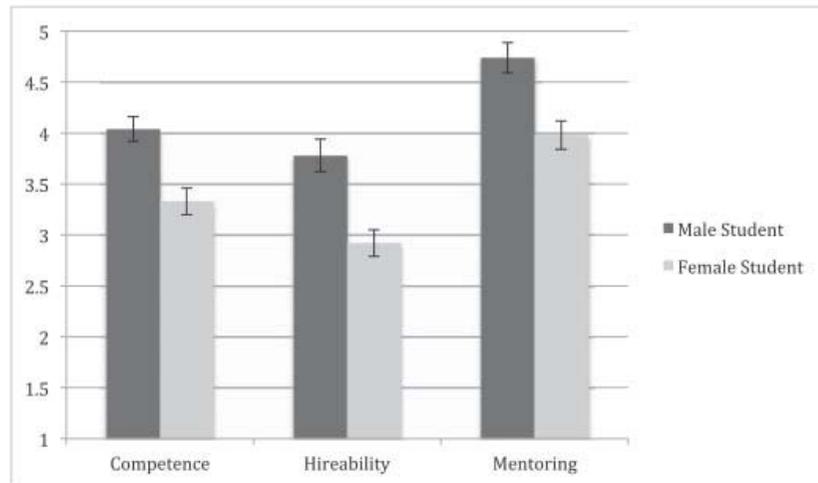


Fig. 1. Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender). All student gender differences are significant ($P < 0.001$). Scales range from 1 to 7, with higher numbers reflecting a greater extent of each variable. Error bars represent SEs. $n_{\text{male student condition}} = 63$, $n_{\text{female student condition}} = 64$.

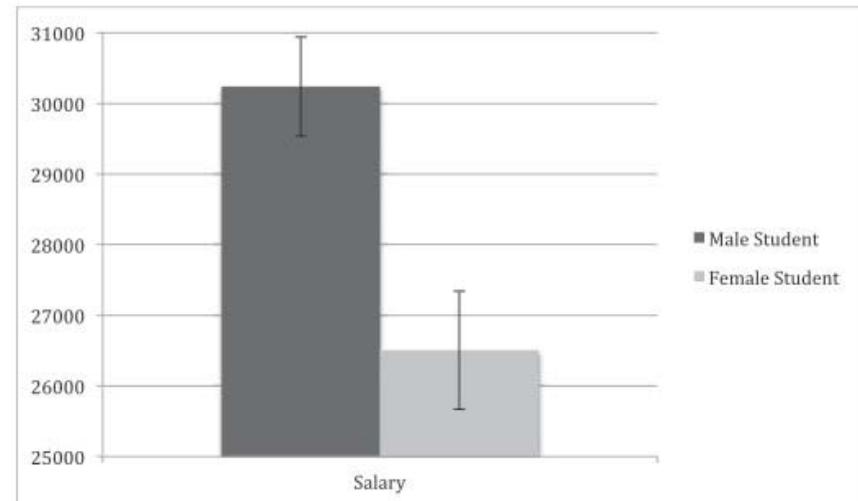


Fig. 2. Salary conferral by student gender condition (collapsed across faculty gender). The student gender difference is significant ($P < 0.01$). The scale ranges from \$15,000 to \$50,000. Error bars represent SEs. $n_{\text{male student condition}} = 63$, $n_{\text{female student condition}} = 64$.

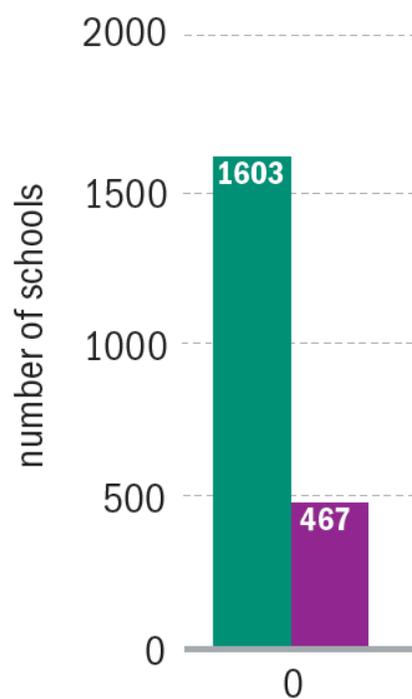
“Scientists presented with application materials from a student applying for a lab manager position and who intended to go on to graduate school. Half the scientists were given the application with a male name attached, and half were given the exact same application with a female name attached”

Moss-Racusin et al, PNAS October 9, 2012 vol. 109 no. 41

The problems set in early...

Figure 1a: Number of schools against the numbers of girls and boys progressing to A-level physics in 2011

3 October 2012 Last updated at 03:26



State schools 'failing girls who want to study physics'

COMMENTS (602)



By Pallab Ghosh

Science correspondent, BBC News

Nearly half of all state schools in England do not send any girls on to study A-level physics, research by the Institute of Physics (IOP) has found.

The IOP study indicates that the situation is likely to be similar in schools across the UK.

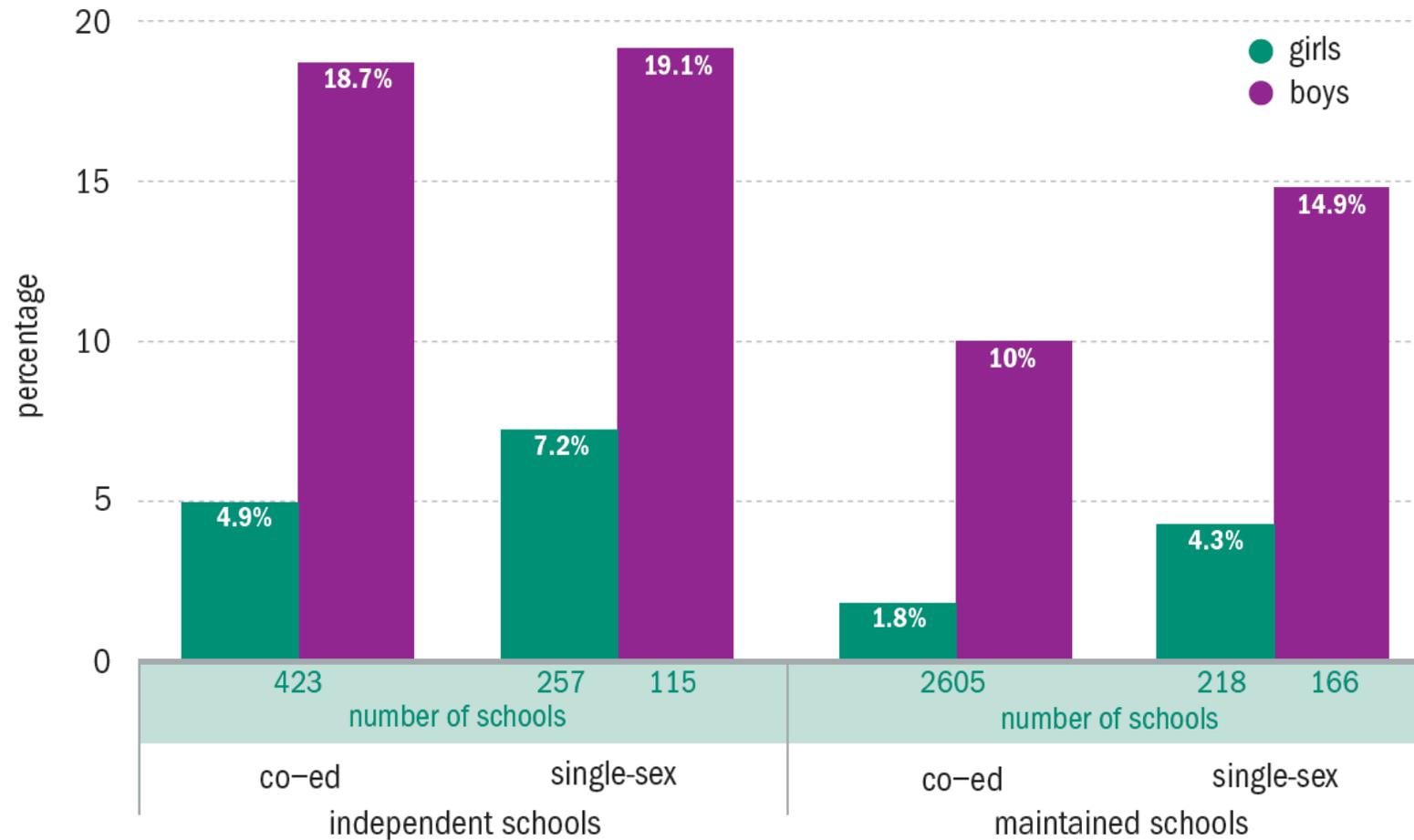
The research also shows that girls are much more likely to study A-level physics if they are in a girls' school.

The Department for Education said it was working to attract top physics graduates into teaching with bursaries.

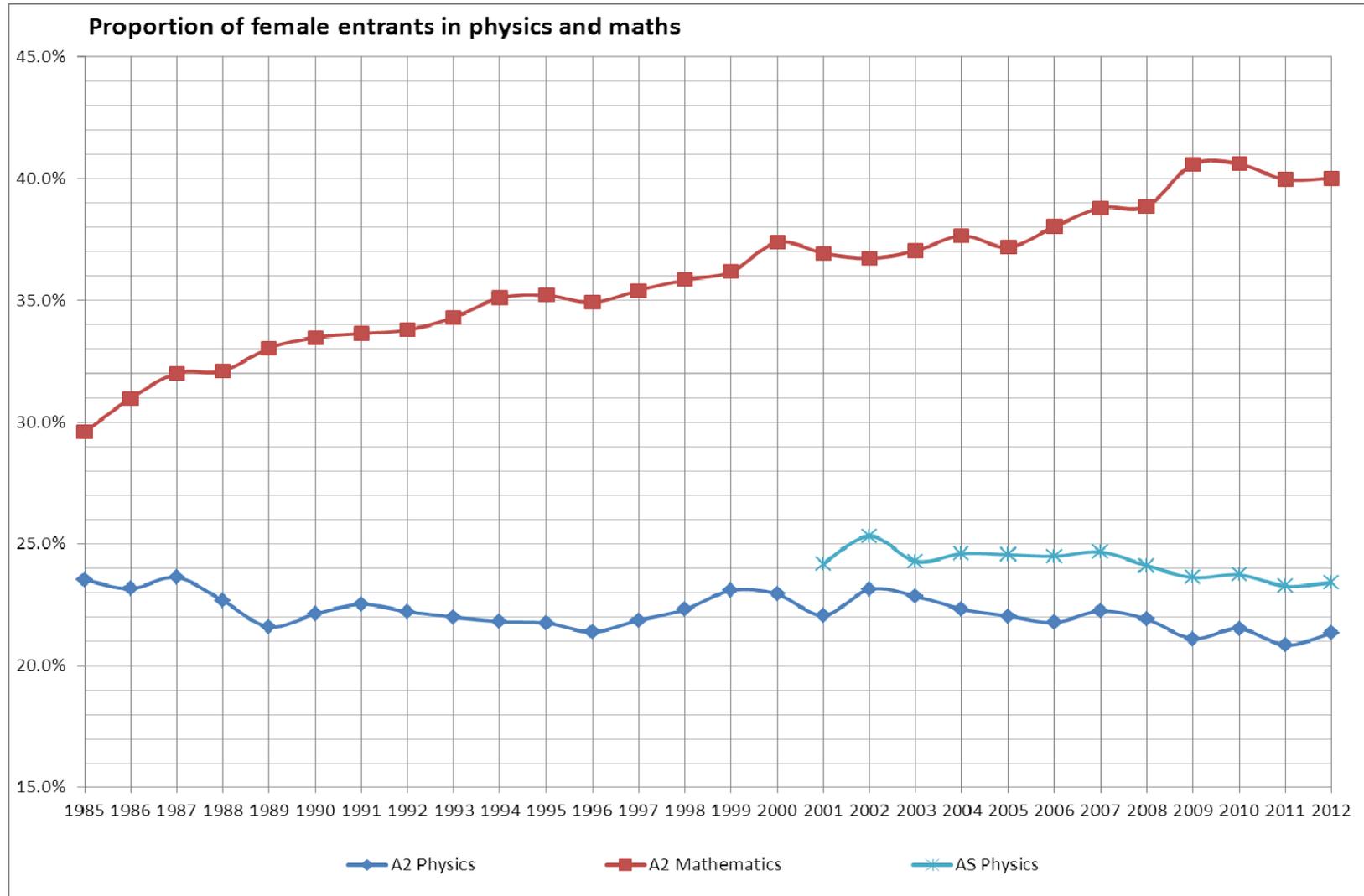


Teachers should challenge the misconception that physics is not for girls

Figure 2: Percentages of girls and boys who went on to take physics A-level in 2011 by type of school



The problems set in early...



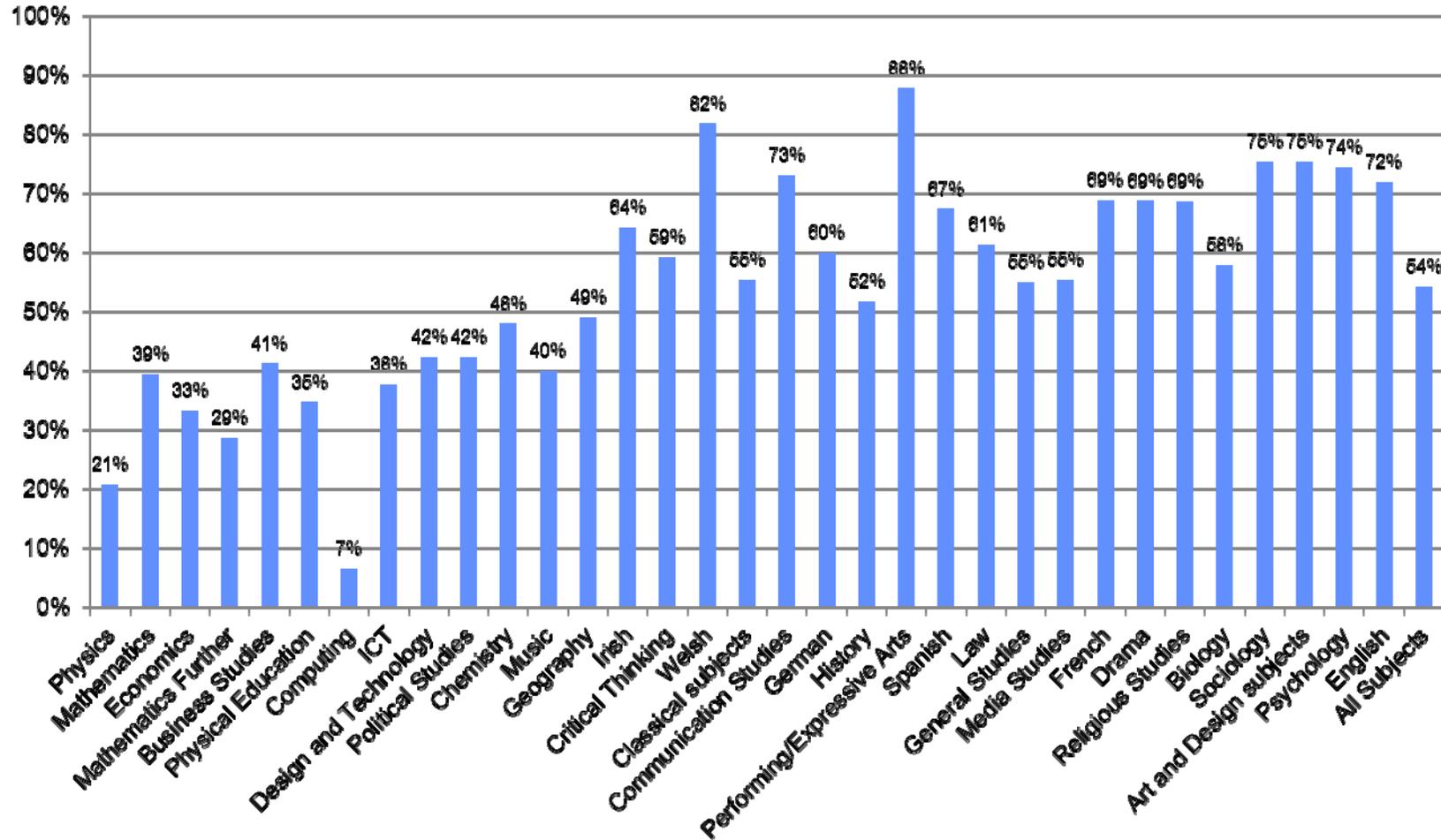
A-level subjects for female students 2012

1	English	63838
2	Psychology	41308
3	Biology	35664
4	Art and Design subjects	34523
5	Mathematics	34301
6	History	26491
7	Sociology	23514
8	Chemistry	23260
15	French	8593
16	Economics	8037
17	Law	7994
18	Physics	7361
19	Design and Technology	7298
20	Political Studies	6591
24	Spanish	4871
25	ICT	4284
26	Mathematics Further	3972
27	Music	3790
36	Irish	203

A-level subjects for male students 2012

1	Mathematics	51413
2	Biology	27410
3	Physics	27148
4	Chemistry	25974
5	English	25800
6	History	25161
14	Physical Education	11030
15	Design and Technology	9807
16	Mathematics Further	9251
17	Political Studies	8669
18	Sociology	7843
19	Religious Studies	7298
20	ICT	6804
24	Drama	4763
25	Other modern languages	4020
26	French	3918
27	Computing	3512
36	Irish	101

% Female entry to A-level subjects in 2013



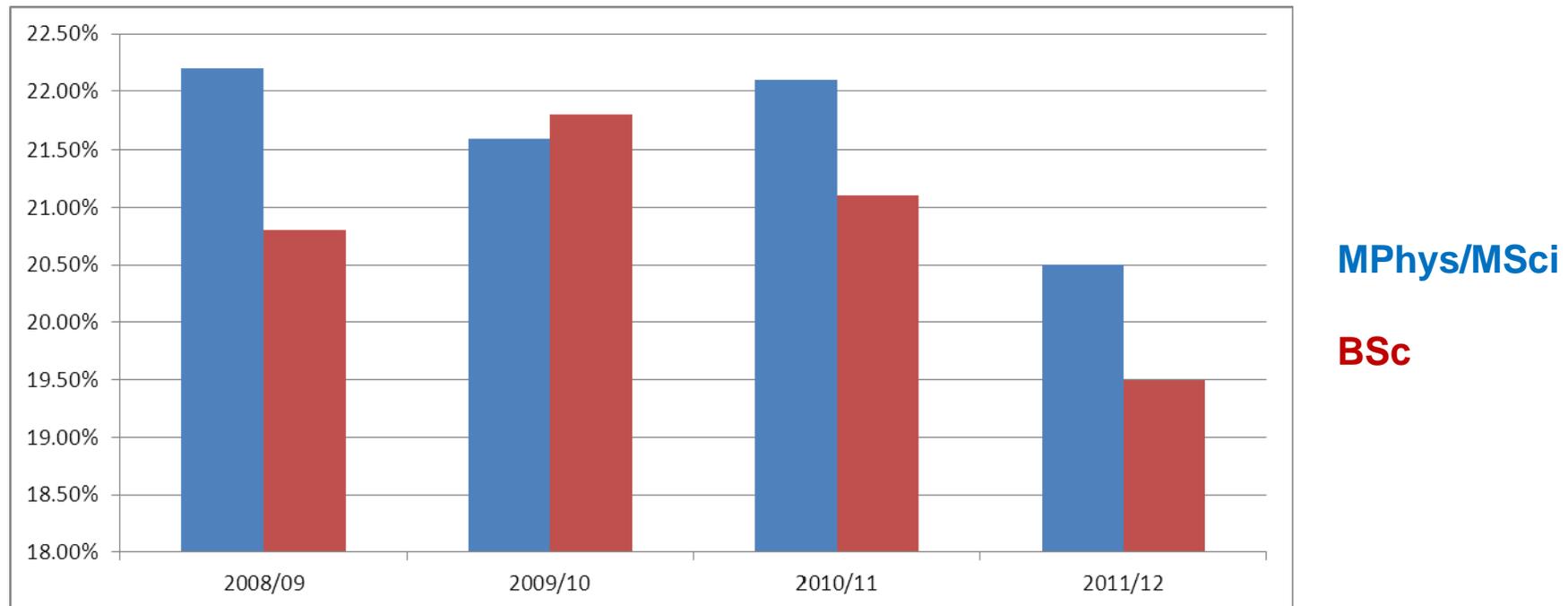
But once women are in, they're in (mostly)...

Table 3: Comparison between the most popular course destinations of male and female accepted applicants with physics A-level in 2011

Overall		Males		Females	
Course destination	%	Course destination	%	Course destination	%
Physics	9.7	Mechanical engineering	10.9	Mathematics	10.5
Mechanical engineering	9.1	Physics	10.3	Physics	7.5
Mathematics	9.0	Mathematics	8.5	Preclinical medicine	5.7
Civil engineering	5.4	Civil engineering	5.8	Chemistry	4.5
Electronic and electrical engineering	4.1	Electronic and electrical engineering	4.8	Civil engineering	3.8
Computer science	3.8	Computer science	4.7	Mechanical engineering	3.4
Chemistry	3.8	Aerospace engineering	4.2	Combinations of three subjects, or other general courses	3.3
Aerospace engineering	3.7	Chemistry	3.6	Architecture	3.3
Preclinical medicine	3.6	General engineering	3.4	Others in subjects allied to medicine	2.5
General engineering	3.1	Preclinical medicine	3.0	Chemical, process and energy engineering	2.4

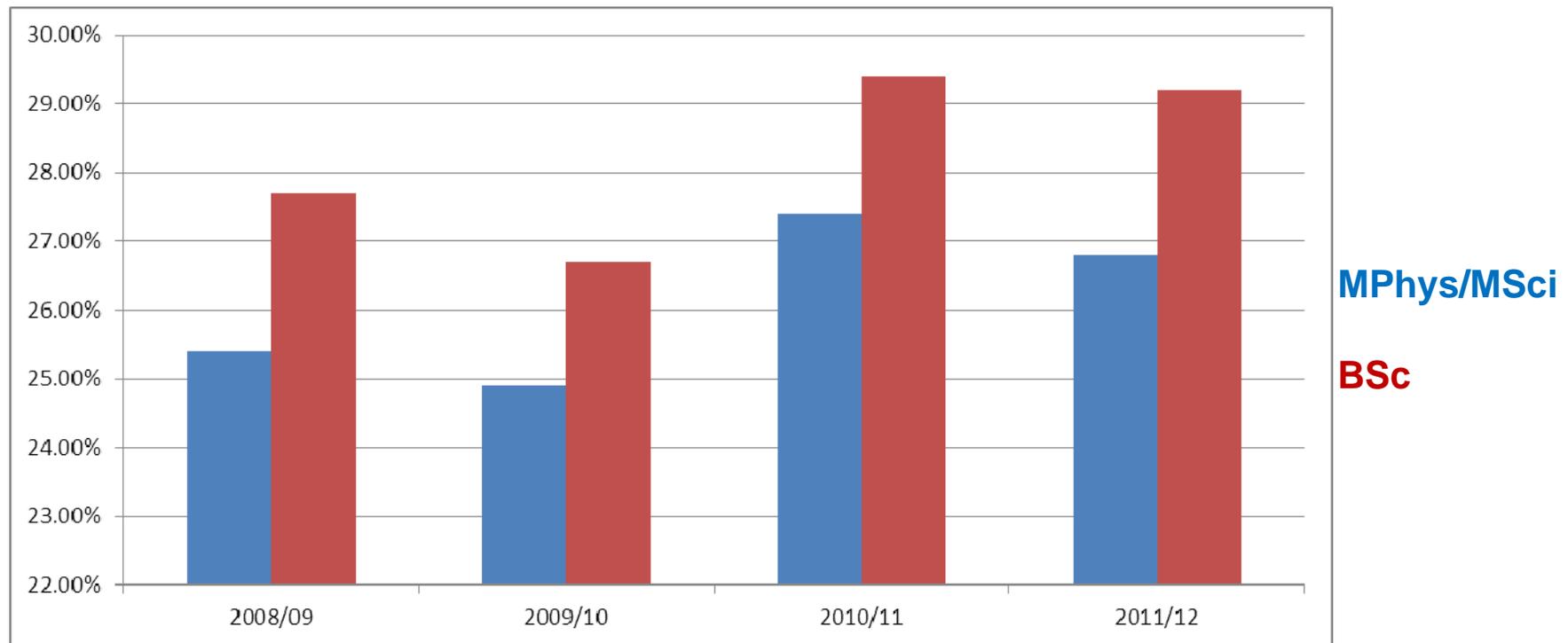
...although they are less likely to complete their degrees...

% Female registration for MPhys/MSci and BSc Physics



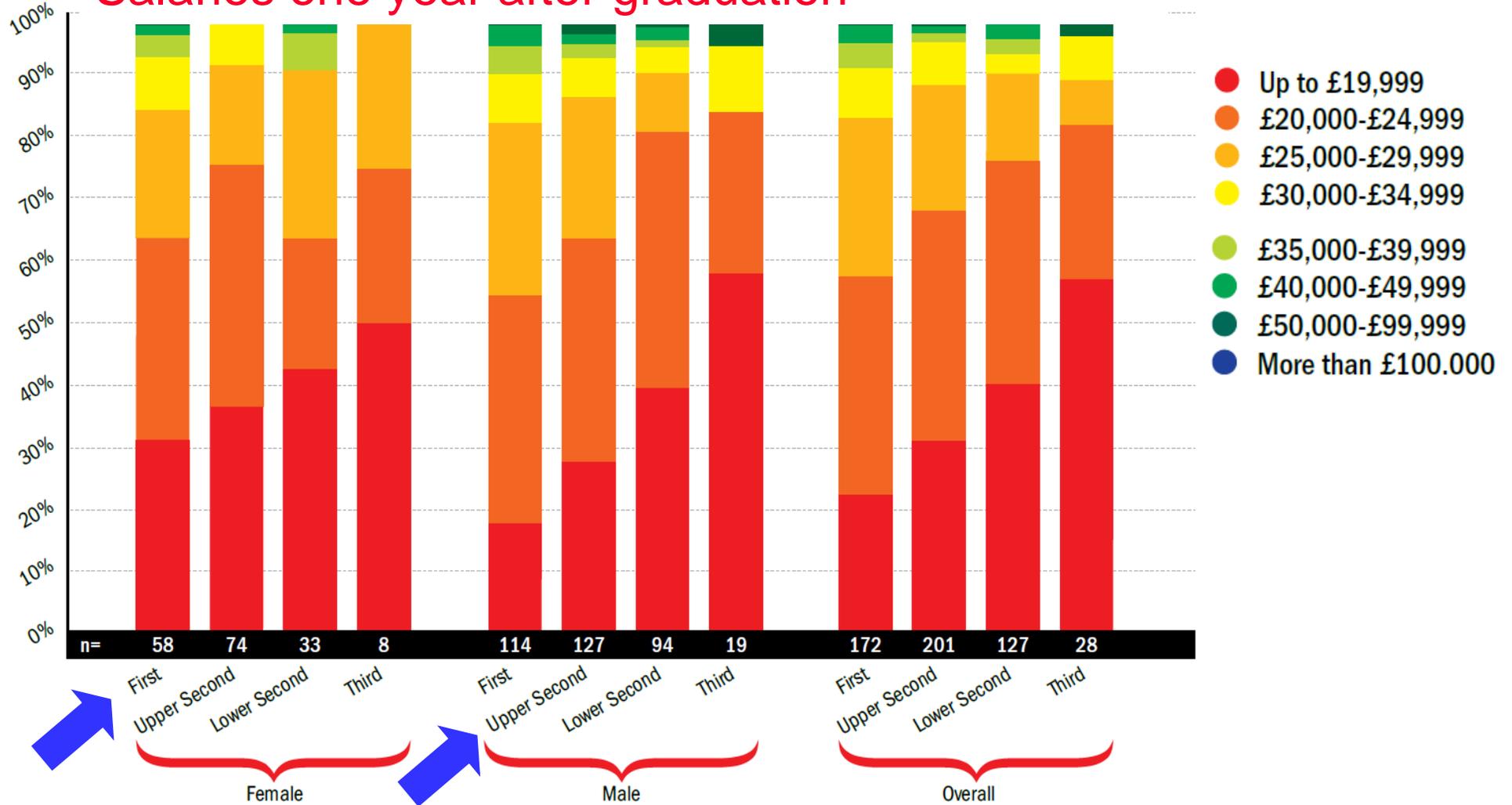
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...and earn less than men from fairly early on

Salaries one year after graduation

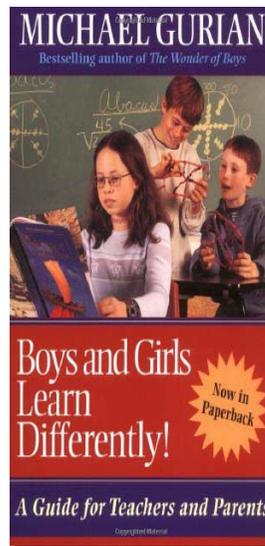
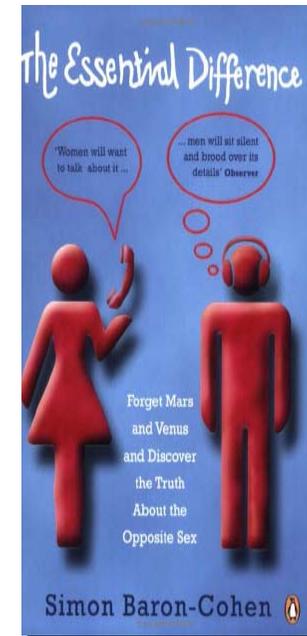
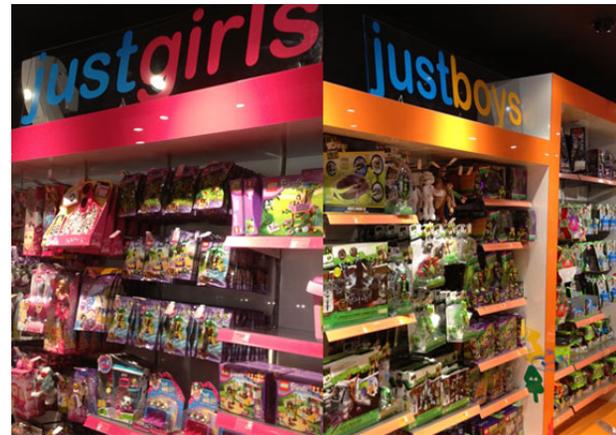


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A culture-specific problem... therefore a problem with culture?

Data from IUPAP ICWIP 2011 conference in Stellenbosch, South Africa, and Waterloo 2014 abstracts, courtesy of Gillian Butcher

Wide-spread gender stereotypes reinforce societal norms



Men really DO have bigger brains: The amazing image that reveals just how male and female brains are wired differently

- Cambridge researchers reviewed 20 years of research
- Found that males generally have slightly larger brains
- Major differences were in the language and limbic system, which controls emotion

The hardwired difference between male and female brains could explain why men are 'better at map reading'

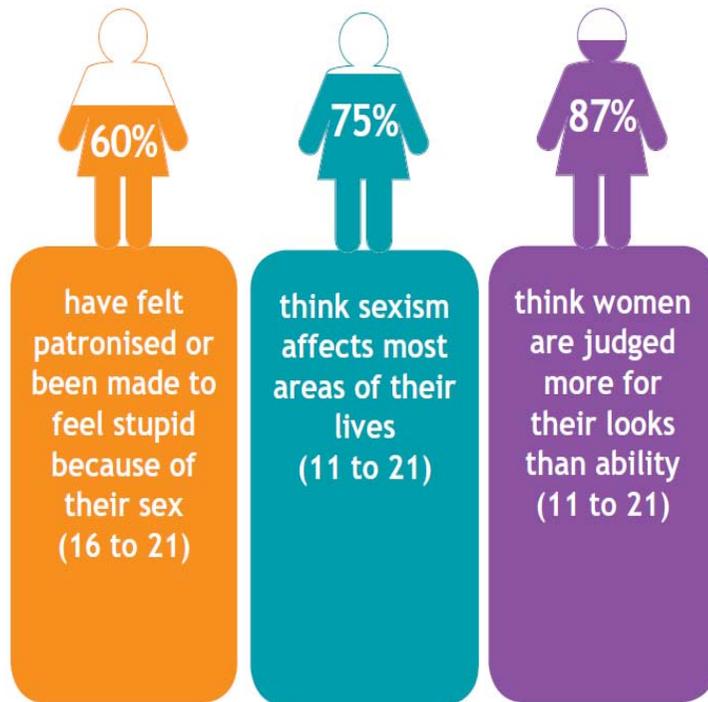
Societal norms appear trivial but provide a highly-gendered backdrop to development



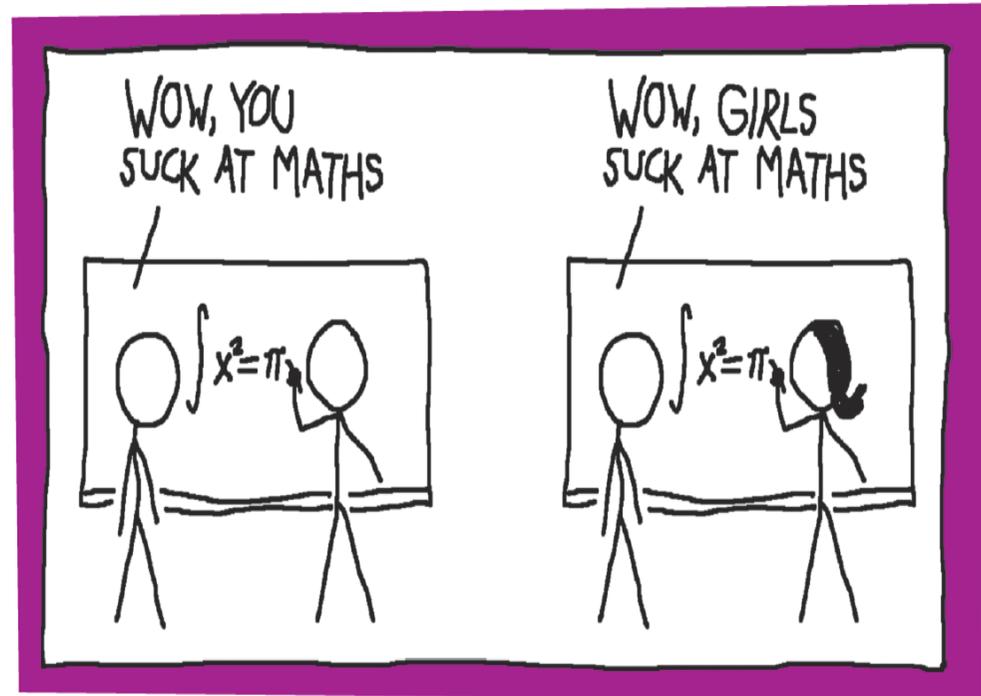
“The brain is much more plastic than the early neuroscientists ever dreamed, it is hugely permeable to society’s influences. Life experiences can (literally) be brain-changing – and any talk of hardwiring is to misunderstand neural development. Until social factors are controlled for, it is impossible to say any differences are solely due to gender. Our brains reflect the society we live in.”

Gina Rippon, Professor of Cognitive Imaging, Aston University

Real impact on girls' self-image



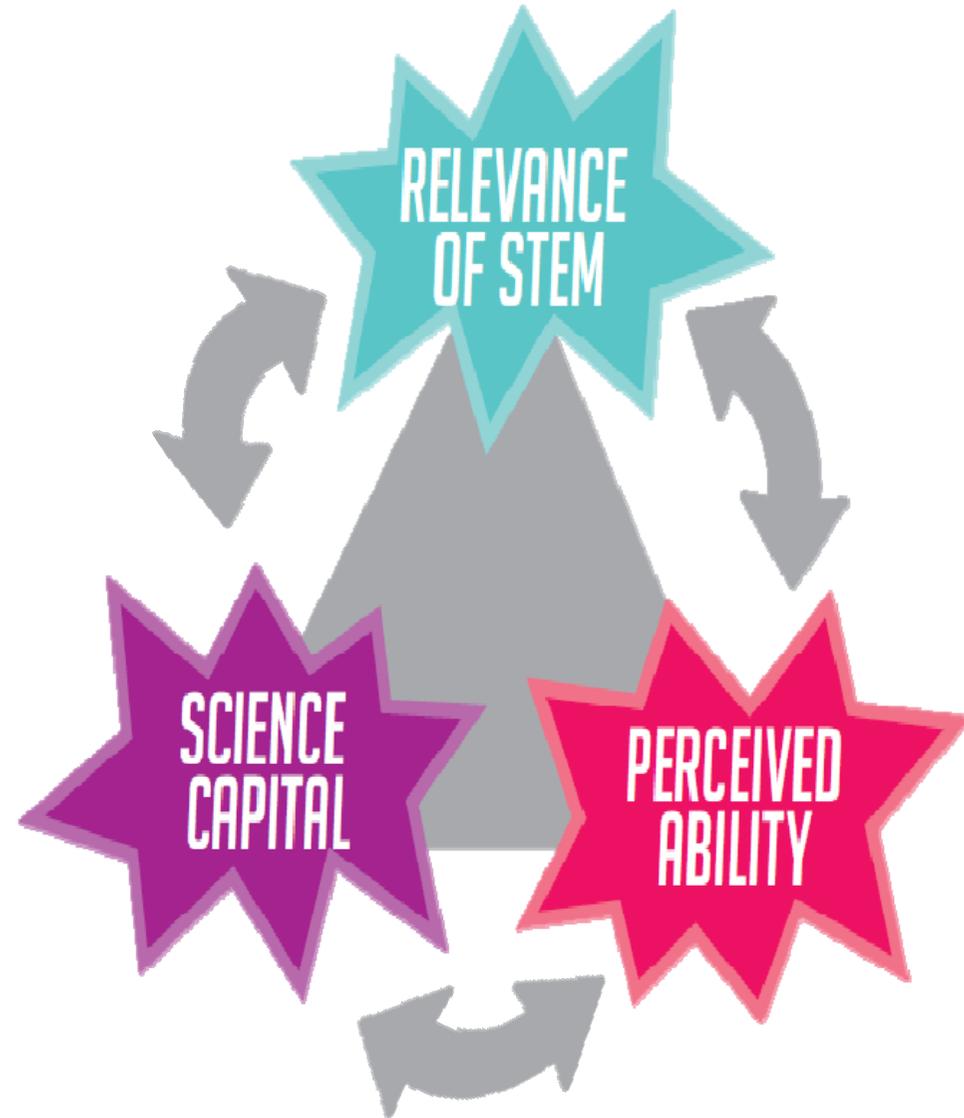
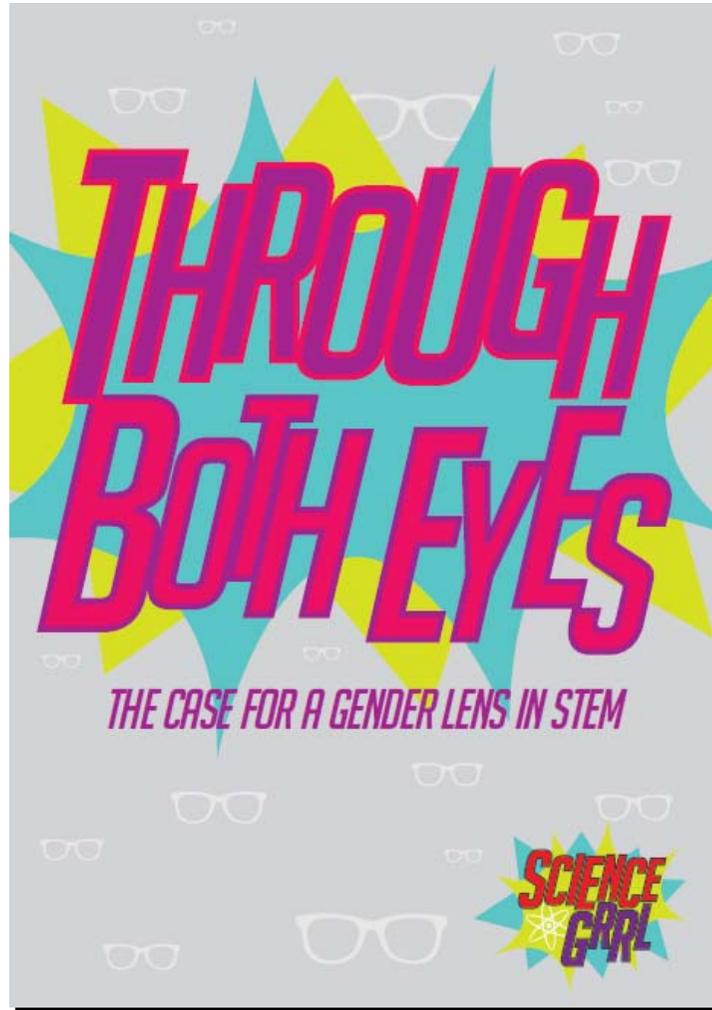
Girls' Attitudes Survey
(Girlguiding 2013)



Adapted from www.xkcd.com/385/

“Girls who choose physics have lower confidence in their conceptual ability than boys even though there was no actual difference in such ability”
UPMAP study, Institute of Education, University of London

Influencing aspirations



Wider society

Classroom

IS IT FOR PEOPLE LIKE ME?



Home

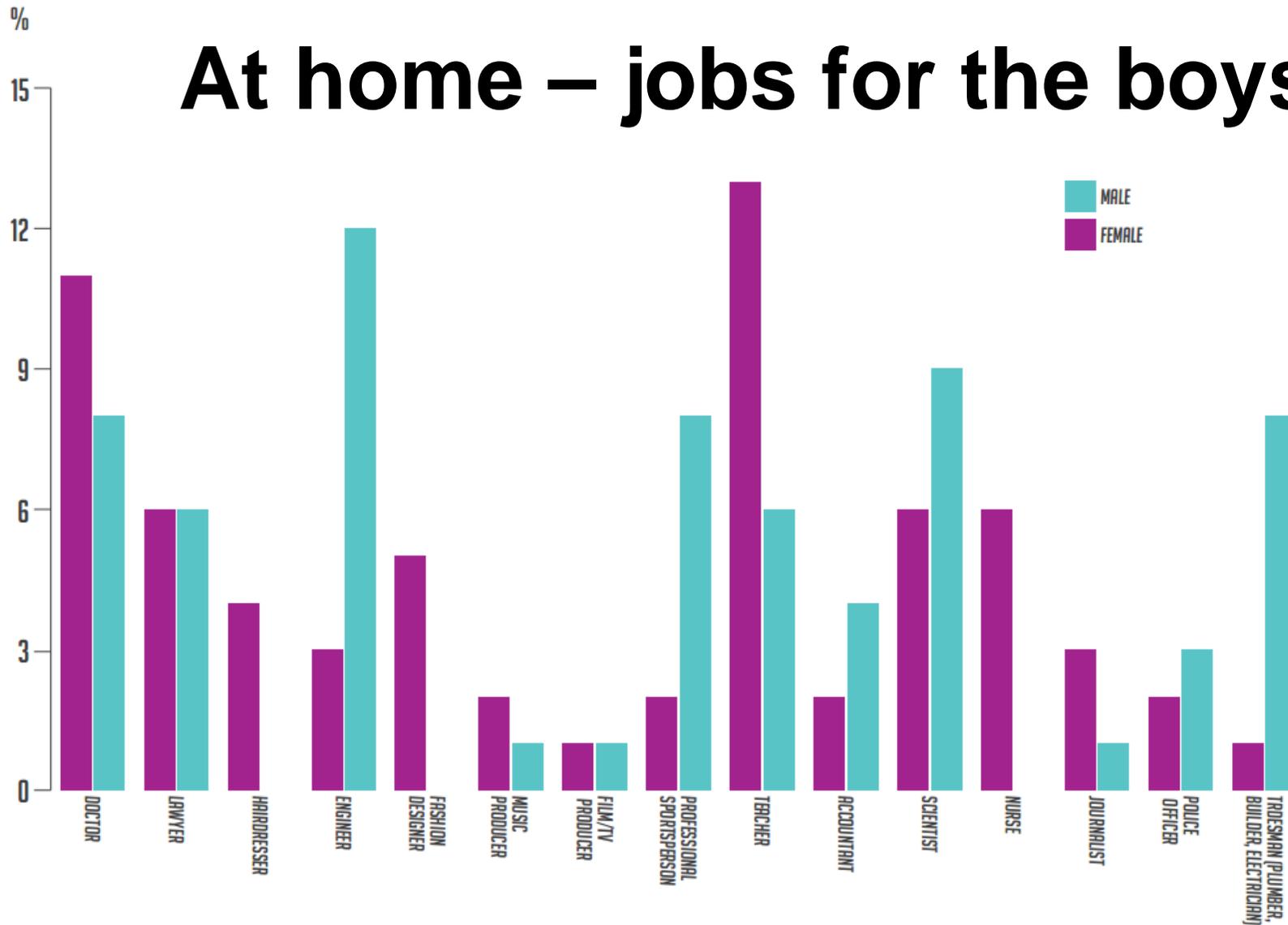
CAN I SEE THE POSSIBILITIES AND PATHWAYS?

DO I FEEL CONFIDENT?

Workplace



At home – jobs for the boys?



Response to the question 'What type of job would you most like your child to pursue when they finish their education?' (Engineers Week polling data 2013)

At home – jobs for the boys?

The best comment that I had all day was from a parent of a girl who was about to go into secondary school. She said

“I always thought of science as being a 'boy' thing, but now we've come here and spoken to all of you today, we know that's not the case.”

Rosie Davies, ScienceGrrl Birmingham chapter, on 'I'm a Scientist, Talk to Me' at the British Science Festival 2014

These expectations are too often mirrored at school and in the workplace

*IN A SCHOOL SPECIALISING
IN APPLIED LEARNING
WITH A FEMALE
HEADTEACHER WITH
ENTHUSIASM FOR
TECHNOLOGY, 94%
OF GIRLS STUDIED
DESIGN TECHNOLOGY
AT KEY STAGE 4*

*IN THEIR 'CLOSING DOORS'
REPORT THE INSTITUTE OF
PHYSICS (2013) CLEARLY
SHOW THAT GENDER
STEREOTYPING IS A
PROBLEM IN SCHOOLS –
FOR BOYS AS WELL
AS GIRLS*

*A KEY CONCERN AMONG
POTENTIAL FEMALE
APPRENTICES IS THAT NON-
TRADITIONAL WORKPLACES
WILL BE UNFRIENDLY
TOWARDS THEM*

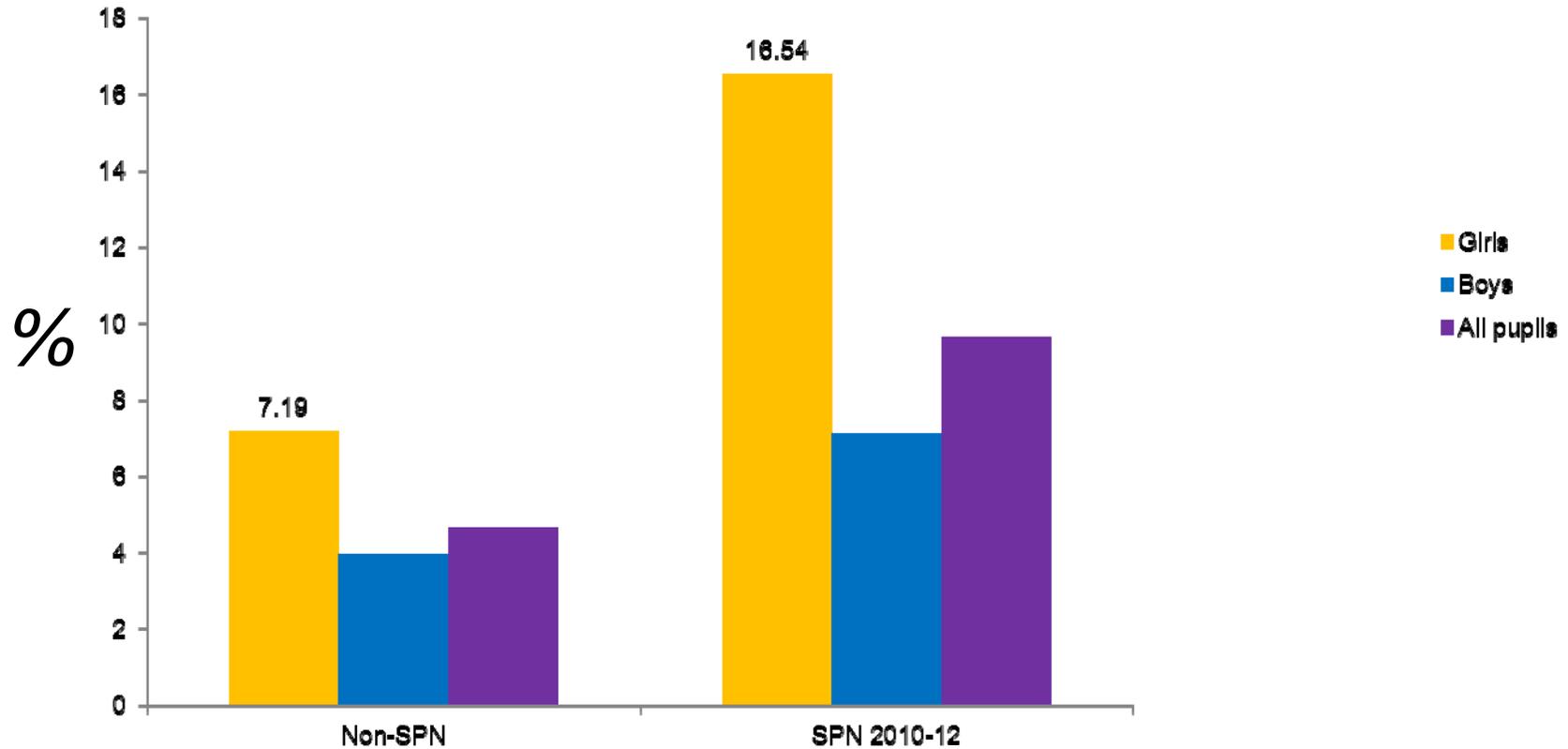
*30% of women and 18% of men believe that
science and engineering companies
consciously or unconsciously favour men*

What can we do?

- **Counter unnecessarily gendered marketing and broadcasting**
- **Promote real role models**
- **Educate, advise and recruit with awareness of the highly-gendered environment we are all living in**
- **Improve the classroom experience**
 - Challenge gendered assumptions across all departments in a school
 - Insist schools promote gender quality and that this is reflected in classroom management (IoP are working with Ofsted on this)
 - Ensure curriculum includes applications to wide range of contexts
 - Creative, real-world practical and group work
 - Engagement with real-life role models given priority over enrichments
 - Support teachers in providing engaging physics education
 - Inform and train careers advisers, improve access to high-quality advice



Improvements in participation in physics



With thanks to

Peter Main, Director of Education, IoP

Ellie Cosgrave, Co-Director, ScienceGrrl

Further information:

http://www.iop.org/education/teacher/support/girls_physics/page_41593.html

www.sciencegrrl.co.uk

[http://research.ioe.ac.uk/portal/en/projects/understanding-participation-rates-in-post16-mathematics-and-physics-upmap\(45a02dd7-1141-4e70-a97b-bcb65adc79f4\).html](http://research.ioe.ac.uk/portal/en/projects/understanding-participation-rates-in-post16-mathematics-and-physics-upmap(45a02dd7-1141-4e70-a97b-bcb65adc79f4).html)

www.wisecampaign.org.uk/

<http://www.portiaweb.org/>

<http://www.open.ac.uk/about/teaching-and-learning/esteem/supi/project-team/elizabeth-whitelegg>

<http://www.publications.parliament.uk/pa/cm201314/cmselect/cmsctech/701/70104.htm>