

## Disclaimers:

1. Math is my field.
2. There is emphasis in women because this is the group I know better. Many of the statements apply to other underrepresented groups (for instance, African American, LGTB, Latinos, ...)



## Some reasons why there is little diversity in math and some ideas to change this

- References to the articles mentioned here can be found at the end of these slides.
- This (always evolving) talk is posted in my website.
- Please send me any comment, suggestion, criticism, and relevant material, specially, anything that you found useful.

**Undergraduate math majors: 43% are women**

**New PhDs in math: 28% are women**

**Postdocs in math: 21% are women**

**Tenured math faculty at PhD-granting universities: 12% are women**

**AMS prizes awarded at JMM 2014: 0% given to women**

From AWM President Ruth Charney's column in the  
Sept-Oct 2014 AWM Newsletter.

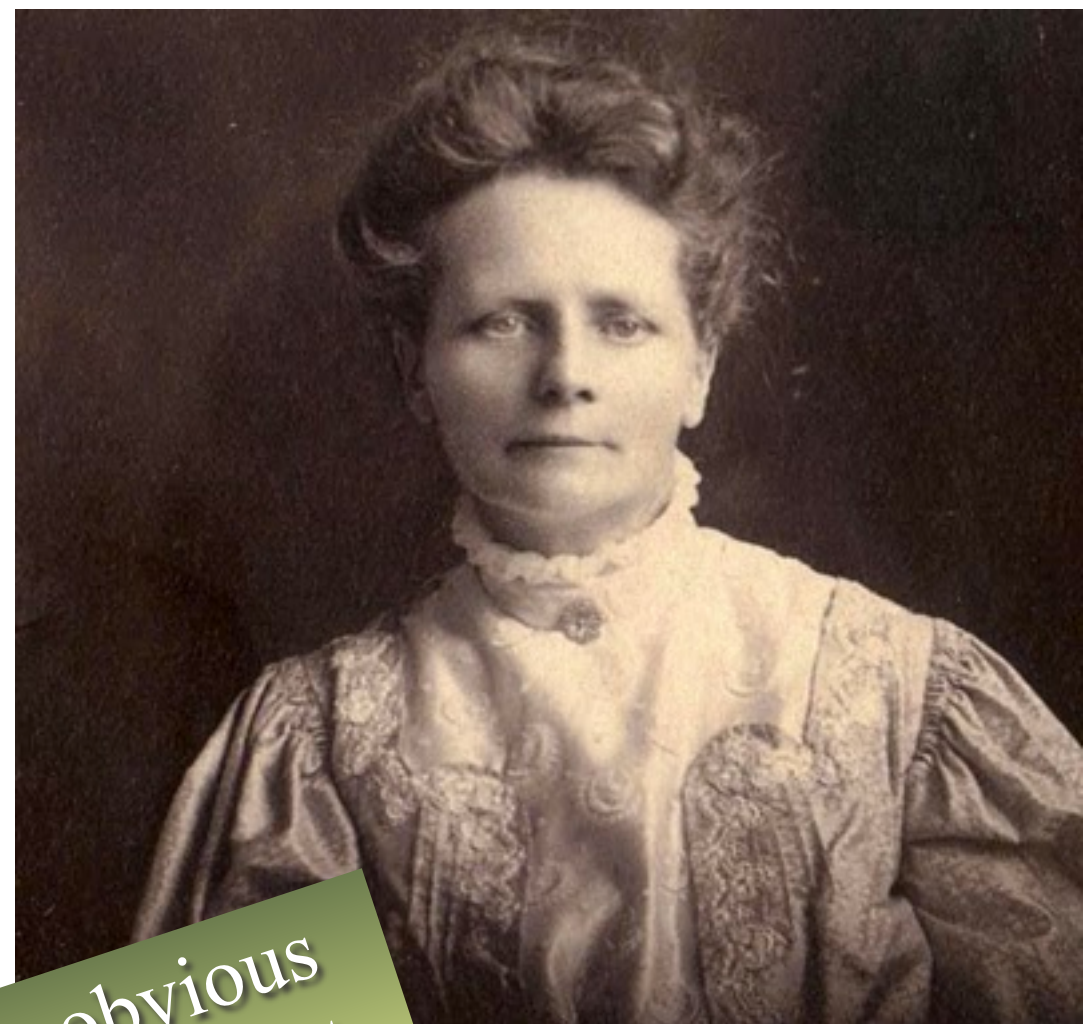


Why?

Why?

Why?

After her husband's death, in **1710**, **Maria Winckelmann Kirch** asked the Royal Berlin Academy of Sciences if she could fill her husband's position as Royal Astronomer (she had been doing the job herself since her husband became ill). **The Academy refused.**



There were obvious obstacles in the past



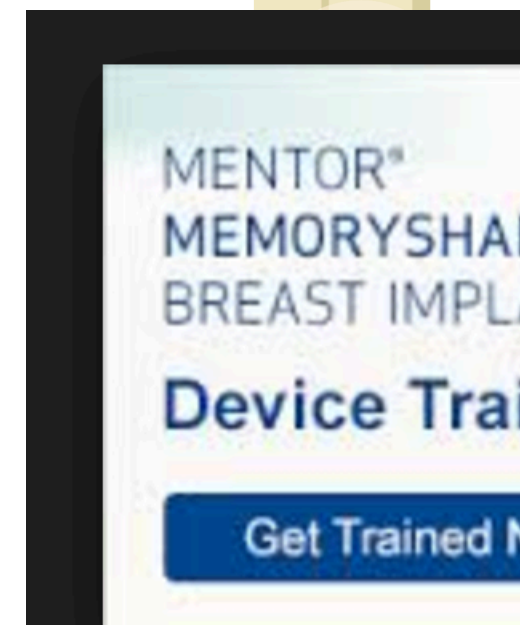
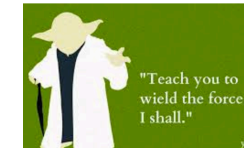
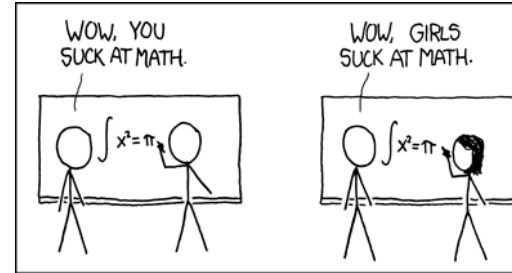
In **1870**, **Sofia Kovalevskaya** took private lessons with Karl Weierstrass, since the **university would not even allow her to audit classes.**



# Why there is very little diversity in math ?

## Models, explanations, ideas.

- ❖ Gender schemas (Stereotypes)
- ❖ Implicit bias (self and from outside)
- ❖ Lack of role models (a vicious circle)
- ❖ Negative messages (expectations of brilliance..)
- ❖ Lack of mentors
- ❖ “Equal calls equal”
- ❖ Impostor feeling
- ❖ Isolation, feeling of not belonging.
- ❖ Accumulation of disadvantage.
- ❖ “Invisibility” of women
- ❖ Tendency to believe that “what it is is what ought to be.
- ❖ Variability hypothesis??????



From the NYTimes





THE NOT SO  
DISTANT PAST

SOJOURNER TRUTH





## Women and the right to vote

1893 New Zealand  
1902 Australia  
(except aboriginal)  
1906 Finland  
1913 Norway  
1915 Denmark  
1917 Canada  
(except Indian)  
1918 Austria,  
Germany, Poland,  
Russia  
1919 Netherlands  
1920 United States  
(with exceptions.  
Voting rights act in  
1965)  
1921 Sweden

1928 Britain,  
Ireland  
1930 South Africa  
(except black  
people, until 1994)  
1931 Spain  
1934 Turkey  
1944 France  
1945 Italy  
1947 Argentina,  
Japan, Mexico,  
Pakistan  
1949 China  
1950 India  
1954 Colombia  
1957 Malaysia,  
Zimbabwe  
1962 Algeria



1963 Iran, Morocco  
1964 Libya  
1967 Ecuador  
1971 Switzerland  
1972 Bangladesh  
1974 Jordan  
1976 Portugal  
1989 Namibia  
1990 Western  
Samoa  
1993 Kazakhstan,  
Moldova  
2005 Kuwait  
2006 United Arab  
Emirates  
2011 Saudi Arabia

# A (male) look a women's suffrage movement

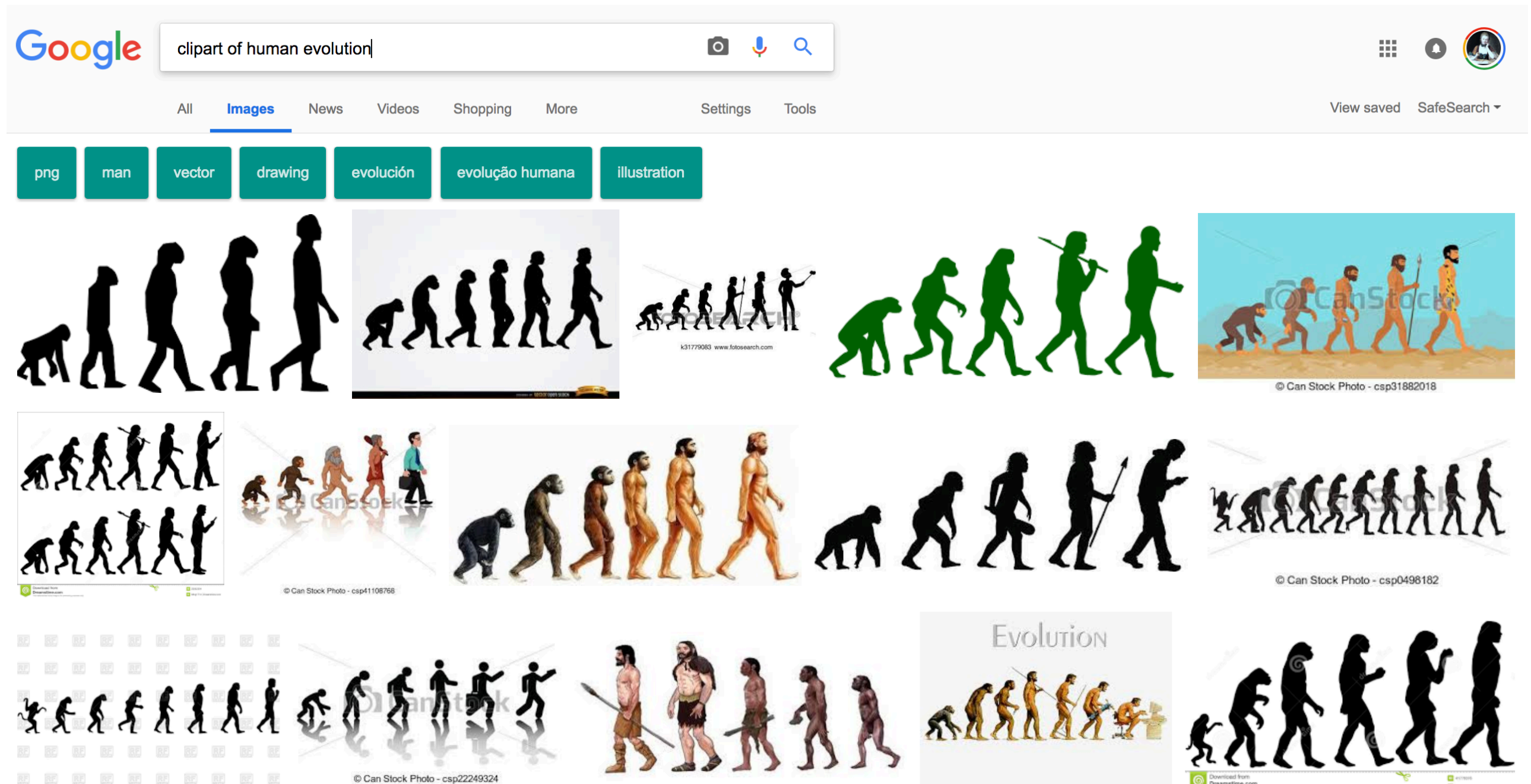




# Words, as time goes by

<b>courtesan</b>	<b>a woman who attends a royal court as a companion or adviser to the king or queen.</b>	<b>Courtier</b>
	<b>a prostitute, especially one with wealthy or upper-class clients.</b>	
<b>Mistress</b>	<b>a woman in a position of authority or control.</b>	<b>Master</b>
	<b>a woman having an extramarital sexual relationship, especially with a married man.</b>	
<b>Governess</b>	<b>a woman employed to teach children in a private household.</b>	<b>Governor</b>

Searching for an illustration that would help me put things in perspective,  
went to google images once more



The conclusion seems to be the that humans evolved to be white and male... does this mean that some of us do not exist?....



# Contributions to the accumulation of disadvantage.

1924 :  
Most men ask "Is  
she pretty?" not "Is  
she clever?"

Most men ask  
"Is she pretty?"  
not "Is she clever?"

Freshness, Charm—the Enticement of a  
Skin More Precious than Personality or  
Cleverness—do you seek it? Then for  
One Week Follow this Simple Beauty  
Method which is Bringing it to Thousands

Often we marvel at her—the girl whose  
only asset is her beauty. She knows so little  
and says so little; yet serenely attracts every-  
one to her side. Too often her clever rival sits  
in a corner, alone.

\* \* \*

Brains or beauty?—but why choose? Com-  
bine beauty with cleverness, charm with wis-  
dom. Develop your beauty to bring out the  
sweetness of your personality. That's what  
thousands of girls have done—and found  
new happiness as a result.

The means are simple. Have a pretty skin  
—remember, you can, if you try. Costly beauty  
treatments are unnecessary—just daily use of  
palm and olive oils as embodied in Palmolive.

It is worth trying for this charm thousands  
have, the clear, fresh skin you want—do this  
one week, then note the change.

Use powder and rouge if you wish. But  
never leave them on over night. They clog  
the pores, often enlarge them. Blackheads and  
disfigurements often follow. They must be  
washed away.

Wash your face with soothing Palmolive.  
Then massage softly into the skin. Rinse thor-

oughly. Then repeat both washing and rins-  
ing. Apply a touch of cold cream—that is all.

Do this regularly, and particularly in the  
evening. *The world's most simple  
beauty treatment*

Thus, in a simple manner, millions since the  
days of Cleopatra have found beauty, charm  
and youth prolonged.

No medicaments are necessary. Just remove  
the day's accumulations of dirt and oil and  
perspiration, cleanse the pores, and Nature  
will be kind to you. Your skin will be of fine  
texture. Your color will be good. Wrinkles  
will not be your problem as the years advance.

*Avoid this mistake*

Do not use ordinary soaps in the treatment  
given above. Do not think any green soap,  
represented as made of palm and olive oils,  
is the same as Palmolive. Palmolive is a skin  
emollient in soap form.

And it costs but 10c the cake!—so little  
that millions let it do for their bodies what  
it does for their faces. Obtain a cake today.  
Then note what an amazing  
difference one week makes.

*Note carefully the  
name and wrapper.  
Palmolive Soap is  
never sold unwrapped*

*Palm and olive oils  
—nothing else—give  
nature's green color  
to Palmolive Soap.*

*Volume and  
efficiency produce  
25c quality  
for only*  
**10c**

**PALMOLIVE**

Copyright 1924—The Palmolive Co. 2367



# Contributions to the accumulation of disadvantage.

1939



1952



We overheard that plaint ... 'If my hair looks such a mess *one more* night, I'll kill myself!'"



Contributions to the accumulation of disadvantage.

1952

# If your husband ever finds out *you're not "store-testing" for fresher coffee...*

... if he discovers you're  
still taking chances  
on getting flat, stale coffee  
... woe be unto you!

For today  
there's a sure  
and certain way  
to test for freshness  
before you buy







2011

THE STATUS QUO

This mother's day,  
Get back to the job  
that really matters





1934



Contributions to the accumulation of disadvantage.

1965



2015



# Contributions to the accumulation of disadvantage.

1970

**SIMPLE ENOUGH FOR A  
WOMAN TO DRIVE. PHEW.**



2008

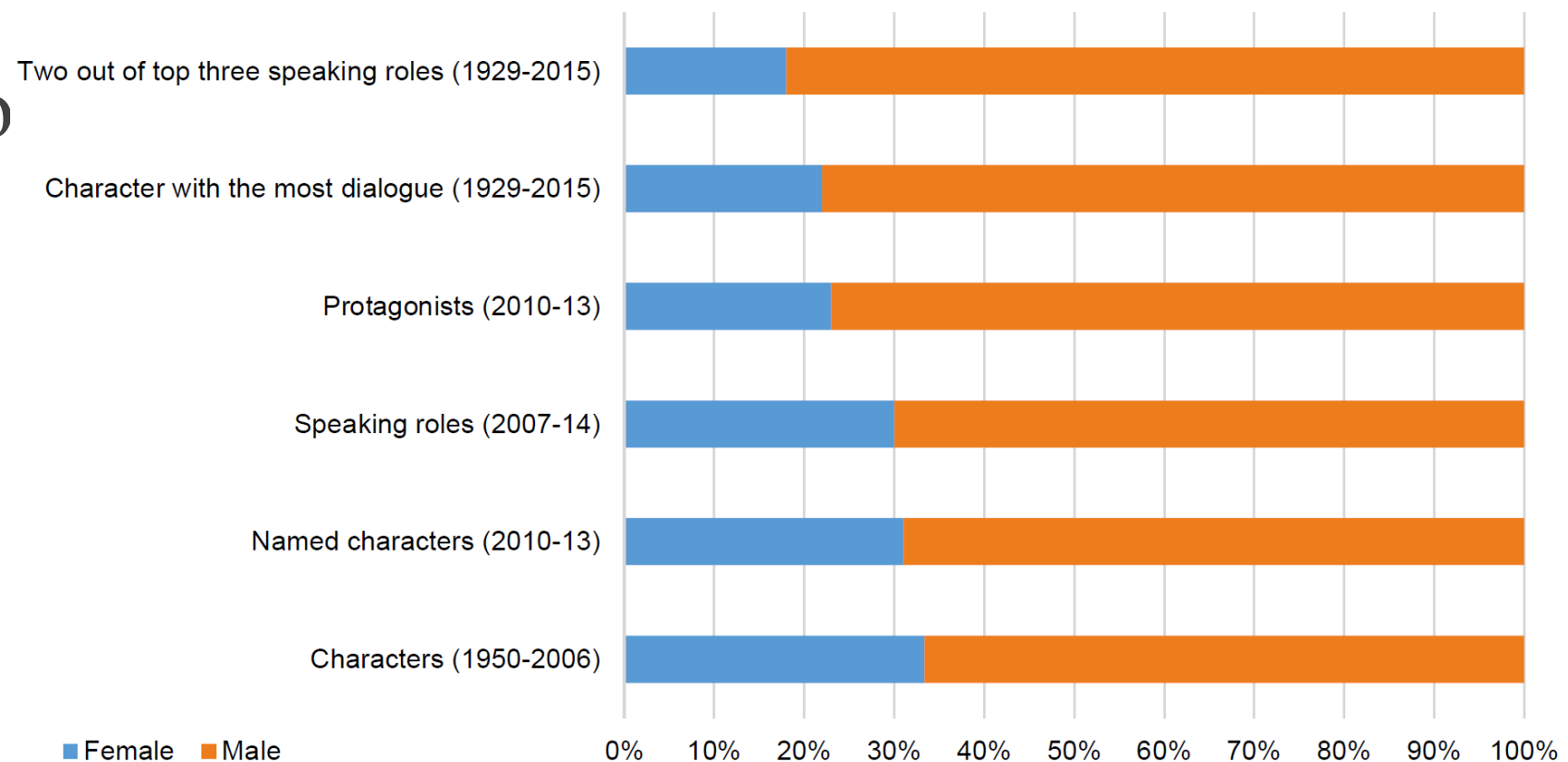
Used BMW's  
You know you are not the first.  
But do you really care?



# Bechdel–Wallace test

To pass the test, a movie, TV show (video game, comic..), must

1. have at least two women in it,
2. who talk to each other,
3. about something other than a man



Graph from Wikipedia

Variation: two ethnic minorities talk to each other for more than five minutes about something other than race



You dad will have to chase the boys away when you are older

**Contributions to the accumulation of disadvantage.**

**You are asking for it**

**like a girl**

You'd be really pretty if you  
just made an effort.

**Aren't you cute?**

**You're such a bitch.**

**"You'll want kids one day."**

He picks on you  
because she likes you

**You won't like that job; you'll have to be  
focused on technology.**

**Is it that time of the month?**

**man up!**

**slut**

**You'd be much prettier if you smile.**

**Can't you take a joke?**

**You're bossy.**

**"Calm down."**

**"Nice [insert objectified body part here]."**

**"Your body/clothing/appearance is 'distracting.'"**

**Can women have it all?**

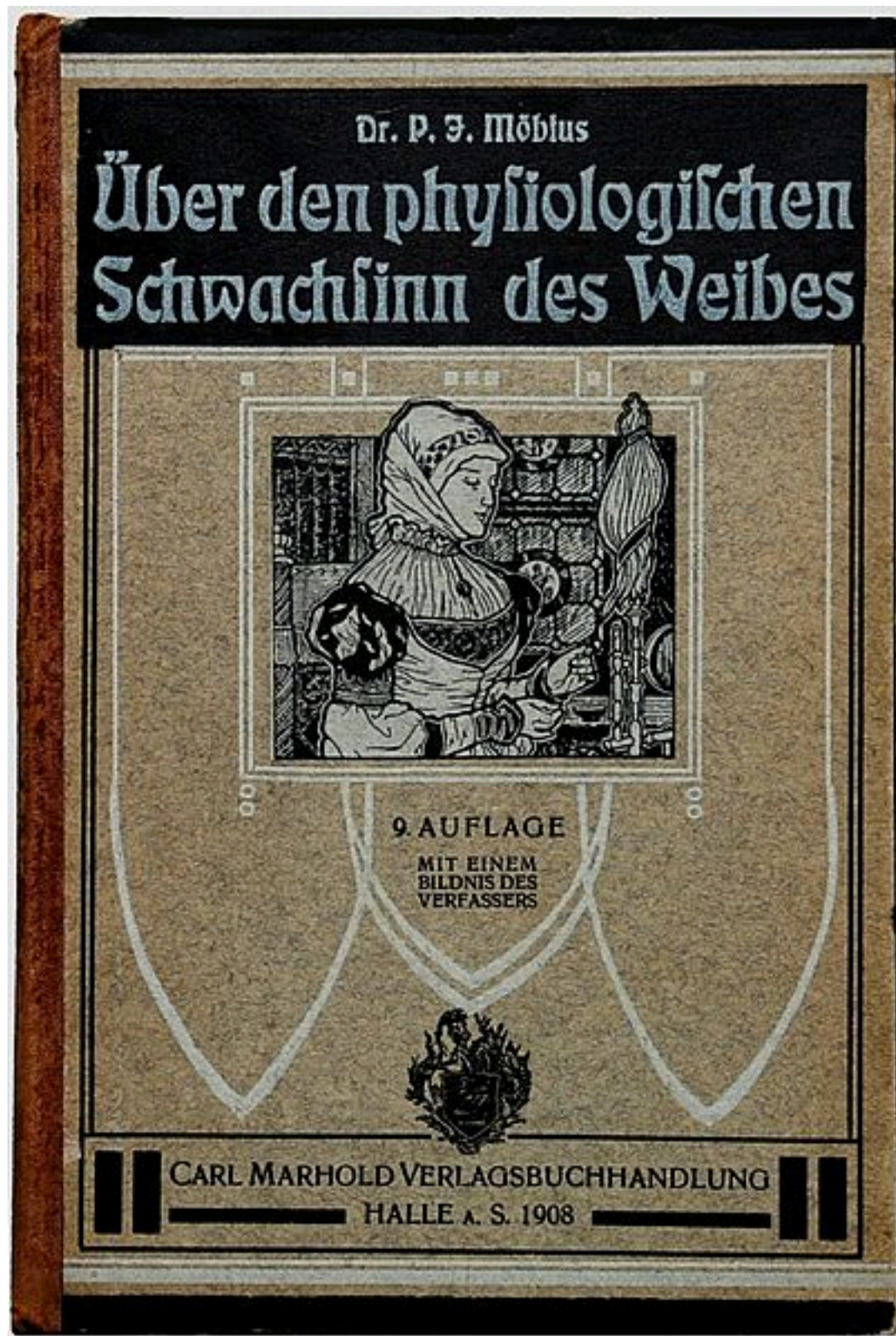
You must have been  
beautiful when you were  
younger.

**prude**

don't wear that to school you  
are going to distract the boys



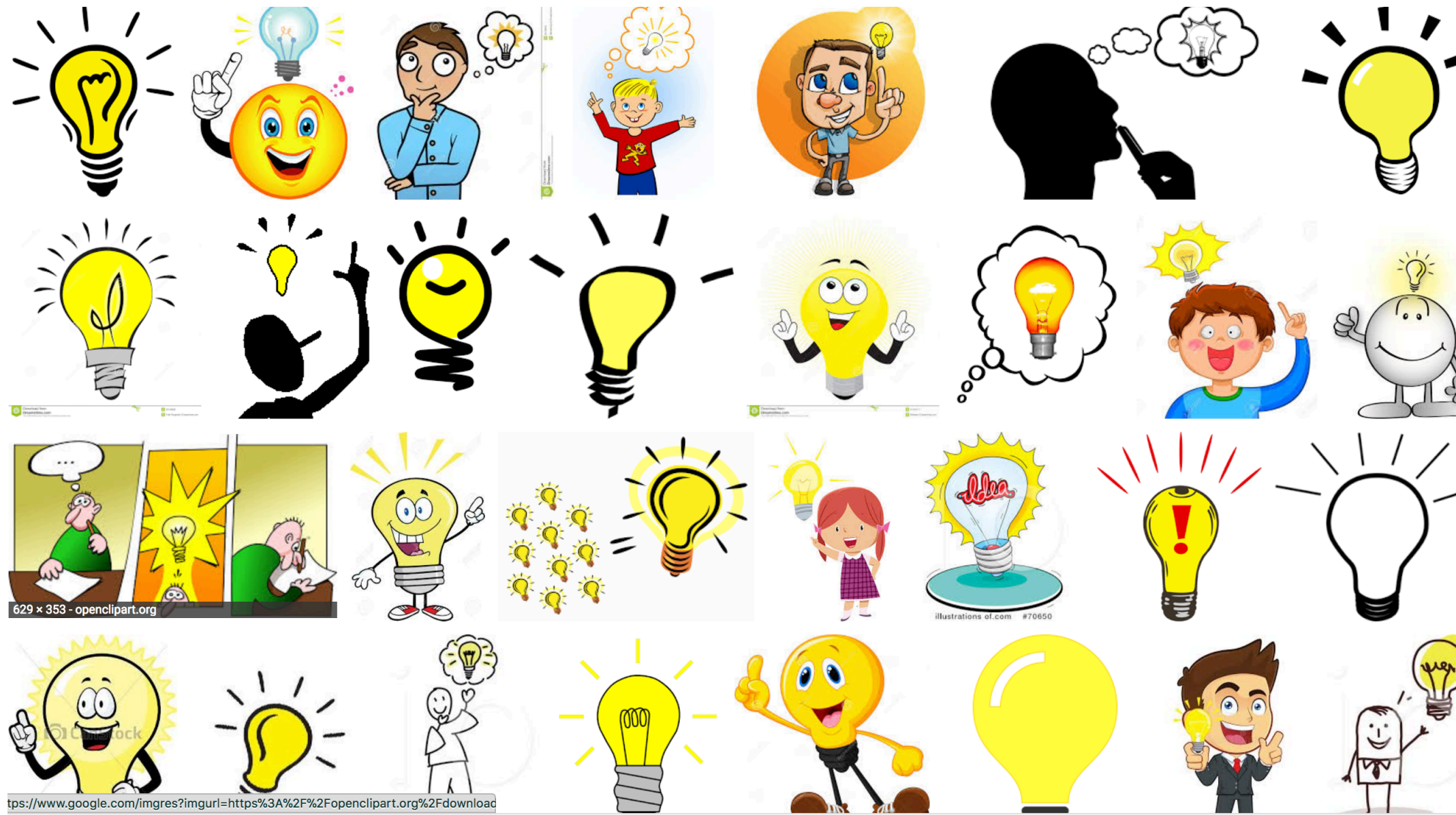
Contributions to the accumulation of disadvantage.



- ❖ On the Physiological Feeble-Mindedness of Woman, P.J. Möbius Published in 1900, by 1906, eight editions had appeared.
- ❖ (Irrelevant Coincidence: P.J. Möbius was the grandson of Augustus Möbius Band.)



While preparing a talk, I wanted to emphasize an idea. I searched in Google for the classical cartoon with a person and floating lightbulb



Human beings in “idea clipart” are male with one exception and white, with no exceptions.



In the last 12 years,

- **women** made up, on average, **24% of the bench**,
- **32% of interruptions were of the female justices**,
- **4% were by the female justices.**



	% Women	%interrup. to all women	%interrup. to each woman
1990	11.11%	35.70%	35.70%
2002	22.22%	45.30%	22.65%
2015	33.33%	65.90%	21.97%



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..don't forget that Ginger Rogers did everything Fred Astaire did,  
...backwards and in high heels."

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**I love math  
Baseball T-Shirt**

★★★★★ (52)

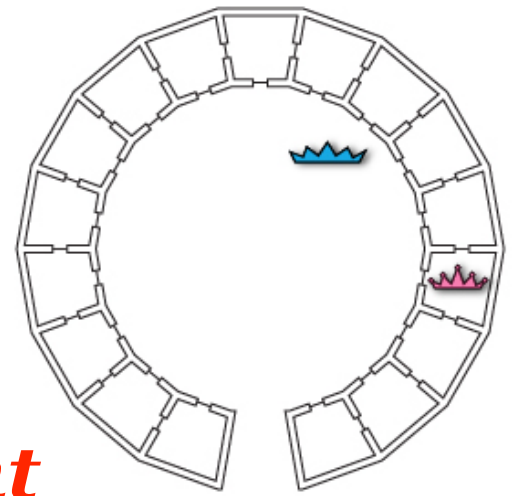


THE STATUS  
QUO IN MATH



# The Princess Problem

BY GARY ANTONICK JANUARY 27, 2014 12:00 PM



A **princess lives in a row of seventeen adjacent rooms**, each connected by a door to each room next to it. Each room also has a door to the outside. The princess enjoys the rooms but never stays in the same room two days in a row: at the end of each day she moves from the room she occupied to one of the rooms next to it (she chooses randomly).

On the first of June a **prince arrives from a faraway kingdom to woo the princess**. The princess's guardian explains the habits of the princess and the rules he must follow: Each day he may knock on a single outside door. If the princess is behind it she will open it and meet the prince. If not, the prince gets another chance the next day. Unfortunately the prince must return to his kingdom on July 1. Can he devise a strategy to make sure he meets the princess before then?



“Math class is tough. Want to go shopping? Okay, meet me at the mall.



1992

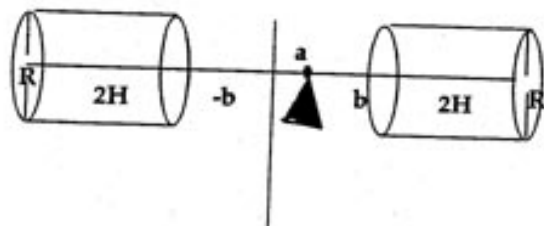
Issues that contribute to the accumulation of disadvantage.



# Aphorism attributed to mathematician Hermann Weyl

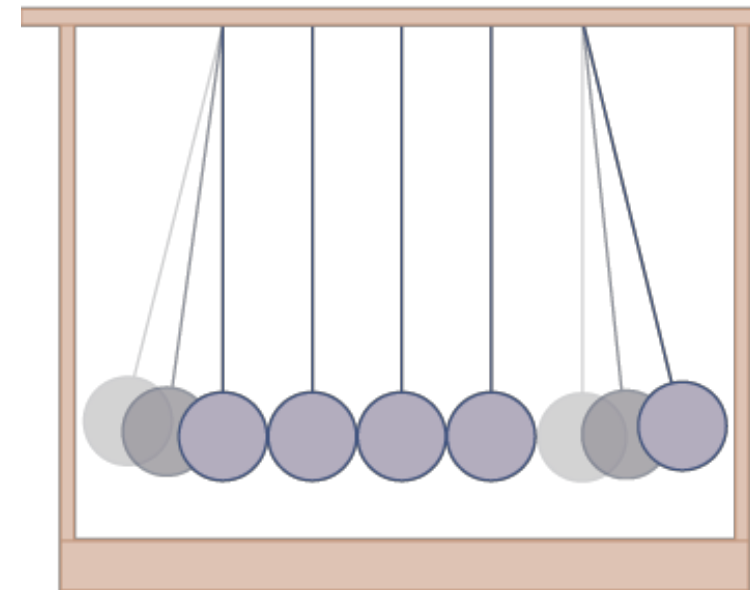
There are only two females in the history of math, Sofia Kovalevskaya and Emmy Noether:

the former wasn't a mathematician,  
the latter wasn't a woman.



Kovalevskaya  
Gyroscope

$$b^2 = H^2 - \left(\frac{1}{4}\right)R^2$$
$$a^2 = \left(\frac{1}{3}\right)H^2 - \left(\frac{1}{4}\right)R^2$$



Issues that contribute to the  
accumulation of disadvantage.

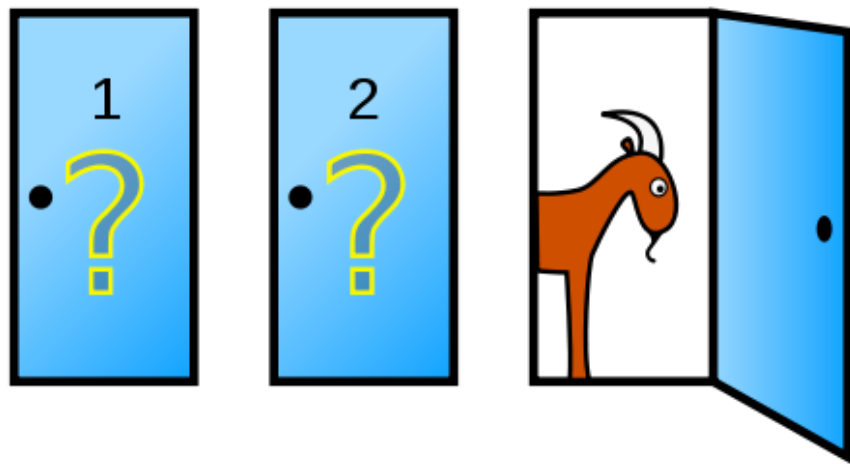


## G. H. Hardy, 1940 , A Mathematician's Apology,

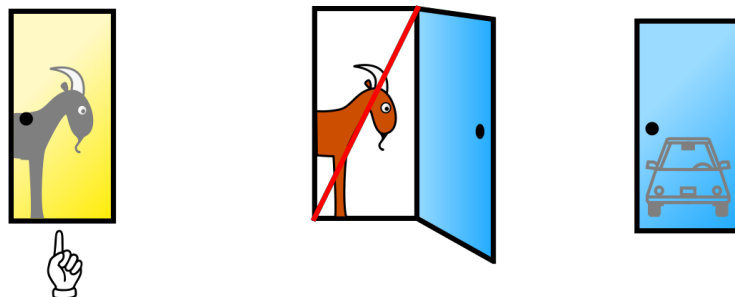
No mathematician should ever allow himself to forget that **mathematics**, more than any other art or science, is a young **man's** game.







**Marilyn vos Savant** is a magazine columnist (with the highest recorded IQ according to the Guinness Book of Records) . She writes column where she solves puzzles and answers questions on various subjects. The most famous of them was the **Monty Hall problem**.



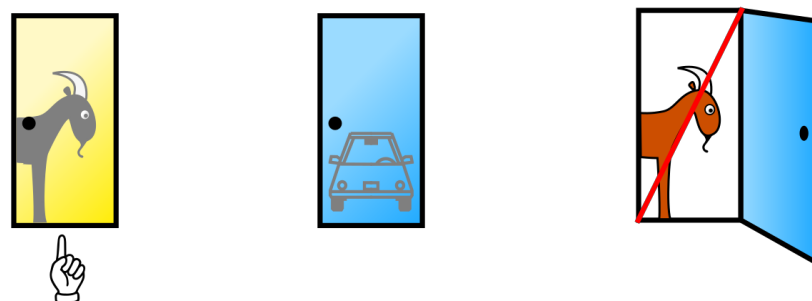
Switch  
and win

On a game show, you're given the choice of three doors:

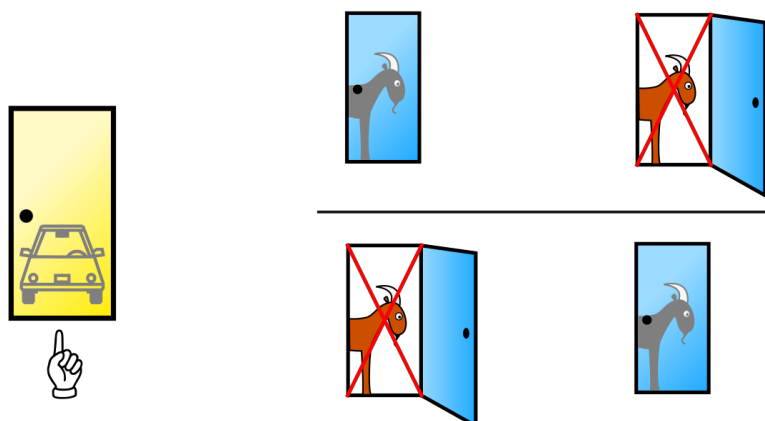
Behind one door is a car; behind the other two, goats.

You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat.

Then the host says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?



Switch  
and win



Stay  
and win

Player choice  
before door is open



**Of the letters from the general public, 92% are against my answer, and of the letters from universities, 65% are against my answer.**

Since you seem to enjoy coming straight to the point, I'll do the same. You blew it!

**MAYBE WOMEN LOOK AT MATH PROBLEMS DIFFERENTLY THAN MEN.**

**You are the goat!**

I am sure you will receive many letters on this topic from high school and college students. Perhaps you should keep a few addresses for help with future columns.

**I am in shock that after being corrected by at least three mathematicians, you still do not see your mistake.**

"Our math department had a good, self-righteous laugh at your expense,"

**You are utterly incorrect about the game show question, .... How many irate mathematicians are needed to get you to change your mind?**

**MAY I SUGGEST THAT YOU OBTAIN AND REFER TO A STANDARD TEXTBOOK ON PROBABILITY BEFORE YOU TRY TO ANSWER A QUESTION OF THIS TYPE AGAIN?**

You blew it, and you blew it big! Since you seem to have difficulty grasping the basic principle at work here, I'll explain. There is enough mathematical illiteracy in this country, and we don't need the world's highest IQ propagating more. Shame!

**This is a call to math classes all across the country. Set up a probability trial exactly as outlined below and send me a chart of all the games**

**Play "not switching" two hundred times and keep track of how often the contestant wins.**

**Play "switching" two hundred times**



	% of female grad students	% tenured women
Harvard	9.1	5.6
Brown	32.6	5.6
MIT	17.8	7.9
Yale	10.7	9.1
Chicago	27.8	9.4
Princeton	28.6	10.0
Cornell	28.1	10.3
Stony Brook	11.3	11.4
CalTech	12.5	11.8
UIC	35.1	11.9
Texas-Austin	36.5	13.3
Michigan	29.4	16.9

Faculty and grad students body in some top math departments  
(Data from 2015 AMS website)



# Stony Brook Math Department Composition in 2015

Equal calls equal

Origin	Total	%
US	16	45.7
Russia	8	22.9
British	2	5.7
China	2	5.7
Israel	2	5.7
Argentina	1	2.9
Germany	1	2.9
Netherlands	1	2.9
Romania	1	2.9
Italy	1	2.9
	35	100.0

## Applicants to SB Math Dept. 2015

Applicant Race (for 5 jobs out 5 posted)	Total Appl		Asian or Pacific Islander		Black		Hispanic		Other		White		Unknown		Int'l Appl	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Male	1008	80.51%	329	79.66%	10	100%	33	86.84%	27	81.82%	602	83.03%	7	21.21%	302	82.74%
Female	216	17.25%	83	20.10%			5	13.16%	6	18.18%	121	16.69%	1	3.03%	54	14.79%
Unknown	28	2.24%		0.24%							2	0.28%	25	75.76%	9	2.47%
Total Appl	1252	100%	413	32.99%	10	0.80%	38	3.04%	33	2.64%	725	57.91%	33	2.64%	365	29.15%



17%

- In 2014-2015, 1214 Ph.D.s in pure math were granted in the US
- 26% of those were granted to women.

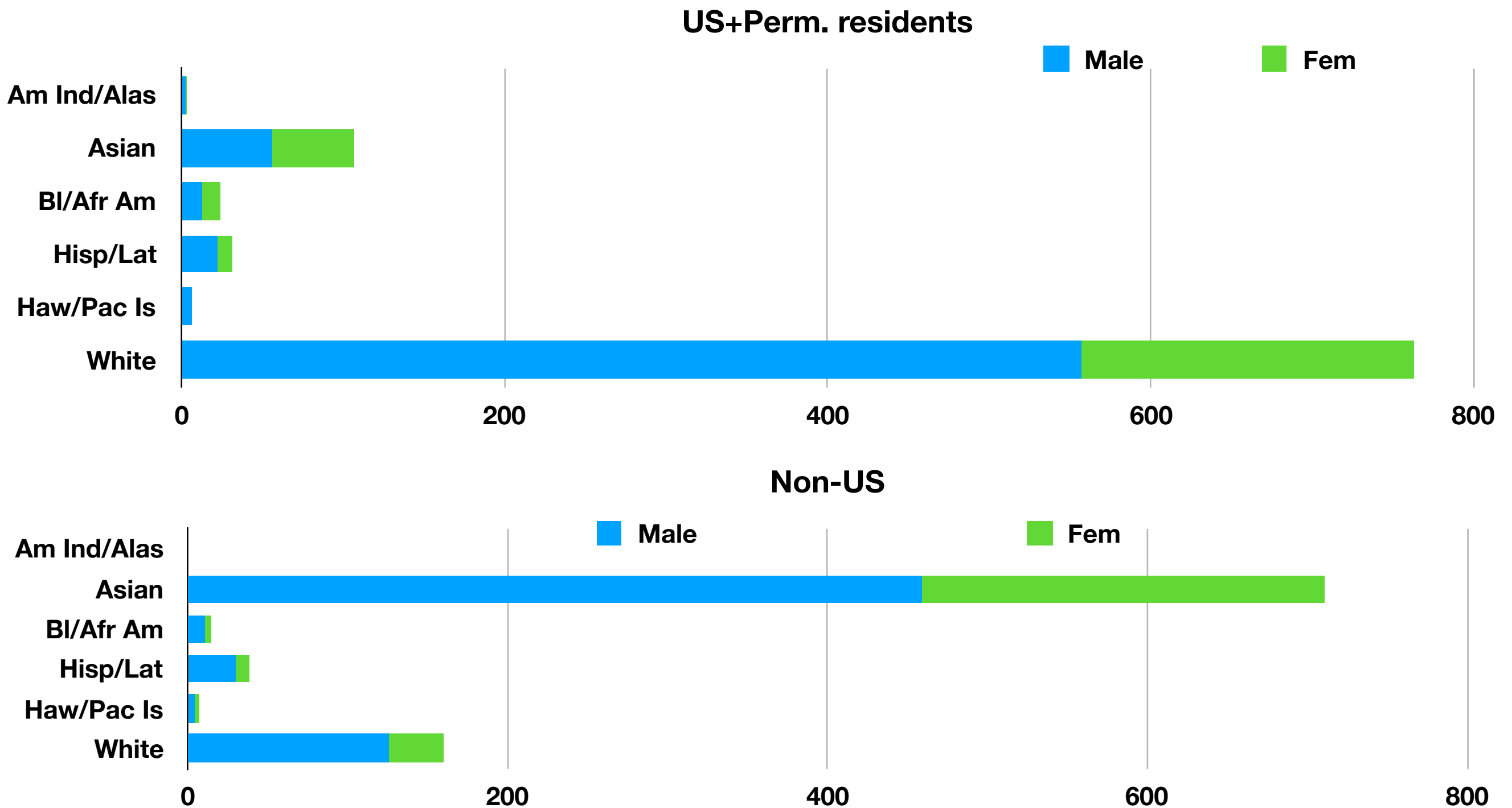
Women disqualify themselves



# All Math Ph.D's in 2015 (including statistics, biostatistics)

	US+Perm.			Non-US			
	Total	Male	Fem	Total	Male	Fem	Total
<b>Am Ind/Alas</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Asian</b>	<b>107</b>	<b>56</b>	<b>51</b>	<b>711</b>	<b>459</b>	<b>252</b>	<b>818</b>
<b>Bl/Afr Am</b>	<b>24</b>	<b>13</b>	<b>11</b>	<b>15</b>	<b>11</b>	<b>4</b>	<b>39</b>
<b>Hisp/Lat</b>	<b>32</b>	<b>22</b>	<b>10</b>	<b>38</b>	<b>30</b>	<b>8</b>	<b>70</b>
<b>Haw/Pac Is</b>	<b>6</b>	<b>6</b>	<b>0</b>	<b>7</b>	<b>4</b>	<b>3</b>	<b>13</b>
<b>White</b>	<b>763</b>	<b>557</b>	<b>206</b>	<b>160</b>	<b>126</b>	<b>34</b>	<b>923</b>
<b>Unknown</b>	<b>19</b>	<b>15</b>	<b>4</b>	<b>15</b>	<b>8</b>	<b>7</b>	<b>34</b>
<b>TOTAL</b>	<b>955</b>	<b>672</b>	<b>283</b>	<b>946</b>	<b>638</b>	<b>308</b>	<b>1901</b>

# All Math Ph.D's in 2015 (including statistics, biostatistics)





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# Imposter Syndrome or Feeling

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Two American psychologists, Pauline Clance and Suzanne Imes, coined the term in 1978

They described it as a **feeling of “phoniness in people who believe that they are not intelligent, capable or creative despite evidence of high achievement.”** While these people “are highly motivated to achieve,” they also “**live in fear of being ‘found out’ or exposed as frauds.**”

Two issues are sometimes merged under the imposter feeling umbrella: “feeling like a fraud” and “being treated like a fraud”.

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# Implicit bias

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- **Implicit bias manifests in expectations or assumptions about physical or social characteristics dictated by stereotypes that are based on a person's race, gender, age, or ethnicity.**
- People who intend to be fair, and believe they are egalitarian, **apply biases unintentionally.**
- Some behaviors that result from implicit bias (...) can either can reduce the quality of the workforce or create an unfair and destructive environment.

Jo Handelsman and Natasha Sakraney  
(President Obama's) White House Office of Science and Technology Policy



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# Ranks of men and women in academia

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- (...) men and women [in academia] start out on roughly equal footing.
- (...) several years down the line, the men are earning more, and they are being promoted at a faster rate than the women are.
- (...) in a group of people with outstanding early promise, will the men and women advance equally in academia? (.. ) After 10 to 12 years, the men were almost a full rank ahead of the women.

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# Publishing in academia

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- ❖ (...) men in academia publish more than women do,
  - Even when you control for productivity, men still advance more rapidly than women do.
  - Although **men publish comparatively more papers, women's papers have a higher citation rate**





# SEXUAL HARASSMENT



# Is it sexual harassment?

## How would you proceed?

- ❖ You (a grad student) are in a conference. A senior person approaches you and starts talking about the talk you both just attended. You listen attentively, asking an occasional question. The senior person looks at you in the eyes and caresses your shoulder.
- ❖ You (a grad student) are in a conference. Along the whole weekend, a senior person sits at your side in every talk and constantly fixates eyes on you.
- ❖ You (a grad student) receive insistent offers of intimate nature from a senior person.



# Sexual harassment includes:

- Unwelcome sexual advances.
- Unwanted touching or physical contact.
- Verbal harassment of a sexual nature, including jokes referring to sexual acts or sexual orientation.
- Discussing sexual relations/stories/fantasies at work, school, or in other inappropriate places.
- Unwanted sexually explicit photos, emails, or text messages.
- Requests for sexual favors.
- Making conditions of employment or advancement dependent on sexual favors, either explicitly or implicitly.
- Pressure to engage with someone sexually.
- Exposing oneself or performing sexual acts on oneself.
- Physical acts of sexual assault.

# Sexual harassment

sexist hostility:

gender harassment:

“put-downs”

crude harassment

Unwanted sexual attention

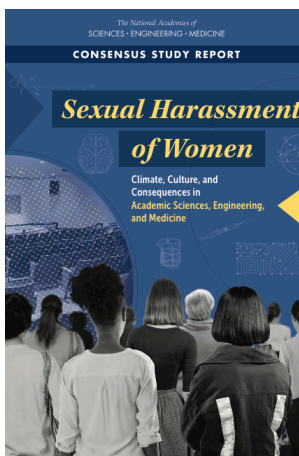
“come-ons”

Impact ≠ Intent

Sexual coercion

Both women and men can and do experience all three forms of sexual harassment, but some subgroups face higher rates than others (e.g. LGTB, POC)

Sexual Harassment of Women, Nac. Acad. Science, Med, and Eng., 2018





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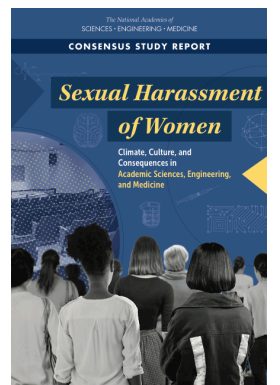
# Sexual harassment in academia

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Academic workplaces are second only to the military in the rate of sexual harassment, with 58 percent of academic employees indicating they had such experiences, according to one study cited in the report.

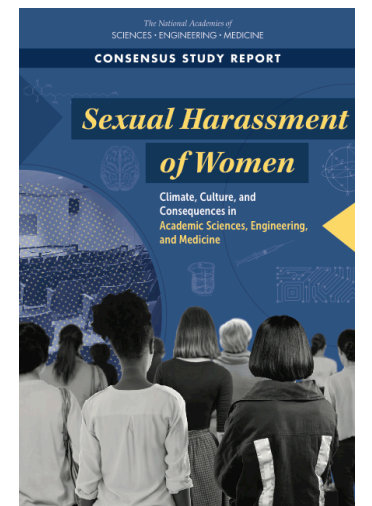
“There is no evidence to suggest that current policies, procedures, and approaches have resulted in a significant reduction in sexual harassment,”

NYTimes-June 12 ,2018 about  
Nacional Academies for Sciences, Enginering and Medicine



Sexual harassment undermines women's professional and educational attainment and mental and physical health.

“The **cumulative** effect of sexual harassment is significant damage to research integrity and a costly loss of talent in academic sciences, engineering, and medicine.”



2018 Report by National Academies for Sciences, Engineering and Medicine



# Sexual harassment

- ❖ **gender harassment:** verbal and nonverbal **behaviors** not aimed at sexual cooperation but that **convey insulting, hostile, and degrading attitudes** about members of one gender.
  - ➔ **sexist hostility:** demeaning jokes or comments about women, comments that women do not belong in leadership positions or are not smart enough to succeed in a scientific career, and sabotaging women
  - ➔ **crude harassment** use of sexually crude terms that denigrate people based on their gender
- ❖ **Unwanted sexual attention:** **Unwelcome sexual advances, which can include assault.** Examples include repeated requests for dates and persistent attempts to establish sexual relationships despite rejection.
- ❖ **Sexual coercion:** A type of sexual harassment in which **favorable professional or educational treatment is conditioned on sexual activity** (such as through the use of bribes or threats). Examples include promises of a better grade or a letter of reference in exchange for sexual favors.

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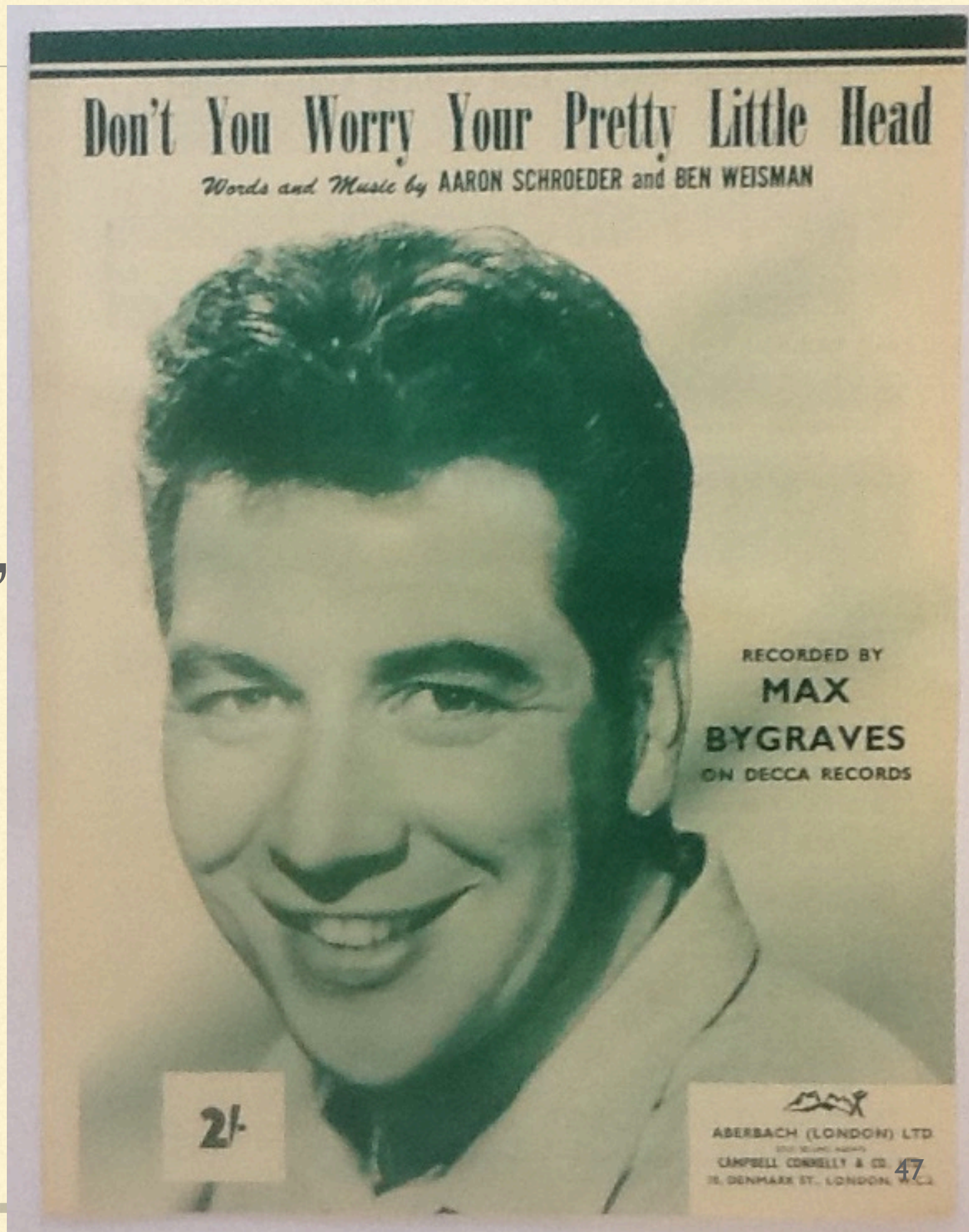
## Sexual harassment in academia: Suggestions of what to do/advice

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- Read the Callisto Survivor's Guide.  
<https://www.projectcallisto.org/survivors-guide.pdf>
- Document as much as possible: Write it down with details, take pictures, save messages, emails..
- Try to find people who went through the same situation.
- Report when and if you are ready.
- Tell a friend.
- Talk to a therapist
- Have an answer prepared



# POSSIBLE EXPLANATIONS, MODELS





# Accumulation of disadvantage

- ❖ **nothing seems overtly wrong** in most work situations, especially in academia and science, where the **meritocratic ethos** is so prominent.
- ❖ People are often unable to perceive or assess **how small imbalances can really add up.**
- ❖ Any single instance of bias is likely to be tiny, and someone might say, **you're making a mountain out of a molehill.**



**Mountains are molehills piled one on top of the other**

Virginia Valian, 1998



# Accumulation of disadvantage

- Members of a simulated organization were assigned a score with a normal distribution.
- 1% of bias points were added to men.
- At the lowest level of the pyramid there were as many women as there were men.
- At the end of the simulation, top of the pyramid, the highest career level, the distribution was 65% men, 35% women.

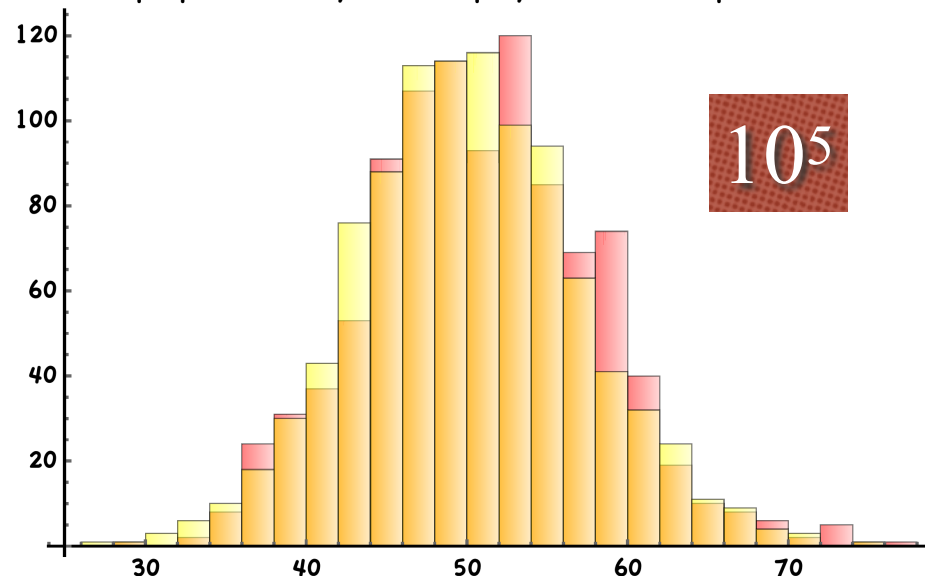
The cause for such distribution is the repeated disadvantage of 1%.



Martell, David, Emrich, 1996

A each hour, each yellow employee has 1% disadvantage in ascending.  
 In the begining, there are 1000 yellow employees and 1000 red employees.  
 The graphs of the two distributions after 100000 hours are shown below, overlapped.  
 There are 39 red employees in the top 5% and 39 yellow employees in the top 5%.

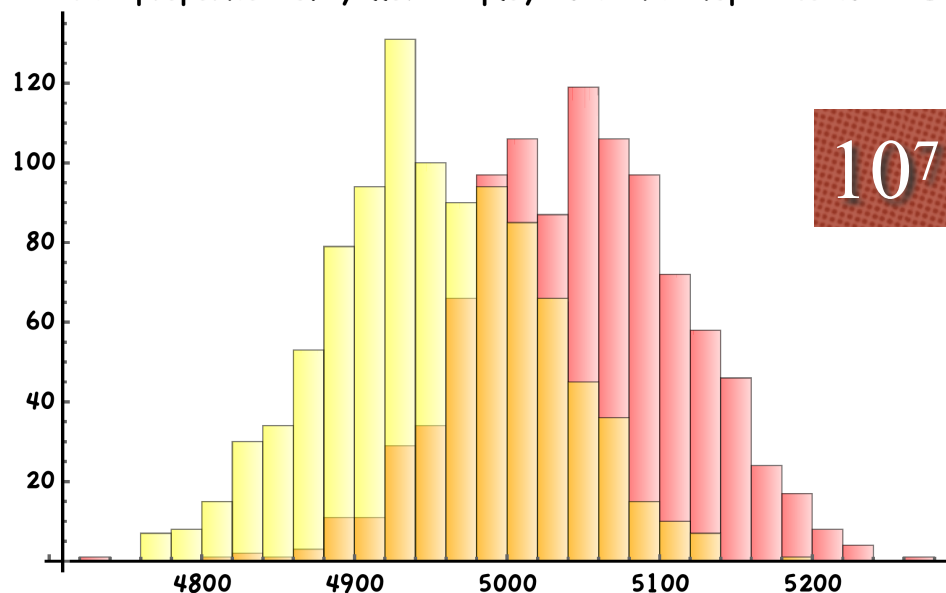
The proportion of yellow employees in the top 5% is 0.50.



A each hour, each yellow employee has 1% disadvantage in ascending.

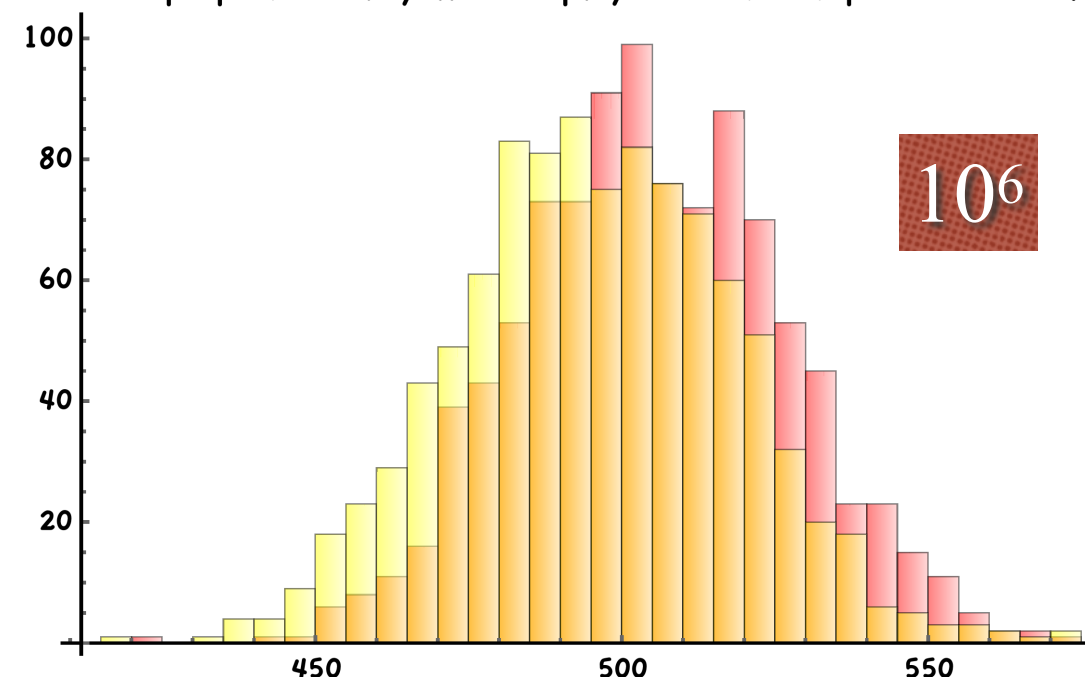
In the begining, there are 1000 yellow employees and 1000 red employees.  
 The graphs of the two distributions after 10000000 hours are shown below, overlapped.  
 There are 98 red employees in the top 5% and 1 yellow employees in the top 5%.

The proportion of yellow employees in the top 5% is 0.01.



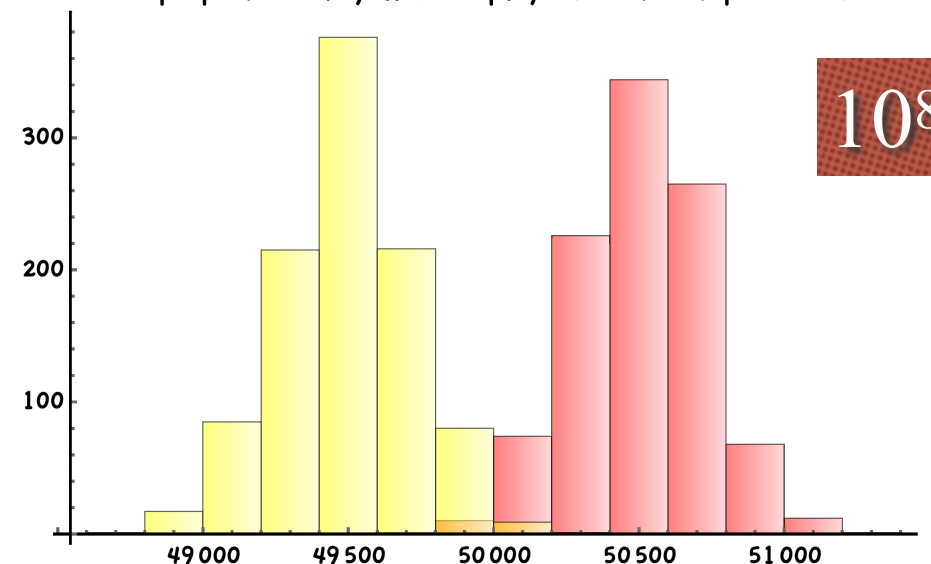
A each hour, each yellow employee has 1% disadvantage in ascending.  
 In the begining, there are 1000 yellow employees and 1000 red employees.  
 The graphs of the two distributions after 1000000 hours are shown below, overlapped.  
 There are 69 red employees in the top 5% and 26 yellow employees in the top 5%.

The proportion of yellow employees in the top 5% is 0.27.



A each hour, each yellow employee has 1% disadvantage in ascending.  
 In the begining, there are 1000 yellow employees and 1000 red employees.  
 The graphs of the two distributions after 100000000 hours are shown below, overlapped.  
 There are 100 red employees in the top 5% and 0 yellow employees in the top 5%.

The proportion of yellow employees in the top 5% is 0.





We tend to believe,

What is, is what ought to be...  
(Naturalization of the status quo)



A typical math department from a research university

...nothing seems overtly wrong in most work situations, especially in academia and science, where the meritocratic ethos is so prominent. (Valian, 1998)

# Lack of self-confidence

...students who were not going on to Calculus II choose from a list of potential reasons,

*'I do not believe I understand the ideas of Calculus I well enough to take Calculus II.'*

- Roughly **twice as many women as men chose this as one of their reasons.**
- Previous research suggests that the perceived lack of understanding by women is not because women do not actually understand the material as well as men;

Ellis, Fosdick, and Rasmussen, 2016



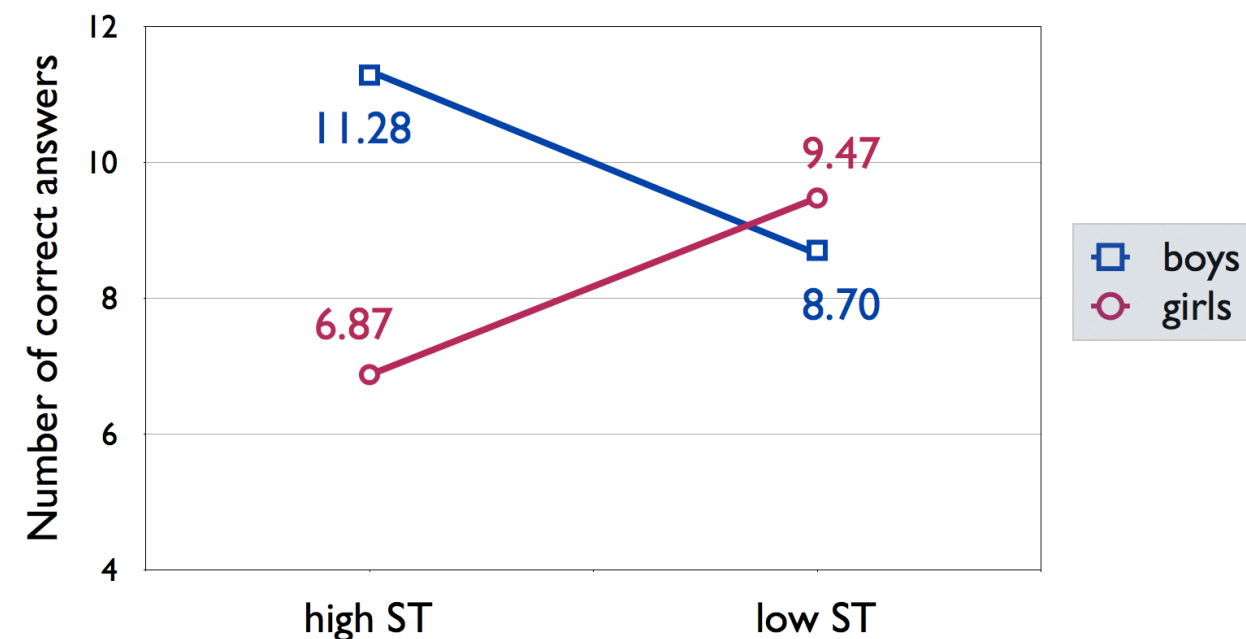
# Stereotype Threat

An instance: Women taking a math test will perform less well when told that women aren't expected to do well in math than when they are told that they can do well.

**Stereotype threat refers to a situation in which people are or feel themselves to be at risk of conforming to stereotypes about their social group..**

If negative stereotypes are presented regarding a specific group, group members are likely to become anxious about their performance, which may hinder their ability to perform at their maximum level"

Stereotype threat and test performance



The effect of stereotype threat (ST) on math test scores for girls and boys. Data from Osborne (2007)

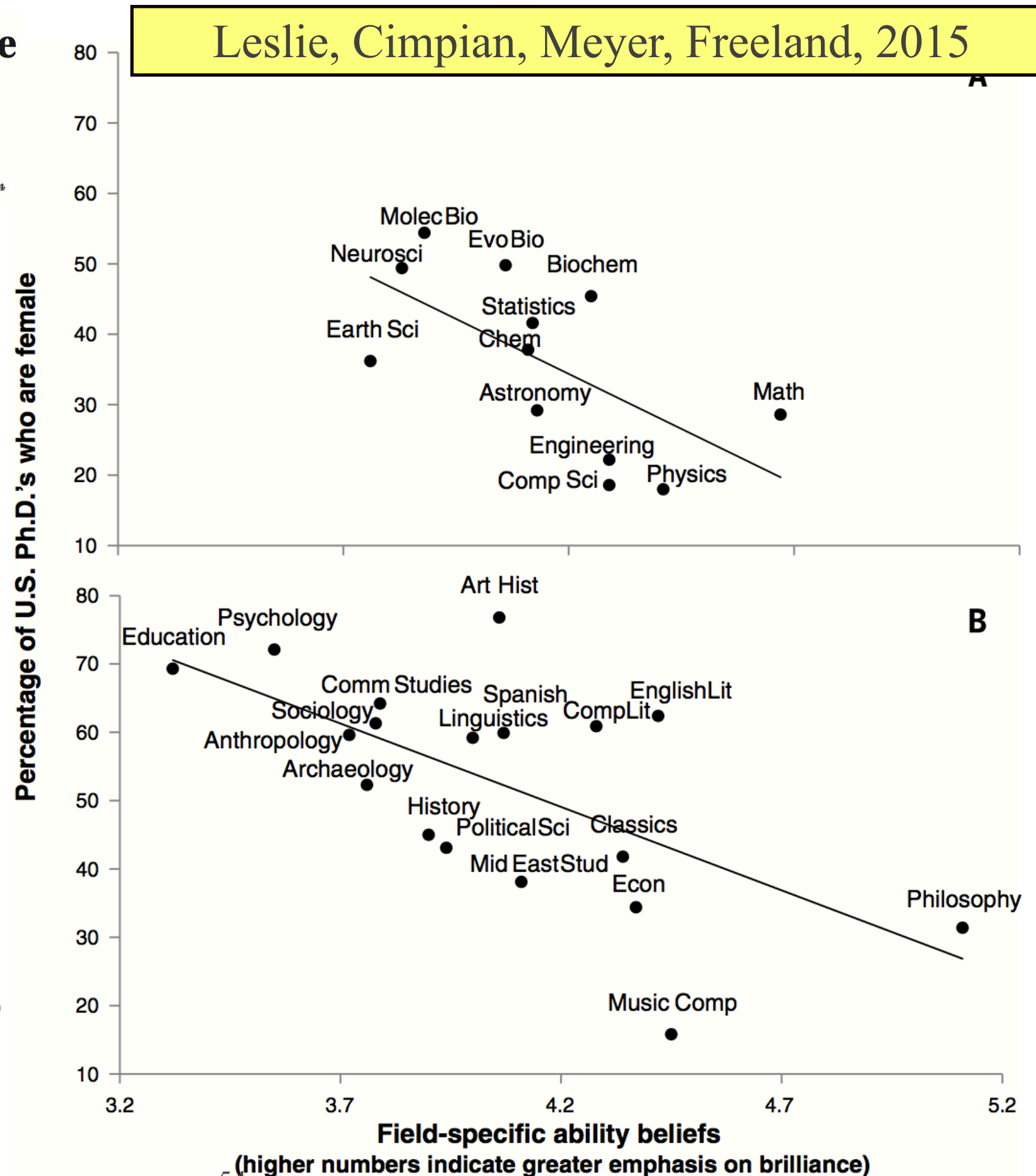
Steele, Aronson, Quinn, 1999

# Expectations of brilliance underlie gender distributions across academic disciplines

Sarah-Jane Leslie,<sup>1\*</sup> Andrei Cimpian,<sup>2\*</sup> Meredith Meyer,<sup>3</sup> Edward Freeland<sup>4</sup>

We hypothesize that, across the academic spectrum, **women are underrepresented in fields whose practitioners believe that raw, innate talent is the main requirement for success, because women are stereotyped as not possessing such talent.** This hypothesis extends to **African Americans'** underrepresentation as well, as this group is subject to similar stereotypes.

## Expectations of Brilliance





# Lack of role models



Role models

One of the initial difficulties I faced as a woman in math was the **lack of a role model**. Despite having kind and encouraging professors here at Stony Brook, **(often) being the only woman in the class, and not having a single female math professor resulted in self doubt. I found it hard to believe that women are good enough for math, or that I am good enough for math.** I blamed all my accomplishments on affirmative action. **This all changed once I met Professor Moira Chas.** Her passion for the subject, the vividness and enthusiasm with which she taught, dispelled every doubt I had with regard to the competence of women in math. Not only that, Moira helped, supported, and encouraged me through difficult times. I don't think I would have been where I am if not for Moira, and I want to pay forward what she has given me.

Apologies for the praise to Moira Chas, which is not the point of this slide.

Lea Kenigsberg (extract from her essay for an NSF grant proposal)

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Thao Do (who scored highest from the SB team on the Putnam the year we finished 4th in the country)

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An excerpt from an email she sent me when she was a Freshman at Stony Brook

“Interestingly, when I searched your email on gmail, I found out that you are the person who takes care of math club in our school, which I attend every week. Also, I think I met you once in the talk of Prof John Milnor. **I admire you a lot because I want to become a female math professor and I know that it is not easy.**”

Role models (my personal experience)

Apologies for the praise to Moira Chas. It is not the point of this paragraph



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Thao Do (who scored highest from the SB team on the Putnam the year we finished 4th in the country)

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An excerpt from a recent email.

I find it very important to have women mathematicians around. At MIT we have a strong female community; each year there's a nice party, and several talks per semester where we invite successful female mathematicians come to share about their career path. Most of my friends at MIT now are female; **I live with 2 other female grad students which is great because we often share our insecurities**, how we feel stupid in math, how uncertain the future is and how hard it must be to find a tenure job nowadays.

Having a  
community

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# Gender schemas

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- ❖ **Women may fear or suspect that their work will not be evaluated in same way a man's is**, so they need more documentation to back up what they are saying. **Men may be more willing to take a flier**, to come up with some intriguing hypothesis for which they have relatively meager data and just put it out there to be proven true or false. Women may believe, perhaps correctly, that they are less likely to be given the benefit of the doubt, and that their off-the-cuff ideas will be dismissed as foolish. **We associate risk-taking behavior with men, and we may be less tolerant of intellectual risk-taking in women.**
- ❖ In many professional situations, **our gender schemas have the effect of making a man seem slightly more qualified and competent than he is, and a woman slightly less**



# Remember the words of former Harvard president Larry Summers?

There are **three broad hypotheses** about the sources of the very substantial **disparities** with respect to the presence of **women in high-end scientific professions**

- ❖ the first is what I call the high-powered job hypothesis... what fraction of young women in their mid-twenties make a decision that **they don't want to have a job that they think about eighty hours a week.**
- ❖ The second is what I would call **different availability of aptitude at the high end**, and
- ❖ The third is what I would call **different socialization and patterns of discrimination in a search.**

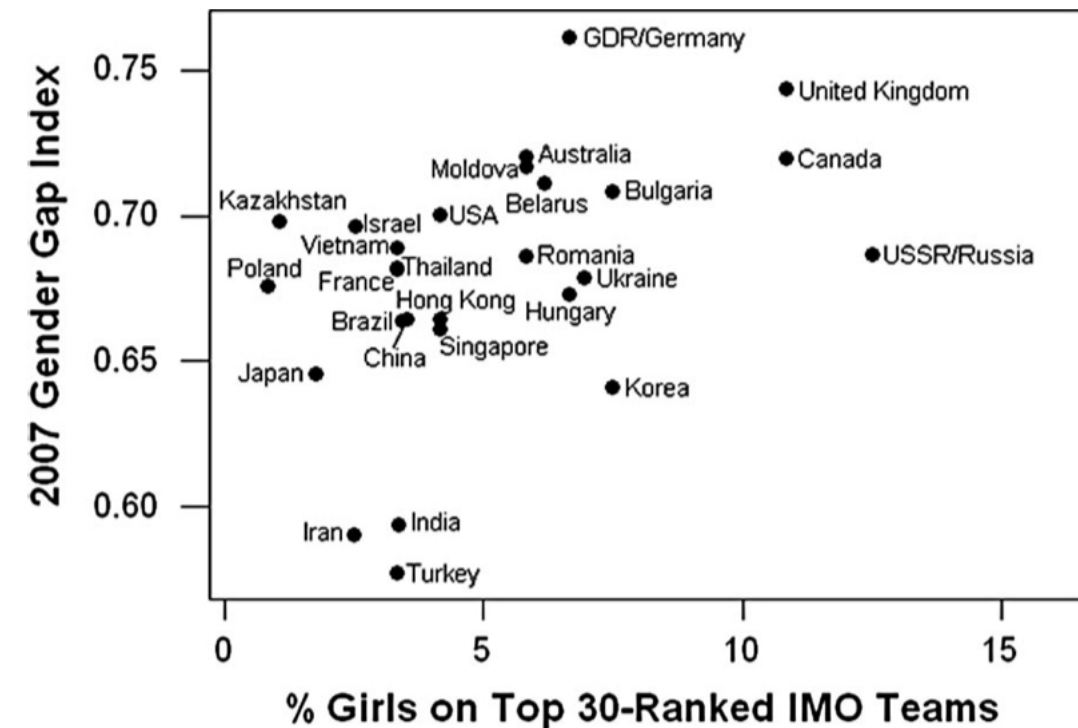


Fig. 3. Presence of females on top 30-ranked IMO teams strongly correlates ( $r = 0.44$ ,  $P < 0.05$ ) with measures of gender equity within countries. The IMO data for percentage of girls on countries' teams from 1989 to 2008 were taken from Table 4. The GGIs were taken from ref. 30.

## Variability Hypothesis? Hill recent paper

Side note: tests developed in the US (...) include almost no questions requiring complex problem solving.

- US girls perform as well as boys on standardized math tests at all grade levels.
- Among the mathematically gifted, there may be as many as 2-to 4-fold more boys than girls.
- **This gender gap has been closing over time at all levels.**

Hyde and Mertz, 2009



WHY DIVERSITY?



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# Why diversity? (my take on it)

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- ❖ We do not want to lose good mathematicians (by being biased)
- ❖ We should be fair, as fair as we can.
- ❖ Diversity helps to achieve excellence (by studying problems from different points of view)
- ❖ We want to attract and retain a diverse body of (grad and undergraduate) students, and a diverse faculty.
- ❖ To make High Authorities happy

# IDEAS FOR INDIVIDUAL SURVIVAL AND CHANGE





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# Ideas for Individual Survival and change

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- ❖ **Offer support** to someone else who feels insecure.
- ❖ **Find a community.** If you cannot find members of a community locally, follow a Twitter feed ( #BLACKandSTEM or #womenandSTEM can serve as reassurance that they really do belong in science. )

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# Ideas for Individual Survival and change

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- ❖ Remember and remind people that **mistakes are valuable (if you learn from them)**. They help in the learning process and produce brain growth. (Jo Boaler)
- ❖ Do not interpret a failure as “I am not good enough at this”.



# Ideas for Individual Survival and change

Emphasize the “**growth mindset**” as opposed to the “**fixed mindset**”.

FIXED MINDSET		GROWTH MINDSET
<ul style="list-style-type: none"><li>• SOMETHING YOU'RE BORN WITH</li><li>• FIXED</li></ul>	SKILLS	<ul style="list-style-type: none"><li>• COME FROM HARD WORK.</li><li>• CAN ALWAYS IMPROVE</li></ul>
<ul style="list-style-type: none"><li>• SOMETHING TO AVOID</li><li>• COULD REVEAL LACK OF SKILL</li><li>• TEND TO GIVE UP EASILY</li></ul>	CHALLENGES	<ul style="list-style-type: none"><li>• SHOULD BE EMBRACED</li><li>• AN OPPORTUNITY TO GROW.</li><li>• MORE PERSISTANT</li></ul>
<ul style="list-style-type: none"><li>• UNNECESSARY</li><li>• SOMETHING YOU DO WHEN YOU ARE NOT GOOD ENOUGH</li></ul>	EFFORT	<ul style="list-style-type: none"><li>• ESSENTIAL</li><li>• A PATH TO MASTERY</li></ul>
<ul style="list-style-type: none"><li>• GET DEFENSIVE</li><li>• TAKE IT PERSONAL</li></ul>	FEEDBACK	<ul style="list-style-type: none"><li>• USEFUL</li><li>• SOMETHING TO LEARN FROM</li><li>• IDENTIFY AREAS TO IMPROVE</li></ul>
<ul style="list-style-type: none"><li>• BLAME OTHERS</li><li>• GET DISCOURAGED</li></ul>	SETBACKS	<ul style="list-style-type: none"><li>• USE AS A WAKE-UP CALL TO WORK HARDER NEXT TIME.</li></ul>

# Ideas for Individual Survival and change

Emphasize the “**growth mindset**” as opposed to the “**fixed mindset**”.

Possible strategies for individual change: A list found in internet (unidentified source)

What Can I Say To Myself?

<u>Instead of...</u>	<u>Try thinking...</u>
• I'm not good at this.	• What am I missing?
• I'm awesome at this.	• I'm on the right track!
• I give up.	• I'll use some of the strategies we've learned.
• This is too hard.	• This may take some time and effort.
• I can't make this any better.	• I can always improve, so I'll keep trying.
• I just can't do math.	• I'm going to train my brain in Math.
• I made a mistake.	• Mistakes help me to learn better.
• She's so smart. I will never be that smart.	• I'm going to figure out how she does it so I can try it!
• It's good enough.	• Is it really my best work?
• Plan A didn't work.	• Good thing the alphabet has 25 more letters!



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# Ideas for Individual Survival and change

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**Advocate for yourself.** This includes

- avoiding words such as ‘just’ and ‘only’ when describing your work,
- use the ‘elevator talk’ to talk to your colleagues about your math interests and achievements.

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# Ideas for Individual Survival and change

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- ❖ My own private mantra: “It’s not about me, **it is about math**”
- ❖ **Understand something really well** and share it with others.



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# Ideas for Individual Survival and change

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- ❖ Do not apologize for every mistake, whether real or perceived.
- ❖ Consider using a more assertive language.

“I noticed the female justices say things like,

**‘May I ask,’ or, ‘Excuse me,’**

before they actually get to the substance of their question, and  
**that’s where they’re most commonly interrupted...**”

Jacobi, 2017

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# Ideas for Individual Survival and change

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**Imagine, in detail, people who violate expected stereotypes in a positive way** and practice thinking about these positive examples.



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# Ideas for Individual Survival and change

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**Fake it until you make it?**



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# Ideas for Individual Survival and change

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## **Learn about gender schemas.**

- Gender schemas are largely non conscious hypothesis we all have about the different characteristics of males and females.
- We see females as nurturing, as communal, and as doing things out of concern for other people.
- We see males as capable of independent action, doing things for a reason, and getting down to the business at hand.

**n≡1(3) masculine**  
**n≡2(3) feminine**

1. **self reliant**
2. **yielding**
3. **helpful**
4. **defends own beliefs**
5. **cheerful**
6. **moody**
7. **independent**
8. **shy**
9. **conscientious**
10. **athletic**
11. **affectionate**
12. **theatrical**
13. **assertive**
14. **flatterable**
15. **happy**
16. **strong personality**
17. **loyal**
18. **unpredictable**
19. **forceful**
20. **feminine**

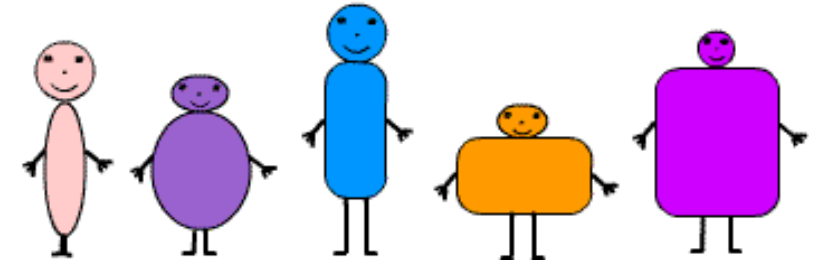
21. **reliable**
22. **analytical**
23. **sympathetic**
24. **jealous**
25. **leadership ability**
26. **sensitive to other's needs**
27. **truthful**
28. **willing to take risks**
29. **understanding**
30. **secretive**
31. **makes decisions easily**
32. **compassionate**
33. **sincere**
34. **self-sufficient**
35. **eager to soothe hurt feelings**
36. **conceited**
37. **dominant**
38. **soft spoken**
39. **likable**
40. **masculine**

41. **warm**
42. **solemn**
43. **willing to take a stand**
44. **tender**
45. **friendly**
46. **aggressive**
47. **gullible**
48. **inefficient**
49. **acts as a leader**
50. **childlike**
51. **adaptable**
52. **individualistic**
53. **does not use harsh language**
54. **unsystematic**
55. **competitive**
56. **loves children**
57. **tactful**
58. **ambitious**
59. **gentle**
60. **conventional**

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This discussion is about a issues affecting certain groups of people,

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- ❖ Not all members of these groups will be affected in the same way.
- ❖ Non-members of these groups might be affected by the same or similar issues.
- ❖ Outliers exists.
- ❖ Problematic situations occur with certain frequency but not all the time, and affect not only members of underrepresented groups.



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THANKS

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# Thanks

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- ❖ Many people, (mainly Virginia Valian and also Benson Farb, Amie Wilkinson, Helen Grundman, Jean Taylor, Dennis Sullivan, Katrin Wehrheim, Moira Soto) gave me suggestions for this presentation. The final product is of course my responsibility.
- ❖ The section about mentoring owes a great deal to a talk by Abigail Stewart. <https://www.drp-network.org/workshop-2018.html>

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# IDEAS FOR CHANGE IN HIRING PRACTICES

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# Ideas for change in hiring practices

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- ❖ **Pause and question our schemas regularly**
- ❖ **Implicit bias makes us forget people who belong to certain groups.** Thus, it may be useful to make a conscious effort to bring those people “to the table” when organizing lists (of conferences, of candidates for a position...)

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# Ideas for change in hiring practices

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- ❖ In fact, **widening the pool of female candidates does help.** Women progress faster through the ranks in those law schools with a high percentage of female faculty members than they do in schools where there are few female professors.
- ❖ **Studies have shown that when people are asked to rate a female candidate for a managerial job, they rate her more positively if she is one of several women in the candidate pool than if she is the only woman.**

Valian, 1998



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# Ideas for change in hiring practices

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**When assessing** the behavior or performance of someone from a stigmatized group, try to **focus on concrete positive and negative factors** and your memory of what actually happened, **rather than relying on overall “gut” feelings.**

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# Ideas for change in hiring practices

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Instead of

*"We particularly encourage applications from minorities and under-represented groups."* write

*"We aim to be a diverse and inclusive department."*

(unless you really have a diverse and inclusive department)

- ❖ Consider placing this sentence right after the sentence near the top, to make clear that it is not a pro forma interest.

ADVISING





# Ideas for advising: A list found in internet (unidentified source)

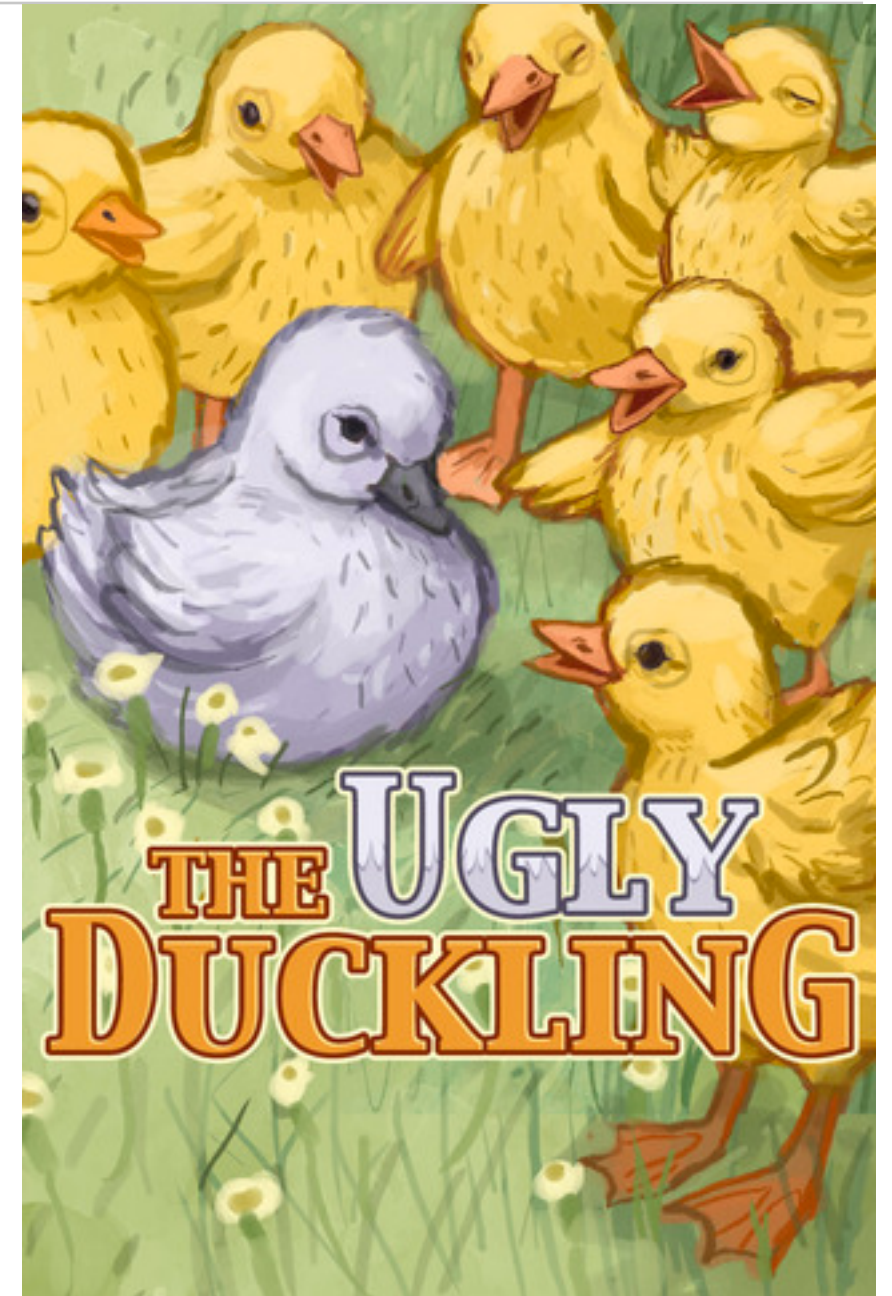
What Can I Say To Myself?	
<u>Instead of...</u>	<u>Try thinking...</u>
• I'm not good at this.	• What am I missing?
• I'm awesome at this.	• I'm on the right track!
• I give up.	• I'll use some of the strategies we've learned.
• This is too hard.	• This may take some time and effort.
• I can't make this any better.	• I can always improve, so I'll keep trying.
• I just can't do math.	• I'm going to train my brain in Math.
• I made a mistake.	• Mistakes help me to learn better.
• She's so smart. I will never be that smart.	• I'm going to figure out how she does it so I can try it!
• It's good enough.	• Is it really my best work?
• Plan A didn't work.	• Good thing the alphabet has 25 more letters!



# Advising students

The mentee/student's expectations:

- ❖ I don't belong
- ❖ I'm not good at this
- ❖ People like me can't do this
- ❖ You aren't like me
- ❖ You can't help me/you won't help me



Based on a talk by Abigail Stewart

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# Advising students

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- ❖ **Surface-level differences** (like gender, race, age...) will **decrease “interpersonal comfort”**.
- ❖ **Find deep level similarities (like values, tastes, experiences).** **Interpersonal comfort decreases anxiety and improves performance.**
- ❖ Seek out ways to collaborate or be on the same footing
- ❖ Consider creating interdependent “jigsaw” conditions, team projects where every member of the team has an individual task.
- ❖ Be aware that most likely, **you will have a certain degree of anxiety** in presence of a member of an underrepresented group.



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# Advising students

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A mentor gives students access to an interpersonal relationship with a "role model" in an area where they are **trying out a "possible self"**.

This identification becomes more **difficult if you seem impossibly skilled**.

Based on a talk by Abigail Stewart

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# Advising students

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How can implicit biases to affect the mentor-mentee relationship? The mentor might

- ❖ have lower expectations than the student can meet
- ❖ give overly positive feedback (because of low expectations)
- ❖ create a patronizing environment

It is important to be aware of our own implicit biases and how these biases might enter mentoring experiences

Based on a talk by Abigail Stewart

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# Advising students

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## Good mentoring practices

- ❖ Communicate high and reasonable expectations. Express confidence student can meet them
- ❖ Provide accurate and fair feedback
- ❖ Provide encouragement

Based on a talk by Abigail Stewart



“

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“My own sex, I hope, will excuse me, if I treat them like rational creatures, instead of flattering their *fascinating* graces, and viewing them as if they were in a state of perpetual childhood, unable to stand alone.”

— Mary Wollstonecraft, A Vindication of the Rights of Woman 1792

“The history of men's opposition to women's emancipation is more interesting perhaps than the story of that emancipation itself.”

— Virginia Woolf, A Room of One's Own

“It is difficult for men to measure the enormous extent of social discrimination that seems insignificant from the outside and whose moral and intellectual repercussions are so deep in woman that they appear to spring from an original nature. The man most sympathetic to women never knows her concrete situation fully.”

— Simone de Beauvoir, The Second Sex

“Misogynists have often reproached intellectual women for 'letting themselves go'; but they also preach to them: if you want to be our equals, stop wearing makeup and polishing your nails. This advice is absurd. Precisely because the idea of femininity is artificially defined by customs and fashion, it is imposed on every woman from the outside[...]. The individual is not free to shape the idea of femininity at will.”

— Simone de Beauvoir, The Second Sex

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# Ideas for dealing with sexual harassment - Institutional

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## **Strive for Strong and Diverse Leadership**

Make it an Explicit Goal: College and university presidents, provosts, deans, department chairs, and program directors must make the reduction and prevention of sexual harassment an explicit goal of their tenure.

Develop Leadership Skills: Support and facilitate leaders at every level (university, school/college, department, lab) in developing skills in leadership, conflict resolution, mediation, negotiation, and de-escalation, and ensure a clear understanding of policies and procedures for handling sexual harassment issues.

Move Beyond Legal Liability: Leadership training programs should include training on how to recognize and handle sexual harassment issues, and how to take explicit steps to create a culture and climate to reduce and prevent sexual harassment—and not just protect the institution against liability.

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# Ideas for dealing with sexual harassment - Institutional

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## Provide Support for the Target

**Access to Support Services:** Provide means for the target of harassment to access support services (social services, health care, legal, career/professional).

**Informal Reporting:** Provide alternative and less formal means of recording information about the experience and reporting the experience.

Provide anonymous, confidential reporting systems. Callisto is an online system that allows targets to control the disclosure of information, access supportive services, and share information on alleged perpetrators.

Provide confidential reporting channels outside of the faculty or usual workplace hierarchy, such as an ombudsperson.

Explore the use of restorative justice processes. The Campus PRISM (Promoting Restorative Initiatives for Sexual Misconduct) Project calls for accountability through collaboration and prevention through education.

**Prevent Retaliation:** Develop approaches to prevent the target from experiencing or fearing retaliation in academic settings.

- Be prepared to take action to ensure the target of the harassment is able to continue his/her academic work. This could include using mutual no contact orders between the accused and accuser, changing class schedules, changing the locks at the housing facility or workplace, rescinding building access for the accused, and reassigning advisors, mentees, and supervisors.



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# Ideas for dealing with sexual harassment - Institutional

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## Improve Transparency and Accountability

**Clear Policies:** Develop and share clear, accessible, and consistent policies on sexual harassment and standards of behavior. Make clear that people will be held accountable for violating the policies.

Include a range of clear disciplinary actions that correspond with the severity of the harassment.

Engage the academic community in policy and practice reviews. Some institutions have created student advisory boards and forums for students to meet with the Title IX Steering Committee.

**Transparency about Handling Reports:** Be as transparent as possible about how the institution is handling reports of sexual harassment.

- Yale University publishes a semiannual Report of Complaints of Sexual Misconduct and an annual campus safety report to inform the campus community.

**Assess Climate:** Utilize climate surveys to further investigate and address systemic sexual harassment.

- The results of climate surveys should be shared publicly to demonstrate to the campus community that the institution takes the issue seriously. The Administrator- Researcher Campus Climate Collaborative (ARC3) survey has been used by more than 150 higher education institutions.

**Research Integrity:** Consider sexual harassment equally important as research misconduct in terms of its effect on the integrity of research.

- The U.S. Geological Survey and the Department of the Interior have broad scientific integrity policies that apply to employees, appointees, volunteers, grantees, and contractors. Some scientific societies such as the American Geophysical Union have developed new ethics policies that explicitly call out sexual harassment and discrimination.