Women in Mathematics: Ambition in an ambivalent society

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Ambition: a strong feeling of wanting to be successful in life and to achieve great things.

What sorts of ambitions do we have as mathematicians?

fame and fortune (winning prizes; proving famous conjectures; making conjectures that become famous)

solving hard, interesting problems

constructing elegant proofs

success as an expositor and/or as a teacher

enriching and contributing to the community

happiness, fulfilment

Obstacle: A thing that blocks one's way or prevents or hinders progress.
Lack: Deficiency or absence.

What obstacles are faced by women in mathematics?

Lack of a sense of belonging;

lack of opportunities (to collaborate, to speak at conferences, to be journal editors);

lack of visibility;

lack of due respect (for research, for contributions to the department or to the community);

lack of role models.

And now we have a vicious cycle: A lack of due respect of women in mathematics, in particular of their research, results in a lack of opportunities for, and visibility of, women in mathematics, which leads to a lack of role models, a lack of a strong sense of women belonging within the mathematics community, giving superficial credence to the lack of respect of women in mathematics.

If you've never seen a good time

How would you recognise one

How would you even find one?

–Sinead O'Connor, from 'Til I Whisper U Something

Belonging: acceptance as a natural member or part.

In the article *Why Do Women Opt Out? Sense of Belonging and Women's Representation of Mathematics* by C. Good et al, published in 2012 in the Journal of Personality and Social Psychology, the authors write:

Sense of belonging to math – one's feelings of membership and acceptance in the math domain – was established as a new and an important factor in the representation gap between males and females in math.

First, a new scale of sense of belonging to math was created and validated, and was found to predict unique variance in college students' intent to pursue math in the future (Studies 1-2).

Second, in a longitudinal study of calculus students (Study 3), students' perceptions of 2 factors in their math environment – the message that math ability is a fixed trait and the sterotype that women have less of this ability than men – worked together to erode women's, but not men's, sense of belonging in math.
Their lowered sense of belonging, in turn, mediated women's desire to pursue math in the future and their math grades.

Interestingly, the message that math ability could be acquired protected women from negative sterotypes, allowing them to maintain a high sense of belonging in math and the intention to pursue math in the future.

Opportunity: A favourable or advantageous circumstance or combination of circumstances; a time or set of circumstances that makes it possible to do something.
Collaborate: 1. To work together, especially in a joint intellectual effort. 2. To cooperate treasonably, as with an enemy.

Collaborations can be great for generating new ideas and bringing together complementary skill sets. Collaboration can also bring women collaborators a greater sense of belonging to the mathematics community. However, often when a woman has a male collaborator, especially one more senior than herself, some people say or think that the man had all the important ideas and insights, or the greater technical strength. Another difficulty women sometimes face is finding suitable collaborators.

In the article *The Matilda effect in science communication: an experiment on gender bias in publication quality perceptions and collaboration interest* by S. Knoblock-Westerwick et al, published in 2013 in Science Communication, the authors write:

An experiment with 243 young communication scholars tested hypotheses derived from role congruity theory regarding impacts of author gender and gender typing of research topics on perceived quality of scienfitic publications and collaboration interest.

Participants rated conference abstracts ostensibly authored by females or males, with author associations rotated.

The abstracts fell into research areas perceived as gender-typed or gender-neutral to ascertain impacts from gender typing of topics.

Publications from male authors were associated with greater scientific quality, in particular if the topic was male-typed.

Collaboration interest was highest for male authors working on male-typed topics.

Respondent sex did not influence these patterns.

Respect: A feeling of admiration for someone or something elicited by their abilities, qualities, or achievements.
Ambivalence: The state of having mixed feelings or contradictory ideas about someone or something.

In mathematics, as in other male-dominated professions, there is much evidence that women are subjected to gender-biased evaluations, often having their performances and contributions devalued, and their competence denied.

In *Penalties for Success: Reactions to Women Who Succeed at Male Gender-Typed Tasks* by M.E. Heilman et al, published in 2004 in the Journal of Applied Psychology, the team ran 3 experiments with a total of 242 subjects. From their abstract:

Results strongly supported the authors' hypotheses, indicating that (a) when women are acknowledged to have been successful, they are less liked and more personally derogated than equivalently successful men (Studies 1 and 2);

(b) these negative reactions occur only when the success is in an arena that is distinctly male in character (Study 2); and

(c) being disliked can have career-affecting outcomes, both for overall evaluation and for recommendations concerning organizational reward allocation (Study 3).

These results were taken to support the idea that gender stereotypes can prompt bias in evaluative judgments of women even when these women have proved themselves to be successful and demonstrated their competence.

In the article *The Impact of Gender on the Review of the Curricula Vitae of Job Applicants and Tenure Candidates: A National Empirical Study* by R.E. Steinpreis et al, published in 1999 in Sex Roles, the authors conducted an experiment wherein they sent 238 male and female academic psychologists one of four versions of a CV: female job applicant, male job applicant, female tenure applicant, male tenure applicant.

All the CVs actually came from a real-life scientist at two different stages in her career, but the names were changed to traditional male and female names. Their findings:

Both men and women were more likely to vote to hire a male job applicant than a female job applicant with an identical record. Similarly, both sexes reported that the male job applicant had done adequate teaching, research, and service experience compared to the female job applicant with an identical record.

In the article *The abrasiveness trap: High-achieving men and women are described differently in reviews* by K. Snyder, published in 2014 in Fortune.com, the author collected 248 reviews (141 by men, 107 by women) from 180 people (105 men, 75 women) who work in the tech industry. The findings:

Feedback received in critical reviews:
In the reviews of men, 2% of the reviews had negative feedback, and 81% had only positive feedback.
In the reviews of women, 71% of the reviews had negative feedback, and 23% had only positive feedback.

Reviews including critical feedback:
In the reviews of men, 58% were without criticism; in the reviews of women, 13% were without criticism.

Women and men received criticism such as

"There were a few cases where it would have been extremely helpful if you had gone deepter into the details to help move an area forward."

"Take time to slow down and listen. You would achieve even more."

However, the author writes that *the women's reviews include another, sharper element*:

"You can come across as abrasive sometimes. I know you don't mean to, but you need to pay attention to your tone."

"Your peers sometimes feel that you don't leave them enough room. Sometimes you need to step back to let others shine."

The author writes that *this kind of negative personality criticism – watch your tone! step back! stop being so judgmental! – shows up in 2 of the 83 critical reviews received by men.*
It shows up in 71 of the 94 critical reviews received by women.

Glass ceiling: An unacknowledged discriminatory barrier that prevents women and minorities from rising to positions of power or responsibility, as within a corporation.

From Wikipedia:
The glass ceiling metaphor has often been used to describe invisible barriers ("glass") through which women can see elite positions but cannot reach them ("ceiling").

These barriers prevent large numbers of women and ethnic minorities from obtaining and securing the most powerful, prestigious, and highest-grossing jobs in the workforce.

Moreover, this effect may make women feel they are not worthy to fill high-ranking positions or as if their bosses do not take them seriously or see them as potential candidates for advancement.

From the book *Why so Slow?* by Virginia Valian (Distinguished Professor of Psycology, Hunter College and CUNY Graduate Center) published in 1998 by MIT Press:

... I want to explain women's lack of achievement in situations where nothing seems to be wrong. Even in apparently egalitarian envorinments, women do not advance as far or as rapidly as men. Something invisible limits their progress.

The central thesis of this book is that a set of implicit, or nonconscious, hypotheses about sex differences plays a central role in shaping men's and women's professional lives. These hypotheses, which I call gender schemas, *affect our expectations of men and women, our evaluations of their work, and their performance as professionals.*

Both men and women hold the same gender schemas and begin acquiring them in early childhood. Their most important consequence for professional life is that men are consistently overrated, while women are underrated.

Recently on Desert Island Discs, Dame Nancy Rothwell, FRS (physiologist and Vice-Chancellor of University of Manchester) related her observations that when a woman looks at a job ad, she says

I can't do maybe half of that; I won't apply

but a man, looking at the same job ad, says

I can do maybe half of that; I will apply.

Extending the metaphor of the glass ceiling, **the glass cliff** describes the phenomenon whereby individuals belonging to particular groups are more likely to be found in leadership positions that are associated with a greater risk of failure and criticism.

This term was coined in 2004 by M.K. Ryan and A. Haslam (University of Exeter), stemming from their research in which they examined what happens when women (and other minority groups) take on leadership roles.

They found that women executives in the corporate world were likelier than men to be put into leadership roles during periods of crisis or downturn, when the chance of failure is highest.

From Wikipedia:

[Their] research showed that once women break through the glass ceiling and take on positions of leadership, they often have experiences that are different from those of their male counterparts.

More specifically, women are more likely to occupy positions that are precarious and thus have a higher risk of failure either because they are appointed to lead organizations (or organizational units) that are in crisis or because they are not given the resources and support needed for success.

Evidence of the glass cliff phenomenon has been documented in business, politics, law, public service, education and sport.

A 2006 study found law students were much likelier to assign a high-risk case to a female lead counsel rather than a male one.

A 2010 study found undergraduate students in British political science likelier to select a male politician to run for a safe seat in a by-election, and much likelier to select a female candidate when the seat was described as hard to get.

Bullying: Bullying occurs when one person, typically (but not necessarily) in a position of power, authority, trust, responsibility, management, etc, feels threatened by another person, usually (but not always) a subordinate who is displaying qualities of ability, popularity, knowledge, skill, strength, drive, determination, tenacity, success, etc.

Too often, women in male-dominated fields, such as mathematics, become the targets of bullies.

From www.bullyonline.org (created by Tim Field and funded by the Tim Field Foundation), examples of bullying include:

Constant nit-picking, fault-finding and criticism of a trivial nature;
often there is a grain of truth (but only a grain) in the criticism to fool the people (including the target) into believing the criticism has validity, which it does not; often, the criticism is based on distortion, misrepresentation or fabrication;

persistent refusal to acknowledge the target and his or her contributions and achievements or to recognise their existence and value;

constant attempts to undermine the target and his or her position, status, worth, value and potential;

being isolated and separated from colleagues,
excluded from what's going on,
marginalized, overruled, ignored, sidelined, frozen out;

being singled out and treated differently;

being belittled, demeaned and patronised, especially in front of others;

being humiliated, shouted at and threatened, often in front of others;

being overloaded with work, or having all their [meaningful] work taken away and replaced with menial tasks;

having responsibility increased but authority removed;

having leave refused;

being denied training [or other opportunities] necessary to fulfill duties [or to excel];

having unrealistic goals set, which change as they approach, also deadlines changed at short notice, or no notice, and the target only finds out when its too late to do anything about it;

being the subject of gossip which has the effect of damaging one's reputation;

having what one says and does twisted, distorted and misrepresented;

subjected to disciplinary procedures with verbal or written warnings imposed for trivial or fabricated reasons and without proper investigation, or with a sham investigation;

being the target of specious allegations of misconduct or incapability which might have just a grain of truth, to give superficial legitimacy to the allegations.

Over the years I've interviewed many women mathematicians about their experiences, and many of them (including myself) have been subjected to bullying. With all of us, our first reaction was
I must be crazy, because no one around me seems to think something is wrong with how I'm being treated.

It's important to realise when you are being bullied or treated unfairly, and websites such as bullyonline can help with this. Given my interviews and experiences, I would add to the list of examples of bullying the following:

Hostility: glares, sneers, nasty and malicious attitudes masqueraded as jokes.

Disparagement as a researcher: saying "She's a good teacher, but not really a researcher," or "She doesn't deserve her grant," or "She probably just typed that co-authored paper."

Prejudicial comments to students, faculty, staff and administrators: saying you are an uncooperative colleague, or a bad influence, or telling the administration you are responsible for problems within the department.

Physical intimidation: bodily backing you up against a wall to disparage or attack your performance, or staring at your breasts during conversations.

Perpetual condescension.
This is common and pernicious: it can undermine your confidence, introduce strong self-doubt, and cause you to lose hope, and impact your ambition. Another emotion often experienced by the target of unfair treatment or bullying:
anger. But you can use anger to help you fight for what is right.

I sing sometimes for the war that I fight, cuz every tool is a weapon if you hold it right. – Ani di Franco from My IQ

When targeted by a bully, what can one do?

Targets of bullying need to fight back.

They need to find the strong people around them; find and insert themselves into a strong, supportive community; and fight for themselves as well as for a larger goal, such as working to change our community so that everyone has opportunity to excel and so that bullying is not tolerated.

Importantly, a researcher being bullied needs to continue doing research.

I recommend the bullyonline resource.

For more on surviving mistreatment in the mathematics community, please see my article *Women in mathematics: participating, surviving, and succeeding* on my website
http://www2.maths.bris.ac.uk/∼malhw/

We, as a community, have responsibility. As a community, we need to:

Recognise and acknowledge our own implicit biases, and work **hard!** to take these into account when making decisions about hiring, promotions, awards, conference speakers – recognise that women in mathematics are a scarce commodity and respond accordingly;

create comfortable working environments: respect individuals' desires, needs, and requirements; don't tolerate bullying of anyone;

support people: begin by getting accurate information regarding their situations and their choices;

identify role models as well as hotshots who are supportive of women;

encourage or create mentoring or research connections;

challenge, don't coddle, women students and researchers; make it clear we believe in their talent and expect them to excel;

invite more women to speak at conferences, seminars, and colloquia.

Why don't we have more women speakers at conferences?

"Women just don't work in this area."

"I asked the two [famous] women in this field, and they were both busy."

"I thought of asking [fill in the blank], but I figured she wouldn't come because she has young children."

"I've never heard of the women who were suggested."

"The women in this area aren't good speakers."

Female Conference Speaker				
B	I	N	G	O
Women just aren't interested in this field	There aren't enough qualified female speakers	We need big-name speakers, and few of those are women	It's a male-dominated field	There aren't a lot of women in C-level positions
Both women we called were booked that weekend	Both women we booked bailed at the last minute	All the women were probably busy	Female speakers are always burnt out from speaking so much	Trying to get more female speakers is sexist
The organizers just wanted to get the best speakers they could find	You can't kick out a male speaker just to fit a woman in there	FREE	You can't shoehorn in a woman where she doesn't fit	Women never volunteer to present
You have to be bold; people aren't just going to invite you to present	Women are shy	Women only ever want to talk about woman-stuff	Women need to act more like men	No one has complained about this before
Attendees want to hear from people like themselves	Well, there aren't that many female attendees, either	We're only responding to demand	Fine, YOU tell me who they should have invited	Who? I've never heard of her.

In the US, this issue has been addressed with some success by the National Science Foundation: To get conference funding from NSF, the list of speakers must include **women**.

However, sometimes we see that it is just the same few women, being invited over and over, without serious attention paid to find other women in the field and offer them opportunities.

Another successful technique that has been used to ensure a conference has many women on the list of speakers:
begin by only inviting women; when the targeted number of women have accepted (and this target should reflect the composition of the community), begin inviting men but continue inviting women.

The American Institute of Mathematics (AIM) has a policy that at least 20% of the participants of any AIM workshop should be women, and they have created and maintain a database of women in mathematics, sorted according to their research areas.

We need to make the inclusion of women speakers a recognised and articulated priority.

We need to be willing to include women who work on problems related to the focus of the conference or colloquia or seminar series, as well as those who work on problems central to the focus.

I invite you to read the excellent article *Addressing the underrepresentation of women in mathematics conferences* by Greg Martin (Professor of Mathematics, University of British Columbia); I got most of my references from this article.
http://www.math.ubc.ca/∼gerg/

In Greg's article, he analyses and refutes genetic explanations for having few women in STEM disciplines, investigates implicit biases, drawing on numerous scholarly articles and studies. He then presents (and expounds upon) the following guidelines:

Plan from the beginning.

Communicate expectations and goals among planners.

Come up with names.

Select speakers attentively.

Create equitable logistics.

Walk the walk.

Talk the talk.

As he writes:

This unfairness can be reduced and eventually eliminated, both by taking deliberate steps to fully include women in our scientific activities and by focusing attention critically on the unfairness itself.

Moreover, in addition to resulting in appropriate inclusion of female mathematicians, we believe that thoughtful adoption of these guidelines will quite simply lead to better conferences, independently of speakers' genders.

Athena Swan: *Will it help bring equality to the treatment of women in mathematics?*

Equality: The state of being equal, especially in status, treatment, rights, and opportunities.

Token: Done for the sake of appearances or as a symbolic gesture.

Placebo: A medicine or procedure prescribed for the phychological benefit to the patient rather than for any physiological effect.

Facade: A deceptive outward appearance.

Skepticism: A doubting or questioning attitude or state of mind.

I got a dead bolt stroll, where I'm going is clear
I won't wait for you to wonder, I'll just tell you why I'm here
cause I know the biggest crime is just to throw up your hands
say this has nothing to do with me
I just want to live as comfortably as I can
you got to look outside your eyes, you got to think outside your brain ...
you don't have to like me for who I am but we'll see
what you're made of by what you make of me
I think it's absurd that you think I am the derelict daughter
I fight fire with words; words are hotter than flames
words are hotter than water
Why don't you give me a call when you decide you're willing to fight
for what you think is real, for what you think is right.

– Ani di Franco from "Willing to fight"

Four heroes in mathematics