

WOMEN IN MATH AND SCIENCE: PARTICIPATING,
SURVIVING, AND SUCCEEDING

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*Me and all the kids from the neighborhood
We'd play out in the street all summer long.
Rule was we had to go home at night,
When the street lights came on.*

*We were oblivious to the rest of the world.
And we'd hold up the cars in the street.
Yeah, we'd always play boys against girls,
And both sides would cheat.*

*Strange men would stop their cars at the curb
Say: "Hey sweetheart come here."
And I'd go up to the window and they'd have their dick out in their hand
And a sick little sneer.*

*And I'd say
"Here we go again! Yeah, ok this time you win."
And I would feel dirty, I'd feel ashamed,
But I wouldn't let it stop my game.*

*We would play hide and go seek.
Territory would be the whole block.
Sometimes the older boys when they'd find you,
They wouldn't want to tag you, they'd just want to talk.*

*They'd say "What would you do for a quarter?
Come on, we don't have that much time."
And I'd think a minute and I'd say:
"Ok...give me the quarter first. Fine."*

*This time you win.
Here we go again!
And I would feel dirty and I would feel ashamed,
But I wouldn't let it stop my game.*

*I remember my first trip alone on the greyhound bus,
A man who put his hands on me as soon as night fell
I remember when I left how excited I was
I remember when I arrived I didn't feel so well.
I remember a teacher at school got me so sick, so scared
I went into the bathroom and I threw up in my hair
And I could go on and on, but it just gets worse*

And I should probably stop here...

Girl, next time he wants to know

What your problem is...

Girl, next time he wants to know

Where the anger comes from...

Just tell him this time the problem's his.

Tell him the anger just comes.

It just comes.

– Ani DiFranco, *Hide and Seek*

Everyone in this room either has been or will be a target of abuse, or they know someone who has been or will be. If we as a community are to battle this effectively, then we need to admit the problem, understand how it manifests itself, know and employ strategies for survival and success, and be constantly pursuing activities to improve the climate and culture in math and science.

In this talk I will be focusing on women in math and science and their struggles. This is not to say that every woman in math and science will face these struggles, or that these struggles are experienced only by women, or only in math and science. However most, although not all, my information has been collected from women in math and science. Much of what I will say is quite generic.

I know that some things I will say today are bound to make some people uncomfortable; this is not my intent. My intent is to inform and to educate. For our community to be effective in gaining the full participation of all people in math and science, we need to recognize barriers, ascertain means of getting around or under them, and ways to erode them. We need to be able to recognize abuse when it happens, and support its targets. We need to be constantly working toward changes that make abuse less frequent and less successful. We need to fight, and we need to win.

Outline of talk:

- I. The general situation for women in math and science: implicit, or unconscious bias
- II. Harassment, discrimination, and abuse: explicit bias
 - (a) Ways these are manifested
 - (b) Emotions experienced by the target
 - (c) Various survival strategies
- III. What we as a community can constantly be doing to improve the situation

I. The general situation for women in math and science: implicit, or unconscious bias

In high school and college, math skills are often judged, or misjudged, by students' performances in math contests, or by who most quickly answers questions posed in a lecture.

Women, more often than men, are not eager to participate in contests. They are taught not to interrupt and stereotypically, they prefer to give some thought to an answer before stating it out loud; but often the lecturer does not allow time for such thought.

Often when professors recognize a talented female math student, they try to “help” her by coddling her, sheltering her, not letting her struggle with tough problems. This means she does not gain the confidence that comes through solving difficult problems on her own, and she may not learn the independence necessary to succeed in graduate school and in the profession.

The *leaky pipeline* is a metaphor for the continuous loss of women in science, technology, engineering and mathematics (STEM), as they climb the career ladder. A 2014 article in the UK newspaper *The Telegraph* reported that only 20% of girls in the UK continue from GCSE Physics to A-level physics (a transition that would be made at age 16). In 2011, nearly half of all schools in the UK sent no girls on to complete A-level physics. One should note that A-level Physics is required to study physics at a UK university.

In the US, for at least 4 decades, nearly half the Bachelor’s degrees in mathematics are earned by women, about 25% of the PhD’s in mathematics are earned by women, but at the higher ranking research universities, typically fewer than 10% of the tenured math faculty are women.

The numbers in physics tend to be even worse. The numbers in biology often look, on paper, much better, until one realizes that very few women are directors of their own labs; most of the women in biology labs carry out experiments designed by the male lab directors.

At math and science conferences, it is typical that there are very few women speakers, and not infrequently, there are none.

This lack of women speakers silently relays a powerful message: in math and science, very few women researchers are as good as the men. This becomes part of the “white noise” that we hear everyday, and slowly but surely, this message gets engrained in the minds of both women and men.

In the article *Let’s face it: gender bias in academia is for real* by Cynthia Leifer et al, published in *The Conversation* in 2015, the authors look at a 2009 analysis of letters of recommendation for 194 applicants to research faculty positions in psychology. They note that these letters use words such as “confident”, “ambitious”, “daring”, and “independent” in letters for men, and words such as “helpful”, “kind”, “warm” and “tactful” in letters for women.

Further, the authors write:

Unfortunately, even when the same language is used to describe candidates or when the key objective criteria of productivity are used, evaluators rated female candidates lower than male candidates.

From the article *The abrasiveness trap: High-achieving men and women are described differently in reviews* by Kieran Snyder, published in 2014 in *Fortune.com*:

I asked men and women in tech if they would be willing to share their reviews for a study and didn’t stipulate anything else I figured only strong performers would be willing to share and ... [I] was most interested in looking at the critical feedback that these strong performers had received.

105 men submitted 141 reviews, and 75 women submitted 107 reviews. Of the full set of 248 reviews, 177 – about 71% – contained critical feedback. However, critical feedback was not distributed evenly by gender.

In the reviews of men, 2% of the reviews had negative feedback, and 81% had only constructive feedback.

In the reviews of women, **71%** of the reviews had negative feedback, and **23%** had only constructive feedback.

Words like bossy, abrasive, strident, and aggressive are used to describe women's behaviors when they lead; words like emotional and irrational describe their behaviors when they object. All of these words show up at least twice in the womens review text I reviewed, some much more often. Abrasive alone is used 17 times to describe 13 different women. Among these words, only aggressive shows up in men's reviews at all. It shows up three times, twice with an exhortation to be more of it.

The author notes 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.

Further, there was no notable difference between those reviews written by men and those written by women.

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. Based on 3 experiments with 242 subjects, they concluded:

(a) *when women are acknowledged to have been **successful**, they are **less liked** and more **personally derogated** than equivalently successful men;*

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

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

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.

The *glass ceiling* describes a discriminatory barrier that is not openly acknowledged, and whose purpose is to prevent women and people from other under-represented groups from rising to higher positions of responsibility, power, and prestige, as well as the highest-paying jobs in the workforce.

It has been posited that an effect of the glass ceiling is to make those facing such discrimination feel that they are not believed to be worthy of advancement, and that often these people eventually internalize this belief.

*Nobody presents you with a handbook
when you're teething and says,*

"Here's how you must behave as a second-class citizen."

*Instead, the humiliating expectations and traditions of segregation creep over you,
slowly stealing a teaspoonful of your self-esteem each day.*

– Melba Pattillo Beals, from "Warriors Don't Cry"

In *What holds women back in mid-career?* by Camille B Kandiko Howson, published in 2016 in the University World News, the author concludes:

What motivated many women were traditional academic values such as the love of science, learning and the pursuit of knowledge, alongside other aspects such as good working environments, flexibility, autonomy and making a wider contribution to society.

The indicators of esteem, or markers of prestige and success in academia, were found to be gendered following male-dominated patterns and pathways. Activities such as receiving invitations to give keynote speeches, winning medals and prizes and holding editorial positions were seen to be more easily accessed by men. Women found it harder to accrue the types of currency that would advance their reputations.

*... she'd simply watched her world shrink and shrink,
while her brothers' worlds expanded.*

– Andrea Barrett, from “The Voyage of the Narwhal”

In *The Glass Cliff: Evidence that women are over-represented in precarious leadership positions* by M.K. Ryan and S.A. Haslam, published in 2005 in *British Journal of Management*:

The authors extend the metaphor of the glass ceiling to that of the *glass cliff*, describing a 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.

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

Specifically, they found that 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, sport, and academia.

*[There is a] cultural distortion which warps women's lives
and suffocates individuals under a weight of stereotypes.*

– Joan Smith, from “Misogynies”

From the book *Why so Slow?* by Virginia Valian, 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 environments, 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.

*The emotional, sexual, and psychological stereotyping of females
begins when the doctor says: “It's a girl.”*

– Shirley Chisholm, the first black woman elected to the US Congress (1968)

The above articles and observations primarily address implicit, or unconscious bias, which many women and men believe to be a major cause of the lack of visibility and advancement of women in math and science.

However, there is also explicit bias, in the forms of harassment, discrimination, and abuse.

II. Harassment, discrimination, and abuse: explicit bias.

I find I must now address my remarks to women who have been or will become the targets of abuse. However, it is important everyone hear these remarks because our community needs to be ready, willing, and equipped to support those being attacked and abused.

We are vulnerable, but we have unrealized strength. The horror stories we hear are true. What we don't hear enough about are the stories of surviving the horrors and subsequently thriving.

We don't yet talk enough about what we as a community can do to remedy the situation and we don't yet, as a community, act enough on our ideas. So far the burden of action has been taken on by a scarce few, but we all own this burden; we all have responsibility.

II(a) Ways harassment, discrimination, and abuse are manifested.

- Hostility: glares, sneers, nasty and malicious attitudes and comments masqueraded as jokes, or comments reflecting an assumption that women don't belong in math and science.
- 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 (coauthored) paper." (This latter remark is so common that pre-tenure women are well advised to have some singly authored papers.)
- Prejudicial comments to students, faculty, staff, and administrators: saying you are an uncooperative colleague or a bad influence on the graduate students, or telling the administration you are responsible for problems in the department.
- Rumors - within your department, your university, your research community: accusing you of having no standards in your classes, of being a slut, or of sexually harassing students.
- Isolation: being told that you are not allowed to talk to the staff or the graduate students, or that you need permission to enter the departmental mailroom.
- Intellectual isolation: not being invited to speak in seminars or conferences, or not getting departmental support available to others to pursue research opportunities.
- Deprivation of power and authority within the department and the university: making departmental decisions at the men's urinal, or not allowing you to chair or even be on committees.
- Physical intimidation: bodily backing you up against a wall to disparage or attack your performance, or only approaching you in pairs, or leaving things in your locked office when you are away.
- Impeding professional development: damning you with weak praise, withholding tenure forms, or not moving forward necessary forms, discussions, or information to allow you to participate in research activities outside the department.
- Applying rules and standards unevenly: when deciding teaching loads, teaching assignments, merit raises, or promotions.

- Perpetual condescension. **This is common and pernicious:** it can undermine your confidence and introduce strong self-doubt.

Together these have a powerful impact: obstacles are being hurled at you every week and every day, making it difficult to do your job, much less excel in it.

Just as with domestic abuse and incest, the abusers as well as other department (“family”) members typically expect the target to become a conspirator in her abuse by keeping it a department secret. (During my hell years I was told by department members, “Don’t hire a lawyer! Don’t talk about this outside the department – it will make us look bad.” Smartest thing I ever did was to hire a lawyer and to talk about my situation with friends and acquaintances in the research community.)

Often the men in the department don’t notice when a woman is being abused – it is below their radar.

Women in math and science aren’t always supportive of other women, and in fact can be among those most harsh on other women. These women are trying hard not to be associated with those they see as 2nd and 3rd class citizens – women. This is an understandable, although a destructive, reaction to their own fear or rage at the treatment of women.

Some people won’t believe your horror stories until they witness the abuse. Many people, including women, will be very uncomfortable when you tell your stories. They may treat you as a leper, as if being a target of abuse is contagious. This does not necessarily mean they don’t believe you, but they are weak and don’t want to help fight for justice. Most people are weak. Find the strong people.

Unabused women are often the ones most doubtful that a woman who is being abused didn’t deserve it or bring it upon herself. This is true with rape as well, but it’s understandable: they desperately want to believe that by doing the “right” things they are guaranteed safety. There is no guarantee. The best safety we have is in a strong and supportive community and in learning to be strong ourselves.

You also need to realize that your institution will protect itself. The mechanisms they have in place to deal with ugly situations are unlikely to bring you satisfaction; they are there to protect the institution, not you. Know this, and find a support network to protect you.

II(b) Emotions experienced when being abused.

- “I’m crazy.” Everyone I interviewed identified this as their first reaction to their abuse. It is critical to realize you are **NOT** crazy, this **IS** happening to you, and it is as horrible as you think. Often it takes other people telling you that this is happening to you, that it is wrong and horrible, for you to realize you are not crazy. But you cannot battle an enemy you refuse to identify. Identify this enemy, and fight.

- Disappointment: you will find most people are weak, lazy, unwilling to fight for justice; you will find that some people you thought were your friends, people you’ve stood by during their dark times, turn their backs on you in your time of trouble. But you will find some people, including some you didn’t expect, are strong, standing by you, helping you fight. **Find the strong people.**

- Powerless - but you aren’t! Learn how to fight back.
- Fear - don’t let this immobilize you! You need to fight.

- Hopelessness and despair - but don't quit if you love your work! Don't believe the people who say you don't belong in your profession. Fight for yourself and for what you love.
- Amazement and horror: how can these people hate you so much? Why do they want to destroy you? They are afraid of you - use this to your own advantage.
- Anger - **USE THIS!** Anger is a powerful emotion; harness it and use it.

*I sing sometimes for the war that I fight
Cuz every tool is a weapon if you hold it right.*
— Ani DiFranco, from *My IQ*

The anger does not go away. Use it well. Do not let it destroy you. Do not let it become a bitterness that erodes you and your credibility; rather use it for something productive. Use it as energy to pursue more research, give more talks, make more research connections, fight to make things better, reach higher.

You are a target; do not become a victim.

It takes a warrior to battle and survive.
— Melba Pattillo Beals, from “Warriors Don't Cry”

II(c) Various survival strategies.

- Hire a lawyer: they are trained to fight and can do so on your behalf. **Hire muscle.** You need to concentrate on your work and on being strong. It's scary to hire a lawyer, it's scary to tell her about what you've been experiencing, to reveal how vulnerable you are. Do it anyway. Choose your lawyer well; only accept one who believes you and will fight for you. You can, and may need to, fire the first lawyer you hire and employ another.
- Don't just focus on your own suffering and mistreatment: this can be debilitating; fight for a larger goal.
 - Find a role model.
 - Work as an activist for a few hours a week: you do not need to be associated with an organization to do this. Define for yourself what it means to be an activist.
 - Educate students about the treatment of women in math and science: but don't just talk about the horror, talk also about women surviving and succeeding.
 - Actively support young women in math and science.
 - Listen to music by strong women: play it **loud**.
 - Read books in which women struggle and triumph. (Some women I know wrote a mystery book in which they kill off their evil chairs.)
 - Cut loose in the safety of friends: scream, laugh, cry, play, plot, fantasize.
 - **Laugh!** Laughter is powerful.
 - Cut your ties with those content with women being promoted from 3rd class to 2nd class citizens: they will hold you down.
 - Strengthen your ties to righteous people who speak truth to power.
 - Make sure you know the number for campus police.
 - Make your home feel very secure.
 - Lift weights – **feel strong**.
 - Buy a big truck – **feel strong**.
 - Apply for grants!
 - Go to more conferences and volunteer to speak.

- Run conferences celebrating women in math and science.
- Do what the abusers tell you not to do: they tip their hands in this way and reveal what they're afraid of.

You may cry a lot – **but don't let your abusers see you cry**. Put up a strong front. This may begin as a bluff, but it's like a self-fulfilling prophecy - it becomes real.

*They win when you respond the way they expect you to.
Change the rules of the game, girl, and they might not like it so much...
They'd think you were no longer their victim.*
– Melba Pattillo Beals, from “Warriors Don't Cry”

You are in a war for your life, your health, and your identity; you must not forget this. You must fight, and you must win.

Sometimes, having been punished in the math and science community for being female, women suppress their femininity. This does not spare them from the punishment, and they suffer more, having killed part of who they are. Instead, we should be celebrating that we are women.

It is critical that you have a strong support network; people from this network can help you realize you are **not** crazy, what's happening to you is awful and wrong. They can help you stand up to the abusers and, eventually, survive and win.

I say eventually since typically abusers don't give up easily. When their target doesn't buckle under their abuse, this makes them mad.

*I have earned my disillusionment
I have been working all of my life
I am a patriot
I have been fighting the good fight.*
— Ani DiFranco, from *Not a Pretty Girl*

Fight for what is right! Don't let the abusers win by destroying yourself with bitterness. Take your well-deserved anger and use it for something positive. Help others learn to be strong so these bastards and bastards like them cannot destroy others. **A strong network is critical**. If you don't already have one, find one and tap into it.

It is extremely helpful to have a reputation for honesty and reliability within your department and within your research community before abuse begins. It is important to have an advisor who will back you up: if you are fairly young when the abuse begins, people in the research community are apt to ask your advisor about the situation. You do not want your advisor telling people you are hysterical and overreacting.

You must recognize that there are some battles that cannot be won. It is critical to have a strong and righteous support network to help you recognize when this is the case and remove yourself; often this means finding new employment. This does not mean you are weak. This can be a way of fighting back. Remember Harriet Tubman's Underground Railroad.

You will be different afterwards: less naive, and with a strength and toughness that will make some people uncomfortable. You will have survived something you didn't think you could.

This allows you to reassess just what your capabilities and limitations really are. You will find you are stronger than you ever thought: you had to be. **This is power – use it!**

Your newly revealed strength will allow you to see new opportunities; take advantage of this. Reach higher!

Next time you kill me make sure I'm dead.

— Unknown

III. What we as a community can constantly be doing to improve the situation.

- Create comfortable working environments: respect individuals' desires, needs, and requirements; accept that we cannot mandate a person's emotions, identity, or sexuality.
- Support people: begin by getting accurate information regarding their situations, and find out how best to support their choices.
- Encourage strong female undergraduates to participate in summer math and science programs: in mathematics, there are programs such as PROMYS, REUs, EDGE,... There are some programs that are only for women.
- Encourage women to apply for grants and offer to proofread their proposals: advise them to replace “may” with “will”.
- Know of research and speaking opportunities and encourage women to volunteer: for instance, The American Institute of Mathematics Research Conference Center has a firm commitment to identify and include at least 20% women in each of their focused research workshops. They have built a database with names of women mathematicians, sorted by their research areas.
- Invite more women to speak at conferences, seminars, and colloquia. Don't just invite the most famous women; look around, become aware of other women in the profession, especially junior women.
- Identify role models as well as hotshots who are supportive of women and, when appropriate, encourage or create mentoring or research connections.
- Challenge, don't coddle, women students and researchers: make it clear you believe in their talent and expect them to excel. By struggling and triumphing, they learn to believe more deeply in their talent.
- Run Research Experiences for Undergraduates, and recruit women and students from other under-represented groups. In the US there are some such programs that are only for women.
- Get good grants program officers, institute directors, and mathematics society officials.

This is a community responsibility, and we are the community.

*The windows of my soul
Are made of one way glass
Don't bother looking into my eyes
If there's something you want to know
Just ask*

*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 got to walk outside you life
 To where the neighborhood changes*

*Tell me who is your boogiemán
 That's who I will be
 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 that it's absurd
 That you think
 I am the derelict daughter
 I fight fire with words
 Words are hotter than flames
 Words are wetter than water*

*I got friends all over this country
 I got friends in other countries too
 I got friends I haven't met yet
 I got friends I never knew
 I got lovers whose eyes
 I've only seen at a glance
 I got strangers for great grandchildren
 I got strangers for ancestors*

*I was a long time coming
 I'll be a long time gone
 You've got your whole life to do something
 And that's not very long
 So 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 DiFranco, *Willing to Fight*