Time for a Culture Change: Cultivating a More Diverse, Equitable, and Inclusive Science

Leslie Ashburn-Nardo, Ph.D.

Vice Provost for Diversity, Equity & Inclusion

Professor, Psychological and Brain Sciences

Acknowledgments

Association for the Advancement of Artificial Intelligence

Drexel UNIVERSITY

Acknowledgments

“Literature Review on the Policies, Practices, Programs, and Other Interventions for Improving the Recruitment, Retention, and Sustained Advancement into Leadership Roles of Women in Specific Science, Technology, Engineering, Mathematics, and Medical (STEMM) Disciplines and at Different Stages in Career Trajectories”

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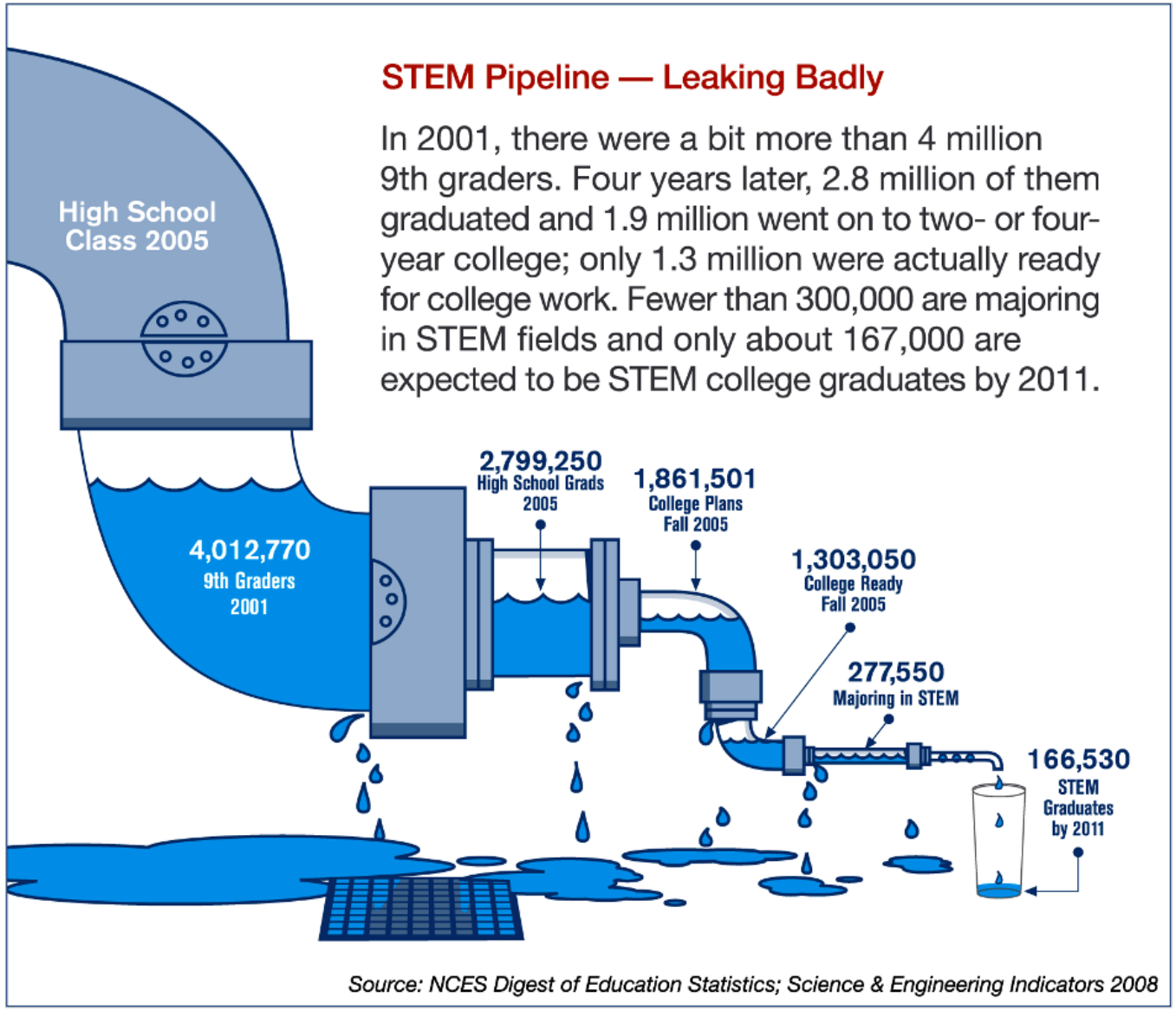
Overview

- Why is STEM so slow to diversify?
  - Challenges across the employee life cycle for members of minoritized groups
- Evidence-based strategies for change
  - Shift the focus from individual solutions to systemic solutions

Why is STEM so slow to diversify?

Leaky pipeline?



Or gauntlet?

Research in Higher Education (2020) 61:540–565
https://doi.org/10.1007/s11162-019-09586-4

Check for updates

Running the STEM Gauntlet: The Complicity of Four-Year Universities in the Transfer Penalty

Diane Cárdenas Elliott[1] · Joni M. Lakin[2]

Received: 12 October 2018 / Published online: 6 February 2020

DEI Challenges at Every Stage of Employee Life Cycle

https://www.linkedin.com/pulse/employee-life-cycle-elc-prerna-dhand-mukherjee/

Stereotypes affect attraction to STEM

- People see STEM careers as more likely to fulfill agentic goals than communal goals.
- The more students value communal goals, the less their interest in STEM.
- Women, first generation students value communal > agentic goals.

Table 3. Resulting Goal-Endorsement Factors: Agentic and Communal Goals

Agentic goals (α = .87)	Communal goals (α = .84)
Power	Helping others
Recognition	Serving humanity
Achievement	Serving community
Mastery	Working with people
Self-promotion	Connection with others
Independence	Attending to others
Individualism	Caring for others
Status	Intimacy
Focus on the self	Spiritual rewards
Success	
Financial rewards	
Self-direction	
Demonstrating skill or competence	
Competition	

Note: A factor analysis of goal-endorsement items supported two distinct factors: agentic goals and communal goals. Cronbach's alphas indicate high internal consistency within each scale.

Diekman et al. (2010). *Psychological Science*
Stephens et al. (2012). *Journal of Personality and Social Psychology*

Stereotypically masculine environments affect attraction to STEM

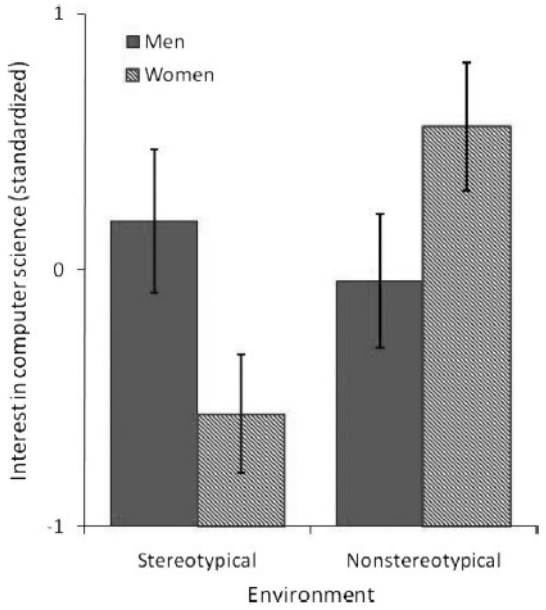


Figure 1. Reported interest in computer science by women ($N = 22$) and men ($N = 17$) in Study 1 when sitting in a room with objects stereotypically associated with computer science or not stereotypically associated with computer science.

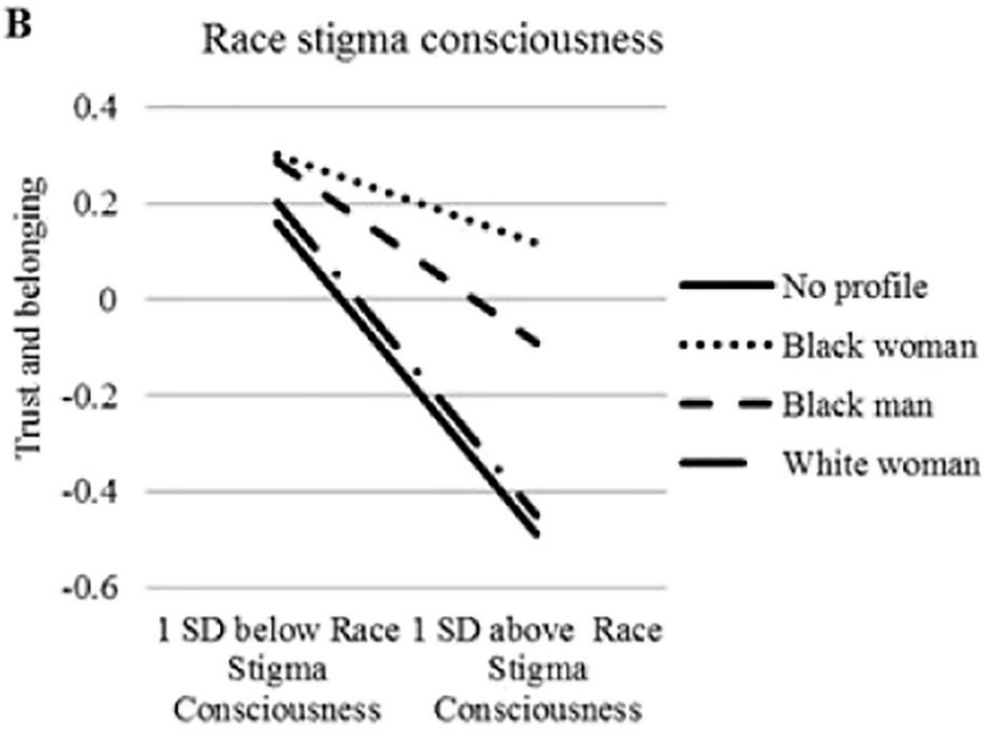
Stereotypic of Computer Scientist (male-dominated field):
Star Trek poster, comics, video game boxes, soda cans, junk food, electronics, computer parts, software, technical books and magazines

Non-stereotypic of Computer Scientist (gender neutral):
Nature poster, art, water bottles, healthy snacks, coffee mugs, general interest books and magazines

Cheryan et al. (2009). *Journal of Personality and Social Psychology*

Representation affects attraction to STEM

- Black women who varied in race stigma consciousness reported anticipated trust and belonging at a STEM company.
- Website featured (or did not feature) a profile of a scientist at that company.
- For Black women high in race stigma consciousness, the presence of a Black woman scientist buffered threat.



Pietri et al. (2018). *Journal of Experimental Social Psychology*

Women historically have had weaker references than men

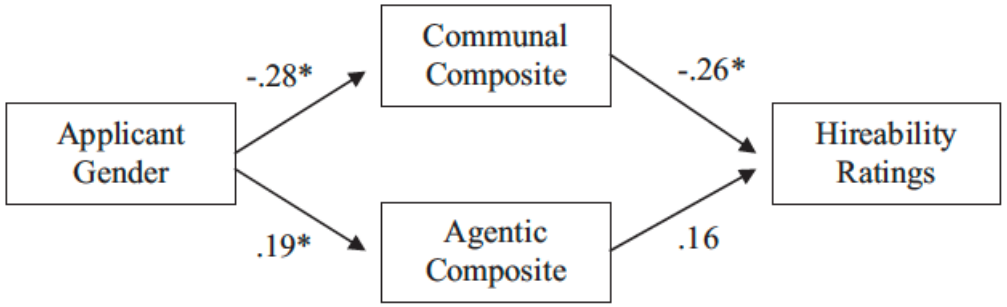


Figure 2. Communal and agentic composites as the mediators of the gender–hireability relationship from Study 2. Standardized estimates are shown. Results are with control variables in the model. $^{*}p < .05$.

Table 4 Descriptive statistics for doubt raisers by applicant gender for study 1

Type of doubt raiser	Female applicants		Male applicants	
	Mean	SD	Mean	SD
All doubt raisers	0.12	0.69	−0.05	0.51
Negativity	0.18	1.21	−0.06	0.87
Hedging	0.13	1.09	−0.04	0.86
Faint praises	0.15	1.14	−0.04	0.90
Irrelevant information	0.10	0.93	0.05	0.84

The scores for all measures of doubt raisers are standardized *z*-scores, and the means are adjusted for the covariates

"She is unlikely to become a superstar, but she is very solid."

Regardless of the gender of the letter-writer

Madera et al. (2009). *Journal of Applied Psychology*
Madera et al. (2019). *Journal of Business and Psychology*

This may be changing

social sciences

MDPI

Article

Assessing Gender Bias in Particle Physics and Social Science Recommendations for Academic Jobs

Robert H. Bernstein [1,2,*], Michael W. Macy [3], Wendy M. Williams [2], Christopher J. Cameron [3], Sterling Chance Williams-Ceci [4] and Stephen J. Ceci [2]

1 Particle Physics Division, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510, USA
2 Department of Psychology, Martha Van Rensselaer Hall, Cornell University, Ithaca, NY 14853, USA; mwmacy@cornell.edu (M.W.M.); sjc9@cornell.edu (S.J.C.)
3 Department of Sociology, Uris Hall, Cornell University, Ithaca, NY 14853, USA; wendywilliams@cornell.edu (W.M.W.); cjc73@cornell.edu (C.J.C.)
4 Department of Information Science, Gates Hall, Cornell University, Ithaca, NY 14853, USA; scw222@cornell.edu
* Correspondence: rhbob@fnal.gov

Abstract: We investigated gender bias in letters of recommendation as a possible cause of the under-representation of women in Experimental Particle Physics (EPP), where about 15% of faculty are female—well below the 60% level in psychology and sociology. We analyzed 2206 letters in EPP and these two social sciences using standard lexical measures as well as two new measures: author status and an open-ended search for gendered language. In contrast to former studies, women were not depicted as more communal, less agentic, or less standout. Lexical measures revealed few gender differences in either discipline. The open-ended analysis revealed disparities favoring women in social science and men in EPP. However, female EPP candidates were characterized as "brilliant" in nearly three times as many letters as were men.

Citation: Bernstein, Robert H.,

Bernstein et al. (2022). *Social Sciences*

Despite identical credentials, STEM applicants perceived to be women (vs. men) evaluated more negatively by STEM faculty

Regardless of faculty gender

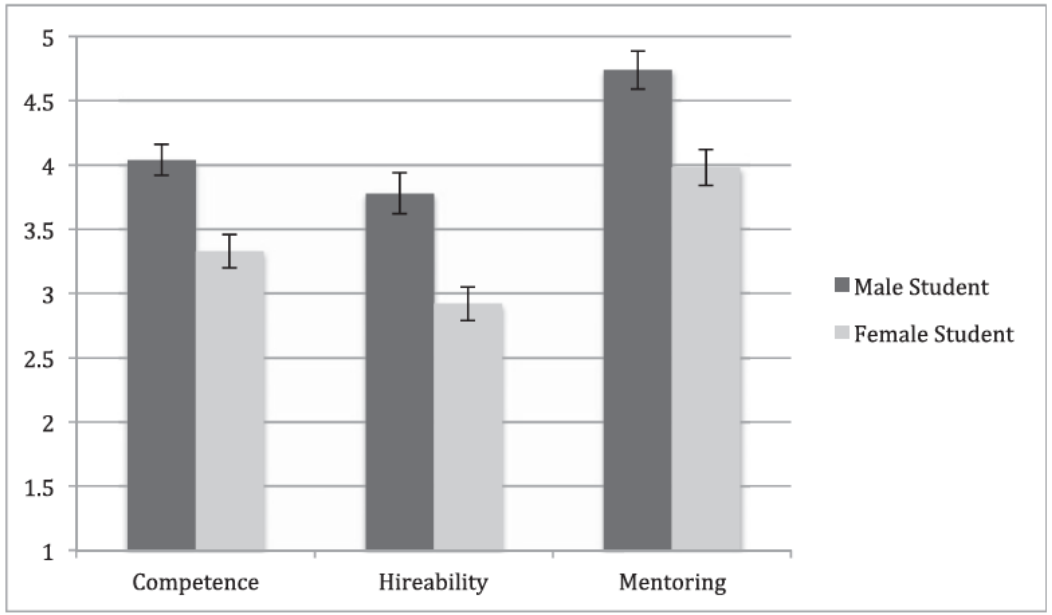


Fig. 1. Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender). All student gender differences are significant ($P < 0.001$). Scales range from 1 to 7, with higher numbers reflecting a greater extent of each variable. Error bars represent SEs. $n_{\text{male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

Replicated and extended to applicants perceived to be Black and Latinx (Eaton et al., 2019, *Sex Roles*)

Moss-Racusin et al. (2012). *Proceedings of the National Academy of Science*

Women given fewer opportunities to advance

- Archival study: top 50 from the 2014 rankings by U.S. News & World Report
- 6 types of departments were examined due to relative gender parity
- Each department's "seminars and events" website reviewed for 2013-2014
- 3,652 speakers identified
- Overall, Men (69%, *n* = 2,519) gave over twice as many talks as women (31%, *n* = 1,133).

- Coded the available pool of likely speakers
- All of the faculty from the top 100 universities (excluding any person we already had in our speaker database)
- N = 19,355 (M 12,538; F 6,817)
- Departments: 22-47% F

Nittrouer et al. (2018). *Proceedings of the National Academy of Science*

Women given fewer opportunities to advance

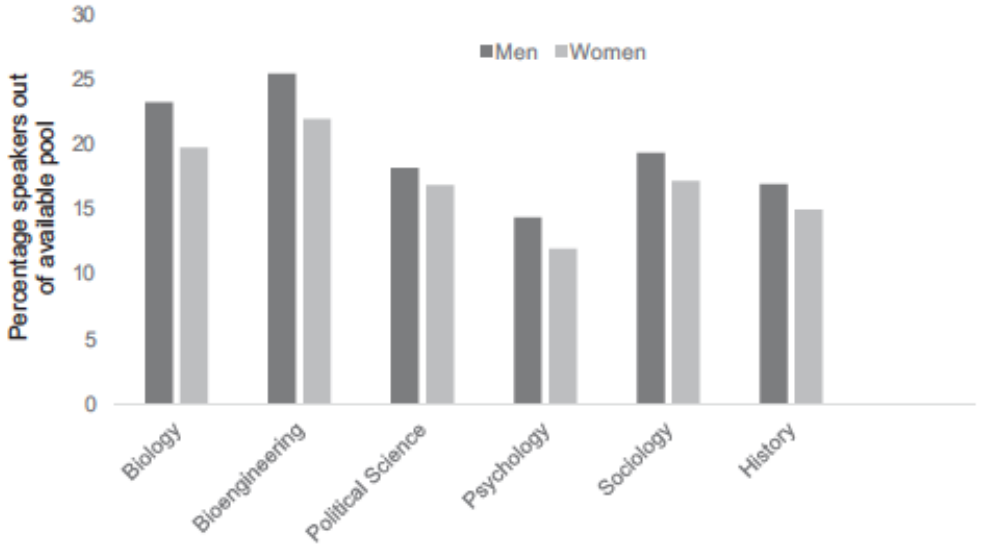


Fig. 1. Study 1: Percentage of male and female speakers out of the available pool by department giving colloquium talks.

Controlling for rank, gender effect persisted: $\chi^2(1) = 18.3$, $p < 0.0001$; 1.2:1

Nittrouer et al. (2018). *Proceedings of the National Academy of Science*

Nationally representative data from the Faculty Survey of Student Engagement

Women and faculty of color do more non-promotable service

Table 1 Regression of service hours per week on female and controls. *Source*: FSSE, 2014

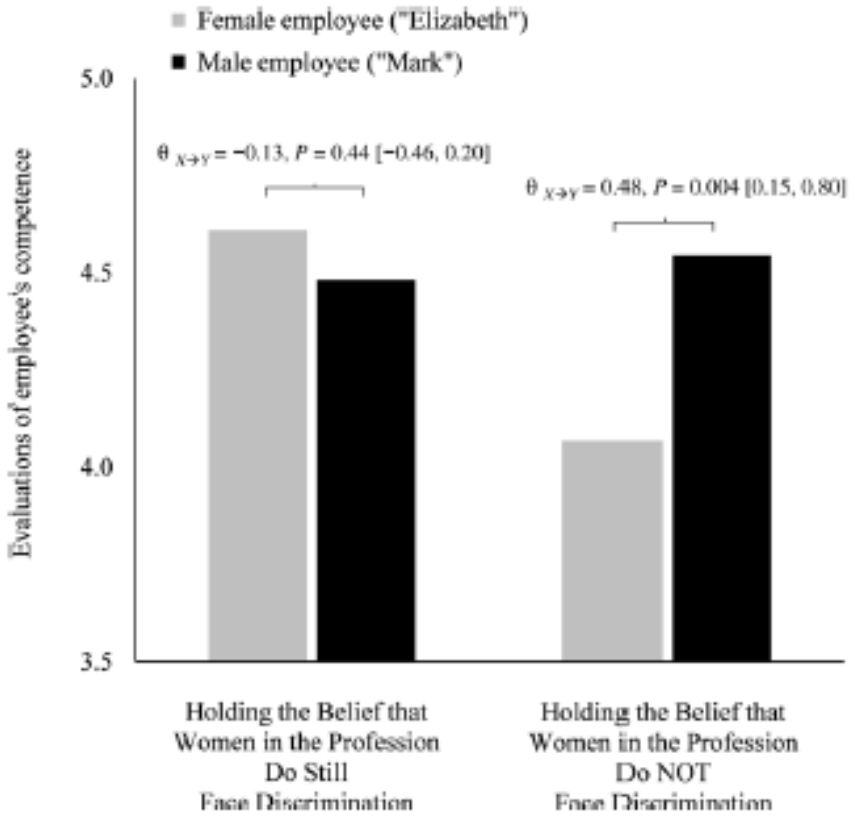
	Service hours per week
Female	0.60 (0.22)***
Rank (assistant as reference group)	
Associate	2.45 (0.19)***
Full	3.84 (0.26)***
Race/ethnicity (Caucasian as reference group)	
Native American	1.93 (1.06)*
Asian/Asian American	−0.76 (0.34)**
Black	0.67 (0.55)
Hispanic	0.51 (0.53)
Pacific Islander	0.53 (1.43)
Other minority	−0.50 (0.56)
Disciplinary area (arts and humanities as reference group)	
Biological sciences	−1.14 (0.35)***
Physical sciences	−1.42 (0.25)***
Social sciences	−0.71 (0.27)***
Business	−0.73 (0.36)**
Communications	0.80 (0.51)
Education	0.66 (0.41)
Engineering	−1.19 (0.46)**
Health	0.10 (0.45)
Social services	0.28 (0.71)
Other	1.23 (0.56)**
Constant	6.80 (0.25)***
R^2	0.09
N	6727

Institution fixed effects included. Standard errors presented below estimates are clustered at the institution level

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Guarino & Borden (2017). *Research in Higher Education*

Bias awareness is necessary…



Begeny et al. (2020). *Science Advances*

Evidence-based strategies for change

…bias awareness is not sufficient for systemic change

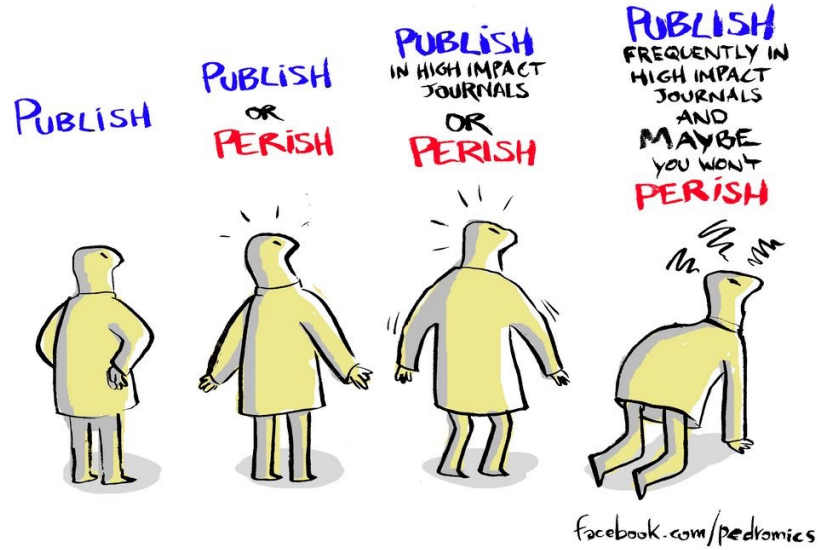
Is STEM a masculinity contest culture?

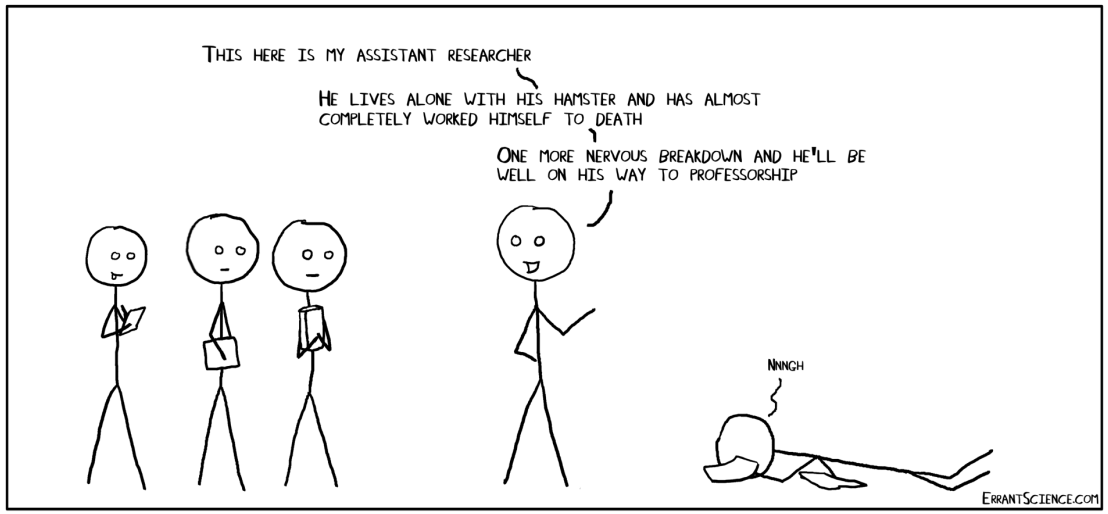
- Show no weakness (e.g., admit no doubt or worries)
- Strength and stamina (e.g., power through adversity, work long hours)
- Put work first (e.g., don't allow family/life to interfere with productivity)
- Dog eat dog (e.g., destroy your rivals)

Berdahl et al. (2018). *Journal of Social Issues*
Glick et al. (2018). *Journal of Social Issues*

Most scientists regarded the new streamlined peer-review process as "quite an improvement."

THE EVOLUTION OF ACADEMIA





THE PATH TO BEING A PROFESSOR IS PAVED WITH EXHAUSTED RESEARCHERS

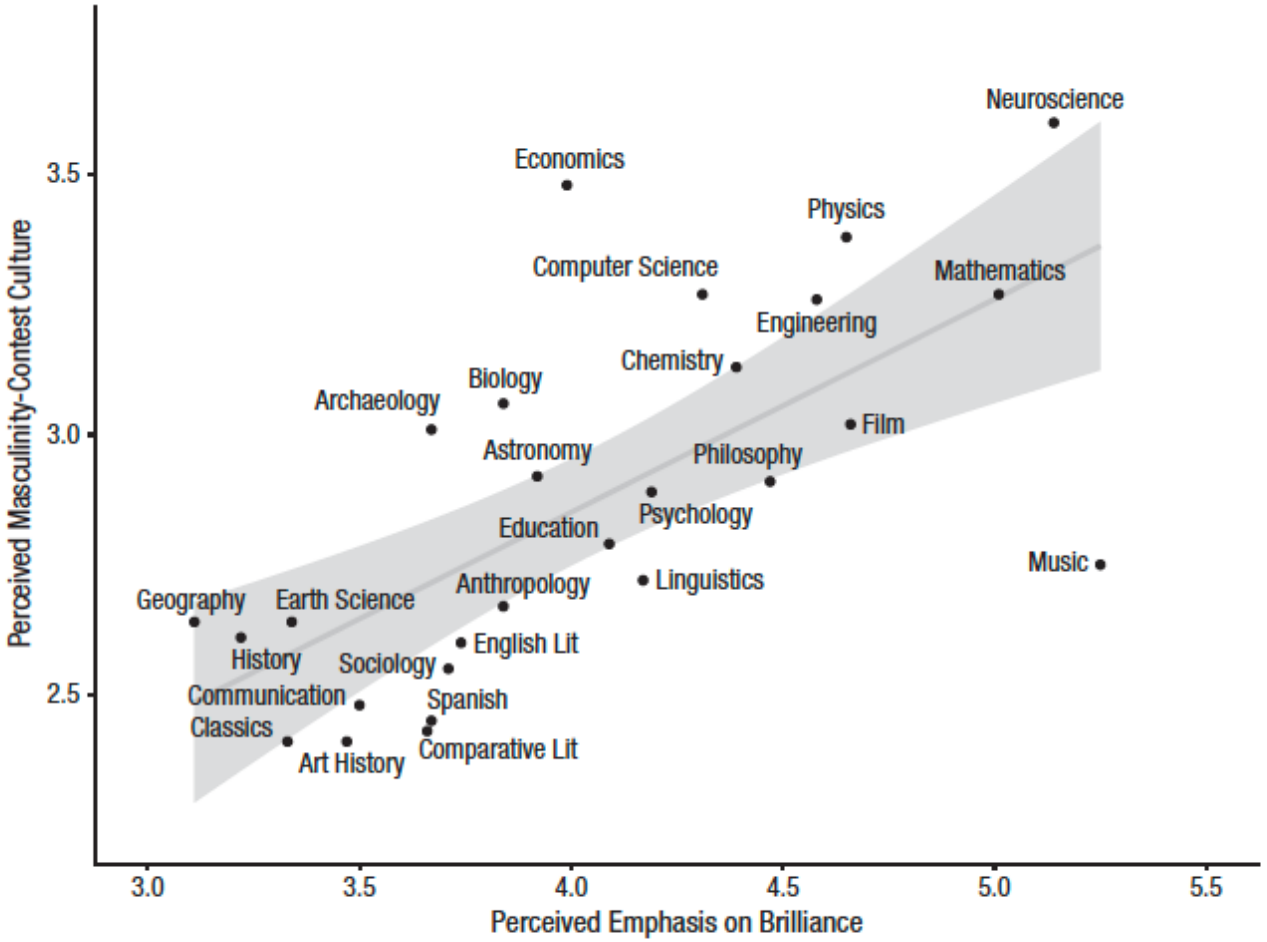
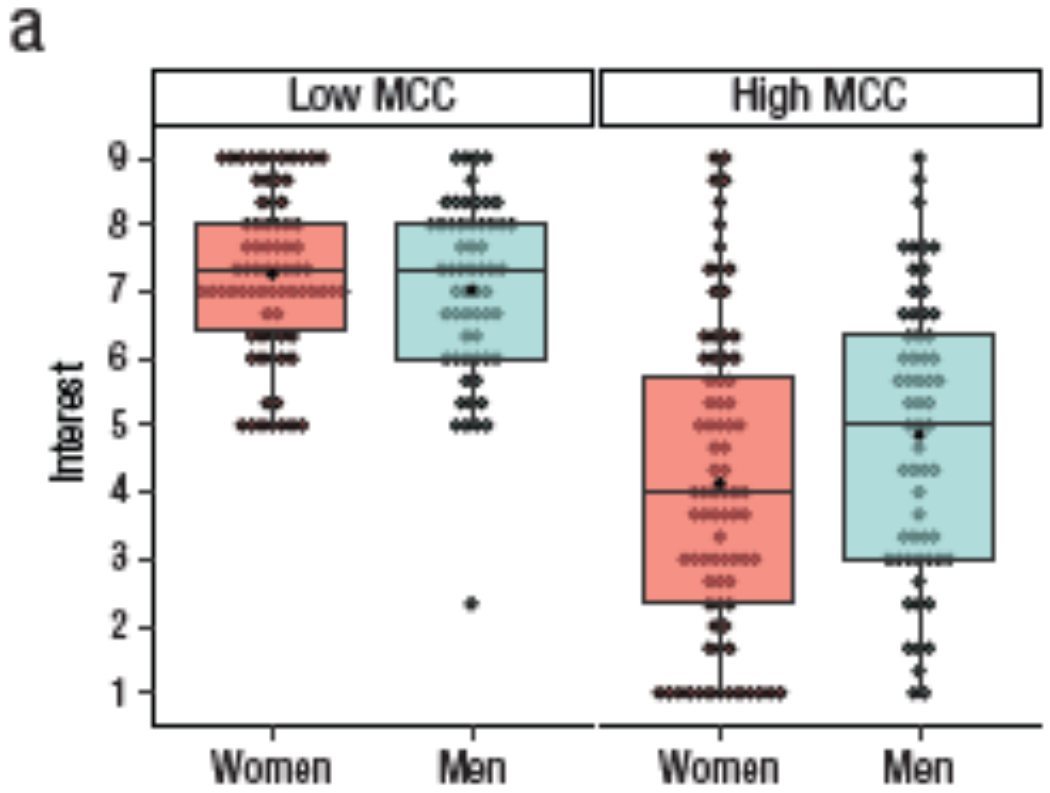


Fig. 1. Relationship between perceived emphasis on brilliance and perceptions of a masculinity-contest culture at the field level in the pilot study. The line indicates the best-fitting regression, and the error band represents ±1 *SE*.

This relationship was stronger among women than men.

Vial et al. (2022). *Psychological Science*



In an organization described as emphasizing “brilliance,” experimentally reducing the perception that it also had a masculinity contest culture eliminated gender gaps in interest, imposter feelings, and belonging.

Vial et al. (2022). *Psychological Science*

Strategy for change: teach “team science”

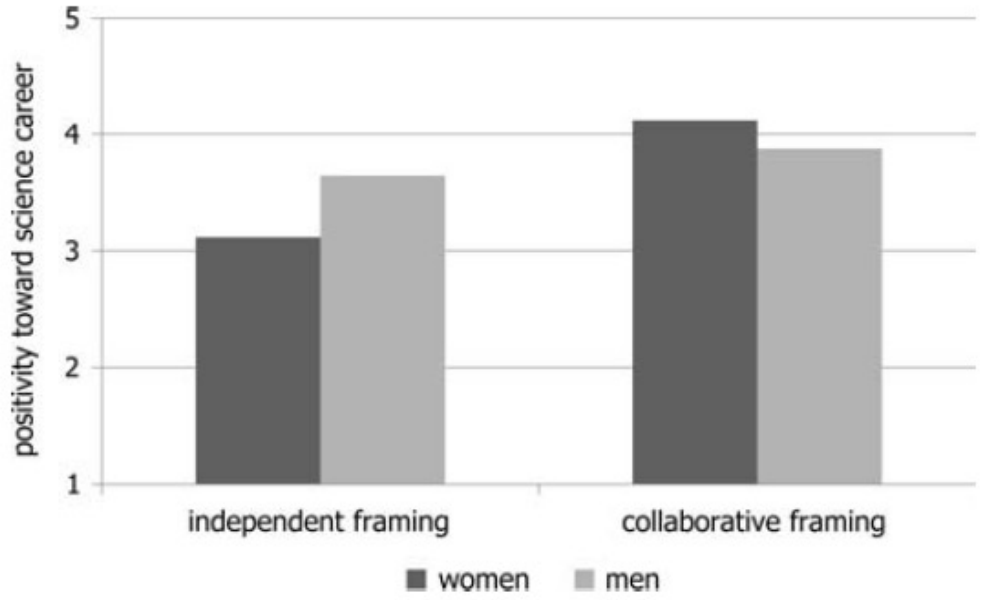


Figure 4. Effects of task framing and participant sex on positivity toward science career (Study 3). Positivity toward the scientist career was rated on scales ranging from 1 to 7.

Diekman et al. (2011). *Journal of Personality and Social Psychology*

Create gender-neutral lab spaces

Attract
Being an appealing inclusive employer

Less of this...
(though I wonder if Star Wars has a different effect in non-STEM classes?)

...and more of this.

https://www.gettingsmart.com/2015/08/21/applying-psychology-learning-sciences-research-developing-makerspace/

Hire with intention

Recruit
Enabling all talent to successfully apply
3

https://doi.org/10.1038/s41562-022-01495-4

US universities are not succeeding in diversifying faculty

J. Nathan Matias, Neil A. Lewis & Elan C. Hope

US universities have made public commitments to recruit and retain faculty of colour. Analysis of three federal datasets shows that at current rates diversity in US faculty will never reach racial parity. Yet, colleges and universities could achieve parity by 2050 by diversifying their faculty at 3.5 times the current pace.

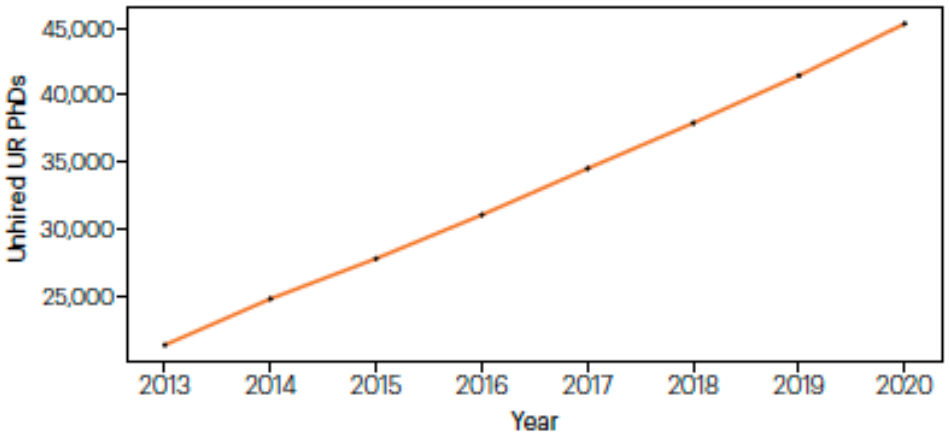


Fig. 2 | Increase in unhired PhDs from underrepresented groups. Between 2013 and 2020, the estimated cumulative number of unhired PhDs from underrepresented groups in the USA increased by 3,394 on average per year ($P<0.0001$, $R^2=0.99$, [3,311, 3,478]).

Matias et al. (2022). *Nature Human Behaviour*

Ensure equity in policies and procedures

- **Transparency:** Departments have widely visible information about faculty work activities available for department members to see.
- **Clarity:** Departments have clearly identified and well-understood benchmarks for faculty work activities.
- **Credit:** Departments recognize and reward faculty members who are expending more effort in certain areas.
- **Norms:** Departments have a commitment to ensuring faculty workload is fair and have put systems in place that reinforce these norms.
- **Context:** Departments acknowledge that different faculty members have different strengths, interests, and demands that shape their workloads and offer workload flexibility to recognize this context.
- **Accountability:** Departments have mechanisms in place to ensure that faculty members fulfill their work obligations and receive credit for their labor.

American Council on Education (2021). *Equity-minded faculty workloads*

Results of a randomized control study of intervention with equity-minded practices

Table 4. Effect of participation on pre- to post- change scores, matched respondents.

Constructs	Survey Item	Standardized regression coefficients
Department Conditions		-.011
	There is awareness of implicit bias	.142*
Work Practices	Transparent work activity data is published	.138*
Action Readiness		.265***
	Faculty know strategies to improve fairness	.165**
	Faculty have concrete steps to ensure equity	.181**
	Faculty can use data to initiate discussions about workload	.251***
	Faculty can create benchmarks for work activities	.142*
Perception of Fairness	Distribution of teaching and service work is fair overall	.228***
Self-Advocacy		.164**
	Faculty feel they can say no to requests	.189**
	Faculty feel comfortable asking for additional resources	.133*

Regression analysis was performed on survey items and constructs controlling for gender, race, rank, and discipline. Significant items at $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

https://doi.org/10.1371/journal.pone.0207316.t004

O'Meara et al. (2018). *PLoS ONE*

Create more inclusive work cultures

3 major initiatives in ADVANCE Project TRACS:

1. Enhanced research capacity and opportunity through dedicated grant support staff and grant-writing bootcamp
2. Enhanced work-life integration by hiring dedicated family advocate for faculty to navigate caregiving resources
3. Enhanced cultural attunement through bias education, hiring of equity advocates, and toolkit for faculty searches

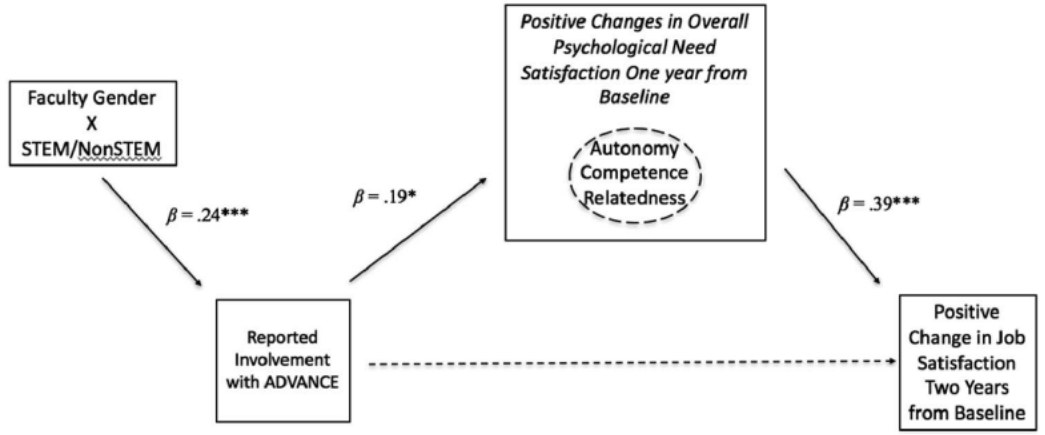


Figure 2. The indirect effect of involvement with Project TRACS on changes in job satisfaction among faculty over time. Standardized β coefficients are included to depict the strength and direction of the association of the given direct pathway (solid line). The greater the Beta value, the greater the impact of the preceding variable on the following variable, with * $p < .05$ and *** $p < .001$. Faculty gender was coded as 1 = female, 0 = male and STEM field was coded as 1 = STEM and 0 = non-STEM. Results show a significant indirect effect between Project TRACS involvement, no matter the person's gender or field of study, and Job Satisfaction (dotted line, bootstrapped, 95% CI .0006 to .108). STEM = science, technology, engineering, and mathematics; TRACS = *T*ransformation through *R*elatedness *A*utonomy and *C*ompetence *S*upport; CI = confidence interval.

Smith et al. (2018). *Journal of Diversity in Higher Education*

Allport (1954) got it right

1. Ensure equal status and value of individuals through fair, equitable practices
2. Espouse common goals to solve shared problems through inclusion in decision-making
3. Encourage cooperation and teamwork, especially in ways that promote friendship potential, by recognizing people as individuals rather than cogs in the machine
4. Institutional support from the top-down to set the norms for behavior