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## UC Berkeley Previously Published Works

### Title

Go beyond bias training

### Permalink

<https://escholarship.org/uc/item/5sq2v2q5>

### Journal

Nature, 557(7705)

### ISSN

0028-0836

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### Publication Date

2018-05-01

### DOI

10.1038/d41586-018-05144-7

Peer reviewed

PhD students, postdocs and professors, and looking for patterns, has also proven valuable, as have institution-wide or department-wide surveys about student and staff experiences.

The only validated tool we know of in this area is the Survey of Organizational Research Climate (SOURCE). It assesses seven dimensions, including integrity norms, adviser–advisee relations and departmental expectations. Results correlate with self-reported rates of detrimental research practices: institutions with low scores of integrity norms will also tend to have higher levels of reported fraud and sloppy record keeping<sup>6</sup>.

The survey can be done online in 15 minutes, and responses are aggregated to ensure individual confidentiality but still show differences across groups. That can help to identify both pockets of good practice and areas needing improvement. One large institution in the midwestern United States has used results to prompt faculty members within specific departments to talk more with graduate students about authorship, peer review and data management.

As well as being used to compare departments across an institution, the results can be compared against anonymous benchmarking data aggregated by the National Center for Professional and Research Ethics at the University of Illinois at Urbana-Champaign (which C.K.G. runs). Now no one can retort, “well, all departments in our field are that way”.

The management literature is clear that one powerful way to bring systemic organizational change is to find ‘bright spots’ — systems or places in an organization that are working well — study them and seek to spread their successful practices. For that, we need data on where the bright spots are, and the will to act.

The solutions are straightforward, if not necessarily simple. ■

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# Go beyond bias training

Ambiguity in expectations and evaluations harms progress, say **Rodolfo Mendoza-Denton** and colleagues.

One morning in February 1934, the police showed up at J. Robert Oppenheimer's home in Berkeley, California, to ask why he had left his date in a car by herself all night. Oppenheimer explained that he had gone for a stroll, got lost in his thoughts and walked home, forgetting his car and companion.

Newspapers reporting this story for Valentine's Day revelled in tales of the

absent-minded professor, an archetype that most of us recognize. Brilliant, but short on social graces, such thinkers are assumed to be too busy pondering the deepest questions of the Universe to be ▶



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▶ bothered with the quotidian.

This archetype, however, can also give licence to the neglect of students. Professors are often excused from knowing the requirements and timelines of graduate programmes. Graduate students regularly receive minimal guidance. The underlying supposition is that the path to success will reveal itself if the student ‘has what it takes’. Lack of direction is often deemed a litmus test for the brilliance of the student.

In our view, women and under-represented minorities face a double whammy under these conditions. First, ambiguous expectations and guidelines allow bias to influence professors’ judgements of student work. Second, environments with unclear or inchoate norms can depress the performance and progress of students in marginalized groups, further perpetuating notions of who qualifies as ‘brilliant’.

Interventions designed to address disparities in science focus largely on changing individual attitudes<sup>1</sup>. Our surveys of science, technology, engineering and medicine (STEM) departments at the University of California, Berkeley, suggest another, complementary target: the structure of the training programmes themselves, and the cultures built around them.

### AMBIGUITY AND BIAS

Professors are generally in control of deciding which of their students’ research is nurtured, funded and eventually published. And, like all individuals, professors’ judgements are subject to bias.

Ambiguous cues about trainees’ and candidates’ performance allow evaluators to incorporate their own, often unconscious, expectations into their assessments. Presented with job applications designed to represent credible but not stellar candidates (would-be research assistants with a published paper and two years of work experience, but low academic achievement), faculty members rated the same work and credentials more positively when it was accompanied by a male name than when associated with a female

name<sup>2</sup>. A similar study found that research abstracts were rated as being of higher quality if presented as being authored by men and on topics, such as computer-mediated communication, that tend to be associated with males<sup>3</sup>. By contrast, another study showed that when candidates for a faculty job were presented as equally strong, according to numerical ratings presumably made by other faculty members, traditional gender biases were reversed, at least in this instance<sup>4</sup>. Similar patterns have been seen with respect to race<sup>5</sup>. In one study<sup>5</sup>, evaluators showed strong preferences towards white candidates when the candidates’ qualifications were ambiguous, but no preference when candidates were unambiguously strong or weak. In short, ambiguity serves as fertile ground for the expression of bias.

In addition, it dents the performance of those under evaluation. In one of our studies, about 150 women were asked to wait in one of three rooms arranged to reflect attitudes of their purported evaluator<sup>6</sup>. In one setting, to suggest that the evaluator held sexist views, the decor included a poster of a bikini-clad woman. In a second, the decor featured a volunteering award with a logo promoting equality to suggest that the evaluator advocated gender equality. The third room was ambiguous, with a banner from a university and a certificate for volunteering in the ‘Ivy League Undergraduate Division’. (A separate survey confirmed the rooms gave the desired impressions.)

We assessed study participants’ concerns about gender-based discrimination with an openly available, previously developed instrument<sup>7</sup>. Concerns did not affect test performance in either the chauvinist or progressive conditions: these groups answered about 8 of 12 moderately difficult analogies correctly. But in the ambiguous room, women who were concerned about being the target of prejudice averaged fewer than 7 correct answers, a strong effect.

**“Structured programmes need not be impersonal or automated.”**

### BRIGHT SPOT

A key requirement for advancement in academia is publication. Almost every step of that process — which project to encourage, how to allocate resources and credit, where and when to submit a manuscript — involves uncertainty. In a survey that R.M.D. conducted with Berkeley psychologist Aaron Fisher and his colleagues across the university’s Division of Mathematical and Physical Sciences, the Department of Electrical Engineering and Computer Science and the College of Chemistry<sup>8</sup>, graduate students were asked whether they had been an author on a paper submitted for publication in the past year. This reflects scholars’ participation in the research enterprise independent of the vagaries of manuscript review and acceptance.

Response rates for men who were not in under-represented minorities and for all students in the engineering and mathematics departments were around 40%. Those for women, people in under-represented groups and the chemistry college were just over 50%. Women and people in under-represented minority groups had fewer submissions than did their white or Asian male counterparts, even when controlling for factors such as time in the programme, advancement to PhD candidacy and teaching responsibilities. To our surprise, however, race and gender did not predict the likelihood of publishing for people in the chemistry college (see ‘No gap in chemistry’).

Intrigued, we went on to examine 15 years’ worth of data from Berkeley’s PhD exit survey, which boasts a completion rate of 98%. The survey includes the questions: “Were you encouraged by faculty in your department to publish?” and “did you deliver any papers at national scholarly meetings?”. The latter is often a precursor to publication.

Again, we found that, overall, women and under-represented minorities were much more likely than white and Asian men to answer ‘no’ to both questions across STEM fields. There were no statistically significant differences in the College of Chemistry.

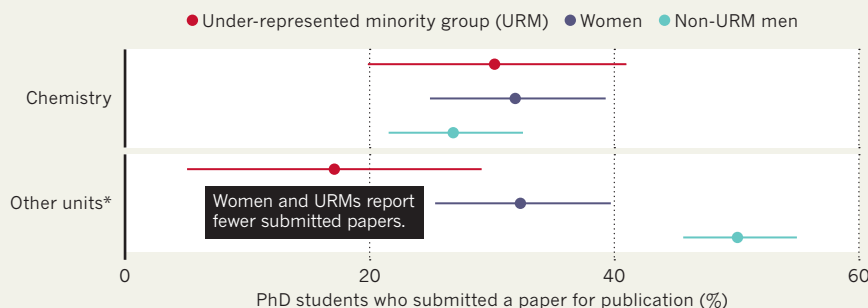
What is happening in the college that seems to be levelling the playing field? Noting that the chemistry programme has been independently recognized for placing women with PhDs into elite faculty positions<sup>9</sup>, our team has embarked on a series of interviews with faculty members, alumni and student advisers in this unit to identify some of the factors that could be fuelling the success of women and minority groups there. We are also interviewing people in the mathematics and physics departments, where we see strong disparities.

### THREE HALLMARKS

Although preliminary, our data suggest that the chemistry college has the following characteristics.

### NO GAP IN CHEMISTRY

The College of Chemistry stands out from some other units at the University of California, Berkeley, because it shows no difference in submission rates across various groups.



\*Division of Mathematical and Physical Sciences and Department of Electrical Engineering and Computer Science.



Setting clear expectations from the start can help all trainees to thrive.

JIM WILSON/NT/REDUX/EYEVINE

**Advancement processes and procedures are clearly defined and systematically applied.** For example, every student is expected to regularly present their research to colleagues and peers, including at a departmental seminar in the second year. This sets a public norm for productivity and affords multiple opportunities to learn from peers and near-peers as they themselves meet these expectations.

**Student progress is overseen by multiple faculty members.** For example, in each broad sub-field of the department, one adviser actively manages students' progress through the early stages of the programme, including helping to match students with research advisers. In addition to the academic and research advisers, each graduate student is entitled to a departmental 'associate adviser' once they pass their qualifying exam. This process ensures that students don't fall through the cracks, and engages multiple faculty members in collegial feedback as the student moves through the programme.

**There is department-wide agreement about expectations for advancement.** There are written guidelines for when students must choose an adviser, deliver seminars and pass qualifying exams. The expectation to publish is promoted officially. Before a student takes a qualifying exam, for example, advisers fill out a form that includes their assessment of when students will submit a paper, establishing that this is a norm, and prompting discussion.

These three observations suggest that requirements and regulations might not be enough. Rather, the community's knowledge, implementation and even application of standards are crucial to creating a culture in which students know what they need to do, and advisers know what they should encourage. We refer to this as a culture of structure.

## RAPPORT AND STRUCTURE

Structured programmes need not be impersonal or automated. The twists and turns of discovery, and of people's lives, demand flexibility and exceptions. Our research suggests that trust between lab heads and lab members is essential — particularly in mentoring relationships that are interracial.

One of us (R.M.D.) and his colleagues published a study earlier this year intended to model interracial mentoring<sup>10</sup>. Some participants were asked to play the part of mentor, giving feedback on a speech for which a trainee had just three minutes to prepare. Trainees were asked to rate the quality of the feedback. In reality, all 'interactions' occurred through a video-chat in which one member of the pair was an actor performing a pre-recorded script.

Before the speech, half of the pairs were assigned an activity in which participants took turns asking and answering questions that escalate in self-disclosure — an exercise known to increase feelings of rapport. The control group took turns reading passages of novels to each other<sup>11</sup>.

According to independent coders — who did not know which activity preceded the feedback session — trainees in pairs assigned to the rapport-building task gave better speeches and mentors provided warmer and more helpful feedback than did those in the control group. This held true for both same-race and interracial pairings.

Of course that's just one study, and more research is needed. But if the tenor of manipulated, short-term 'mentoring' can affect performance and feedback, it seems likely that the tenor of a trainee-adviser relationship could, too. In many STEM departments, emotions and feelings are deemed distractions. Our research suggests, instead, that establishing trust could be a

key way to boost performance and parity through the ability to value each other.

In sum, our findings suggest fresh ways of interrupting bias in STEM education. Departments should adopt transparent policies and expectations for student progress that are communicated clearly to all. Professors and mentors should take time to build trust and rapport with students.

It is time we laid to rest the 'see you in five years' model, rooted in the specious notion that brilliance will find a way. Brilliance is most reliably nurtured through structure and trust. ■

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