



ILLUSTRATION BY THE PROJECT TWINS

PHD POLL REVEALS FEAR AND JOY, CONTENTMENT AND ANGUISH

Graduate students mostly love what they do, but workload pressures continue to take their toll, finds *Nature's* 2019 PhD survey. **By Chris Woolston**

Getting a PhD is never easy, but it's fair to say that Marina Kovačević had it especially hard. A third-year chemistry student at the University of Novi Sad in Serbia, she started her PhD programme with no funding, which forced her to get side jobs bartending and waitressing. When a funded position came up in another laboratory two years later, she made an abrupt switch from medicinal chemistry to computational chemistry. With the additional side jobs,

long hours in the lab, and the total overhaul of her research and area of focus, Kovačević epitomizes the overworked, overextended

“We don't want to just look at graduation rates. That's great, but what did it take to get there?”

PhD student with an uncertain future.

And yet she could hardly be happier. “I think I'm exactly where I need to be,” she says. “I love going to work each day. I have lots of things to do, but I'm not stressed. I can't imagine anything else that would bring me this much joy.”

The results of *Nature's* fifth survey of PhD students bear out Kovačević's experience, telling a story of personal reward and resilience against a backdrop of stress, uncertainty and struggles with depression and anxiety. The

Work/Careers

survey drew self-selecting responses from more than 6,300 early-career researchers – the most in the survey’s ten-year history. The respondents hail from every part of the globe and represent the full spectrum of scientific fields.

In survey answers and free-text comments, students expressed widespread and deep-seated frustrations with training, work–life balance, incidents of bullying and harassment, and cloudy job prospects. This year’s survey also included new questions suggested by early-career researchers, including ones on student debt, bullying and harassment, and carer responsibilities. A question about mental health – asked of all respondents for the first time – shed light on some of the more troubling effects of higher education.

But as with *Nature’s* previous surveys of doctoral students, the positives generally outweighed the negatives: 75% of respondents said they were at least somewhat satisfied with their decision to get a PhD, a slight decline from 78% in *Nature’s* most recent PhD-student survey, conducted two years ago¹ (see ‘Sustained satisfaction’).

The survey, created in concert with Shift Learning, a market-research company based in London, was advertised on nature.com, in Springer Nature digital products and through e-mail campaigns. The full data set is available at go.nature.com/2nqjndw.

For the first time in its history, the survey was offered in four languages – Spanish, Chinese, French and Portuguese – in addition to English, to increase international participation. More than one-third (36%) of responses came from Europe, 28% from Asia, 27% from North or Central America, and 9% from Africa, South America and Australasia. About 700 responses came from China.

Surveys that dig into the details of PhD life can reveal much more than can conventional big-picture measures, says Ruth Gotian, assistant dean for mentoring and chief learning officer in anaesthesiology at Weill Cornell Medical College in New York City. “We don’t want to just look at graduation rates,” she says. “That’s great, but what did it take to get there? Were students in the lab all of the time? Were they depressed or anxious? If they’re unhappy, we have to figure out why.”

Nature conducted in-depth follow-up interviews with selected respondents. Students spoke of their disappointments and accomplishments, their decisions and regrets, and the reasons that they are continuing on their PhD paths, pitfalls and all. It’s important for PhD students to have an outlet for sharing their feelings and frustrations, says Anna Sverdlik, an educational psychologist at McGill University in Montreal, Canada. Too often, nobody bothers to really ask. “There’s a perception that PhD students are already in a very privileged position,” she says. *Nature* asked, and students spoke.

Perilous journey

Students are literally going to great lengths to earn a PhD: nearly 40% of respondents are studying away from their home country. Mariam Fonseca-Hernández, for one, had studied meteorology in her native Cuba before enrolling in the physical oceanography PhD programme at the Ensenada Center for Scientific Research and Higher Education in Mexico. The change of country was difficult enough for her, but tackling a new field proved much more challenging than she had expected. “I struggled a lot in my first year,” she says. “I started having anxiety attacks. I wanted to quit everything.”

She is not alone in her distress (see ‘Overextended and stressed’). More than one-third of respondents (36%) said that they have sought help for anxiety or depression caused by their PhD studies. (In the 2017 survey, 12% of respondents said that they had sought help for the same reason, but only survey participants who listed mental health as one of their chief concerns could answer the question.)

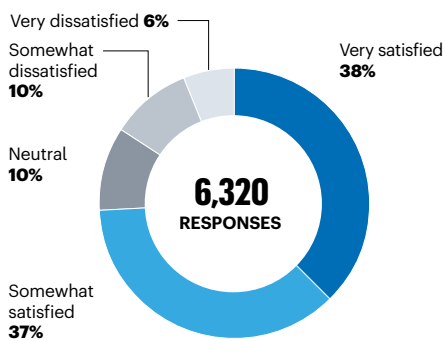
That response echoes other investigations into the mental-health status of students. For example, an international survey published by the World Health Organization in 2018 found that 31% had shown signs of a mental disorder, such as major depression, general anxiety disorder or a panic disorder, in the previous 12 months². A survey of undergraduates in the United States³ found that about 19% reported getting professional mental-health help at their institutions in 2015. That was an increase from the 14% who sought help in 2009. “It could be that more people are aware of anxiety and depression,” says Sara Oswalt, an education and human-development researcher at the University of Texas at San Antonio and the lead author of the US survey study. “Admitting that you’re struggling doesn’t carry the stigma that it did 20 years ago.”

Fonseca-Hernández says that she received useful support and guidance from a psychologist at her university, which puts her in somewhat rare company. Of respondents who said that they had sought help for anxiety or depression, only 26% said they got real assistance at their institutions. Nearly 10% said they wanted to get help at their university but

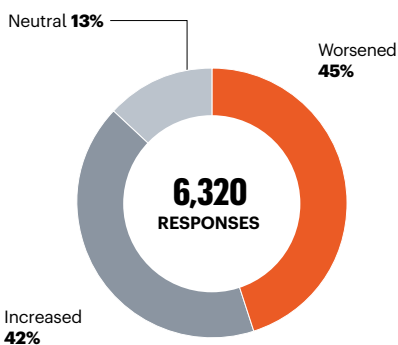
SUSTAINED SATISFACTION

A majority of respondents are still glad they decided to pursue a PhD, although the attitudes of some have worsened over time.

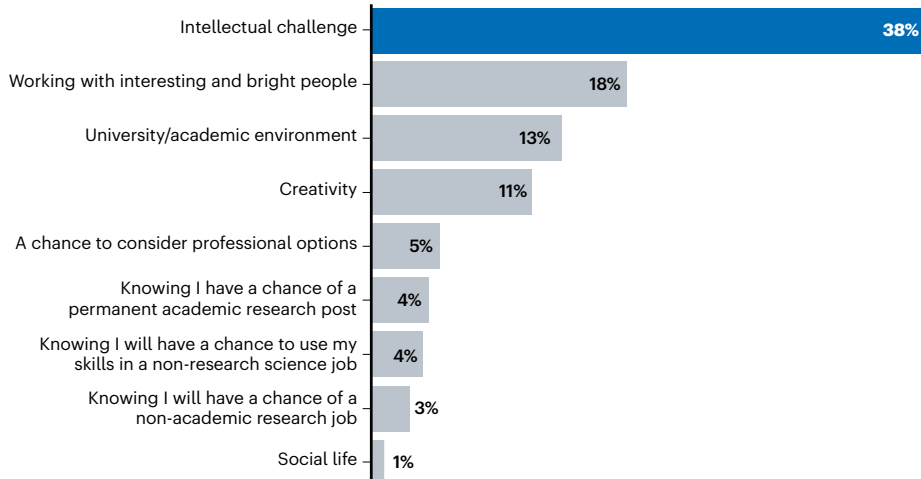
Q: How satisfied are you with your decision to pursue a PhD?



Q: Since the start of your graduate-school experience, has your level of satisfaction increased, worsened or remained the same?



Q: Overall, what do you enjoy most about life as a PhD student?

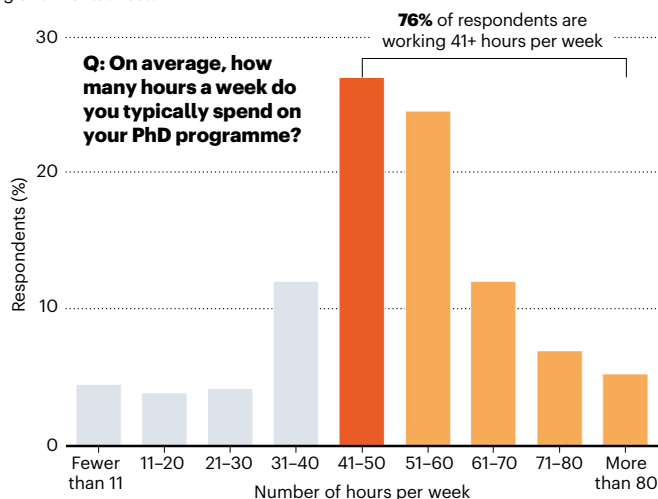


OVEREXTENDED AND STRESSED

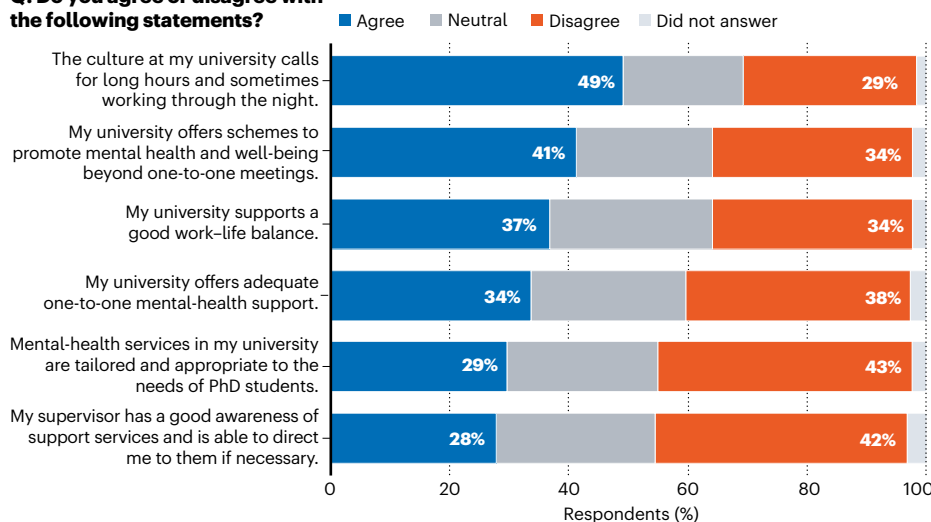
Long hours in the laboratory and other demands have taken a toll on PhD students' well-being and mental health.

36%

of respondents have sought help for anxiety or depression caused by PhD studies. One-third of them sought help from places other than their institution, and 18% sought help at their institution but didn't feel supported.



Q: Do you agree or disagree with the following statements?



that none was available. "Access to services is an issue," Oswald says. "There are not enough counsellors and resources available for everyone who needs them, and that's a global issue. For those 10%, it's a critical concern."

Out of balance

The survey clarified some of the most important sources of emotional strain. When asked to rank their main concerns, uncertainty about job prospects and difficulty maintaining a work-life balance loomed above other factors. Those two worries also topped the list in 2017.

Concerns varied by region. Respondents in Africa were especially troubled by difficulty in securing funding and by expected financial pressures after graduation. More than half of respondents in Africa listed student debt as one of their top-five concerns. And worries about debt weighed more heavily in Asia (31%) and North and Central America (29%) than in Europe (21%). Respondents in North America were more likely than were researchers in other regions to struggle with 'impostor syndrome',

the feeling that they don't deserve their position or simply don't belong in graduate school. Problems with work-life balance ranked as a particular concern in Europe.

Overall, nearly 40% of respondents said they were unsatisfied with their work-life balance, a juggling act that can break down in many ways. Sometimes it stems from a lack of funding. Kovačević, who didn't have a scholarship when she started her PhD programme in Serbia, waited on tables and served drinks in between her experiments. "I was physically doing something all day," she says.

Some PhD students also have families to support, a challenge that can seem overwhelming. In the survey, slightly more than 10% of respondents said they were responsible for caring for a child under 12, and the same proportion reported caring for an adult. Fonseca-Hernández says she has to take her five-year-old daughter to an expensive off-campus day-care centre because there isn't an option on campus. "They should have day care on campus for working students," she

says. "It's hard for us to be good PhD students and good parents."

Sreejith Radhakrishnan thought he was busy when he started his PhD programme in veterinary medicine at Imperial College London, but becoming a father changed his perspective. "When people go into a PhD programme, they may not realize what a large time commitment it is," he says. "Before the baby, I was working all the time, but I still had a little time for leisure. Now it's just PhD work and baby work."

Radhakrishnan hangs on largely because he feels deeply committed to his project, which involves searching for ways to slow the spread of rabies in his native India. He frequently visits tiger reserves, looking for feral dogs that can be caught and vaccinated. He says that he spent nearly four years trying to put together the funding to start his PhD, so he began the programme with extra determination and focus. Even so, he says he often faces down impostor syndrome, a state of mind that transcends qualifications or accomplishments. "The more you learn about something, the more you realize that there's still a lot to understand," he says. "I still don't consider myself an expert on dogs and rabies, but I'm getting better at sharing my opinion."

Falling short of expectations

On the whole, Radhakrishnan says, his PhD programme is a good fit, and he's not alone in that feeling. Some aspects of the experience got especially high marks. Nearly three out of four (75%) were satisfied with their degree of independence, with 27% of those saying they were extremely satisfied. Sixty-seven per cent were satisfied with their overall relationship with their principal investigator, and 27% of those were extremely satisfied.

But even satisfied students have their share of setbacks and complaints. Forty-five per cent of respondents said that their satisfaction levels fell as they got deeper into their programme, slightly outnumbering the 42% who said their satisfaction increased. That finding echoes other research, including a 2018 review article⁴ by Sverdlik and her colleagues showing that satisfaction with PhD programmes tends to decline over time.

Unmet expectations can be a major source of dissatisfaction and disappointment. Nearly 40% of respondents said that their programme didn't meet their original expectations, and only 10% said that it exceeded their expectations — a sharp drop from 2017, when 23% of respondents said that their PhD programme exceeded their expectations.

Nature's PhD surveys and similar investigations could help students to develop a more realistic view of what lies ahead, Sverdlik says. "If students knew that most of the people around them feel like impostors, if they knew that their satisfaction was going to decrease as they go through the programme, they could

at least prepare for it," she says.

Zhuo Yang did not expect the challenges he experienced when he moved from his native China to pursue a PhD in chemistry at the Scripps Research Institute in La Jolla, California. "I thought all I would need to worry about was science," he says. "But I found out you have to worry about getting along with other people in your lab and communicating your science to other people. There's a lot more to think about than just doing your experiments."

Like many others, Yang found that the stress of PhD work worsened over time. "It's really hitting me that I have to publish and graduate," he says. On top of those pressures, he has to worry about his visa, a concern for many foreign-born students in the United States. If he were to go home to his family in China to rest and recharge, he'd need to reapply for a visa to return to the United States, a process that could take a month. "I can't expect to take a month off, so I haven't been able to visit home," he says. "That's only added to the pressure."

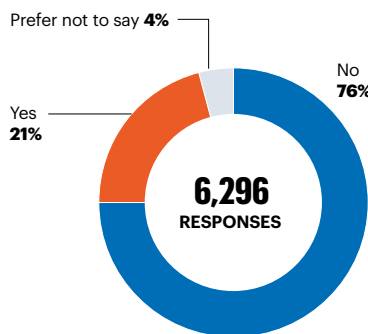
Harassment and discrimination

The survey also uncovered widespread instances of hurtful behaviours that can demoralize students and derail career paths (see 'Bad behaviour'). Overall, 21% of respondents said they had personally experienced

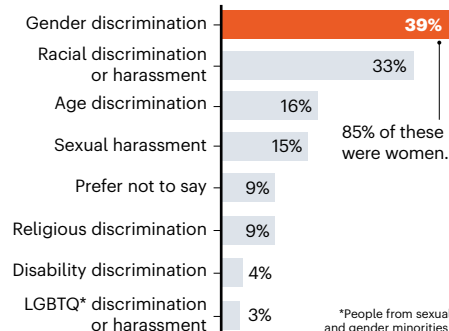
BAD BEHAVIOUR

Instances of harassment and gender or racial discrimination remain distressingly commonplace. The most frequently reported perpetrators are supervisors.

Q: Have you experienced discrimination or harassment in your PhD programme?



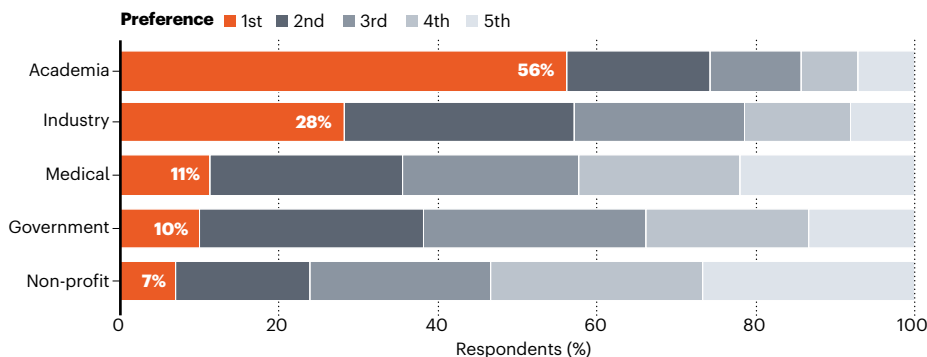
Q: If yes, which of the following have you experienced?



ACADEMIC DREAMS

PhD students around the world continue to aspire to careers in academia despite a global job crunch. Industry — a growing job sector for PhD scientists — rates a distant second.

Q: Which of the following sectors would you most like to work in (beyond a postdoc) when you complete your degree?



harassment or discrimination, and the same proportion reported experiencing bullying. One-quarter of respondents who identified as female reported personally experiencing harassment or discrimination compared with 16% of those identifying as men. The highest rates of harassment or discrimination (24%) were reported in North America, and the lowest (18%) came from Australasia.

Some used the survey's comment section to elaborate on their troubles. "Similar to how sexual harassment had its 'me too' moment, workplace harassment of graduate students needs a spotlight," wrote a female student in India. A female student in Belgium wrote, "I have witnessed and been the subject of bullying and intimidation by an academic supervisor ... The absolute impunity of the top academic professors is astonishing and the biggest threat to young researchers (including mental health)." In the survey, 57% of students who said they had experienced bullying reported feeling unable to discuss their situation without fear of personal repercussions.

Long work hours are another persistent complaint. Nearly half of the respondents agreed with the statement 'There is a long-hours culture at my university, including sometimes working through the night'. The same number reported personally working more than 50 hours every week, a rate that hasn't changed much since 2017. Among those who worked more than 41 hours a week, 85% said they were dissatisfied with their hours.

Uncertain futures

PhD students aren't always sure that all of those hours will pay off. Only 26% of respondents felt that their programme was preparing them 'very well' for a satisfying career. Two-thirds thought that their PhD would substantially or dramatically improve their job prospects, a rate essentially unchanged from two years ago. And despite a global shortage of jobs at universities and colleges, 56% of respondents said that academia is their first choice for a career (see 'Academic dreams'). Just under 30%

chose industry as their preferred destination. The rest named research positions in government, medicine or non-profit organizations. In 2017, 52% of respondents chose academia and 22% chose industry.

Matt Murray, a PhD student in molecular medicine at Yale University in New Haven, Connecticut, is one of the respondents who doesn't know where all of his efforts are going to lead. "I still have doubts that I made the right decision," he says. "You have days where you hate everything and just want to go home."

In some cases, doubt might be a warning signal that pursuing a PhD isn't the best choice. "If you're having second thoughts, maybe you need to wait," says Fonseca-Hernández. But despite the mental-health struggles she has faced, she mostly feels she's in a good place in her life and career. "I manage to live with my anxiety now," she says. "I've learnt a lot, and the people here have been very supporting."

Institutions also have much to learn. This survey and others like it should point the way for institutions trying to adapt to the needs of their students, Gotian says. Even though a majority of students are satisfied with their programmes, she says, their complaints and frustrations deserve close attention. "We don't want to run programmes the way we did 20 years ago," she says. "People have changed, technology has changed, the job market has changed. We need to constantly evolve."

Despite everything, Murray feels that he is ultimately on the right track, even if he doesn't know where it's heading. "At the end of the day, I like being a scientist because there's so much uncertainty," he says. "The doubt's not winning."

Chris Woolston is a freelance writer in Billings, Montana.

1. Woolston, C. *Nature* **550**, 549–552 (2017).
2. Auerbach, R. P. et al. *J. Abnorm. Psychol.* **127**, 623–638 (2018).
3. Oswald, S. B. et al. *J. Am. Coll. Health* <https://doi.org/10.1016/07448481.2018.1515748> (2018).
4. Sverdluk, A., Hall, N. C., McAlpine, L. & Hubbard, K. *Int. J. Dr. Stud.* **13**, 361–388 (2018).