IMAGES.COM/CORBIS

GRADUATE STUDENTS

Aspirations and anxieties

Nature's international student survey reveals changing career preferences — and a need for inspiring mentors.

BY GENE RUSSO

Life as a graduate student can mean hours of daily toil, little social contact and no guarantee that all that work will lead to a job. But it can also offer intellectual stimulation, independent projects that nurture a love of discovery and the development of a skill set that opens a host of science-related opportunities for a budding scientist.

No wonder, then, that a survey of graduate students suggests many are ambivalent about their work and their future. The results imply that doubts grow as students advance towards completing their degrees, and suggest that students experience deficiencies in career planning and advice from their supervisors (see 'Changing attitudes').

About 5,000 graduate students from dozens of countries responded to the survey, which *Nature* publicized through its e-mail lists and website, the Naturejobs.com newsletter and social media. Respondents hailed from a variety of scientific fields, but the basic biological sciences were most heavily represented.

Across all disciplines, PhD students became less pleased with their experience as their degrees progressed. Of first-year students who responded to the survey, 76% were "satisfied" or "very satisfied"; that decreased to 66.8% for second-years and 61.3% for third-years, although the numbers varied with region (see 'Continental divide'). Jo Rae Wright, dean of graduate-school programmes in cell biology at Duke University in Durham, North Carolina, was struck that the biggest drop was after the first year. "Students sometimes don't know what to expect", she says, and the reality can fail to live up to their aspirations. Hugh Kearns, a psychologist at Flinders University in Adelaide, Australia, who studies the graduate-student experience, says that the change could also be due to research results not turning out as expected. He notes that new students sometimes have unrealistically optimistic ideas about the feasibility of their research aims.

Satisfaction with "degree of independence" fluctuates. More than 72% of first-years were very or somewhat satisfied; that dipped to 64.1% for third-years, but rose again to 67.9% for fourth-years. What might be going on? "It's the nature of graduate education that stress and independence are linked," says Wright. She suggests that, in the United States anyway, as students get to the end of their graduate degrees, they focus more on their individual projects. This means more independence, but also a rise in anxiety: the pressure is on to conduct a successful project while sorting out future education, a postdoc or job prospects.

BETTER ADVICE, BETTER OUTCOMES

Advisers might not be doing enough to help graduate students to navigate the difficult later stages of their degrees — at least, the survey suggests that students perceive a deficiency. Among respondents in the first year of their PhDs, 62.6% were very or somewhat satisfied with the guidance that they received from their advisers; only 52.9% of second-years said the same, and 46.7% of third-years. The decline levelled off for fourth- and fifth-years, with about 43% very or somewhat satisfied. Likewise, satisfaction dipped noticeably when it came to "recognition from adviser". About 65% of first-years were somewhat or very satisfied, compared with only 48.6% of fourth-years.

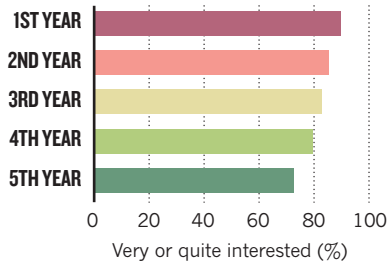
Adviser recognition is an "essential element" of quality supervision, says Marja Makarow, ▶

Changing attitudes

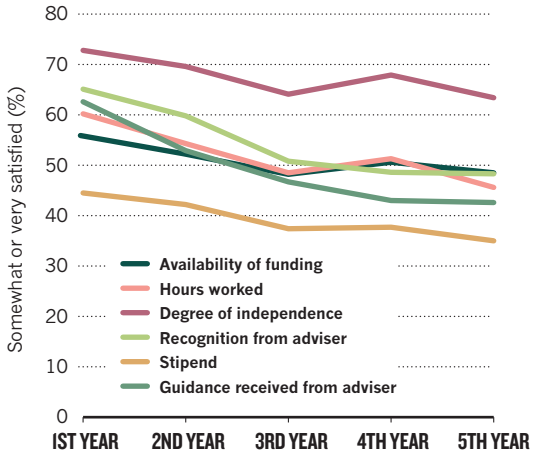
Below are selected statistics from our international survey of graduate students. We had more than 5,000 respondents, with a heavy representation in the life sciences.

Q Overall, how satisfied are you with your graduate-school experience?

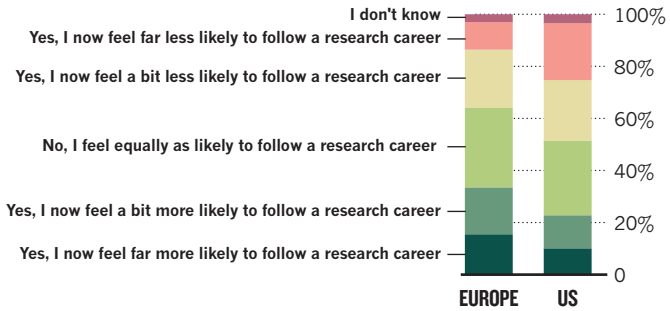
Q How would you rate your current interest in your work?



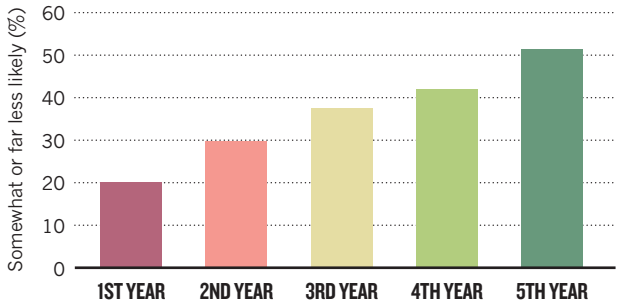
Q To what extent are you satisfied with each of the following attributes or aspects of your graduate-school experience?



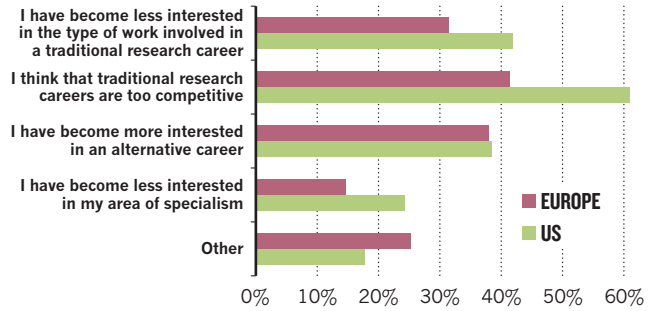
Q Do you think that your likelihood of commencing a research career has changed since starting your PhD?



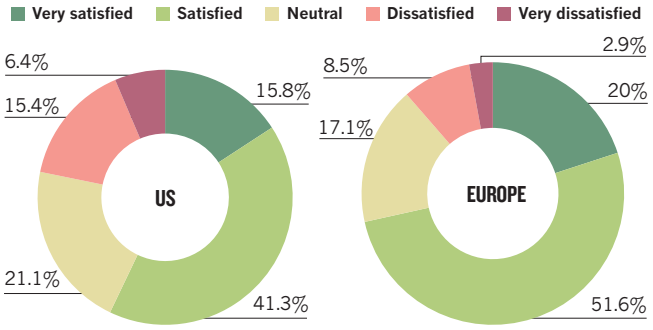
Q How much less likely to commence a research career have you become since starting your PhD?



Q Which, if any, of the following are reasons that you feel less likely to follow a traditional research career than you did when you started your PhD?



Q Overall, how satisfied are you with your graduate-school experience? By region.



▶ chief executive of the European Science Foundation in Strasbourg, France, and a long-time student adviser as professor of molecular biology at the University of Helsinki. "If there's no mutual valuing, you're missing something terribly important."

Kearns and his collaborator Maria Gardiner — with whom he runs workshops for graduate students and advisers and writes occasional columns for *Nature*'s Careers section — say that the survey's findings are consistent with their research, which highlights how crucial a good adviser is to the graduate experience. They have found that a lack of direction and clear advice from an adviser leads to significant declines in student satisfaction.

Kearns and Gardiner also find that many PhD students gradually lose confidence because they get little feedback about their performance. "This may, in turn, manifest itself in reduced satisfaction," says Kearns.

Advisers can minimize stress for their students by helping them to map out possible career aspirations. "We do need to do what we can to make that experience as rich and rigorous as possible, but also as humane for students as possible," says Debra Stewart, president of the US Council of Graduate Schools in Washington DC. University deans and career centres should help faculty members to inform students about non-academic career tracks, she says. Faculty members often encourage students to follow the academic route not only because it is what they themselves love, but also because it is what they know best. "We have to help them paint a richer picture of careers," says Stewart.

Graduate students, for their part, need to consider their career options earlier, says Jennifer Rohn, a research fellow at the MRC Labo-

ratory for Molecular Cell Biology at University College London. Just 44.6% of respondents started thinking about their job preferences before they began their graduate degrees; 19.9% did so in their first year of study and 15.6% during their second. Too many left the decision until later in their degrees, says Rohn, who has advocated a shake-up of the postdoctoral career structure (see *Nature* **471,** 7; 2011). "To me, this implies they are not entering [postgraduate education] to train for a trade — they are drifting into it because they don't have alternative plans, or it's just 'the next step' somehow and they can defer making a decision for a few more years," she says. "Given how poor the job prospects are in academia, this is a concern."

But to Wright, 44.6% is a surprisingly high number of students considering their future careers before they start their PhDs. "That's not my experience," she says. "Our students say they don't consider until they near the finish line." She points out that perhaps the new student has "thought about" career aspirations only fleetingly. They might not have followed up by actively researching options or discussing them with mentors and others in the know. Wright suspects that few students do so. She hopes to change that at Duke through a coordinated effort to expand career-development counselling, involving not only faculty members, but also alumni and the university careers centre.

Thomas Skalak, vice-president for research at the University of Virginia in Charlottesville, emphasizes the need to impress upon students that they are, in the end, responsible for their own education. He likes to suggest that they act as 'intellectual entrepreneurs' by fastidiously minding their own education, graduate project, research focus and career prospects.

ACADEMIC BOOM AND BUST

Academic careers are still highly sought after, although graduate students are by no means ignoring industry and other options. About 57% said that they would pursue a postdoc in academia after graduating; 17.5% preferred a postdoc in industry. About 53% said that before starting their graduate education, they had wanted to end up in academia. Rohn wonders whether enough of these respondents had been properly briefed about the very strong competition that surrounds academic jobs. "By and large, graduate school is still perceived largely as a gateway to an academic career, and nobody is disabusing [students] of this notion," she says. "Or if they are, people aren't listening. It's human nature to believe you can be the exception."

The survey implies that the longer students spend in graduate education, the less attractive an academic career becomes. About 78.8% of first-year PhD students said they were "very" or "quite" likely to pursue a university research career; that dips to 70.3% for second-years. The decline continues throughout the degree, with 66.8% of third-years, 64.5% of fourth-years and 62% of fifth-years answering the same.

Intense competition for original results, publications and jobs seems to be a major factor in this change. Among those respondents who had grown less likely to follow a conventional research career since starting their graduate degrees, 49.4% attributed their change of heart to competition, 36.9% had become more interested in an alternative career and 36.4% had become less interested in the work involved in traditional research, although there were significant regional discrepancies. (Respondents could choose more than one reason.)

CAREER QUALMS

Data from the University of California, San Francisco, suggest other reasons for turning away from academia. In 2008, Cynthia Fuhrmann, the university's programme director for academic career development, polled biomedical-research graduate students about their career preferences. As in *Nature*'s survey, she saw a drop in interest in academia. Among the 469 respondents, 42% of first-years wanted to be a "principal investigator at a research-intensive institution"; that dropped to 25% for third-year students. Of those who gave reasons, many cited the long work hours required, the challenge of getting funding, a distaste for daily tasks such as grant writing and the slow pace of research, and the intense competition for tenure. Some also had what Fuhrmann terms "positive" reasons for their change of preference — such as learning about an exciting new job opportunity. The results will be published in September in *CBE — Life Sciences Education*.

Again, mentorship can make a difference — and have a big influence on career directions. Fuhrmann has seen more than one student who was doubtful about pursuing academia decide to go ahead after talking to a mentor. She suggests that more transparency from mentors — not only about successes, but also about disappointments — could help students resolve to stick with their plans. For example, when principal investigators do not get funded, they often shield their protégés from the failure. Perhaps they should instead share such undesirable outcomes with their trainees and explain how they plan to press forward, change tactics or find bridge funding. "Trainees notice these things anyway," says Fuhrmann, "and it could be helpful for principal investigators to share how they deal with stressors."

Around the world, students trying to complete a PhD in the sciences often face a daunting task. The survey data suggest that although they relish their independence, such students consistently crave wise counsel. Given tight university budgets and a scientific workforce and opportunities that continue to evolve, advice is as important now as it has ever been. ■

Gene Russo *is Careers editor at* Nature.

➲ **NATURE.COM**
For more data tables from the graduate survey, visit:
go.nature.com/eqmi3e

REGIONAL DIFFERENCES

Continental divide

Graduate students in Europe seem to have a more positive attitude towards their work than those in the United States, according to *Nature*'s graduate-student survey.

Of Europe-based students who responded, 71.6% were somewhat or very satisfied with their overall experience, compared with 57.1% in the United States and 62.3% in Japan. Whereas 18.2% of US-based respondents said that their experience had "significantly worsened" since they had started their degrees, just 8.3% of Europe-based respondents and 4.4% of respondents in Japan agreed. Graduate students in Europe also reported greater interest in their work — 46.1% were very interested, compared with only 32.7% in the United States.

When asked whether they had become less or more likely to continue on to a research career since they became graduate students, 21.8% in the United States replied that they were far less likely; just 10.6% of Europe-based respondents said so.

Differences in cultures, lifestyles and institutions make it difficult to pinpoint the causes of the discrepancy. However, Marja Makarow, chief executive of the European Science Foundation in Strasbourg, France, suggests that a move towards more-structured PhD programmes in many parts of Europe in recent years could have boosted satisfaction there. At many European institutions, says Makarow, tutelage has expanded beyond the conventional one-on-one with an adviser, and now includes a group of faculty members. Some previously unstructured programmes now have workshops and lab courses. Also, getting a PhD typically takes three to four years in parts of Europe, whereas it can take five or more in the United States, which can cause dismay.

Far more students in the United States say that intense competition discourages them from pursuing a research career than do those in Europe. Among the US-based respondents who had become less likely to pursue a research career, 60.9% thought that "traditional careers are too competitive", compared with just 41.3% of Europe-based respondents. G.R.