

CAREERS

TURNING POINT Neuroscientist's successes lead to post in his native country p.261

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BY AMBER DANCE

Kathy Kennedy faced a decision six months into her PhD. Having spent time in various labs studying parasitic liver flukes and the intestinal bacterium *Clostridium difficile*, she had to choose where to spend the next three-and-a-half years while completing her thesis. The rotations helped her not only to make an educated decision about which research group to join, but also to meet colleagues and learn extra skills.

Five or ten years ago, her experience would have been unusual in Europe, where doctoral students would find a mentor, then immediately join his or her research group. They rarely had classes or a choice of research topics. "I went into the lab until I was done," recalls Christine Loscher, who directs the Bioanalysis and Therapeutics Structured PhD Programme (BioAT) at Dublin City University, and is Kennedy's chosen adviser.

A doctorate in Europe traditionally involved a one-on-one relationship between master and apprentice. In Germany, for example, the word for that influential mentor is *Doktorvater* — 'doctor father'. Pursuing related interests and coursework was not generally on the agenda. PhD holders usually went on to make their careers in academia, so the *Doktorvater* was training his or her replacement.

Kennedy's experience reflects a new kind of doctorate. A structured PhD generally includes the research training of a conventional degree, together with other elements that keep students on track and help to prepare them for a variety of post-PhD careers. Students have multiple advisers and administrators to guide them, receive formal training in scientific and soft skills and have opportunities for travel and interdisciplinary study. In principle, they receive a broader education than any single supervisor could provide.

NEW-LOOK DOCTORATES

The rise of structured PhDs has been rapid. In 2007, just over one-quarter of European institutions had established structured doctoral programmes; by 2010, it was almost two-thirds, according to the European University Association (EUA) in Brussels¹. And whereas in 2007 almost half the institutions offered formalized classwork — usually taking the form of short modules that ran for a day or two — 72% did so in 2010.

In many ways, Europe's move towards structured PhD programmes is making the ►

GRADUATE STUDENTS

Structured study

European institutions are introducing organized doctoral programmes that broaden students' education.

continent's doctoral education more like that in the United States, where students apply to programmes rather than to principal investigators, and undertake coursework and rotations before beginning their theses. According to a survey² of 160 institutions released in October 2012, more than 90% of North American universities offer structured PhDs. But differences remain: US PhDs tend to take longer — most students graduate in seven years, compared with four in the European Union (EU) — because they include the training that European students typically get in a separate master's degree. EU programmes also tend to put more emphasis on broad skill sets likely to be useful in non-academic positions.

In Europe, the implementation of 'structure' varies widely. In some places, such as France and the United Kingdom, structured programmes are already the norm. Others cling to the conventional model or have not yet implemented structured PhDs. Even within a nation, some institutions or departments may offer structured programmes whereas others do not.

GATHERING SKILLS

Now in the second year of her PhD, Kennedy has taken classes in presentation skills, statistics and scientific writing, as well as modules more specific to her research topic: the immune system's recognition of *Clostridium* surface proteins. BioAT is a joint effort between six Irish institutions, and Kennedy will interact with colleagues in other disciplines, institutions and countries. She will meet formally with Loscher and a second adviser twice a year to make sure that her work is on track. She will also have the chance to study intellectual property and commercialization — which will come in handy if she, like many PhD students, ends up pursuing a career in industry. "You become a more well-rounded student because all these different areas are covered," she says.

Candidates who have trained in structured programmes, and taken classes on topics such as patent searches and intellectual property, can hit the ground running in an industry job, says Declan Moran, a manager at Ipsen, a pharmaceutical company in Dublin.

And although such extra course requirements may mean a greater commitment to the classroom, one's research project need not be neglected, say advocates. Ideally, the classes and programme together provide a framework

for students' main studies. "This does not diminish the PhD itself as an original piece of research," says Conor O'Carroll, research director at the Irish Universities Association in Dublin. "It's to enhance the traditional PhD."

There is some early evidence that it is working. O'Carroll conducted surveys of a total of 1,455 PhD trainees across seven Irish universities in 2008, 2009 and 2010 (ref. 3). Even in that short period, students' experiences changed as more of them entered structured programmes. For example, the number of students who had received detailed timetables at the start of their PhDs rose by 20% between 2008 and 2010. Students also became 25% more likely to discuss their research projects in detail with their advisers at the start of their programmes, and there was a 20% increase in student satisfaction with the availability of their mentors. The number of students with more than one supervisor rose by 18%. All these factors contribute to a happier student, says O'Carroll.

Structured programmes also boosted candidates' scientific output, he found: their students were 6% more likely to publish a paper than were those in conventional training. They were also 5% more likely to present their work at an international meeting.

UNEXPECTED BENEFIT

Students come out of structured programmes with a broad set of skills — some of which they may not have known they needed. When she began her PhD in biochemistry at the Free University of Berlin, Agnieszka Denkis was fairly sure that she wanted an academic career. But three years later, she is considering entering industry to do research with real-world applications. She doesn't have to look far for information on how to make the transition — her programme offers workshops on industrial careers.

Denkis is also developing transferable skills outside official modules. She has helped to organize a symposium, getting practice in fund-raising and inviting presenters. And through teaching, she has worked on her public speaking. Trainees in conventional PhDs can also seek out these opportunities, but structured programmes organize them and make them easier for students to find.

Students in structured PhD programmes are generally not dependent on a single supervisor: Sarah-Jo Sinnott, who is in her third year of the Health Services Research programme at University College Cork in Ireland, has

four. "I seem to collect them," she jokes. When she started her studies, she was assigned one mentor, who studies dental public health. As she developed her thesis topic, a study of new insurance co-payments for prescriptions in Ireland, she recruited a lecturer in pharmacy studies and two economists. Her programme is a multi-institutional effort, so she can receive guidance from faculty members at University College Cork, Trinity College Dublin and the Royal College of Surgeons in Ireland, also in Dublin.

Having a diverse committee means that trainees have someone to go to if they fall out with their primary advisers. They can also get multiple references after they graduate.

In some programmes, the supervisors, too, receive structured training. "In the traditional model, it was just assumed that if you're a good researcher, you're a good supervisor," says Thomas Jørgensen, senior programme manager for the Council for Doctoral Education at the EUA. These days, by contrast, Irish faculty members can attend workshops in mentoring. Swedish advisers are often required to pass a test on rules such as how much time they must set aside for advising. Other new supervisors may simply share a coffee with a more seasoned mentor to get some advice, says Jørgensen.

Through classes, rotations and social events that bring together students working on different research topics, structured programmes facilitate networking that might not otherwise be available to students. That enhanced interaction pays dividends, says Eric Haertel, a second-year PhD student in the Molecular Life Sciences programme at the Swiss Institute of Technology (ETH) in Zurich. Trainees from ETH and the University of Zurich, which is a partner in the programme, get together for barbecues and to drink tea, and attend an annual retreat with student presentations and a party. Without the programme, Haertel wouldn't know anybody at the university, he says. The most valuable element of those social events is chatting with other students about his and their work, and solving problems together. And simply knowing who else works on the same topic can be useful, says Haertel, when he runs out of reagents and needs to borrow something.

The networking of PhD candidates helps their advisers, too, because students can bring back valuable information from other labs, or can start collaborations, says Loscher. For example, during one of her rotations, Kennedy performed luciferase assays, which measure the expression of genes linked to the firefly enzymes that produce light; now she can teach the technique to the rest of Loscher's lab group.

ACROSS BORDERS AND SECTORS

Many structured programmes promote networking across national and disciplinary borders. Ilaria Alborelli entered a programme at the University of Basel in Switzerland with an eye towards a project in fruitfly development.



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Sarah-Jo Sinnott

But she broadened her experience through rotations in neurobiology and stem-cell labs. The programme also includes funding for international travel. "It's good to experience research in different environments," says Alborelli. Making it easy for students to travel also helps them to reach the best labs for their research, adds O'Carroll.

The process of applying for a structured PhD varies with the programme. In the conventional model, trainees found a professor to take them on and joined that lab. In some universities, this still happens, but the principal investigator then encourages the student to join an appropriate programme.

In other cases, applicants approach the programme first, and faculty members jointly decide whether their qualifications merit an interview. During the interview visit, applicants meet several faculty members and look for a good match; if a professor and student want to work together, then the student is admitted. And in some programmes, students do not even decide on a mentor until they have started their degrees and completed their rotations. This 'group application' process helps faculty members too, says O'Carroll. Instead of picking through individual students, they can let the programme select the best candidates.

Structured studies may not be the best fit for everyone, says Sarah Weigelt, a postdoc at the University of Münster in Germany, who will start a job as a junior professor at the University of Bochum in April. "It's quite dependent on the personality," she says. Some trainees thrive in a clearly defined curriculum, but others know exactly what research they want to do, and Weigelt wouldn't want them to be delayed by structured coursework. She would prefer to see universities offer a range of PhD options so that students can choose their ideal path.

Although picking the right sort of programme matters, the key factor in success may still be finding the right research project. "You have to like what you're doing," says Sinnott. "You're going to be married to it." ■

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1. Sursock, A. et al. *Trends 2010: A decade of change in European Higher Education* (EUA, 2010).
2. *TRANS-DOC Survey on PhD Programme Structures and Administration in Europe and North America* Presented 15 October 2012 in Brussels; available at go.nature.com/sm6lp9.
3. O'Carroll, C. et al. The PhD in Europe: Developing a System of Doctoral Training That Will Increase the Internationalisation of Universities. In *European Higher Education at the Crossroads* (eds Curaj, A., Scott, P., Vlasceanu, L. & Wilson, L.) 461-484 (Springer, 2012).

TURNING POINT

Rui Costa

Rui Costa, a neuroscientist at the Champalimaud Center for the Unknown in Lisbon, accepted his latest accolade last October: a US\$15,000 Young Investigator Award from the Society of Neuroscience in Washington DC, for his innovative approach in detailing the brain circuits involved in learning. Trained as a veterinary surgeon, Costa traces his success to a 1997 New Year's resolution to follow his research muse.

Has animal behaviour always interested you?

Yes; as a kid, I loved watching natural-history television programmes. In my last year of veterinary school, I did a research internship at the Swedish University of Agricultural Sciences in Skara, in which I studied suckling behaviour in cows and dolphins. I wanted to understand the origins of behaviour and realized that I would have to study the brain.

What do you consider the most pivotal moment in your career?

I worked as a dairy-cow vet for one year after getting my doctorate of veterinary medicine at the Technical University of Lisbon. But I knew that I had to follow my passion for research. On New Year's Eve of 1997, I quit. I had no job and no salary, but I wanted so badly to be a researcher that there was no question that I would find a way to make it work. It sounds crazy, but putting yourself in a position of not going back frees you to pursue your passion.

How did you end up in the United States at the University of California, Los Angeles (UCLA)?

I found a government-sponsored programme at the University of Porto in Portugal, in which students took a year of classes and could then do their research at any university that would fund them. I decided to contact memory researcher Alcino Silva, who was moving to UCLA.

Why did you choose Silva?

He had done the first genetic manipulation of the mouse brain. I believed that looking at brain circuits was the best way to study genetics and behaviour, so I e-mailed him. It wasn't my technical skills that convinced him to take me on, so it must have been my passion for the research.

Were the experiments that you wanted to conduct technologically feasible?

Not really. I have always wanted to image brain activity while genetically manipulated animals were learning and behaving, but the technology didn't exist then. Even today, we can still image only the surface of the brain. But I knew



that Miguel Nicolelis, a neurobiologist at Duke University in Durham, North Carolina, was recording many primate neurons at once using hundreds of electrodes. Looking for a postdoc position, I wrote to him and said that I would love to modify this technique to record activity in mouse brains. He immediately replied that he had had the same idea, and called a few minutes later. He used a phrase in Brazilian Portuguese that means, "Let's go ahead, because people are coming from behind".

Did you always intend to return to Portugal?

I married an American and I liked being in the United States. Yet I missed my family in Portugal and I felt that because Portugal had given me this opportunity, I would one day return. However, I didn't want to just go back and not do science. In 2004, António de Sommer Champalimaud, a Portuguese entrepreneur, died and willed roughly one-third of his fortune to launching the Champalimaud Foundation. The foundation decided to start a neuroscience programme at the Champalimaud Center for the Unknown, with two other researchers and me. In 2007, we shook hands to seal the deal.

How has the experience been so far?

Everything has gone smoothly. The building has an excellent view of the sea and a huge open lab space. We were able to recruit great talent from around the world and have grown to 15 labs, with 130 people. When I arrived, I got a big grant from the European Research Council; last year, I received a 5-year International Early Career Scientist award from the Howard Hughes Medical Institute in Chevy Chase, Maryland. The centre has had a lot of press and publicity, so there is a lot of hype about the place — which helped with recruitment. Now we need to start publishing results to show the public what we are doing. ■

INTERVIEW BY VIRGINIA GEWIN