CAREERS

DIVERSITY A chemist helps others to come out and network **p.265**

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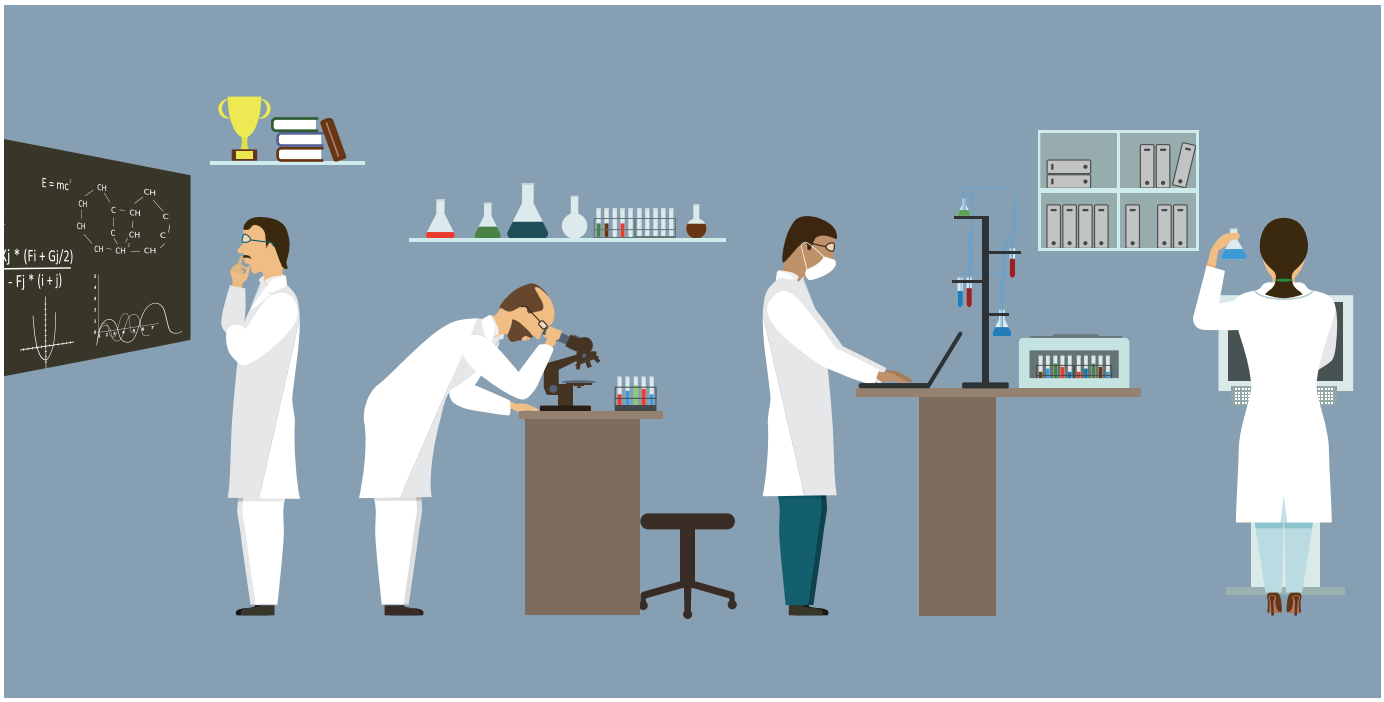

GROUP DYNAMICS

A lab of their own

The make-up of a lab is crucial to success in publishing its research — and now, scientists are exploring how to compose the best research group possible.

BY CHRIS WOOLSTON

Scientists around the world are working to solve the same basic formula: what number and mix of group members makes for the most efficient and productive lab?

Some principal investigators (PIs) produce a steady stream of high-impact papers with just a couple of people in the lab; others successfully oversee a team that could populate a village. Some stock up on postdocs, and others aim to balance career stages and positions: graduate students, staff scientists and technicians.

One of the most important steps for new PIs to take early in their career is to identify the formula that works best for them. In the past, they have had to decide the make-up of their group largely on the basis of their instincts and, often, financial realities. But now, they have some data to turn to. Studies on how lab size and composition affect productivity give researchers guidance in their quest for better science, more publications and higher impact.

Junior faculty members who are deciding how to staff their lab need to consider their priorities: do they want to maximize the number of publications, or focus instead on impact? Do they favour hands-on or hands-off management? The number and type of people in a lab can affect all these important parameters, so PIs should build their labs with care — and with a plan.

BIGGER IS BETTER

Two studies published last year suggest that most labs could produce more papers and make a bigger splash by — perhaps unsurprisingly — bringing more people on board. One of these, a 2015 study of nearly 400 life-sciences PIs in the United Kingdom, found that the productivity of a lab — measured by the number of publications — increased steadily, albeit modestly, with lab size (I. Cook, S. Grange, & A. Eyre-Walker *PeerJ* http://doi.org/bcwf; 2015). In terms of sheer paper production, "it's best for a lab to be as big as possible", says co-author Adam Eyre-Walker, a geneticist at the University of Sussex, UK. Notably, the study found no sign that individual members become less productive or less efficient as labs grow. "Adding a team member to a large lab gives you the same return as adding one to a small lab," Eyre-Walker says.

The second paper, a study of 119 biology laboratories from 1966 to 2000 at the Massachusetts Institute of Technology in Cambridge, found that productivity inched forward when an average-sized lab of ten members added people (A. Conti & C. C. Liu *Res. Pol.* **44,** 1633–1644; 2015). But this study did detect limits: once lab size reached 25 people — an ▶

unusually high number achieved by very few labs — the addition of team members no longer conferred benefit. Further, a lab's productivity tops out with 13 postdocs, the study found.

Co-author Christopher Liu, a former biochemist who now researches strategic management at the University of Toronto, Canada, points out that his study was limited to biology labs at one institution, which makes it tricky to generalize the findings. Still, he says, PIs should pay attention to the take-home message: bigger isn't always better. "Going from 15 to 20 people is probably not great," Liu says. "But going from two people to seven is something that you should probably do. A group of two people is pretty fragile."

GROWING PAINS

Sarah Teichmann, a molecular biologist at the EMBL–European Bioinformatics Institute and at the Wellcome Trust Sanger Institute in Hinxton, UK, can attest to both the pay-offs and the challenges of growing a lab. "When I started in 2001, it was just myself and a PhD student," she says. "I grew my group slowly. After three years, I had three PhD students and a postdoc."

She might have kept that modest configuration, but a change of focus forced a change in lab size. After several years of work on the computational aspects of gene expression and protein folding, Teichmann added an experimental angle to her research. She started by hiring one postdoc to focus on experimental work, but soon realized that he needed help. "He was alone and isolated," she says. "It didn't really work. There has to be a critical mass of experimental and computational people or it won't take off."

A €1.3-million (US$1.4-million) grant from the European Research Council in 2010 enabled her to add three people, and her lab was on the way to bigger things, including more grants, awards and high-impact publications. Today, she leads a group of five postdocs, four PhD students and two staff scientists — one for the computational side and one for the experimental side — with a steady flow of visiting scientists.

Adam Eyre-Walker prefers in-depth discussion.

YING EYRE-WALKER

Staying on top of such an enterprise has been daunting for her and her team (see 'How to pick the right group'). "The bigger your group is, the less face-to-face time you're going to have," she says. "There are only 24 hours in a day." Teichmann tries to keep the lab running smoothly by hiring people who work well together and support each other without her constant involvement. Her strategy is working: she has had her name on 16 publications since the start of 2015, including two articles in *Science*. She also won the 2015 EMBO Gold Medal, a prize awarded to outstanding young scientists in the life sciences.

Still, as Liu points out, bigger labs aren't always the key to a productive career. A smaller group can work for those who prefer to manage team members themselves and whose research doesn't require a huge roster.

For his part, Eyre-Walker finds comfort in the knowledge that small labs can make a big splash: his study found only a weak correlation between lab size and the average impact factor of each paper. He oversees a relatively small team of three PhD students and a postdoc, and says that he can remain deeply engaged with the analysis of all the work in his lab. "I couldn't cope with any more people," he says. "I like it like this. I can still do science. I'm not just managing people."

Some PIs learn through experience that they prefer a less-populous team. Koen Venken, a geneticist at Baylor College of Medicine in Houston, Texas, rapidly built a team of ten lab members after starting his faculty job in 2014. But he soon realized that his team members weren't working well together. "It was a mistake, and I'm happy to admit it," he says. After some rapid downsizing, he now has a group of two PhD students, one postdoc, one lab technician, one research associate and a non-tenure-track instructor, a mix that has proved to be productive and efficient.

Looking back, Teichmann is glad that she took a slow, deliberate approach to building her lab. "Going slow is important for the sanity of the PI," she says. Eyre-Walker agrees. "You have to feel your way into it. Start small, and see how you get on. The worst thing you can do as a new faculty member is take on five PhD students."

QUALITY FIRST

But size is only one measure of a lab. PIs who are assembling a team also have to consider balance — and that means weighing the relative merits of graduate students, postdocs, technicians and other potential members. According to the *Research Policy* study, postdocs — especially those who have external funding through fellowships — are the key drivers of productivity. Overall, adding a funded postdoc to the average lab boosts output by about 29% of a published paper every year.

Graduate students don't contribute much to productivity, but they do play an important part in the group. The analysis found that students are as valuable as funded postdocs for generating 'breakthrough' papers, which the study defined as anything published in *Science*, *Nature* or *Cell*. Adding either a funded postdoc or a graduate student to the average lab increases the chances of such a paper by about 8%, the team found. Postdocs without their own funding, who may not be quite as accomplished as their funded peers, do not improve the odds of a breakthrough paper at all.

Many PIs eventually have to concede to financial and other realities. Sergey Kryazhimskiy, an evolutionary biologist at the University of California, San Diego, was originally dead set against hiring postdocs. He recognized that many postdocs end up stuck in their positions and are not able to move on to tenure-track

MATTERS OF SIZE

How to pick the right group

Lab size affects not only the principal investigator (PI), but also the other members of a research group. Postdocs and graduate students should think about the scope and scale of a lab when choosing a place to work, says Koen Venken, a geneticist at Baylor College of Medicine in Houston, Texas.

Venken says that large labs have much to offer trainees, including plenty of opportunity for independence. The PIs in such labs simply won't have time to look over everyone's shoulder. But that does not mean that team members will be left to their own devices. They have each other, and they can often call on lab technicians for help with tricky tasks.

Small labs might be better for trainees who want a close, collaborative connection with their PI, Venken says. And, he adds, postdocs and graduate students who don't have the luxury of handing tasks over to a lab tech may end up learning skills that could be valuable in future job searches. Papers from small labs can be as important and influential as those from large labs. Furthermore, Venken notes, papers from small labs are less likely to carry a large roster of authors, which makes it easier for an individual contributor to stand out.

Ultimately, it is up to lab members to make the most of their situation, no matter where they land. "If someone is very proactive and innovative, they can be highly independent in a small lab, even when the PI is hands-on," Venken says. C.W.

jobs — and he did not want to play a part in what he views as an unfair system with enormous stakes. "If you're a responsible PI, you would like your postdocs to proceed somewhere after your lab," he says. "It's difficult to assign them risky projects. You're playing with their lives."

He had a plan for avoiding his ethical dilemma: he would bring in staff scientists who were committed to their lab careers. But when he actually got his faculty position earlier this year, he realized that pragmatic considerations outweighed the ethical ones. He estimates that at his institution, it costs nearly twice as much to hire staff scientists as it does to hire postdocs, partly because they get benefits such as paid time off and health insurance.

Unable to stick with his original strategy, Kryazhimskiy has started to interview postdocs. He is looking for candidates whom he thinks will have a good shot at a faculty job, even in a tough academic market. Another option is to find someone with other career goals, such as a job in industry. From a purely practical perspective, he thinks that postdocs will be the best investment of his grant money.

PIs whose labs — and grants — are on the large side may be better able to absorb the cost of staff scientists. For Teichmann, at least, her two staff members are key to her lab's success. Both are accomplished researchers who know how the lab works and how to get things done. She expects to hire two more professionals: a lab manager and a software developer. "Then I would have four core people who can support my postdocs and PhD students," she says. Unlike postdocs and graduate students, those four professionals wouldn't be locked into a pressurized timeline to graduate or to move on to another job.

"The bigger your group is, the less face-to-face time you're going to have."

Venken would eventually like to add a few people to his lab, too — perhaps some postdocs, graduate students or a mixture of both. "I just want people who are invested in everything that we're doing," he says.

The size and structure of a lab can be hugely important, but in the end, the quality of any workplace comes down to the quality of the people, PIs say. Whether they are looking for graduate students or postdocs, whether they desire a large or small research group, new PIs need to find team members who are ready to contribute. "The first set of individuals that you hire is very important," Liu says. "They set the tone for the entire laboratory." ■

Chris Woolston *is a freelance writer in Billings, Montana.*

TURNING POINT
Out for chemistry

David Smith, a chemist at the University of York, UK, spent his early career avoiding personal discussions with colleagues because he did not want to reveal that he is gay. In January, he gave the plenary talk at the first LGBT (lesbian, gay, bisexual, transgender) STEMinar, a conference devoted to networking.

JOHN HOULIHAN

How did the LGBT STEMinar come about?
A postdoc at the University of Sheffield, UK, Beth Hellen, decided that she wanted to get a bunch of LGBT scientists she knew through Twitter together for networking. She thought 20 people would attend, but about 80 showed up. It was, as far as I know, the first ever meeting in the United Kingdom to specifically target LGBT scientists across all disciplines. It was a really nice meeting, with genuine networking. Similar things have gone on in the United States, especially at the big conferences, like the American Chemical Society meetings. But this has never been a feature of UK–European science.

Do you think it will continue?
Yes. One of the most heartening things about the meeting was that it got support from high-level societies such as the Royal Society of Chemistry and the Institute of Physics. It's a time of big change in science. Fifteen years after the culture broadly changed, we are now talking about our personal lives and acknowledging who we are. There are plans for another LGBT STEMinar at Sheffield next year.

How did you find the diversity as a student?
It was not great. I think when I was at the University of Oxford, UK, where I got my PhD, there were about 1,000 chemists in total. At least 75% of them were white men. I have no idea how many of the chemists were LGBT, but I do know that they were silent. Occasionally, there were rumours or gossip about individuals, but it was always negative. It was a hostile environment in the early 1990s. That started to change when former prime minister Tony Blair introduced civil partnerships in 2004.

So 'don't ask, don't tell' was the de facto policy?
Yes. I wasn't 'out' when I started at the University of York. As a result, I engaged in a lot of self-censorship. When chatting about the weekend with colleagues, I'd neutralize the gender of my partner or just not talk about my personal life at all. But I'd end up in difficult situations — half lying, half telling the truth and trying to remember what I had told individual people to be consistent in conversations.

What prompted you to come out?
I was in a long-term relationship and it got more ridiculous not to talk about it. I had been in my job for 4 or 5 years when another gay colleague arrived in the department. It gave me a bit of confidence. I came out in 2002, and I received an overall positive response. Some people were surprised but the uncomfortable period didn't last long. York has one of the most diversity-friendly chemistry departments.

You've been very open since then. Do junior colleagues contact you to discuss LGBT issues?
Yes, I get tens of e-mails from people globally, often people in junior positions, such as postdocs who are unsure about what impact coming out could have on their career. The apprenticeship model leaves junior researchers dependent on their supervisor's recommendation. People worry that even unconscious bias could bleed into a reference letter for a job application. There's no easy answer. Every supervisor is different. The last thing I want to do is say 'come out', and have supervisors write horrible letters.

You make fun YouTube videos, and encourage your students to do so, too. Why?
My videos — notably the chemistry of mephedrone or the science behind the television show *Breaking Bad* — got general traction beyond students. I decided to encourage my students to make videos as a way to empower them with a voice. I wanted them to realize that they don't have to just absorb knowledge, they can be a source of it. It also became a way for me to discuss diversity issues and use it as an education tool. ■

INTERVIEW BY VIRGINIA GEWIN

This interview has been edited for length and clarity.