7. Leadership and Lab Management

Making the Leap to Independence

From: dx.doi.org/10.1126/science.caredit.a0700029

By Irene S. Levine— First published March 2, 2007

Independence is a lofty goal. It's what every parent wants for their child and every citizen wants for their nation. It is also what most scientists aspire to after years of training and working for other people.

But the practical challenges of achieving independence in a scientific research setting are formidable. First, you have to secure a position, lab space, and sufficient funds to buy equipment and hire people, during a time of constricted budgets and increased competition. And once the first round of resources is in hand, you have to be skillfully employed in a coherent scientific effort even as you seek another round of resources. The effort requires a mix of scientific, technical, project management, and interpersonal skills. More intangibly, the path to independence requires flexibility, persistence, and self-confidence. Not everyone has what it takes. Then again, not everyone aspires to scientific independence.

"Those who succeed are well-grounded people who have seen success and believe they can do it too. They are not the type of people who worry too much or are easily intimidated," says Michael Hochella, Jr., a professor of mineralogy and geochemistry at Virginia Polytechnic Institute and State University in Blacksburg, Virginia.

Earning Your Wings

One prerequisite to independence is an academic position that provides the space, freedom, and employment stability necessary to engage in independent research and to build a research team. But this is only the beginning. Although academic positions generally come with startup packages, setting up a lab from scratch is expensive and it's soon necessary to go hunting for more funding.

The scientific community has long considered single-investigator research grants, such as the R01 offered by the US National Institutes of Health (NIH), the Holy Grail of science funding—but that goal often remains elusive, particularly for young investigators. The success rate for R01 grants, for example, remains disappointingly low. Of 22,148 applications reviewed in 2006, only 3,610 (or 16.3 percent) were funded. Over the 25-year period between 1978 and 2002, the median age of doctoral biom edical researchers receiving their first independent research grants from the NIH rose from 37 to 42.

Recognizing this as a threat to the development of the next generation of researchers, NIH decided to turn the problem on its head. Last year, it announced the K99/R00 Pathway to Independence award, a new mechanism designed to increase the share of federally funded awards received by younger investigators and to create institutional incentives to help postdocs become independent investigators. After two years of funding at $90,000 per year, grantees can apply for an additional three years of funding for up to $250,000 per year. And since the grants cover full overhead costs, they provide a strong incentive for universities to create positions for these grantees.

In Europe, the governments of the UK and Ireland have made similar efforts to expand the number of transitional awards for early-career scientists. Back in the United States, NIH has just announced a "new" award—dubbed the New Innovator Award—that is intended for newly independent biomedical scientists. The number of New Innovator awards is likely to be tiny, however.

More Than Science

But money isn't everything. Becoming a successful scientist requires getting the work done. What differentiates those trainees who go on to become independent investigators from those who continue to work for others? Although there is little hard data, the common assumption is that only the best and the brightest go on to independence.

But there is more to it than intellect and scientific skill. To become successful as independent investigators, young scientists must possess—or acquire—a battery of nonscientific skills. Traditionally, individuals were left to pick these up on their own, but they may now take advantage of many excellent programs that focus on teaching them the skills of successful grant applications and scientific management. One of the most ambitious and comprehensive of these efforts is a program in lab management supported by the Howard Hughes Medical Institute (HHMI) and the Burroughs Wellcome Fund in the USA. (Howard Hughes Medical Institute, *Making the Right Moves: A*

Practical Guide for Scientific Management for Postdocs and New Faculty, Second Edition, with a free download)

A successful principal investigator (PI) must know how to bring a team together and nurture each individual, says Peter J. Bruns, vice president for grants and special programs at the HHMI, who was on the faculty of Cornell University in Ithaca, New York, for more than 30 years. His advice to budding lab managers: "When you look at successful mentors, you'll find that they recognize the human needs of their people. They listen to their problems, work-related or not. They help them succeed as people," Bruns says.

Many scientists believe that personality plays a crucial role in achieving independence as well. "The scientific abilities of independent investigators versus the nonindependent ones are essentially the same," says Hochella. "In my experience, the difference may lie in both the level of ambition and basic personality," says Hochella, whose career mentoring doctoral and postdoctoral trainees has spanned more than two decades.

Do You Have What It Takes?

The foundations of personality are part nature and part nurture. With effort, people can make some changes around the edges but most core character traits endure. How we are hard-wired may make us more or less likely to become independent researchers. According to some of the experienced lab managers interviewed for this article, at the top of the list of traits required for independent research are persistence, self-confidence, and flexibility.

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Persistence. Independent research isn't the path for the scientist who is motivated by quick rewards, Hochella says. Research independence requires tenacity, drive, and the willingness to hang in for the long haul. "Young scientists who wish to become independent need to be able to see the rewards down the line, set their minds on it, and go for it," says Hochella. "They remain calm, take things one step at a time, and know that if they pass all the individual hurdles, they will have a good chance of making it."

Michael Thoennessen, a professor and associate director of the National Superconducting Cyclotron Laboratory (NCSL) at Michigan State University in East Lansing believes that mentors can help young scientists by modeling the costs and rewards of persistence. "He can convey to the mentee that he loves his job, although it involves intense work, long hours, and is sometimes loaded with administrative tasks," he says.

Experience in the PI's basic tasks can also give aspiring scientists a leg up while they're still in training. Steve K. Lower, an assistant professor of earth and environmental sciences at Ohio State University in Columbus is one of Hochella's protégés who has gone on to secure his own grants from the National Science

Foundation (NSF) and the Department of Energy. "As a graduate student, my adviser allowed me to play a big role in the writing of NSF grants. He also allowed me to review the panel reviews" of the grant proposals he helped write, says Lower. Aside from learning the nuts and bolts, those experiences helped him recognize the importance of persistence and humility, he says.

Confidence. "Those who succeed are well-grounded people who have seen success and believe they can do it too. They are not the type of people who worry too much or are easily intimidated," says Hochella.

Adam Rich, an assistant professor of biological sciences at the State University of New York, Brockport, believes that "confidence" doesn't quite describe the essential quality—more like fearlessness, he suggests. "I was willing to develop new or novel protocols to get an experimental question answered. I was basically willing to try anything, and therefore, wasn't afraid to push techniques beyond where they were supposed to work," says Rich.

Mentors can help trainees become more self-confident by engaging them in meaningful discussions and treating them as peers rather than "down-the-pecking-order" students and postdocs, says Thoennessen. "Trainees gain confidence when they realize the people they respect in the field don't have all the answers," he says.

Flexibility. "The ability to handle ambiguity and uncertainty with some equanimity, even to embrace it, is really critical," says Thoennessen. This requires a willingness to learn new roles, even or especially when it means moving beyond one's comfort level or skill set, he says.

"I enjoy the process of science and can be happy working on a variety of different projects," says Rich. He took his prior work and expertise in the area of gastrointestinal motility and applied it to a new animal model, the zebrafish, to show that he could do what he proposed to do and then added a new hook to get it funded. "When considering projects, I always keep two things in mind: what work will be fun to do and what work is fundable," says Rich.

Working smart. One of the most universal keys to adapting to an independent position is learning to get more done in less time. Between teaching, research, grant writing, mentoring, and committee work, new faculty members have a lot more to do than they did when they were grad students and postdocs, so they can't afford to waste time—and that means working smart as well as hard.

"I recall professor Hochella saying, 'You can make discoveries by spending a month in the lab or a day in the library,'" Lower says. He first put that lesson into practice when he spent a good part of his first summer of grad school in the library. "At the end of the summer, I had figured out what was missing from my area of research. I knew where I could carve a niche," he says. He's been applying the lesson ever since.

Different strokes. Not everyone is interested in pursuing independent research. "There are many young scientists who don't have a burning ambition or an inherent need to lead. They are content with following, knowing that they are just as capable," says Hochella. "They just don't want the hassle."

"Today, many students don't want to be clones of their professors," says Bruns. He hopes that the graduate school community will recognize the need to prepare some equally talented graduate students for jobs other than doing "big research in big groups."

Indeed, in a time of increasingly collaborative science, perhaps it's the concept of independence itself that needs revising. A seminal report from the National Research Council (NRC) published in 2005, called *Bridges to Independence: Fostering the Independence of New Investigators in Biomedical Research*, suggests that the traditional definition of an independent researcher—as an individual, usually in a tenure-track position, who has received his or her first RO1 research project grant (or equivalent) as a principal investigator—is too narrow. Rather, it says an independent researcher is "one who enjoys independence of thought—the freedom to define the problem of interest or to choose or develop the best strategies to address the problem." Encompassed in the broader term is the notion that researchers need not be in tenure or even self-sustaining to be independent. They can achieve independence by making distinct contributions to the research enterprise even if they're not in charge of the lab.

The problem is that there aren't many alternatives to PI-ship for established academic scientists. Although some non-PI jobs may be found within universities—running core facilities, for example—these kinds of jobs are relatively few. Far more common are older scientists stuck in postdocs with little job security, even a decade or more past their Ph.D.s. But these are not jobs that anyone aspires to. So early-career scientists who aren't eager to head up their own research enterprise should consider opportunities to teach or to find work outside academia—at government labs or in private industry—where they can do good work without having to build and support a laboratory and a team. The kind of teamwork described in that NRC report is far more common in industry than it is in academia.

In one of the all-time most popular career advice books, *What Color Is Your Parachute?* (first published in 1970 and updated many times since), author Richard Nelson Bolles says, "The key to a happy and fulfilling future is knowing yourself. This self-knowledge is the most important component of finding the right career." If your pursuit of independence feels like a slippery slope and you're not enjoying it, sometimes it helps to reassess your career goals and talk them through with a trusted mentor, a career counselor, or a mental health professional.

Managing Scientists

dx.doi.org/10.1126/science.caredit.a0700160

By Karyn Hede— First published November 9, 2007

Christina Hull chuckles when asked where scientists acquire their interpersonal skills. She acquired hers the same way most scientists do: They were thrust upon her when she started her laboratory at the University of Wisconsin, Madison. Suddenly she was the boss, faced with the daily challenges of motivating students, negotiating with peers in committee meetings, resolving conflicts in the lab, and a dozen other tasks that require what are broadly called "people skills."

Hull acknowledges that possessing good management ability is essential to productive scientists, but she received no formal management training prior to taking the reins. Her experience is not unusual. Fully half of US postdoctoral scientists responding to a 2003 Sigma Xi survey said that they had received no training in lab or group management, and nearly all the rest had received only ad hoc or "on-the-job" training. Most wanted formal training in lab management, but only 4 percent had attended a workshop or done formal coursework.

Even established senior scientists recognize the disconnect. "Science is odd in some ways," says Robert Doms, chair of the Department of Microbiology at the University of Pennsylvania School of Medicine. "You spend all your time as a student and postdoctoral fellow learning how to be a good experimentalist. Then you become an independent scientist, and if you are successful, before long you are no longer doing experiments because you don't have any time, and personnel management becomes a major issue."

Like many scientists, Doms modeled his management style on that of his scientific mentor, Ari Helenius, a virologist at Yale University School of Medicine, whose style Doms admired. The ad hoc method can work sometimes, but it's hit-or-miss.

"There are some horrible pathologies in some labs in the relationships," says Edward O'Neil, director of the Center for the Health Professions at the University of California, San Francisco (UCSF), who offers laboratory management workshops throughout the United States. "People stay because they are inspired by the science, but they leave the training in some of these labs really wounded people. Then they will use that as a model for leadership."

In his workshops, O'Neil tries to get scientists to change their behavior by asking them to frame a hypothesis. For example, "If I stop yelling at my technician when he makes a mistake and work together to correct the problem, he will finish experiments more quickly and completely." Then, O'Neil asks them to collect and analyze data to see if the data fit the hypothesis.

Becoming an Effective Leader

Success in science is often measured by number of publications, citations, and similar metrics. But when Alice Sapienza, a chemist with a Ph.D. in organizational behavior who is now at Simmons College in Boston, Massachusetts, asked experienced scientists what qualities they most admire in a scientific leader, she got a very different answer.

Sapienza says her research suggests that the best leaders are those with the best people skills.

Sapienza says her research suggests that the best leaders are those with the best people skills. She surveyed more than 200 scientists and engineers from the United States, Europe, and Asia, asking them to describe the most effective scientific leader they knew. Leading the list were people of "caring and compassion," followed by those who "possess managerial skills" such as effective communication and conflict resolution. Technical skill was a distant third.

Another common misperception among scientists, she says, is that managing people in a laboratory environment is somehow different from managing people in other types of workplaces. "People are people," Sapienza says. "There's a very short list of things that go wrong when people work together."

So how do you make sure those things don't go wrong? "There is no easy fix," she says. "It should not be surprising that it will take time to become an expert in the discipline of interpersonal behavior."

Carl Cohen, co-author of the book *Lab Dynamics: Management Skills for Scientists* (and a former *Science* Careers contributor), recommends taking short courses in management and reading books such as William Ury's *Getting Past No*, which he found invaluable in developing negotiation skills. There's a whole literature out there, he says, that can be very helpful.

O'Neil recommends yearly performance evaluations for everyone in the lab, including the lead investigator, using what's known as a 360-degree evaluation in which people give and get constructive feedback from supervisors and those they supervise. This kind of assessment taught Sapienza that she needed to be more explicit with her students and postdocs in setting goals and expectations.

Formalizing Training

Not long after her trial by fire at Wisconsin, Hull, a former Burroughs Wellcome Fund (BWF) Career Award recipient, got a taste of formal training when she participated in a five-day lab management "boot camp" sponsored by BWF and the Howard Hughes Medical Institute (HHMI) in Chevy Chase, Maryland, in 2005.

"I decided to go to [the course] grudgingly," she acknowledges. "I wasn't sure it was worth a week of my time." She feared the course would be a bunch of "business-speak" that didn't apply to the issues she faced in the lab. But by the end of the course, she was glad she had gone. She says she valued hearing the collective expertise of experienced scientists who had been through the same issues she faced, and she learned enough about her own personality and management style to make changes she says have improved her skills as mentor and manager.

"I realized there were some things I was doing that my lab expected me to do differently," she says. "My students pointed out that I don't manage interruptions well—that I allow them to interrupt me too much. I thought that was interesting because I was very much into my open-door policy. When I became more protective of my time, they respected my time more."

Peter Bruns, vice president for grants and special programs at HHMI, says that HHMI is unlikely to offer the lab leadership course again. Instead, the institute is trying to disseminate its model by "training the trainers": teaching the nuts and bolts of how to run such courses to a core group of 17 interested professional societies and universities that want to offer them.

HHMI gave small seed grants to each partner and asked for evaluation data from the workshops. In aggregate, more than 90 percent of respondents who participated in the courses said that they would recommend them to a colleague, according to Maryrose Franko, senior program officer at HHMI.

Michelle Hermiston, a new assistant professor of pediatric hematology at UCSF, took a laboratory leadership course offered by UCSF's office of postdoctoral education this past spring. "I'm a huge cheerleader for the leadership course. I found it extremely useful, as did all of my friends who also took it," she says. She particularly appreciated the tips on how to assess work styles and how to ask difficult questions about potential weaknesses during the hiring process. "For many of us who have been trained in science, learning how to do those things can be challenging."

Hermiston says that the course has already had an effect in her lab. Her technician told her recently that she has become much more open to feedback and said how nice it has been not to have to guess what she is thinking. "I've become much more cognizant of what level of hands-on management people need at different stages of their training," she says. "It's probably changed some of my behaviors for the better in that I give and ask for feedback more often."

The United Kingdom has decided that such training should come long before a scientist finds herself running her own lab: A fundamental change is under way that aims to make "soft skills" a part of doctoral education in science. In 2002, a government-commissioned panel recommended that all science graduates receive such training. In answer to those recommendations, Research Councils UK, the nation's primary research-funding body, now disburses £21 million (about US$42 million) per year to universities for professional development for graduate students and postdocs in areas such as project management, supervising others, and communicating with the public. The goal isn't to improve laboratory management per se; it is, rather, to give graduates skills that make them more attractive to potential employers in all sectors.

There is still some skepticism on the part of supervisors, and some people believe that the money would be better spent elsewhere. But the program seems to be having an effect. "We're probably about halfway there in terms of getting transferable skills into Ph.D. programs," says Iain Cameron, head of the Research Careers and Diversity Unit within Research Councils UK. "We've made a huge amount of progress since 2003, but we've still got some way to go."

Such skepticism is not confined to the United Kingdom. When Elizabeth Ellis, director of Graduate Training in Biomedical Sciences at the University

of Strathclyde, UK, gave a talk on the UK's integrated-training model at an Association of American Medical Colleges meeting last year, she encountered skepticism there as well. "There seemed to be some resistance to mov[ing] towards skills-based training in the United States, and there was little understanding of why transferable skills were needed," she writes in an e-mail.

Brian Schwartz, a physicist and vice president for research and sponsored programs at the Graduate Center of the City University of New York, has been co-teaching courses on business skills for scientists for 10 years. Schwartz says students and postdocs are often savvier than their supervisors about the need for such skills in the job market. He advises students to take such courses throughout their graduate careers. "Even while getting a Ph.D., take some other courses," he says. "A lot of students say, 'But my thesis adviser won't allow me.' I say, 'Don't tell 'em.'"

"Scientists have to learn that it's not the science they're managing, it's the people who are doing the science that they're managing," says Sapienza. "Sometimes that's a quantum leap for people to understand."

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