The scientific swerve: Changing your research focus

Ali Salanti was studying malaria when an unexpected discovery led him into cancer research. Although a move this dramatic is unusual, many scientists reorient their research in ways that affect their students, collaborators, and institutions. This prompts the question, why deliberately move into a new field? What are the risks and benefits of taking such a step? And what factors are important to consider before doing so? **By Chris Tachibana**

Throughout his career, **Ali Salanti** was "100 percent dedicated to studying malaria." Then his group at the Department of Immunology and Microbiology at the University of Copenhagen, Denmark made a discovery: The malarial protein VAR2CSA binds a modified carbohydrate that is abundant on cancerous but not normal cells. Knowing it would change his career to study VAR2CSA as a tumor-targeting protein, Salanti weighed the challenges and rewards and ultimately thought, "This needs to be explored." Now, one-third of Salanti's group researches malaria and two-thirds studies cancer, supported in part by about €2 million from the European Research Council (ERC).

Conventional wisdom says that getting research funding requires publications, recommendations, and connections in the field. The U.S. National Institutes of Health (NIH) advises scientists to move gradually into new areas, with small developmental grants. Salanti, however, dove right into cancer research with a large proposal. Although he says the writing process was "anxiety-provoking," he focused on his transferable skills and knowledge, rather than his lack of experience. "I was up front about my limitations in oncology, but stated what I can contribute," he says. "The driving force for all my research is cost-effective therapy or prophylactics that can be used widely, so what I do in malaria carries into cancer." Salanti's fresh approach gave him an edge. "The ERC wants new ideas," he says. "They'll fund high-risk, high-gain projects."

Salanti's institution supports his move because it attracts students, scientists, and funding. Adding a new research program required adjustments, though. Salanti became more selective about accepting seminar and conference invitations. He takes students for cancer projects but ensures they have oncology co-supervisors. Senior scientists oversee the malaria and cancer programs, but the lab operates as a single group. This arrangement leads to the cross-disciplinary sharing of methods and expertise encouraged by funders such as NIH and ERC. "It's not always easy," he says, "but overall, it enhances our research."

Most scientists won't have a VAR2CSA-type discovery to draw them into a new discipline. Many may feel the urge to refresh or redirect their research, though. Here's advice for early, mid-, and late-career scientists about deliberately changing your research focus.

No life-changing results required

Dan Burgard didn't have a career-changing result that drove his research in a new direction. The University of Puget Sound chemistry professor simply wanted to study something different. Burgard finds projects by looking for community questions that a scientist can help answer. That approach pulled him from studying emissions from the region's cars, buses, and ships, to measuring drugs in what comes, collectively, out of its toilets. cont.>

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Burgard's wastewater-analysis research started with a conversation about students taking attention deficit hyperactivity disorder (ADHD) medications, such as Adderall and Ritalin, to try to improve test performance. He had just read about testing wastewater for cocaine as a way to measure regional use, and a research project was born.

To shift from sampling air for inorganic chemicals to analyzing sewage for organic compounds derived from ADHD drugs, Burgard brushed up on methods he hadn't thought about in years, attended conferences in a different field, and navigated the bureaucracy of a new funding agency. Nevertheless, like Salanti, Burgard finds that his newfound work is connected to what he was doing before. "I'm still doing environmental and analytical chemistry," he says, "but now it's separation with chromatography and analysis with mass spectrometry, which I learned about in graduate school but never used. I'm still quantifying things with spectrometry, but now it's for drug epidemiology."

Burgard says being at a university where his primary responsibility is teaching was an advantage in taking on his new project. Scientists supported mainly by grants may have to plan their finances more carefully during their research transition. "I didn't have to get funding to start the project," Burgard says. "I just needed to talk to the local wastewater treatment plant about sampling, and make a friend at the University of Washington with mass spec instruments."

As research questions arose, Burgard connected with other collaborators. He worked with his university's psychology department on student drug-use surveys to complement the chemical analyses. The results from surveys and campus wastewater samples showed there was higher use of ADHD medications during test times as compared to the first week of classes.

Among the benefits of switching research gears, Burgard says, was the fact that his promotion and tenure reviews recognized that he expanded methods and research opportunities for students and extended collaborations on campus and with other universities. With his additional expertise, he was in a position to turn Washington State's 2012 legalization of recreational marijuana into a scientific opportunity. He now has an NIH grant to use wastewater analysis to study the impact of retail marijuana sales on the community's use of the drug. Submitting a proposal to an unfamiliar agency was a major project in itself, but Burgard says, "If you have a good enough research question, it makes you want to go down that road and keep going." He doesn't feel he is traveling in an entirely different direction, however. "It never occurred to me that the new work was a big thing," he says. "It was just the next thing."

This is normal

Like Burgard, many scientists alter their research focus, at least slightly, over their career, according to studies by **Boleslaw Szymanski,** a computer science professor at Rensselaer Polytechnic Institute in Troy, New York. Szymanski's group followed the work of more than 14,000 scientists from 1976 to 2009, using data from American Physical Society journals. The results showed that most researchers tend to stay in their field, but that those who don't progress along a related path. In describing their findings, Szymanski and colleagues use an analogy inspired by Isaac Newton's reflection on his own research: They describe a scientific career as a walk along the beach, moving from one interesting shell (in this case a research topic) to another.

These findings support a similar analysis that Szymanski's group performed on data from journals and from U.S. National Science Foundation (NSF) grants in computer science. In this field, scientists

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tend to shift research focus roughly every 10 years. Some make once-in-a-career moves to substantially different areas. The field itself changes with technological advances, Szymanski says, so even researchers who stay in one area at least change methods over time.

Szymanski's own career exemplifies evolving research interests. From high-performance computing, he moved to modeling biological, social, and other networks. His own research walk succeeds, he says, because of strong collaborative relationships. "Working with good collaborators in other disciplines gives you stereoscopic vision," he says. "You look at the same problem but from different viewpoints, so together, you have a complete view."

A particularly encouraging result from Szymanski's work is that scientists are just as productive, when measured in terms of publications, before and after changing their research emphasis. Nonetheless, departments should be patient when a researcher takes a new direction. Szymanski's analyses show that publications come in bursts, followed by pauses that are most likely needed to obtain funding and accumulate data. "To some extent," Szymanski says, "our message is encouraging to scientists: You can change your research focus and be successful."

How science is done now

Supporting scientists in exploring new fields is **Guntram Bauer's** job. He is director of scientific affairs and communications at the Human Frontier Science Program (HFSP) in Strasbourg, France, which funds life science research and international collaborations. The governments of 14 member countries and the European Union support HFSP. "Our mission and scope," Bauer says, "has always been bringing scientists with different approaches and from different disciplines together to work jointly on a life science project."

One HFSP postdoctoral program supports nonbiologists, such as physicists, chemists, or engineers working in the life sciences. Even biologists applying for HFSP postdoctoral support for a life sciences project must move into a new area, for example, from genetics to crystallography. They must also move to a country where they've never worked before.

Relocation to both a new field and a new country is a requirement, Bauer says, "because seeing how things are done in a different scientific environment opens our minds." Bauer himself has worked on international research collaborations in Germany and the United States, and now works with a multinational group at HFSP. Based on his experiences, he feels that overcoming the challenges of entering a different field and being part of a multidisciplinary team leads to personal and professional growth and an appreciation of diverse work cultures. He says that HFSP itself benefits from the varied perspectives of its review committee of chemists, computer scientists, physicists, and life scientists.

Finding research opportunities in new areas might not cont.>

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Featured participants

The Camille & Henry Dreyfus Foundation
www.dreyfus.org

Department of Immunology and Microbiology, University of Copenhagen
isim.ku.dk

European Resource Council
erc.europa.eu

Human Frontier Science Program
www.hfsp.org

Rensselaer Polytechnic Institute
rpi.edu

Seattle University
www.seattleu.edu

Sucafina
www.sucafina.ch

University of Puget Sound
www.pugetsound.edu

U.S. National Institutes of Health
www.nih.gov

U.S. National Science Foundation
www.nsf.gov

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– Sue Jackels

require much exploration outside your field, Bauer says. He was amazed at how much biology was presented at a recent physics meeting, for example. He notes a general awareness by scientists that answering fundamental questions requires being inclusive and considering approaches from all disciplines. "Science is moving in a more multidisciplinary and open direction," he says. When HFSP started emphasizing cross-disciplinary work in 2000, scientists were challenged to find journals that would publish work that straddled multiple fields. Now, Bauer notes, journals have broadened their scope, and researchers have more options for showcasing their work, such as preprint services like aRxiv and bioRxiv as well as TED talks, blogs, and social media.

Nevertheless, Bauer advises that making a deliberate move into a new discipline takes time. It's a "matchmaking exercise" to align the interests of a researcher with opportunities in the field. Start preparing early, he advises: Talk with people in the area you might move into. They can guide you regarding the high-priority research questions in their field and how your skills might help answer them. As you move toward writing a proposal, these contacts can help build a fundable application.

A worthwhile investment

A conscious scientific shift can occur anytime in a career. **Sue Jackels'** research path shows how an established professor can make a bolder move than a scientist who is just starting out. In the 1990s, Jackels and her husband were chemistry professors at Wake Forest University in Winston-Salem, North Carolina, looking for new opportunities. She describes their situation in chemical terms: "We were at equilibrium, at a steady state in our careers. We wanted a change." Jackels moved to Seattle University and her husband took a position at the University of Washington.

Jackels was studying inorganic compounds as magnetic resonance imaging (MRI) contrast agents when she attended an international meeting of chemistry educators at Jesuit universities that inspired a change. After a colleague from Nicaragua talked about struggling coffee farmers, Jackels went to the country to see for herself. She visited coffee farms and potential collaborators and "found a question that a chemist could help answer." If farmers knew precisely when to halt bean fermentation, they could consistently produce superior coffee for the high-end market.

Jackels used a sabbatical to launch the research program she and her husband now run. Funding has come from Seattle University, NSF, and The Camille & Henry Dreyfus Foundation. With students, Jackels developed a portable field laboratory using battery-powered instruments and simple test-strip assays. On trips to Nicaraguan coffee farms, Jackels and her team did chemical analyses to determine when fermentation should stop, and correlated the results with cues that farmers could easily detect, such as a particular appearance, feel, and smell.

Jackels' work involves more than chemistry, of course, including learning languages, policies, and cultures of other countries. These complexities make her project rich, meaningful, and rewarding—and a professional risk. Jackels says, "You should do this kind of change only as an established researcher."

That said, Jackels adds that a sabbatical at any stage of a career is a chance to reinvigorate a research program. In addition to the leave that led to her coffee work, she used an earlier sabbatical to move into the field of MRI contrast agents. Both times, she used her own savings to partially support herself. "Some people won't take a sabbatical unless they are fully funded to do it," she says, "but you should view a sabbatical as an investment. It will pay off in future grants and research productivity."

When changing fields, Jackels stresses, networking and relationship building are very important factors. Find a topic that everyone is passionate about, she advises—including your scientific team, collaborators, and end-users of your results. "To surface research questions," she says, "we ask about the concerns of the farmers and our collaborators, and we make that our question and develop our common passion around it." Following this approach, Jackels and her student research team are now working with East African coffee farmers. Funded by the Geneva, Switzerland–based Sucafina coffee company, their research question is how to measure and prevent development of a chemical caused by insect and microbial damage that makes coffee smell like rotten potatoes.

Jackels retired from teaching and administrative work, but still does research, which continues to take her in surprising directions. She collaborated with her university's business school to sell Nicaraguan coffee on campus and is working with Nicaraguan families on educational opportunities for their children, for example. When you start down a new research track, she says, "one thing just leads to another."

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