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HIV RESEARCH How a pathologist pursued an unconventional vaccine **p.557**

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PSYCHOLOGY

Faking it

In the face of routine rejection, many scientists must learn to cope with the insidious beast that is impostor syndrome.

BY CHRIS WOOLSTON

Every early-career scientist has hit a stumbling block: a bad grade on an exam, a low score on a grant proposal or the first rejection from a journal. But for many, this normal stuff of science twists into something darker and more insidious — a creeping sense of professional inadequacy that prompts them to question their place in the field, no matter their

area of study or their level of brilliance.

There is a term for this type of self-doubt, coined in the 1970s by two US psychologists who saw it in their clinical practices: the 'impostor phenomenon'. Now commonly known as impostor syndrome, the condition can manifest itself in myriad professions, from office workers to artists to athletes, says Frederik Anseel, a psychologist at Ghent University in Belgium. Scientists, he says, are

especially vulnerable, largely because they work in a hero-oriented field that treats its highest achievers as if they were sports stars, leaving many others to wonder in silence whether they are second-stringers or worse. "Young people think that no one else is having these feelings," he says.

Researchers who struggle with the syndrome have to learn how to tune out feelings of inadequacy and develop a more realistic view of their abilities and their value, he says. In a profession where sporadic failure — in grants, in jobs, in publications — is the norm, the real failure is unnecessarily giving up on a promising career.

UNHAPPY SUCCESSES

In 2014, Anseel and his colleagues took a closer look at impostor syndrome in a study of more than 200 Belgian workers in finance, education and human-resource management. The team found that workers who reported feelings that are consistent with impostor syndrome tended to score higher on measures of neuroticism and excessive perfectionism in personality tests (J. Vergauwe *et al.* *J. Bus. Psychol.* **30**, 565–581; 2015). They were also not as happy with their jobs as were colleagues who did not experience the syndrome — even though some of the afflicted had advanced to the upper levels of their professions.

Anseel says that his other work — which includes ongoing studies of mental-health issues among young researchers — gives him confidence that his findings about impostor syndrome in the white-collar world apply to science as well. He says that it is easy to see how even successful scientists can feel that they are actually underperformers. Scientists, he says, often trivialize their own achievements. "You get a paper published in *PNAS*, and you tell yourself, 'That's doable. I'll never get a paper in *Nature* or *Science*.'" Similarly, any grant could be larger; any job could be better; any paper could be more highly cited. "You set yourself up to fail one way or the other," he says.

The phenomenon shows up across academia, including at top research institutions. Josh Drew, an evolutionary ecologist at Columbia University in New York City, has seen PhD and master's degree students struggle with self-doubt at the Ivy League school. Every student had passed tough admission standards — but that was not enough to bolster their confidence. For many, their classes at the university represented the first time in their educational experience that they didn't feel as if they were the smartest person in the ►

► room. “They were all outstanding students as undergrads,” he says. “Here, being at the top of your class is just average.”

In a highly competitive arena, self-doubt can be a career killer that prompts would-be contenders to dismiss chances to vie for important opportunities. “I saw many students who were shooting themselves in the foot,” Drew says. “They weren’t applying for grants and awards that they would be competitive for.” He began to address the syndrome in an introduction-to-graduate-school class. The talks drew some buzz, and he soon developed a formal presentation to deliver to other departments at Columbia and beyond (see ‘Help for impostors’). Clearly, he had struck a chord. “Every talk I give, people say, ‘I thought I was the only person who felt this way,’” he says.

TIMELESS CONDITION

Drew reassures people who feel like frauds by pointing out that they are in some lofty company. Two years after publishing *On the Origin of Species* in 1859, Charles Darwin complained that “one lives only to make blunders”. And while working on *The Grapes of Wrath* (1939), John Steinbeck wrote, “I am assailed by my own ignorance and inability,” fretting that “sometimes, I seem to do a good little piece of work, but when it is done it slides into mediocrity.”

While preparing his lecture, Drew solicited Twitter comments from scientists who had struggled to overcome the syndrome with various degrees of success. One respondent, an associate professor of biology, tweeted: “It has crippled my professional life from day one.” Moses Milazzo, a planetary scientist with the Astrogeology Science Center in Flagstaff, Arizona, tweeted, “Because of Impostor Syndrome: I have decided not to pursue opportunities; I am never ready to publish my papers; etc.”



Ecologist Josh Drew loads samples of reef fish into a tank of liquid nitrogen in Nagigi, Fiji.

SOCIAL SUPPORT

Help for impostors

Evolutionary ecologist Josh Drew of Columbia University in New York City hosts a talk called ‘Fighting the Impostor Syndrome’, which offers tried-and-tested coping strategies for the common condition. At a basic level, he urges researchers to advocate for themselves. That means avoiding words such as ‘just’ and ‘only’ when describing their own work, and not constantly apologizing for every mistake, whether real or perceived. He says that offering real support to someone else who feels wracked by doubt is a quick and

effective way to improve your own sense of belonging. To really pick yourself up, bring someone else up with you.

Drew says that members of groups that are underrepresented in science often benefit by reaching out to others and finding a community. For some, simply following a Twitter feed such as #BLACKandSTEM or #womenandSTEM can serve as reassurance that they really do belong in science. His message? “You’re not here because you ticked some box. You’re here because you bring a lot to the department.” **C.W.**

Milazzo thinks that impostor syndrome is nearly universal among scientists — at least among those who are self-aware enough to realize that they don’t know everything. But he also says that he experienced particularly severe effects of it, and he traces at least some of his unease to his background. He grew up in an off-the-grid adobe house on the border of the Navajo Nation reservation in northern Arizona, which later contributed to his sense that he did not belong in the university crowd. Not many of his instructors, advisers or peers could relate to hardscrabble desert life in a house that had no reliable electricity and little contact with the outside world.

“I didn’t even know what *Cosmos* was until I got to grad school,” he says of the popular 1980s TV show. Then again, life in middle-of-nowhere Arizona did give him an intimate familiarity with the night sky. During the long walk along a dirt road to the school bus stop, he often navigated by the light of the Milky Way.

Milazzo says that he first heard the term impostor syndrome early in his graduate-student days at the University of Arizona in Tucson — and he recognized it immediately. “Having a name put to it made it clear that other people felt it,” he says. But knowing that he was not alone didn’t keep him out of the trap. He decided not to apply for a NASA grant for satellite-based research, out of fear of exposing his own ignorance. “I removed myself from the grant process because it would be obvious that I didn’t know what I was talking about,” he says. As it turned out, one of the successful proposals was very similar to his idea. “If I had pursued it, I might have been competitive,” he laments now.

And even after helping to win a NASA grant to develop a middle-school curriculum that would be based on the space agency’s exploration of the Solar System, Milazzo still struggles to persuade himself that he belongs in science. “We put a lot of work into that proposal, but I wasn’t very confident that it would get funded,” he says.

Matt von Hippel, a researcher at the Perimeter Institute for Theoretical Physics in Waterloo, Canada, says that he, too, feels like an impostor from time to time, but he has a strategy that helps him to push through it. Instead of second-guessing the people who admitted him to graduate school and awarded him a PhD, he decided to embrace their judgement.

“You can trust the system to have put you in vaguely the right job,” he says. “If you’re invited to give a talk, that’s a sign that you’re ready to give a talk.” Late last year, he was asked to give a colloquium on mathematical techniques in particle physics at Oregon State University in Corvallis. It was a big opportunity that came sooner in his career than he expected, and he thought about turning it down. Ultimately, he opted to adhere to his strategy. “I decided to say ‘yes’ and see how it goes,” he says. In his view, the talk was a success.

UPHILL BATTLE

Biologist Victoria Metcalf had plenty of opportunities to doubt herself and second-guess her career choices. Her low point came in early 2000 during her PhD studies in New Zealand, when television-news crews surrounded her lab and a regulatory authority threatened to throw her and her supervisors in prison. Her lab had cloned genes from the tuatara (*Sphenodon punctatus*) — a treasured native New Zealand reptile — but lacked the permits that a new law had retroactively made mandatory. Authorities eventually dropped their threats, but her research was stalled for six months while she obtained the proper permits. “Those were really soul-destroying times,” she says. “It had a huge impact on how I perceived my worth in academia.”

Scientists are accustomed to measuring things in precise detail, but their own value can be difficult for them to quantify. Ansell thinks that many researchers would be more confident — and thus more likely to write the grant, submit the paper, apply for the job — if they were to embrace the inevitability of

failure. “When one of my students gets a rejection letter, I can show them five or ten of my own,” he says. “The academic environment should be more open to failure stories.”

Drew reminds young researchers that even the chairs of their departments — scientists who seemingly have it made — do not always get their grants funded or their papers accepted. It would be telling, he says, if everyone published a ‘shadow CV’ of all their rejections to go along with the standard CV that lists successes.

Researchers can also help to ease their distress by making an effort to stop comparing themselves with colleagues in their lab or department. “Comparisons won’t make you happy, so don’t do it,” Anseel says. Instead, he says, researchers should set their own personal standards of achievement and then do their best to meet them.

Metcalf has mostly won her battle over her sense of inadequacy, although her career has had its ups and downs. After she earned her PhD, she took a postdoc position in the United States that she quit after only six months,

an outcome that made her feel even more like a scientific impostor. “I had a low sense of self-worth,” she says. But she pushed through it, quickly found another post and went on to have a successful career that included research trips to the Antarctic and a highly sought-after faculty position at Lincoln University in Christchurch, New Zealand.

Yet her troubles didn’t end. In 2011, she lost her faculty job after an earthquake damaged much of the city. Instead of taking that setback as a sign that she needed to abandon science completely, she shifted from research to outreach. She is now the national coordinator of the Participatory Science Platform, a New Zealand government programme that promotes research collaborations between scientists and communities. “Anyone who knows me knows that I was meant for this job,” she says.

As part of her duties, Metcalf has had many chances to speak to young people with different backgrounds and career aspirations. Many of them are already experiencing the symptoms of impostor syndrome, which gives her an opportunity to inspire by example. “My story really resonates,” she says. “I’ve had my battles. You just have to keep fighting.” ■

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TURNING POINT

Louis Picker

Louis Picker is not afraid to break with convention. Trained as a pathologist, he was on the front line when the AIDS epidemic emerged in the 1980s. He is now combining his interests in immunology and viruses to pursue an unusual HIV vaccine at Oregon Health and Science University (OHSU) in Portland — a project that was considered a fool’s errand by many when he began.

How did you get started in research?

I had always wanted to be a scientist. I started an MD–PhD programme at the University of California, San Francisco, but found it much too slow, rigid and hierarchical. I left that programme, but did a year of research there. Ultimately, I decided to become a pathologist specializing in immunology. It’s astonishing how much biology you can learn from looking at hundreds of biopsy slides and by performing autopsies every day. I got a feel for the immune system that you couldn’t get by doing graduate research on a mouse.

Describe your first AIDS autopsy.

I was a pathology resident at Beth Israel Hospital in Boston, Massachusetts. The devastation left by AIDS stuck with me. I decided to learn more about the disease so that I could do something about it one day. I had the opportunity to move into HIV research in the mid-1990s and haven’t looked back since.

What led you to HIV-vaccine research?

Early in my career, I worked on a flow-cytometry-based assay to measure specific T-cell responses to viral infection in humans. I chose to work with cytomegalovirus (CMV), a virus that infects around 50% of adults in the United States and triggers a T-cell response that lasts throughout a person’s lifetime. These factors enabled me to test the specificity of the assay. After studying CMV-specific T cells, I hypothesized that CMV could be exploited to create a vaccine that stimulates an immediate immune response to a variety of pathogens. By incorporating bits of HIV into the vaccine, we could prime T cells to hit the intruding virus early and hard. Our data in non-human primate models show that the vaccine stops infection with the simian counterpart of HIV in slightly more than half of recipients.

What does the next year hold for you?

We will move into clinical trials with our potential HIV vaccine. We are also exploring the use of unconventional viral vectors to manipulate the immune system against



tuberculosis, malaria, hepatitis B and cancer at a level heretofore unappreciated.

Why did you choose research over more-lucrative private practice?

I knew that if I wanted to make a difference — and to pursue the CMV-based vaccine while others focused on conventional antibody-led approaches — I had to do lab-based experiments. As a pathologist, I would never have had access to patients. The best way to do relevant science was to test my ideas in a non-human primate model. The job I took at the OHSU was one of two possibilities I had at the time to do that type of work.

How easy was it to pursue your idea?

I was fortunate to have negotiated a start-up package at the OHSU that gave me the leeway to gamble. Either I’d make it or break it. I was warmly welcomed by researchers in the HIV field, which I appreciated. But it took me a while to feel that I fit in. Self-doubt was a powerful driver for me.

How risky was your decision?

To be honest, it helped that I had an MD. I knew I would always be able to get a job as a physician, so the degree allowed me a little more freedom in the early years. In the first crucial years while I was establishing myself, I figured I could always return to pathology. Most people with PhDs don’t have that option.

What makes a great scientist?

You have to be a little bit of a lunatic. But your out-of-the-box thinking also has to be right. ■

INTERVIEW BY VIRGINIA GEWIN

This interview has been edited for length and clarity.