

Chapter 8: Some Key Ingredients for Becoming a Scientist

Petra Vetter

Ok, so you want to become a scientist? Great idea — it is a wonderful and fascinating job (from a scientist's point of view, of course). At the same time, it is a very challenging job, too. In the following, I will describe my experience in the scientific world and summarize what I have learned are the merits and challenges of this job, in the hope it will inspire you and help you make up your mind whether this is a path you want to follow. I will outline the key ingredients that I think make a successful scientific career.

Passion

In the first place, you have to find a topic that you find genuinely fascinating and inspiring. A topic you feel an insatiable curiosity for, which you love spending even your free time reading about, about which you feel you can't learn enough. A topic that makes you wonder about lots of new research questions and that sparks your creativity to write about and design new experiments. I am a brain scientist, and trying to solve the puzzle of how this jelly-like bunch of neurons, sized like a cauliflower, sitting inside our skull in entire darkness, is able to create all our perceptions, sensations, thoughts, and feelings, is endlessly fascinating to me. I think that even if I ended up in a different job, I would still spend a lot of my free time reading and writing about the brain — I know this sounds really nerdy, but a science nerd is what you need to be to succeed

in science! Like many people, I found my passion a bit by accident. Originally studying biochemistry, I stumbled across a textbook on biological psychology in a university bookstore. Skimming through the book, I realized it was possible to apply the methods of biology to investigate how our brain creates complex phenomena like consciousness, attention, perception — and I was hooked. At the time, there weren't many possibilities to study this topic in Germany, only within yet another five-year psychology degree. But I discovered that study programs in cognitive neuroscience existed in the UK and the US. Studying cognitive functions of the brain felt like a “wild dream” to me, but I managed to get a scholarship from the German Academic Exchange Service to do a master's in cognitive neuroscience in London — and it changed my life. My joy of reading research papers in my field is still the same as it was then, more than 20 years ago and many hundreds of papers later. I still marvel at the privilege of being able to design and conduct experiments on how the human brain creates perception and consciousness.

During my career, I realized that, in order to be successful in science, you need to become an expert on a specific topic. If you can find a topic that could be of high relevance for your field, but that not many have explored yet, this can make it easier later on to sell yourself as one of the “pioneers” of that field; you may have fewer competitors, though you may have to do a lot of groundwork first. In a field populated by many others, you have more competitors, the “obvious” research questions have often already been addressed, and it can be trickier to find your niche of expertise. In the end, however, you should just choose a topic or research field you really burn for.

Ambition

Apart from passion for your research topic, ambition is another key ingredient. Curiosity and a love of reading about your topic alone will not make you a successful scientist who earns a living. You also need to have the ambition to contribute to your field, to provide even the tiniest piece of new evidence, new knowledge, or new insight. You must want to push

the boundaries of your topic and contribute to its theoretical advancement. In addition, in order to earn a living with science, and often also to actually carry out your research, you need money, and you need to become part of the academic system (at least initially). And the academic system is built around ambition — staying the eternal student won't get you a job. You keep employment in science if you finish your undergraduate degree with good marks, if you have the ambition to sweat through and complete a PhD, if you drill down on your expertise in several stages of postdoc training, and if you then face the challenge of finding a faculty position, applying for bigger and bigger research grants (and keeping on failing with them), chasing more and better publications, initiating collaborations, and growing your research group. As a researcher, you are expected to always want to reach for the stars, right up until your retirement. Even if you don't approve of all these aspects of the academic system, you need to play the game at least up to a certain point. Even if you decide for a research-related job in industry or are lucky enough to get one of the rare permanent mid-level positions at a university, you need to have completed a PhD and often some postdoctoral training. And if you want to become a professor, completing all of that training alone won't do, since the expectations get higher and the competition tougher (exponentially!) as you go higher up on the academic ladder. So, to keep your head above the water in this system, you need at least a certain amount of ambition.

Perseverance and Resilience

If I had to identify the most important predictor for success in an academic career, I would say it is perseverance — the sheer stubborn drive to keep on pushing things forward for a very, very long time, irrespective of obstacles, failures, and setbacks. Research can be an extremely rewarding, but also an extremely frustrating, business. Experiments fail or don't replicate, results come out weird and unexplainable, theories become increasingly complex the more they advance, papers you worked on for years keep getting rejected (often for not entirely explainable or fair

reasons), and time-consuming, long grant applications get rejected, despite excellent reviews, just because there is too much competition and not enough money. For each small success in research, there are on average ten setbacks. If you are a person who regularly needs an experience of success in life, do not go into science! Resilience and a great tolerance for frustration are instead the personality traits you need to bring if you want to stay in research. One trick to keep going is to find joy and motivation in your work even when it has just been a hail of failures and rejections. This is where passion, the very first ingredient, becomes so important. If you burn for your topic, you will find the fun and motivation to keep on working on it, despite all setbacks. Also, keep in mind that scientific progress lives off disagreements and contradictions — if the picture were clear, there wouldn't be any point to do research. Predictions not being fulfilled, results turning out more complicated than thought, theories not being as clear-cut as initially thought — this is what prompts more research and drives progress forward. One possible perspective to take is to say: this is where the fun starts — when results are not easily explainable, when theories are unclear, this is where creativity and out-of-the-box thinking is required and the big, exciting mystery-solving exercise begins.

Another trick is to stubbornly keep on going, no matter what. Of course, take constructive feedback and criticism on board; if reviewers have a valid argument for why your paper or grant application does not quite meet the requirements, then try to improve in the next round. And allow yourself many next rounds and keep on submitting your work, up until it is finally accepted. Another trick is not to take rejections and criticisms personally — your rejected paper or application is not a sign of your being incompetent or not a good enough researcher, it just means that this particular work doesn't meet all of the often very high expectations, so just take it as chance to learn and improve. It is also okay to feel frustrated or disappointed right after a rejection (you'd be surprised how many very senior and established big-shot professors are gutted about some rejections!). The important thing is to pick yourself up and keep on going, just keep on going . . .

Community

One of the main reasons why I'm still in academia, and have not given up yet, is the people and the scientific community in my field. When I started my PhD at the Institute of Cognitive Neuroscience at University College London, it was exhilarating to meet so many people being passionate about the brain! (If you are a nerd about something, it is great to meet a community of other nerds.) For me, the years of my PhD and my subsequent postdocs were a very formative and significant phase of my life, mostly because I was surrounded by people with the same passion and ambition, and many of them became dear and longstanding friends or scientific collaborators. We don't just share the passion for our scientific topic; scientists often share similar personality traits such as passion, ambition, perseverance, and resilience, the ingredients I have already mentioned. And finding a community of like-minded people is a joy for everyone. It is a particular joy as you often end up working and collaborating with those people in the years to come. And being able to do a job in which you enjoy the company and teamwork of people you like is a great blessing that makes up for a very big part of the mentioned frustrations that come with the job. When I'm grappling with yet another rejected grant application, rejected paper, failed experiment, etc., just having a brief chat with my science friends and collaborators really gets me back on track (also because everyone is in the same boat!), and it sparks my motivation again on why I'm doing this job.

Independence and Academic Freedom

Another aspect that I very much enjoy about being a scientist is the famous "academic freedom," or independence of thinking and working. Within certain limits, you can choose your research topic and specific research questions, as well as most of the people with whom you work. You can choose the research field in which you do your master's and PhD, and within that you usually have a choice of topic by selecting the research groups and projects that you are most interested in, as well as your su-

pervisors. Later on, you also have the freedom to drill down on research questions that you find most relevant, promising, or fascinating. However, once you need to acquire money for your research, whether it be a postdoctoral fellowship or a research grant needed to fund your group, your choice becomes a bit more limited again. Money for research is often provided according to certain priorities that are politically decided (e.g., for topics with societal relevance like health, energy, or security), and you need to relate your research to these priorities. Alternatively, fundamental research is also funded independent of political priorities, but then it is important to demonstrate scientific impact and feasibility. If you are a young researcher, nobody gives you money for a research topic you don't have experience and expertise in. So that restricts your freedom again, because you need to propose a project that is based, at least to some extent, on the previous research you have done in your PhD or postdoc training — only there you can show enough experience that makes a new project sufficiently feasible. Choose your PhD topic and postdoctoral training projects wisely, both in terms of topic and acquired skills, because they will to a large part determine which projects you will get funding for later on. In hindsight, I wish I would have known that at the beginning of my career. Having said that, I think you can change topics between your PhD and several postdoc trainings (I did) without too much damage to your career, but only once or twice, and only if you don't change to an entirely new field every time.

I was lucky that my PhD and postdoc supervisors were always open to my ideas and that they let me develop my own research questions as long as they were roughly aligned to their research interests and funding. If you have a good research project idea, then it is usually possible to make it happen by finding the right collaborators, money, and time. This is not always obvious to achieve, and you need to accept that many project ideas will eventually not see the light of day. But if you do get your own idea realized, then this is highly rewarding! In fact, for me this is one of the fun aspects about being a scientist: I can wonder about how the brain achieves a certain function, or why we behave in a certain way in certain situations, and if nobody has found an answer yet, I can design an experiment to find out and get at least a partial answer. This is cool!

Even if you don't do experimental research, you can satisfy your curiosity by researching a topic nobody else has explored in detail yet.

Another aspect of academic freedom is that you can usually choose to defend your own scientific opinion as long as you have good arguments or evidence for it. Again, scientific progress lives off disagreements, and you have the freedom to develop your own view or own theory in your field. For people with independent minds, this can be a lot of fun. Here it is important to enjoy debate and discussion and the art of evaluating arguments and evidence.

A dear friend and colleague of mine summed it up like this: "One of the virtues of our job as a scientist is the freedom from boredom!" Use this freedom and choose research questions that do not bore you.

Creativity and Intellectual Challenge

The independence in academia also makes space for creativity. Not everyone associates a scientific job with being creative, but in fact it requires a lot of unusual ideas, out-of-the-box thinking, and creative problem solving. It needs creativity to come up with a truly novel and impactful research question, to find hidden and unexpected effects in experimental data, to interpret results that do not quite fit the current theories, and to develop novel theories that tie together potentially contradicting evidence. If you enjoy this kind of intellectual creativity and enjoy solving mysteries, then science is a lot of fun. A scientific job never stops being an intellectual challenge, granting you the "freedom from boredom" mentioned above. Up until retirement, there is always a mind-boggling number of new papers with new evidence, updated theories, and novel methodological advances to keep up with, there are always new mysteries and problems to solve, and the job becomes more varied the further you advance in an academic career. Instead of drilling down on one research question, as in your PhD, you start pursuing several research projects in parallel, extending your methodological experience, and supervising and mentoring more and more advanced students. And when you are a group leader, you need to manage a research team, ap-

ply for research funding, engage in different teaching activities, and take on institutional responsibilities like organizing talks and conferences, sitting on various university and funding committees, reviewing grants and papers, and much, much more — the task list becomes longer the more you advance in an academic career. This has the advantage that the job never becomes boring, but the disadvantage that the management of this huge workload becomes a whole new task. If this scares you, don't worry too much, because you will grow into the job and get more efficient the longer you do it.

Self and Time Management

As already mentioned, workload, project complexity, and competition increase the more you advance in an academic career (and this is probably true for many non-academic jobs, too). To stay successful, you need to find a way to maintain your sanity — both your physical as well as your mental health. This is of course quite individual, but working day and night until the last minute before an important deadline is something you can do occasionally, particularly in your master's, PhD, or post-doc training. But sooner or later you will realize it is not a sustainable work strategy in the long term — it will result in your becoming physically or mentally ill (many common symptoms I hear from colleagues are back pain, migraines, and, less often reported, depression). One deadline chases the other and you don't have much time to take a break in between, and the workload hardly ever diminishes. Plus, the constant flow of rejections and setbacks, as described above, can sometimes be tough on your mood. To stay healthy and productive, it's critical to learn how to manage your time and energy well so that it is sustainable in the long term. In my mind, one key aspect is to find and make time for activities that balance the challenges of the work — for example, regular exercise, doing something fun, and spending time with friends and family. This sounds quite trivial, but if your to-do list by far exceeds what could ever be done in a 24-hour day, then you need to specifically plan and make time for such balancing activities. And that leads to another

important aspect, which is setting priorities. In the end, there is only so much you can do in a lifetime. I realized already in the second year of my PhD, frustratingly, that my life would be too short for all the cool experiments I could think of. So, while the passion for my topic never stops sparking my creativity about research questions to explore and experiments to run, I've also learned to become more realistic about how much is feasible to do in a year, a month, or a day. In the end, the only solution to this problem is setting clear priorities for the research projects you really burn for, the collaborators you really enjoy working with, and taking on those responsibilities that really maintain and drive your career forward. And then make time for activities that recharge your batteries, otherwise you risk, literally, a burnout.

To conclude, if you are burning for a research topic and you love scientific argumentation, constant intellectual challenge, analytical thinking, and independent work, then going into research is certainly a good start. In order to succeed in academia in the long term, you also need to be ambitious, perseverant, and tolerant of frustration, as well as someone who enjoys teamwork and managing a team. Then an academic career can be a wonderful and very rewarding job!

