VIEWPOINT

Choices in neuroscience careers

Tamas Bartfai, Tom Insel, Gord Fishell and Nancy Rothwell

Abstract | How do I choose a mentor? How do I decide what field of neuroscience to work in? Should I consider doing research in industry? Most students and postdoctoral researchers aiming for a successful career in neuroscience ask themselves these questions. In this article, *Nature Reviews Neuroscience* asks four successful neuroscientists for their thoughts on the factors one should consider when making these decisions. We hope that this Viewpoint will serve as a useful resource for junior neuroscientists who have to make important and sometimes difficult decisions that might have long-lasting consequences for their careers.

Q *What factors should young scientists (Ph.D. students and postdoctoral researchers) consider to ensure they choose wisely when selecting their field of study, place of study, laboratory and mentor?*

Tamas Bartfai. Hot topics come and go; for example, 10 years ago many laboratories were looking for postdoctoral researchers who were working on programmed cell death. This is not the case any more as, although the topic is still important, it has found its place within neuroscience and its significance in CNS development and disease has been scaled down to more appropriate proportions. Similarly, in the 1980s many laboratories in the pharmaceutical industry wanted to recruit molecular biologists to clone important drug targets; this is also not the case any more.

Rather than choosing a 'hot topic', it is much more important to find a great mentor: somebody who has made a significant contribution to science, who has name recognition and whose laboratory attracts the brightest young people who will provide both real camaraderie and competition. It is clearly better to be in a laboratory with a well-known scientist with a depth of experience, who has little time but who provides a stimulating environment with many competing postdoctoral researchers who will be your peers during the decades to come, than it is to work in the laboratory of a young scientist who might themselves still be struggling and might even change their affiliation or direction during the time that you are training with them.

In my mind, picking a good mentor who is placed in a good scientific institution where there are many other great scientists is more important than the actual field of study. You can pick your 'own' field of study later.

Gord Fishell. If you are truly excited about what you're doing, your chances of succeeding increase enormously. For me, science is about having a question that I am passionate about. Find the right question and the rest will follow. The difficulty, of course, is discovering a topic that is sufficiently captivating. In trying to figure out what is worth studying, I think that postdoctoral researchers tend to focus too much on methods rather than biological problems. New methods are important, but only to the extent that they move a problem forward. If you start by deciding what it is that you wish to understand, then seeing an approach by which to tackle it will probably come more easily. As for choosing a laboratory, pay attention to its personality, which in no small part tends to be a reflection of the principal investigator (PI). For my own part, it is the enthusiasm and insights of my postdoctoral researchers and students that provide the atmosphere that allows good things to happen.

Tom Insel. Of course learning powerful techniques is important, working somewhere that discoveries are being made is important, and having a mentor who cares about you is important. But my main advice is: go with what you are passionate about. Find a big problem that you feel is important. The best problems might be old questions that can now be resolved with new techniques or new approaches from an interdisciplinary perspective. The problem needs to be tractable, but you should not worry about whether or not it is popular. Great scientists avoid the herd — they go their own way and eventually have others following.

Nancy Rothwell. Choose an 'important question' — that is, one that addresses a fundamental issue in the field; these questions might or might not be 'trendy'. Note that trendy areas are inevitably (and often inappropriately) competitive, and that future trends are not always predictable — for example, understanding the development of *Caenorhabditis elegans* was a fundamental but not trendy area, and yet it won the Nobel prize for the key scientists. It is equally important to consider, when choosing a laboratory, the environment you will work in and the people you will work with. It is important that the institution, department and supervisor you are considering are supportive of the careers of young scientists. So, ask whether they are well funded and well regarded and whether they provide real training and mentorship. On any laboratory visit, ask to meet young Ph.D. students and postdoctoral researchers (separately from the laboratory head), ideally in an informal setting. Ask them about the laboratory's past record of success and the career progression of young scientists in the laboratory.

Q *What is the relationship between people working in academia and the pharmaceutical and biotechnology industries like today?*

T.B. The relationship between people working in academia and industry has changed dramatically in the past 10 years. The perception that people in industry have safer and better-paid jobs has been disproved by

Box 1 | **The contributors**

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Gord Fishell received his Ph.D. in 1989 from the University of Toronto, Canada, in the laboratory of Derek van der Kooy. Since then he has been interested in the mechanisms that act to pattern the telencephalon. For the past 12 years, he has been at New York University's School of Medicine, USA, where he is a Professor in the Department of Cell Biology. He was previously a co-coordinator of the Developmental Genetics Program at NYU's Skirball Institute. In 2006 he became coordinator of the Smilow Neuroscience Program, a new research initiative at NYU. His laboratory studies various aspects of telencephalic development, most notably the developmental and genetic origins of cortical interneuron diversity.

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the lay-off of several thousand scientists in every major pharmaceutical firm. Academic scientists who work as consultants in industry often find it hard to understand that in industry many advanced projects are discontinued for non-scientific rather than scientific reasons (for example, if the marketing department indicates that, for commercial reasons, it no longer requires the development of a particular drug). In other words, commercial considerations are often more decisive for the (dis)continuation of a study than the scientific importance of the problem that the study is trying to solve.

In the past, academic scientists were often quite happy to collaborate with industry scientists on drug development: they would be glad to see that a newly developed drug was based on their discovery. Now, there is also an element of hostility: academic researchers are sometimes used by companies to evaluate their research projects, and they will judge these projects on their scientific merit rather than their medical potential. This might lead to the termination of the project, with the result that the industry researchers who were working on the project lose their jobs.

When I worked as Head of Research for Psychiatry and Neurology at Hoffman-La Roche in the late 1990s, the relationships with academic scientists were significantly better, warmer and deeper than they are now. This is partly due to the fact that we had collaborations with university laboratories that continued for much longer than they do today, and partly due to the fact that more companies than nowadays were headed by scientists rather than business managers. Both academic and industry research were expanding, so the financial strains were less on both sides. It is also the case that most academic researchers then were less demanding, both financially and in terms of transfer of materials; they were also more interested in learning how the process of discovery occurs in the industry. By now, two decades since their launch, only a fraction of biotechnology companies is successful and even fewer are widely successful.

Many academic researchers act as advisors or are founders of pharmaceutical companies. They believe that new drugs can be discovered in academia as well as by biotechnology companies. Although this might be true for some biological molecules, many of which are very important and become expensive drugs, it is not the case for most low-molecular-weight drugs that can be taken orally. No academic institution has a track record of developing multiple low-molecular-weight drugs over an extended period of time, and no academic institution has collected the necessary many years of accumulated experience from multiple disciplines, from biology to medicine and process chemistry to toxicology, whereas this sort of multidisciplinarity is the very basis of major pharmaceutical companies. The National Institutes of Health blueprint programmes might aim to achieve this, but they have certainly not yet been able to match the cumulative experience of the major pharmaceutical companies.

The switch between academia and industry is difficult in either direction, because the goals that academic and industry researchers aim for are so different and because the achievements of these researchers are measured so differently. Individualism and showmanship are, to a certain extent, the lifeblood of famous academic scientists who place emphasis, as they should, on originality. A scientist in industry would not survive long with these attributes, even if hired at a high-level position.

I have made the switch from academia to industry twice, and even though I have held prestigious positions at Roche, The Karolinska Institute and The Scripps Research Institute, I do not recommend making this switch without serious thought. It is simply the case that academia does not prepare scientists well for working in industry, and industry careers do not easily translate to academia. There is also considerable (although not well-informed) jealousy about how easy you might have had it on the other side. Unfortunately, this means that relatively early in your career you have to decide where you would like to work. Nobody should think that, as an academic, they will surely be recruited by a major biotechnology or pharmaceutical company to lead research there: these are the exceptions, not the rule. Being a consultant in industry certainly helps you to become known in industry, but it does not guarantee that an invitation to lead the company's research will follow as a result.

G.F. The emergence of industry as a partner to academia is truly exciting and offers an interesting alternative to university-based research. I think there used to be a stigma attached to going to industry, but this is rapidly fading. The important issue is to understand that academia and industry have different objectives. Although this can result in enormously productive collaborations between the two, in the end industry is about producing an end product whereas academia is simply interested in moving knowledge forward. Which path you should choose is therefore a matter of introspection. Are you interested in knowledge for its own sake or do you wish to see that knowledge applied?

As for moving from one to another, I believe that scientists should be cautious. Although a successful young scientist will find many exciting opportunities in industry, it tends to be difficult to return to academia from industry. Obviously there are exceptions: for example, Lee Rubin at the Harvard Stem Cell Institute has successfully gone back and forth between academia and industry throughout his career, but I believe that his inclinations and talents make him uniquely suited to be the interface between the two.

T.I. The National Institute of Mental Health (NIMH) supports training in academia but not in industry. The cultures are different but not antagonistic.

N.R. The relationship is getting better, but there is much room for improvement as there is still some serious mutual distrust. As an academic who has worked and still works very closely with industry myself, I am horrified by the widespread, very negative views of industry held by some people in academia. To some it is as though, in transferring to industry, perfectly normal and acceptable scientists move to 'the dark side' and become something unacceptable. In fact, most scientists who work in industry are just the same as those in academia, as is their key goal — namely, to solve problems.

There are no easy answers about transitions between academia and industry because the problems and issues involved in moving between the two are case-specific. A transfer from academia to a small biotechnology company where you will still publish peer-reviewed papers would allow an easy transition back to academia. By contrast, transferring into an area where it is hard to maintain the traditional 'academic' aspects of a *curriculum vitae* (CV) (such as being published, successfully applying for grants, supervising and mentoring Ph.D. students, teaching, *et cetera*) makes it much harder to move back. However, once you have reached a really senior level none of this matters so much.

There is no 'best' time to transfer between academia and industry; however, the more established you are and the stronger your CV, the more you can call the shots in both academia and industry.

Q *What is the best way for a neuroscientist early in their career to establish contacts with other neuroscientists?*

T.B. I have used computers since 1963, when I started writing programs for a living, and I have used the internet ever since it was available. Yet, I am skeptical of the real value of an internet-based scientific network between people who have not had a face-to-face meeting. The best way for a neuroscientist who is early in their career to become part of a network is through participation in as many small meetings (100–300 people) as possible: to get to know personally the key opinion leaders and the promising young people in the field. Once such meetings have taken place, the internet is a fine tool to keep the contacts made at these meetings alive. In addition, seeing such key people in action helps you to understand their statements and put them in context and follow their discussions on the internet. I believe that, compared with actual scientific achievements, networking skills are far overrated among young scientists: in the long run, no amount of networking skills will replace the impact of the original findings you have made.

I should also add that your mentor's networks are much more important than we admit: coming from the laboratory of X might just be the best networking tool that there is.

G.F. At present, small meetings provide by far the best way to get to know people both in and outside your field. My uncontested favorites are Gordon conferences and I never fail to come back from them invigorated. Large meetings, such as the annual one sponsored by the Society for Neuroscience (SFN), offer huge variety, but this comes at the cost of intimacy. For the new graduate student or postdoctoral researcher entering neuroscience, the SFN meeting can be overwhelming. Obviously the internet offers a growing new interface, but I question whether it will ever take the place of face-to-face interactions. In this regard, the greatest impact is likely to come from open-source publishing and novel initiatives such as the Faculty of 1000.

T.I. Neuroscience, like any modern science, is a surprisingly social endeavour. We all recognize the importance of 'team science'. Just as important are the relationships that you establish early in your training: they provide emotional support, scientific insights and career information. I want to stress the value of having a supportive social network during training. Graduate school is usually emotionally difficult, although no one tells students this before they enter their first year. I tell students that the most important task in pre-doctoral neuroscience training is learning to deal with failure. Compared with earlier phases of your training, in graduate school there is less structure, the measures of success can be unclear, and sometimes it can seem that nothing ever works the way you want it to. For students who have so far only known success, this can be really discouraging. Having a support group that includes some students who have survived the tough times can be really helpful.

N.R. Networking is critical. It really helps if you are a naturally outgoing person, but many of us are not, and there is a danger of being too pushy (here there can be real cultural differences). Of course, attend all the meetings you can, talk to people and participate in the external events — the bar is an incredibly important place for networking! Spend time innovating and invigorating: for example, organize a seminar series or a meeting of your colleagues, volunteer as the student representative for your national society, offer to help organize a local or national meeting or host a visiting speaker (and make sure that they are really well looked-after). Write to colleagues politely and with some inspiration: for example, an e-mail in which you just ask 'Would you like to collaborate?' is likely to get an instant 'delete' from a busy senior colleague. A better approach would be to compliment them on their work and try to hook them on what you are interested in. If you receive no reply, try one very polite follow-up.

Scientific blogs might help communication between scientists, as long as they do not descend into chit-chat and unvalidated comments.

Q *Apart from training young scientists in research techniques, do current Ph.D. and postdoctoral training programmes prepare neuroscientists adequately for careers at and away from the bench?*

T.B. Current postdoctoral training is fully sufficient, in particular if the postdoctoral researchers have been in at least two laboratories of different expertise, preferably in different countries. Today's postdoctoral researchers are far savvier than we were (I got my biology Ph.D. in 1973). You should realize that a good outcome in a job interview requires you to show the laboratory head that you either bring a very specific skill and methodology to the laboratory or that you have the general ability to learn whatever it takes to be successful in the position. If the group leader does not want you for the specific skill and does not think that you are a 'generalist', then you will not get the position. Doing a Master of Business Administration (MBA) degree or other non-scientific degree often backfires because it begs the question, did you not trust that you will be a good enough scientist? Doing such degrees and knowing about topics unrelated to research has become possible and might be desirable for both researchers in industry and academic scientists, but it is deep knowledge of your specialty and not having another degree that will lend you credibility.

G.F. Anyone who has done bench science knows the high level of dedication and perseverance required. That sort of life experience will serve you well regardless of what you end up doing. Neither a Ph.D. nor a postdoctoral programme can or should try to prepare individuals for all possible eventualities. Obviously, the one career you would hope they would prepare you for is the one that involves directing an independent laboratory, but even here they are likely to fall short. Successful PIs inevitably end up wearing many different hats. They need to be able to come up with projects, write grants and deal with the strong personalities of the people working in their laboratories (as might be expected, people with strong personalities are precisely the kind of creative people you find in good laboratories). It is the rare PI who continues to do bench science from start to finish within a few years of running their own laboratory. As Andrew Lumsden once put it, "We work very hard to find a few good chaps who can do an experiment decently and then make damn sure they never do another one." In the end, the quality that unifies the most successful scientists is their ability to identify important problems and devise approaches to address them. Both students and postdoctoral researchers tend to become absorbed in the details of their projects. The extent to which they can learn to see the broader picture during their training is, I believe, the best predictor of their future success.

T.I. It is important to separate learning about content from learning about process. Good training provides both. Content changes quickly in neuroscience: last year's facts can become next year's myths. Although learning the content — for example, neuroanatomy or molecular biology — is essential, it should always be considered the current state of knowledge. By contrast, the process of doing science is remarkably stable — by process I mean learning how to pose questions, design experiments and deal with unexpected results. These skills are valuable in a range of careers, from academia to industry, business or law.

How to prepare for a career in science? I believe that the best predictor of success as an academic scientist is a trainee's ability to write clearly. It is no accident that many of our most successful scientists were English majors. Of course, grant writing is not like writing fiction, but it is a learned skill that should be mastered during a postdoctoral fellowship, if not before. In addition, successful scientists need to be business managers, life coaches and team players — all skills that can be honed during training.

N.R. Some training programmes do provide adequate training. At my university, Ph.D. students and young postdoctoral researchers receive training in career development, verbal and written communication, how to seek external funding, how to handle collaborations, conflicts and supervision and much more. These training courses are essential and in fact do not take you away from the laboratory for that long. If you are not receiving this sort of support, demand it or move!

Q *What are the major developments in (neuro)science that have affected your career?*

T.B. There have been many major developments during the time that I have worked in neuroscience (starting in 1973). These include the development of patch-clamp techniques, transgenic animals, gene cloning and expression, high specific-activity labelled ligands, imaging techniques, methods for measuring single-neuron transcriptomes and many others. It is possible to ask questions about behaviour at a molecular level today, whereas this was not in the books in the 1970s.

The number of neuroscientists has grown around 20-fold in this time — this includes scientists who produce poor data as well as those who contribute good data. It has also become clear that the discipline, although it is developing at fantastic rates in its subdisciplines, is further removed from integrating its theories than ever before. Although speed and specialization are now highly valued, it becomes clear how much weaker we are integratively compared with molecularly when a drug for a neurological or psychiatric disease is sought.

The development of the internet, allowing easy access to articles that have been published after 1980, has been great, but in many respects the internet's influence is overrated: when I ask colleagues how many important papers they have read in the past year, they still answer 3–5, although many more articles are published yearly now than 20 years ago. The number of truly original papers has not increased, and the extent to which they are read is limited by the internet. It is sad that most young, internet-weaned neuroscientists have never read the classic papers by Ramón y Cajal, John C. Eccles, Bernard Katz, *et cetera*.

My research career has not been different from what I envisioned because, quite frankly, I did not have today's students' career goals. I had no blueprint that I could now compare with my actual career. I was given some advice by a famous particle physicist for whom I worked as a 17-year-old: "Go and train with the best, they will not only teach you but they will hand you over to the next great scientist as a piece of their handiwork until such time that you want to stand on your own". This is exactly what happened to me. I therefore believe that finding the right laboratory and fighting to get into it is worth everything. Because the people who run these laboratories are all great for some particular reason, and it is worth the fight to learn from them.

My research career was somewhat lonely because I chose a very specialized subject that was often regarded as a narrow topic, namely the fever response. In this field there were no great, well-funded laboratories, so instead I went to study with great scientists in many different fields, in the laboratories of Ulf von Euler and Lennart Stjärne, Paul Greengard, Gerald Edelman, Marshall Nirenberg, Julius Axelrod and Bruce Merrifield for longer or shorter times, and I learned from each of them, and from my colleagues in industry, immensely.

My goals of working in science, teaching and staying clean in science could have been fulfilled in academia and industry alike. My advice for any young neuroscientist is to find a good mentor in a good institution where many other disciplines flourish too, as a lot of the answers you seek will come from physicists, chemists and others outside of neuroscience.

G.F. I have had the great fortune to be working in mammalian developmental neurobiology during the period when technical advancements have finally made the problems tractable. Near the end of my Ph.D., I was rather depressed by the realization that the state of neurobiology at that time allowed us to identify important questions concerning the development of the mammalian nervous system but prevented us from designing experiments with the sophistication to address them rigorously. The advent of molecular biology, cloning and gene targeting transformed the field. The first step in overcoming the impasse was developing the ability to clone genes and study their expression *in situ*. Even more important was the arrival of gene targeting. The development of conditional gene targeting then allowed the creation of tools for not only studying gene function but, more importantly, for functionally altering activity in the nervous system in a directed fashion. The opportunities to study both the development and the function of the nervous system are now open-ended. This stems to a large extent from the pioneering work of the Nobel Prize winners Mario Capecchi, Martin Evans and Oliver Smithies. Indeed, from the perspective of mammalian neurobiology, the progress that will be made in the next 10 years will largely be made by standing on their shoulders.

T.I. Freeman Dyson famously noted more than 10 years ago that "New directions in science are launched by new tools much more often than by new concepts."[1]. I basically agree with that observation: the development of the polymerase chain reaction (PCR), transgenic mice and, recently, channelrhodopsin rapidly changed the conversation in systems neuroscience. The ability to access the scientific literature through the internet has transformed the information base of what all of us do. The most important lesson from all of this is that we should be training students for change. Most of what I was taught about the brain and behaviour 30 years ago would now be considered obsolete. Much of what we are teaching today might look no better 30 years from now. At NIMH we are always looking for the scientist who will be a 'disruptive innovator' and overthrow today's dogma.

My own career has been completely nonlinear and unplanned. I trained in psychiatry, learned neuroscience at the bench and picked up administrative skills on the fly. Throughout, I have been obsessed with the neural basis of emotion, especially social emotion such as parental love. When I started in neuroscience, neuropeptides were the hot topic and receptors were just being mapped. These opportunities took me into the neuroanatomy of systems that are important for behaviour. With the advent of transgenic mice and more precise molecular tools, I had to learn about molecular biology. In the past decade, I have become more interested in the public health implications of neuroscience. How can we translate our understanding of the brain and behaviour into better outcomes for people with mental disorders? Now, with the emerging power of clinical genomics, we can undertake reverse translation and take clinical discoveries back to the laboratory to understand how genomic variation alters neural systems and neural function. One thing is entirely clear to me: in terms of our ability to answer important questions, there has never been a better time to go into neuroscience. What I would give to start over now that we can finally answer the questions I could barely ask 30 years ago!

N.R. There have been massive changes in technology, approaches and discovery. I can remember going through numerous pages of *Current Contents* each week (a weekly print publication that documented all of the published papers in biology and medicine) and marking them off before going to the library to request a photocopy! I made slides with Letraset (sheets of artwork elements that could be transferred to create figures) on tracing paper, and faxes were the only fast method of communication. My god I sound old! Scientific breakthroughs have also come thick and fast — for example, brain imaging methods, computational and systems approaches, and the multiple ways we now have fast access to worldwide technologies have all promoted rapid scientific development; but, on the down side, there has also been a massive increase in the regulatory environment and in bureaucracy.

doi:10.1038/nrn2386

1. Dyson, F. J. Imagined Worlds. (Harvard Univ. Press, Cambridge, Massachusetts, 1997).

FURTHER INFORMATION
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