

Created Christmas Eve, 2003 in Oliva, Spain despues un buen comida de jamon, queso, pan, y flan... ahh si, y cervezas. Evolving since then, from many mistakes I've made and successes we've shared.

*Things I wish people told me when I was first a grad student, although it wasn't such a bad thing that I learned them on my own. Yet I hope this advice will benefit you. I don't expect anyone to be just like me; I expect you to be yourself. This advice is intended to help you through this pivotal time in your career. Ignore it if you like; it's me being introspective and passionate (and pedantic?) about science.*

**Communicate.**

**--With me:**

*By saying what you mean.* We're only human and so sometimes hold things back, but I urge you not to. Speak your mind; be honest about what you feel. I am working on this myself, so don't be afraid to nudge me to do so as well if you think I'm holding back. This point is why I am writing this "manual" for you. I am busy (cliché, I know, we all are in academia, always; welcome to the club!) and sometimes disorganized/forgetful because of that mania, but above all I don't want to be hard to approach. Don't be intimidated by me; I'm just another person in your life. OK so I sign the thesis paperwork, but don't worry about that, I am quite forgiving and say/do lots of dumb things myself. ☺ I am absent-minded like any academic, but sometimes worse so due to some lingering health problems. Be patient with me if I am forgetful- it doesn't mean you're not important. I'm just juggling a lot, and drop some balls. Feel free to remind me to pick them up if they need it.

**--With each other and others associated with our lab:**

Cooperate and share. Give freely of your assistance to those who need it, regardless of expectations of assistance in return. Try to resolve disagreements in a mature, diplomatic and civilized fashion. It can only help improve your PhD experience, and form friendships and collaborations that last your lifetime. Start off on a good footing and keep it that way. Be a peacemaker in times of strife, except when it really matters that you take sides. Be outspoken without hogging the limelight. Scorn petty politics and excess gossiping. Become a leader. *A rule I try to follow, and sometimes fail at, is to "take the high road" when a choice presents itself that affects others.* Do the right thing. Choose the values that work best for you and the world. Stand by your morals and be a good human.

**--With the broader scientific community:**

*By attending scientific conferences, joining social networking etc --* and not just hanging out with cliques. Get out there and meet other researchers/science communicators, talk to them (do a lot of listening early on rather than blathering about stuff you may not know as well as them, but don't be silent either!). Fight the shyness most of us (me included) have. Ask questions. Be interested in their work, and be open about your work. Same thing goes for communicating by other means: in the office or meetings or seminars, phone, e-mail, visits to labs, etc. These are your colleagues. You will benefit from getting to know them (with future jobs, collaborations, invitations, etc.), as you should be spending the rest of your life working with them. Why not start early? If you don't speak up, you will be ignored. Grad school is sink-or-swim; start by swimming to make a name for yourself. Don't be obnoxious, arrogant, dishonest, manipulative, or overly territorial. Being confident and even a bit competitive is OK as long as you do it for the right reasons and still respect your colleagues in the end. Become known for your strong intellect, integrity, broad-mindedness, and convictions, not a big mouth or insincere hype.

**--With the past and present:**

*By becoming an expert in the literature* (peer-reviewed and any other) in your field. Remember the old adage about the doom that awaits those who are ignorant about history. Learn the history of your field. Who's who, what they did, when they did it, and why they did it. Where did they go right/wrong? This is a crucial way to figure out where the gaps are in our knowledge, and so find niches for your research. Go for it! Don't just read the best papers/journals. Read the crappy ones too. Sometimes there are little gems hidden inside the crappy papers, or forgotten controversies/mysteries that need resolution. Read the work of those whom you disagree with the most carefully, so you understand their point of view. ("Know thy enemy")

*Never stop reading;* peruse the bibliographies of every key paper you see and hunt down the papers that sound interesting, then ransack their bibliographies-- accumulate a library. This is communicating with your forebears. Don't avoid papers because they are "too long;" if it is published it deserves to be read just as much as your work does. For my PhD, I mostly stopped reading most fiction literature and focused on immersion in science books/papers. It helped a lot!

**--With the present and future:**

*By publishing your work as soon as you can.* Do not do work that is not publishable! Plan how every project you do will become a paper in the future. There is no time to waste. Publish, publish, publish! I will be harping on you to do this. Unpublished research makes me sad. There is little point in it; you're not doing science just for your own edification, although that is still part of the motivation behind it all.

## Organize.

### --Time management:

*Plan out every week:* what will you be doing each day? A smartphone or calendar/diary will be very helpful. Keep a “to do” list and prioritize crossing things off that list. What is most important? Do that now, or schedule it for that open day this week and stick to that schedule. Then do the other things. I am not perfect in this, but I’m getting better with practice and can at least argue that I’m efficient.

### --Focus:

*As a grad student you have just 3-4 years to get your PhD research done.* A typical student in the USA may get 6 years and not even start their thesis work before the end of their 3<sup>rd</sup> year. You may later be competing with these people for jobs, so you will need to focus to attain a level playing field. You do not have a luxury to wander, do many side projects, and switch thesis ideas every week or so. From day one you need to get rolling. How? Talk to me and others, but here are some pointers:

You should first get to know your surroundings (people, places, and things around the lab and college), then dive into the literature for most of the first year while dabbling in teaching, helping with some others’ research, collecting initial data, discussing your research topics and plans, and otherwise learning what grad school is all about and whether it’s truly for you (big decision!). The first year should particularly be an introspective, philosophical year of personal development. Two goals of your 1st year should be to the literature review that will be your first chapter, and to write your first PhD paper (in time for your 1<sup>st</sup> yr appraisal), or *at least* present your first paper at a conference.

Your later PhD years will become increasingly focused on the thesis research, culminating in about six months of frenetic writing. The experience will be much more enjoyable if you do your utmost to remain focused. If you feel like outside constraints (e.g., teaching, other projects, meetings, my requests) are making it hard for you to focus, talk to me and we’ll work it out. Plan all of your thesis work with me as targeted toward future publications.

## Define Yourself.

*--Get to know who you are.* What are your limits? Are you terrible at math, or geometry, or computers, or anatomy? If you come to realize such things, you then have the power to make a decision: let those limits define you, or work to extend those limits and improve yourself. Likewise, if you know your strengths well, you can tailor your research to fit those strengths while you work on other facets of yourself. If you think hard enough about it, you’ll realize that many “limits” are just something in your mind, and hence can be overcome, but only if you want to and you try. As a scientist, push yourself to be a questions-researcher, not just a methods-producer (or worse yet, just a user). Methods are ephemeral; answers can be eternal (if you’re lucky).

[*Story time!* I came to uni hoping to be a marine biologist, or Hollywood screen writer, or something fun. I found that booze and drugs were also a fun occupation, but that’s another story. Then I took a class in evolutionary biology and another in functional morphology, read some Darwin, and had the epiphany (in some ways triggered by a health crisis; a close call with cancer) that I wanted to study the evolution of locomotion or something like that related to palaeobiology. Yet I had next to no training in these; it’s just what I wanted to do. I took 18 months off before coming to grad school. During this time I read lots, grew up a bit, and took palaeontology courses on the side while working as a volunteer in a museum. It didn’t stop there. I came to grad school hating math and physics, but wanting to do research that required those skills. Hence more classes, and many hours with faculty teaching me basic mechanics one-on-one. Meanwhile I published some basic anatomy/evolution papers. I still didn’t quite ‘get it,’ but kept pressing on. It was a struggle. I did a postdoc in an engineering lab where everything was about math and physics; immersion. I learned a shitload, and am still learning. So I didn’t know much when I started grad school, and I’ve come a long way from there. This goes to show that anyone can if they have some basic smarts and motivation.]

*--Decide who you want to be.* In 5 years, 10 years, at retirement. Sure, everything will change and all our best plans tend to take MUCH longer than we expect, but set goals anyway and revise them as needed. It can only help. Is academia really for you, or should you shoot for a consultant or other job outside academia now or after your PhD? Don’t just coast along. Have goals for who you want to become and chase them down vigorously. Does teaching stimulate you more than research? These are important decisions in your life, and making them early (but not rashly) is better than realizing too late that you’ve wasted years of your life. And so what if you do realize that you prefer another path? That’s what life is all about, so don’t feel crushed if it happens. The adventure is all in choosing which paths we follow in life. It is my preference to take control of the timing of those choices myself rather than let them choose me.

There are also choices to be made beyond science and career. **Most importantly, what are your moral standards as a scientist?** Do you want to take the high road and be as honourable as you can in your work, or cut corners in order to save time? These may seem like obvious questions, and I hope you always try to take the high road, but my point is you’d better be thinking along the way! It is easy to forget to think about why you make certain choices over others. Human brains are great at self-deception. Immoral choices could really come back to bite you even if they help in the short term. Science is dispassionate and objective, but we are humans; passionate and subjective. I keep meeting scientists that clearly haven’t realized this. We’re not robots. Science is much deeper and

stronger when one appreciates its human element. You will make bad ethical choices, but you will learn more from them if you think along the way. *Nice people do win sometimes, though, contrary to conventional wisdom.*

### **Be Independent.**

--*Avoid becoming a clone of your supervisor or anyone else.* It's bad for your career; good institutions don't want to hire people like that even if they are good. Take advice and use role models freely, but on your own terms, in pursuit of your own goals. You will gain self esteem and confidence, and be valued as a wise person. If you disagree with advice you are given, speak up! Don't do something unless you are convinced you are doing it for the right reasons. People may rush to give advice and thus give you obviously faulty advice; it is foolish to follow that advice just to avoid conflict. Assess everyone's advice as if it could potentially be wrong – don't be totally convinced until you've convinced yourself. This comes as part of developing yourself as a critical thinker, which probably is the most important quality in a scientist.

--*Take charge of your career from the beginning.* Don't wait for me or someone else to pick up your slack. You want to come out of grad school as the best damn candidate for the next job in your career sequence you can be. You may be the best judge of what that is; others may not know you well enough to judge. Not that you should stubbornly cling to all of your ideas or argue over every detail, but find a balance between striking your own path and following the lead of others. Finally, do things that distinguish you from others – work on organisms that other folks don't work on, choose research that is not terribly crowded with other researchers, don't just use a technique because everyone else does, and cultivate collaborations that promote intellectual outbreeding (i.e., don't always just work with the same folks). Become unique. Defy disciplinary boundaries. Never let someone tell you “don't do that, you're a biomechanist [or whatever].” Define your own identity as a researcher; eschew labels.

--*“Work-life balance” is nonsense. Practice work-life integration;* boundaries can be fluid. Science is about an all-consuming passion for the natural world; it shouldn't be contained within 9-5 working hours or it gets stale. Nor should it prevent you from having fun, including taking breaks to “refuel” when your Science-Fu levels are low. In these days of a terrible job market, the competition is insanely tough so you need to work efficiently and prioritize what is best for your career (which may be best for your life in a broader sense).

### **Build Foundations.**

--*Target your science to rest upon the firmest possible foundations.* If your work has some underlying assumptions that are crucial, make sure you investigate these assumptions in a lot of detail. Try to build up from this firm foundation as your research proceeds. Not sure how important your assumptions are? Better find out before someone asks you at a critical moment and leaves you stumped. Be your own work's worst critic and you'll be a great scientist. There must however be a balance between skepticism and self-effacement on one hand and confident scientific progress on the other.

[Story time 2! In my PhD I wanted to reconstruct how fast a *T. rex* could run, because I thought it was a fun, interesting, and challenging topic. Some palaeontologists might have just thrown a few together with a back-of-the-envelope calculation then just published that (and still gotten into Nature). But I saw weaknesses in the foundations of my work: I knew the skeletal anatomy well, but everything else was assumptions, whose importance was hard to evaluate in advance. I spent most of the 6 years of my PhD doing the best work I deemed possible on the soft tissue anatomy, and all this turned into four papers (now well-cited) along the way (hard work pays off!). Then a final year polishing the mechanics, as I focused on sensitivity analysis of the quantitative parameters needed to model running. Finally I got ‘that coveted Nature paper’ after 7 years of work. The moral is, even if the work takes a long time, if it makes your research as strong as it realistically can be (i.e., a firm foundation), do it regardless. But balance this with publishing early and often, by tackling more bite-sized but nonetheless valuable projects along the way.]

**And finally, a private story about life**—My life almost ended December 16, 2002 [REDACTED]. This has colored my view of life a lot. Life used to be less dark for me. It's short and unpredictable, so live it now how you want to. Whether it comes early or late, you should aim to leave the world having improved it in some way and leaving a legacy for the future. For me, this is my family, my science, and my students. I don't talk about this much to anyone these days, but I do think about it every day.

### **A ‘shopping list’ of other advice, in no particular order:**

- **PUBLISH OR PERISH.** Plan your thesis with me so that each main chapter becomes a paper that you publish, ideally doing most of that during your PhD so your CV looks lovely at the end and you can get a job. This is vastly important to keep in mind. Unpublished research is pretty pointless. Hardly anyone will ever read your thesis, but thousands or more will read your papers.
- **Publish Open Access** when you can. This means publishing in journals that make the paper readily available (at least within 6-12 months, or immediately), but also **making your key data available openly to others.** We will discuss how to do all this as publications take shape.

- Don't publish in books. They take too long, becoming obsolete by the time they are published, often are mishandled by editors, don't get cited much or are easily ignored, and not found by some reference searching tools; just BAD all around.
- Consider trying what I did as a PhD student: stop reading fiction books. Only read science-related (including history of science, popular books etc) books to educate yourself broadly and deeply. This will help you to learn to read/assimilate information quickly and may give you a robust foundation of basic knowledge. Come back to reading "Game of Thrones" later- it will still be there, and you'll need mental breaks. I know some people will hate this idea, but it is worth considering. A PhD can work well as an ascetic, hermetic immersion in science. Especially if you want to end up well-rounded in expertise; many PhDs end up too specialized.
- Read science blogs and participate in grad student societies. Get involved in the broader community. But don't let it take over your time too much- you need to get a PhD first. Plenty of time later once your career is on more solid footing, but in moderation such networking/engagement skills and contacts can be very valuable. Social networking such as Twitter is now a critical part of science communication.
- Learn how to make a logical, dispassionate, but enthusiastic argument and have a calm, rational argument with others. I found that "arguing on the internet" (a dinosaur email listserver) helped me a lot to develop this skill, which is hugely valuable in science. The first person to lose their cool and blabber irrationally loses. Good to learn how to avoid.
- What if you realize a PhD is not right for you? This is natural, normal, and almost expected of everyone doing a PhD. Self-doubt is perhaps the most important trait a scientist can have! And a PhD is hard, with an uncertain future ahead. I seriously considered quitting my PhD after not passing my first qualifying exam (viva) and having to retake it. Talk to me about it, or your friends, or the grad school, or all of us. It's only 3-4 years and it should be about training you to move on to whatever career comes next. We can make changes if you communicate your goals, needs and doubts.
- Life after a PhD is stressful and full of uncertainty. Be aware of that. Academia might not be right for you, but a PhD might still be worthwhile. See this page for some statistics and links that are quite helpful. While only a small percentage of PhD students actually become academic faculty or especially professors, our lab's status as a world leader and the tutelage we'll provide should mean that you'll be ahead of the curve. Regardless, keep the conversation open with yourself, and with me—I would not be angry or ashamed if you left academia. I am here to help you take your career to the next level, whatever that may be.
- More to come as I think of nuggets of advice that seem wise to me at the time.

### Helpful links for more information: (hardly comprehensive, but a start)

- <http://www.vitae.ac.uk/>
- <http://www.postdoc.duke.edu/resources/career-resources>
- <http://www.societyofbiology.org/documents/view/732> and similar pages from the SoB
- <http://career.ucsf.edu/pff/job.html>

### Basic advice and blogs:

- <http://neurochambers.blogspot.co.uk/2012/05/tough-love-insensitive-guide-to.html> (this one is especially great for PhDs!)
- <https://neurolab.gatech.edu/labs/ting/unsolicited-advice> (all around good advice from Lena Ting)
- <http://www.eeb.yale.edu/stearns/advice.htm>
- <http://blogs.discovermagazine.com/cosmicvariance/2011/05/18/soliciting-advice-non-academic-careers-for-ph-d-s/>
- <http://theresearchwhisperer.wordpress.com/2011/06/13/networking/>
- <http://archosaurmusings.wordpress.com/2012/07/26/academics-on-archosaurs-john-hutchinson/> (in case you're not sick of me yet)
- <http://www.zoo.cam.ac.uk/zoostaff/larg/pages/Tim%20CluttonBrock%20-%20Survival%20Strategies%20for%20Scientists.pdf>
- <http://www.tyelab.org/Philosophy.html>

### Are you not good enough to belong here? Impostor Syndrome and science:

- <http://contemplativemammoth.wordpress.com/2012/04/25/how-i-cured-my-imposter-syndrome/>
- <http://blogs.scientificamerican.com/context-and-variation/2012/08/09/impostors-the-culture-of-science-sci-foo/>
- [http://sciencecareers.sciencemag.org/career\\_magazine/previous\\_issues/articles/2008\\_02\\_15/credit.a0800025](http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2008_02_15/credit.a0800025)

### Academic job search advice:

- <http://polypedal.berkeley.edu/twiki/bin/view/PolyPEDAL/InterviewQuestions> (hugely detailed; take this to your job interview!)
- <http://www.acsu.buffalo.edu/~jbeebe2/IntvQs.htm> (first 3 in list work; rest of links broken)
- <http://www.insidehighered.com/career-advice/academic-career-confidential>
- <http://scientificsides.wordpress.com/2012/08/05/from-postdoc-to-pi-ten-simple-rules-for-applying-part-1/>
- <http://contemplativemammoth.wordpress.com/2011/11/22/how-to-get-a-faculty-job-in-20-not-so-easy-steps/> (excellent scientist-blogger)