On Keeping Your Soul

John Baez

The great challenge at the beginning of ones career in academia is to get tenure at a decent university. Personally I got tenure before I started messing with quantum gravity, and this approach has some real advantages. Before you have tenure, you have to please people. After you have tenure, you can do whatever the hell you want - so long as it's legal, and so long as your department doesn't put a lot of pressure on you to get grants. (This is one reason I'm happier in a math department than I would be in a physics department. Mathematicians have more trouble getting grants, so there's a bit less pressure to get them.)

The great thing about tenure is that it means your research can be driven by your actual interests instead of the ever-changing winds of fashion. The problem is, by the time many people get tenure, they've become such slaves of fashion that they no longer know what it *means* to follow their own interests. They've spent the best years of their life trying to keep up with the Joneses instead of developing their own personal style! So, bear in mind that getting tenure is only half the battle: getting tenure while keeping your soul is the really hard part.

To do this, you have to make sure you never lose that raw naive curiosity that got you interested in science in the first place. Don't get too wrapped up seriousness. The universe is a cool place; exploring it is fun! As Grothendieck put it:

In our acquisition of knowledge of the Universe (whether mathematical or otherwise) that which renovates the quest is nothing more nor less than complete innocence. It is in this state of complete innocence that we receive everything from the moment of our birth. Although so often the object of our contempt and of our private fears, it is always in us. It alone can unite humility with boldness so as to allow us to penetrate to the heart of things, or allow things to enter us and taken possession of us.

This unique power is in no way a privilege given to "exceptional talents" - persons of incredible brain power (for example), who are better able to manipulate, with dexterity and ease, an enormous mass of data, ideas and specialized skills. Such gifts are undeniably valuable, and certainly worthy of envy from those who (like myself) were not so "endowed at birth, far beyond the ordinary".

Yet it is not these gifts, nor the most determined ambition combined with irresistible will-power, that enables one to surmount the "invisible yet formidable boundaries" that encircle our universe. Only innocence can surmount them, which mere knowledge doesn't even take into account, in those moments when we find ourselves able to listen to things, totally and intensely absorbed in child's play.

So: keep playing around with all sorts of ideas, techniques and tools. Read voraciously. Don't be scared of *experts* and their *jargon*. Become one yourself, but then give the game away by explaining things in simple language whenever possible. Talk to lots of people! Teach them; learn from them; don't worry too much about impressing them. Don't be scared to ask basic questions - and don't be surprised when nobody knows the answers. The simplest questions are the last to be answered.

But while I'm in pontification mode, let me add some more "practical" - some might even say cynical - words of advice as well. To succeed, you must be both idealistic and practical.

Some Practical Tips

1. Go to the most prestigious school and work with the best possible advisor. A good advisor will give you a hot topic to work on where you can get results that people will find interesting. A good advisor will be so famous that merely being their student will cause people to be interested in you. A good advisor will go to bat for you when it comes time for you to get a job. A good advisor will be politically well-connected and lubricate your way straight to the holy groves of academe. A good advisor will also work your butt off and scare the crap out of you by expecting you to know about millions of things - don't let that put you off.
2. Publish. Publish papers that get definitive results on fashionable subjects, so they'll get cited. Publish papers that open up promising new lines of investigation. Publish papers that people can actually read - but don't tell anyone else this trick, or everyone will start doing it, and then where will you be? Publish papers that show you have your own research program. Publish papers that create a shock wave the moment they hit the archive! But most importantly: publish.
3. Go to conferences. There's an infinite number of conferences, and you should go to them. Give lots of talks, chat with lots of people, make connections, find out where the jobs are, find out what people are working on, find out what people *will be* working on. Have fun and be friendly. And most of all: give good talks!

On Giving Good Talks

People should leave your talks feeling happier and wiser than when they came in. So often it's the opposite. Be an exception. Your talks should be clear, concise, fun, exciting, and *never ever run over time*. For each extra minute your talk runs over, 10% more of the audience will decide you are a jerk and start fantasizing about you falling down a trap door.

Practice your talks! Give them in front of a video camera and see how silly you look staring at the overhead projector, blocking the view for the audience with your own shadow, mumbling "omega squared phi times psi cubed d theta" like some mad scientist when you could actually be looking at the audience and telling them something cool. Watch yourself struggling to turn on the laser pointer, tripping over the microphone wire, fumbling around for the next transparency, struggling to slowly slide a piece of paper down the transparency in a pathetic intellectual striptease, desperately struggling against Microsoft to get your Powerpoint presentation to work, engaging in all sorts of pointless antics that distract from the subject matter, wasting precious time, *boring people to death*. And resolve to **do better**!

You are on stage: be entertaining! Don't show people equations they don't really need to see - that's what journal articles are for. Convey your wisdom in memorable sentences. Be eloquent. Be formidable, yet fun. And most of all, convince people that you are someone they would like to have around. Yes, someone they would want to give tenure.

Rota's Advice on Talks

I also urge you to ponder this advice taken from Gian-Carlo Rota's *Ten Lessons I Wish Had Been Taught*. I've paraphrased it at some points.

Lecturing

The following four requirements of a good lecture do not seem to be altogether obvious, judging from the mathematics lectures I have been listening to for the past forty-six years.

1. Every lecture should make only one main point.
   The German philosopher G. W. F. Hegel wrote that any philosopher who uses the word "and" too often cannot be a good philosopher. I think he was right, at least insofar as lecturing goes. Every lecture should state one main point and repeat it over and over, like a theme with variations. An audience is like a herd of cows, moving slowly in the direction they are being driven towards. If we make one point, we have a good chance that the audience will take the right direction; if we make several points, then the cows will scatter all over the field. The audience will lose interest and everyone will go back to the thoughts they interrupted in order to come to our lecture.
2. Never run overtime.
   Running overtime is the one unforgivable error a lecturer can make. After fifty minutes (one microcentury as von Neumann used to say) everybody's attention will turn elsewhere even if we are trying to prove the Riemann hypothesis. One minute overtime can destroy the best of lectures.

3. Relate to your audience.
   As you enter the lecture hall, try to spot someone in the audience with whose work you have some familiarity. Quickly rearrange your presentation so as to manage to mention some of that person's work. In this way, you will guarantee that at least one person will follow with rapt attention, and you will make a friend to boot.
   Everyone in the audience has come to listen to your lecture with the secret hope of hearing their work mentioned.
4. Give them something to take home.
   It is not easy to follow this advice. It is easier to state what features of a lecture the audience will always remember, and the answer is not pretty.
   I often meet, in airports, in the street, and occasionally in embarrassing situations, MIT alumni who have taken one or more courses from me. Most of the time they admit that they have forgotten the subject of the course and all the mathematics I thought I had taught them. However, they will gladly recall some joke, some anecdote, some quirk, some side remark, or some mistake I made.

Blackboard Technique

Two points.

1. Make sure the blackboard is spotless.
   It is particularly important to erase those distracting whirls that are left when we run the eraser over the blackboard in a nonuniform fashion. By starting with a spotless blackboard you will subtly convey the impression that the lecture they are about to hear is equally spotless.
2. Start writing on the top left-hand corner.
   What we write on the blackboard should correspond to what we want an attentive listener to take down in his notebook. It is preferable to write slowly and in a large handwriting, with no abbreviations. Those members of the audience who are taking notes are doing us a favor, and it is up to us to help them with their copying. When slides are used instead of the blackboard, the speaker should spend some time explaining each slide, preferably by adding sentences that are inessential, repetitive, or superfluous, so as to allow any member of the audience time to copy our slide. We all fall prey to the illusion that a listener will find the time to read the copy of the slides we hand them after the lecture. This is wishful thinking.

Rota's comments on impeccable blackboard technique apply equal well to talks using transparencies, computers and so on.

Math or Physics?

This is for people who are torn between a research career in math and one in physics.

Nobody can stop you from learning and thinking about both math and physics - you should go on doing both! The real issue is whether you want to work in a math

department or a physics department. It's possible to switch from one discipline to another after grad school, but it's not easy, since departments prefer to hire people with an appropriate degree. So, it's wise to decide which job suits you best before you apply for grad school - if not sooner.

To decide, you need to know how these two jobs differ. For this, it's best to talk to as many mathematicians and physicists as you can, and find out what their jobs are like. Talk to your professors! It's also great to go to some conferences - there's often money for students to attend conferences. I can only summarize:

Mathematicians get promoted by publishing in math journals; physicists by publishing in physics journals. Read both kinds of journals and see which you can best imagine yourself publishing in. Spend time in a good library and browse. I spent my whole undergraduate career doing this! There are some journals at the boundary of math and physics, like *Advances in Theoretical and Mathematical Physics* and *Communications in Mathematical Physics*. Look at these. But also look at a bunch of journals that are full-fledged physics, like *Physical Review* A, B, C, D, and E, and *Physical Review Letters*, or solidly mathematical, like *Annals of Mathematics* or the *Transactions of the American Mathematical Society*. You'll see these come from different worlds! Mathematicians typically write in the definition/theorem/proof style, while physicists write shorter papers, and more of them, often packed with formulas, but usually leaving out all the details of calculations.

Physics is a faster, looser, more energetic discipline. You are also evaluated more heavily on how much grant money you can pull in.

Here's another way to put it: do you like things to be clearly stated in a rigorous way, or do you like to use your physical intuition to get to the answers?

Where To Go For More Advice

If you know an older scientist who has qualities you admire, consider asking them for advice: most people like giving it, though the wise usually wait until they're asked (unlike me). I don't know many written sources of advice for young scientists, but they must exist. Here are three aimed at mathematicians, but surely not completely useless for other scientists:

- Steven G. Krantz, *A Mathematician's Survival Guide: Graduate School and Early Career Development*, American Mathematical Society, Providence, Rhode Island, 2003.
- Steven G. Krantz, *How to Teach Mathematics*, American Mathematical Society, Providence, Rhode Island, 1999.
- Cameron Sawyer, A Timeline for a Job Search in Mathematics, MathDL, 2001.