© 2018. Published by The Company of Biologists Ltd | Journal of Experimental Biology (2018) 221, jeb195958. doi:10.1242/jeb.195958

CONVERSATION

Early-career researchers: an interview with Chris Richards

Chris Richards is a Research Fellow at The Royal Veterinary College (RVC), UK, where he studies the evolution of the frog musculoskeletal system. He received his Bachelor's degrees in Biology and Violin from Oberlin College, USA, in 1998 before completing his PhD with Andy Biewener at Harvard University, USA, in 2009. He then completed an independent Junior Fellowship at the Rowland Institute, Boston, USA, before moving to the RVC in 2014, where he currently holds a European Research Council grant.

Can you tell us about your childhood and how you became interested in science?

I grew up in upstate New York in Poughkeepsie, which is basically a suburb north of New York City, and I think that my love of science came from both of my parents. But it goes back to my grandfather, who trained as a chemist. He lived in the south, in Virginia, in the late 1930s and 1940s. But at that time there weren't a lot of opportunities for black chemists in the US, so he went on to establish the first pharmacy in the area serving the black community; he is a bit of a legend in our extended family and the local community for this accomplishment. His interest in science rubbed off on my father, but in the form of electronics and engineering, so I grew up watching him do electronics and that curiosity rubbed off on me. His goal was to fix things, but my goal was to figure out how things worked. I would just tear apart all of my toys, which drove my parents crazy. So, that's where the mechanistic interest came from.

I grew up watching him [my father] do electronics and that curiosity rubbed off on me

My interest in biology came from my mum. When we were very young she took me and my brother to see the dinosaurs at the National History Museum in New York City. I was so excited, but when we saw them, they didn't really impress me. What made me want to be a biologist was a scale-model of a regular house fly on display in the entrance. You could see all the little hairs and all the details, and I was just blown away that something so small could be so detailed. It looked like the most intricate machine I'd ever seen.

I also had a biology teacher in secondary school, called Mr Jolly. Digital video technology was new at the time, so he would try to show us videos of cellular processes. But sometimes he loaded the wrong one. On one occasion, a swimming cuttlefish popped up on the screen. It just looked so exotic and interesting and I think that that was another moment when a light went off in my head, when I realised, 'Wow, that's really cool. I want to study biology'.

Where did you study for your undergraduate degree?

I majored at Oberlin College in Ohio. It's a small liberal arts college in the US, which is fairly well known for its music. At the time, Oberlin was the only undergraduate university where you could do music and you could major in something else. I have an undergraduate degree in Biology and another in Violin. Music was really central to our lives when I was growing up. My parents took us to violin lessons twice a week for years and I played in a youth symphony orchestra when I started in secondary school; that was a really good experience.

At college, the only challenging thing was scheduling, because the science lectures were in the morning and the lab practicals were in the afternoon, but orchestra was also in the afternoon. Sometimes, I had to knock on the professor's door to ask if I could move my practical class because it clashed with orchestra.

I learned early on that I need to have at least two things going on at once, because if one thing is not going well, then I can switch to the other. Music was very competitive and unforgiving and playing violin is really demanding, so if I had a difficult lesson or there was something I couldn't get, then I could say, 'OK, I'll put that away and I'll go study my organic chemistry'. For me, music and science were complementary.

I learned early on that I need to have at least two things going on at once

Chris Richards works in The Royal Veterinary College, Hawkshead Lane, Hatfield AL9 7TA, UK.
e-mail: ctrichards@rvc.ac.uk

Journal of Experimental Biology (2018) 221, jeb195958. doi:10.1242/jeb.195958

How did you decide which of your two passions to follow?

My undergrad degree was a 5 year programme and I think that I made that decision somewhere in the third year. It was clear that, to excel at the violin, I would have to go into another graduate programme, which would be another 2 years of intense study at a conservatory. I thought that was probably not for me. I also realised that you can do music on the side, but you can't do science on the side. At that time, my biology advisor was Yolanda Cruz; she was an incredible teacher. She told me that it's possible to continue in science and get a PhD and I thought that sounded cool. Once I made that decision, my violin playing improved; it was like lifting a weight.

How did you pick up enough research experience while you were at a liberal arts college to progress on to graduate school?

When I was a sophomore (second year), I found a programme that was based at the University of Arizona doing plant biology. At that time, I was interested in molecular biology. I thought that working on plants would allow me learn the techniques for molecular biology. There wasn't a lot of competition to get into that programme, so I went and it was super fun. I was initially there for a 4 week project over the winter and then they invited me for a longer internship over the summer. That research experience got me started and I was able to put it on my CV to get further experience.

Another thing that can be helpful when you're trying to build experience is volunteering in a lab if you have a little bit of flexibility. Most professors are happy to have the help. I did that once. My brother was doing a PhD in chemistry at Berkeley. I had a winter break of a month and I decided to stay with him, so I wouldn't have to worry about housing. I sent some cold emails to PIs in Berkeley asking if I could volunteer and one invited me to join his lab for a month, because I didn't need any financial support.

I sent some cold emails to PIs in Berkeley asking if I could volunteer and one invited me to join his lab for a month

How did you make the transition from being an undergraduate to doing a PhD?

That was a little bit round about. After doing several courses at Oberlin, I realised that I was interested in the whole animal rather than just the cellular stuff. David Egloff, my undergrad invertebrate biology professor, suggested that I went to Friday Harbor Laboratories, where I took marine invertebrate and invertebrate embryology classes. We spent a lot of time observing living animals, watching them behave. I remember asking the professors, 'How are they turning? How are they propelling themselves?' and they said, 'First of all, I don't know. Second, it's not known.' I thought, 'How could this be? It's so basic', and that's where the biomechanics came in.

At that time, I was looking into the handful of programs in the US where I could study invertebrate biomechanics, but they happen to be at universities that are very hard to get in to. I applied but I didn't get in; my test scores weren't good enough. That derailed me a bit. Then I did a muscle physiology class during my last semester. The professor, Taylor Allen, said, 'Well, you got knocked back, but I have a colleague in Cleveland who needs a technician. You might consider working for him for 2 years', which is what I did. That was really good experience and the key for me getting into good programmes. I got my name on a paper. I also spent some money and took a class to learn how to take the tests, which I retook and did well. Then I did another 2 years in Boston, working as a lab technician doing gel electrophoresis, before I reapplied to graduate school. By then I had a lot of research experience and a publication, so I got in everywhere that I applied. I decided to join Andy Biewener's lab at Harvard, but I didn't work on invertebrates. One of the best bits of advice I got was from David Egloff. He said, 'Go to the best muscle lab or biomechanics lab that you can find'. In other words, learn that first and then if you want to work on invertebrates, you can do that later. The intention was to eventually work my way to invertebrates, but that has not happened and it probably won't.

How did you end up at the Rowland Institute?

Andy suggested it as a possible option. Early in graduate school I had needed a lot of mentorship from people in the lab who taught me basic muscle techniques, how to set up an experiment and record data, and how to process and filter signals. By about my fourth year, Andy was happy with the direction that I was taking and he felt that I was very independent. He suggested that I try for a Rowland fellowship. At the time I wasn't having the best of luck looking for other postdoc opportunities, but luckily I got a Junior Fellowship. They are like mini-faculty positions, but the Junior Fellows do not teach, cannot have PhD students and are only on 5 year contracts.

[Andy] felt that I was very independent. He suggested that I try to go for a Rowland fellowship

The experience was incredible. The fellowship provided my salary and start-up money, which included funds for a postdoc as well as equipment. It was more than enough for my own biomechanics/physiology work; the costs of high-speed cameras, muscle physiology rigs and consumable supplies are almost negligible compared with some of the equipment the other fellows needed. And I was super lucky because Chris Clemente applied to work with me and he was amazing. I had the ideas from a muscle physiology and engineering stand-point, and his biology ideas helped us basically to keep everything in a biological context. I also had another great postdoc, Angela Rivera. She came after Chris and helped to develop a really cool muscle prep where we stimulate two antagonistic muscles to control a robotic frog foot.

In a way, I was isolated in the Rowland Institute, because there was a heavy physics bias; I was the only person working on organismal biomechanics. But, it was also really helpful, because I was surrounded by physicists and engineers and mathematicians. The Acting Director, Mike Burns, is an amazing physicist, so I would go down to his office and ask him math problems and he would just fill out the board with the equations. I was lucky to have access to incredible resources.

How did you transition to where you are today?

That was very hard. My wife, who is also a biologist, is originally from Portugal and we were in Boston together. We had decided a couple years before that we wanted to look at Europe, so she could be closer to family. Realistically, the options were Germany and the UK. I knew about the Royal Veterinary Collage and Alan Wilson, who is a professor there, and it sounded like a good place to look into. I basically asked Alan how I would come to the RVC and he said, 'If you get money, you can go anywhere'. So, I applied for a

Journal of Experimental Biology (2018) 221, jeb195958. doi:10.1242/jeb.195958

European Research Council starting grant, which was a lot of work, and I got 5 years of funding until February 2019.

It sounds like we were lucky ending up in the same place doing good things, but the reality is that we had to be patient. Sometimes, you have to accept sacrifices in the short-term. My wife had to move a year and a half before I was able to come to the UK. She applied for a temporary position at the journal Nature in London for 6 months and got it. At the end, she was offered a permanent position as a manuscript editor at Nature Communications then later at Nature Ecology & Evolution, but I didn't have any prospects at the time, so I said she had to take it, and we'd see what happened with my applications. There were sleepless nights for a while.

The reality is that we had to be patient. Sometimes you have to accept sacrifices in the short-term

How will Britain leaving the European Union (Brexit) affect you?

It means that there is currently a level of uncertainty in our lives. My wife is European, so her status is going to change after Brexit and we are not sure what that is going to entail. At the moment, we are going through the application process for residency for me through her. We are trying to do that before Brexit, because afterwards we just don't know what is going to happen. So far, it has meant filling out a bunch of forms and then sending off my documents. The hardest thing is not having my passport. The process can take up to 6 months. It should be fairly straight forward because we both have jobs, we are married and we have a child who was born in the UK.

What would you say are the 'hottest' methods in your field at the moment?

Definitely XROM (X-ray reconstruction of moving morphology). It is the biggest advance in my opinion since Muybridge did high-speed video in the 1800s. It's not necessarily a new method now, but I think that it is really hot. From a vertebrate point of view, being able to see the bones moving is so crucial. You can also implant markers in the muscle and tell how the muscle is shortening. It basically allows you to answer questions that we haven't been able to answer before. We are starting to use it, but it is hard to do on small animals. Last week, we managed to get our first frog experiment to work.

There is also another technique, but this one is so new that I don't know if it has a name yet. It has come out of Greg Sawicki's lab. It's a new approach to measuring muscle fibres contracting against a load. Greg and Ben Robertson have created an electronic simulation of the animal body and limb that applies a load to a muscle, such that the muscle 'feels' resistance according to the mass of a simulated body and the leverage of the limb joints. My group is currently working on improving the technique.

How do you think your interest in music has influenced your science?

To be a musician, you have to have a thick skin to take harsh criticism. From a very young age, you are ranked very visibly when you play violin; the closer you sit to the conductor, the higher your rank. It is very clear to the audience. I think that builds character. But I think most importantly I learned discipline. If you try something and it doesn't work, just keep on trying and improving incrementally. The key is don't repeat mistakes. I practise my presentations in the same way. Sometimes, I find it difficult to fit everything into 15 minutes at the Society for Integrative and Comparative Biology meeting, so I spend literally hours practising the talk. I just keep looping and asking, 'OK what did I do wrong? Let's improve that'. In music, we call this type of practice 'passage work', so I do passage work.

Most importantly I learned discipline

How do you and your wife juggle child care?

That is the nice thing about being an academic; the job is a little more flexible since I am not teaching at the moment. When our daughter is sick, one of us stays home with her one day and the other one stays home the next. Generally, that means one of us will have to work in the evening as well. When I was working on my grant proposal, that was very hard. I had to ask my wife to do more of the child care so that I could work at the weekend and late at night, but I try to make up for it when I have periods that are less busy. Also, my wife goes to 2–3 conferences a year, so we have to decide which conferences we are going to and make sure that we are not double booked.

If you could have dinner with anyone from history who would it be?

Mozart; apparently he had music running in his head all the time. I would ask him about that, what his process was, because, apparently, he could conceive a symphony as a whole. I would want to know, 'Do you just hear it as a whole then figure out which instruments make that sound you hear, or do you come up with the melody and then figure out what goes on behind the note?' My impression is that he heard the entire wall of sound and he had to take dictation from what was inside his mind. There is so much I would love to ask him.

Chris Richards was interviewed by Kathryn Knight. The interview has been edited and condensed with the interviewee's approval.