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CONVERSATION

Early career researchers: an interview with Lauren O'Connell

Lauren O'Connell is a Bauer Fellow at Harvard University, USA, where she studies genetic and environmental contributions to behaviour and physiology in poison frogs. She received her Bachelor's degree in Biology from Cornell University, USA, before moving to the University of Texas at Austin, USA, for her PhD in the laboratory of Hans Hofmann, which she completed in 2011. O'Connell received a L'Oréal USA For Women in Science Fellowship in 2014 and was recognised for her outreach work by L'Oréal USA in 2016.

How did you become interested in science?

I first became interested in science because I grew up on a working farm with animals, which introduced me to animal behaviour and genetics. I didn't realise that working outside with animals could be a professional career (apart from farming) until much later when I was in college and I was exposed to scientists researching wild animal populations.

I went to a community college after high school. In the USA, a community college is a local 2-year school and it is much cheaper than university. I come from a family with six kids and my parents didn't have the money to send everyone to college, which is very expensive in the USA. I did my first 2 years of study at Tarrant County College so that I could stay and help my family work on the farm in Texas. After that, I transferred to Cornell University, where I studied neurobiology and behaviour. I applied with no expectation of getting in, but to my surprise I was accepted and then uprooted myself from my comfort zone on our farm and moved to New York.

How did you identify the topic that you wanted to work on for your PhD?

I originally went to Cornell to study biochemistry, but then I saw that courses in neurobiology and behaviour looked much more interesting, so I started interacting with faculty through these courses. Then, I realised that a lot of people study neurobiology and animal behaviour in natural settings – especially at Cornell, which is a home of neuroethology – so I decided that I wanted to study animal behaviour from a mechanistic perspective.

After my undergraduate degree, I went back home to Texas, to the University of Texas at Austin, to pursue a PhD with Professor Hans Hofmann studying social networks in cichlid fish communities. What I like about the cichlid model is that you are able to study community dynamics within a controlled lab setting, but you are also able to follow up with field observations as well. The project offered enough control to be able to really study the system in the lab, but then it has a lot of implications for ecology and evolution as these animals behave the same in the lab as they do in the field.

Where did you go after completing your PhD and why did you go there?

After my PhD, I decided to do an independent postdoctoral position as a Bauer Fellow at Harvard University. These independent fellowships allow you to address a really novel question that no one else works on. You are given the resources, both financial and technical, and a supportive community to pursue risky science. I think these positions are really important because if you are young and have a new idea, it is very difficult to get funding. You either need preliminary data to apply for grants or you have to get a new job with start-up funds. Moreover, it would be very difficult to get a job if you have never worked on this question or organism before. These kinds of independent fellowships are like innovation hubs where young people can address totally new questions in science with a lot of support.

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The director of the programme, Professor Andrew Murray, gave a seminar at the University of Texas when I was a graduate student. He had lunch with the grad students where he told us about the programme. At the time, I wanted to study the evolution of parental care. I thought parental care was a really interesting question because it is considered the antecedent to social behaviour in many taxa, but I was not satisfied with many of the animal models at the time. In many taxa, especially in mammals, paternal care is coupled to pair bonding, where mothers are usually involved along with

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fathers. What I wanted to do was take a comparative approach with an animal clade that had a lot of variation in reproductive strategies, where I could study parental care independent of pair bonding. Poison frogs are one of the few clades of animals that show diversity in reproductive strategies within closely related species. I wanted to study the neural mechanisms of parental care and determine how these mechanisms have evolved to give such diversity in reproductive strategies. At the time, no one did neuroscience work with poison frogs and so there was nowhere for me to postdoc to pursue this question. I needed some type of independent position that had funds and a molecular lab.

As Bauer Fellows, we get formal mentorship through a committee of Harvard faculty that we meet with formally once a year. I also meet with Andrew Murray every 2 months. There are also many other structured activities for the fellows. It is very important that there is a community of fellows we can collaborate with and talk to as independent positions bring a unique set of challenges.

Why is science outreach important to you?

I was never exposed to science, or science as a career path, until it was very late in college and so doing outreach is really important to me because it lets students know that these types of career paths are open to them; that you can have a job walking around in the rain forest collecting frogs. Also, I didn't meet a woman who had a PhD until I was in college. My introductory biology teacher, Professor Jean de Schweinitz at Tarrant County College, was the first woman I had met who had a PhD and had done research. I think having diverse mentors changes students' ideas of what a scientist looks like. If you ask most school children to draw a scientist, they draw an Einstein-ish figure: an old white guy with crazy hair. Outreach especially allows women and minorities to understand that they too could be field scientists or bench scientists. Also, most students don't know that you get paid to go to graduate school [in the USA], which is different to medical school. This opens up more opportunities for students from low socioeconomic backgrounds to come into science, which is very important.

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Tell me about your Little Froggers outreach programme

The real excitement about science is discovering something that no one else knew before, so I wanted to bring that excitement into public [state-funded] school classrooms. We place frogs into public school biology classrooms in glass terraria. We typically give them frogs that are bright blue because students are naturally drawn to these charismatic animals. I have also written curricula, developed in collaboration with high school and middle school science teachers, which allow them to integrate poison frog biology into teaching on evolution, ecology, animal behaviour and development. For example, if they are doing a development module, we give them a tadpole that will undergo metamorphosis during that module and the students can observe a tadpole becoming a little froglet. We started out with two schools: one school is a suburban high school, about an hour outside of Boston, and the other is an ethnically diverse inner city school.

I also have two full-time high school biology teachers in my lab during their vacations as part of this collaboration. With them, we are trying to figure out how habitat quality influences poison frog toxicity. Poison frogs get their toxins from their diet of ants and mites. Over the summer, these teachers worked full time in my lab and discovered that the frogs in high-quality habitats have more toxins than frogs in low-quality habitats. We took the frogs' stomach contents and gave them to the high school students to dissect and classify prey items to determine dietary differences in frogs from different habitats. We helped them isolate genomic DNA and do PCR for the DNA Barcode of Life, so that they could identify these ant species. Recently, the teachers conducted field studies in Ecuador during their spring break, where we collected the ants identified by their high school students for chemical profiling. We are integrating this chemical analysis into their spring semester so high school students can determine which frog toxins come from which ant species.

In 2014, you won a L'Oréal USA For Women in Science Fellowship and you also won a Changing Face of STEM Mentorship award in 2016; can you tell me about the fellowships and how they have contributed to your career?

The L'Oréal USA For Women in Science Fellowships really fulfil a dire need for women in science who are on a training path. Many women fall out of the leaky pipeline during their postdoc years when they decide to have families or pursue careers outside academia. I think that the L'Oréal USA For Women in Science Fellowship is really game changing because it gives you funding during a critical time in training, either for science or your salary. For example, in my award year, four out of five of us were young mothers who were looking for extra funds for more experiments or a salary for an additional year to be competitive on the job market. With the money the fellowship gave me, I was able to start a whole new research programme in my lab about poison frog toxins. The L'Oreal USA For Women in Science funding allowed me to get preliminary data and then my first federal grant.

The L'Oréal STEM mentorship award allowed me to expand our Little Froggers programme into eight new schools, including two all-girl schools, a couple of special needs' classrooms and four classrooms in low-income districts in Boston. The most expensive part of the Little Froggers School Program is the terrarium and all the stuff that goes inside to make the frog happy. A lot of things that are enriching for students are not part of the normal classroom supply list and come out of teachers' pockets, which really limits the scope of our programme, especially in low-income districts where teachers are already strapped for cash. The fellowship allowed us to buy all these materials – the frogs, the tanks and 5 months supply of frog food – for the teachers.

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What do you think are the main challenges faced by women in science and how do you think they can be tackled?

I think a major problem for women and under-represented minorities in science is implicit or subconscious bias. It is not intentional, but everyone has some implicit biases. Women and under-represented minorities get affected by these implicit biases

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and the choices that are made, such as who to invite as a plenary speaker at a conference or who you want to collaborate with or the person you hire. A lot of organisations now require implicit bias training, which I think it is a great step forward, because the first step towards fighting implicit bias is to recognise that you have it.

Harvard has a website called implicit.harvard.edu and there are many tests that you can take for determining your implicit biases. Implicit bias training should be required for people in leadership roles. I was at a L'Oréal event in the last year, talking with NIH and NSF directors where they were also looking at incorporating implicit bias training for federal grant awardees.

You attended a JEB symposium in 2016, on the Evolution of Social Behaviour; what was your experience of the meeting?

I really liked the JEB symposium. It brought together different people who worked on different animals at different levels. We probably wouldn't attend the same conferences, so it was a great networking opportunity to meet people who thought about animal behaviour in different ways and on different scales. I was on the job market this year and the JEB symposium was an important meeting for me because I ended up getting interviews at some of the universities represented at the symposium. It also gave me a lot of important contacts with experience who I can ask for guidance.

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Do you use preprint servers, if so why and what impact do you think they will have on research?

All of our papers go on preprint servers. I think they are really valuable, especially to young scientists who are in the transition zone – going up for jobs, or applying for grants and fellowships – because publishing a paper can take a year or two, going through peer review and several rounds of revision. It is a way to get early feedback from the scientific community and it allows you to show that you have been productive – that you have finished this project or you know how to use a technique – and you can reference it, so it is early proof that you are a productive scientist before the paper comes out.

We have had useful feedback where members of the scientific community have discussed our preprint at a lab meeting and then sent us the comments, which has been extremely helpful because we were able to incorporate not only the comments from the peer review process but also from the people who actually care about our work.

Here is an example of why I really like preprint servers. We published one of our preprints about the genetic structure of a frog in Ecuador on bioRxiv and we got an email from an Ecuadorian student whose Master's project was about the genetic structure of these frogs; we had reached the same conclusions. They had used different techniques and fewer populations than we did, but the preprint allowed us to pool our data rather than having one group scoop another. We were able to combine our data sets and publish one paper and that could only happen on a preprint server.

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How do you think peer review can be improved for the 21st century?

This is a really complex question. I absolutely believe in the peer review system, it improves your paper and its readability; papers usually come out better on the other side of peer review. One of the new things is signing reviews, which I think makes reviewers a little more tempered. But I have heard concerns from others where they think that signing a review puts them at risk from people who might retaliate. I also think that being blind to the authors is useful; there is a bias that negatively affects young researchers where very senior people who are well known may have an easier time publishing papers in top journals. I like the eLife model (where the referees get together and discuss their comments and produce a single report) because it gives you a focused task list that distils down what you really need to do, versus all those tiny comments that one reviewer might want.

Where is your favourite field site and why?

We have this field site in the Andes in Ecuador, which is called Otokiki and is named after the frogs we study. It takes 2–3 days to get there and we camp in the middle of the Andean cloud forest and stay with local people. It is not reachable by road and it is pristine forest, of which there is not much left.

All of our field work in Ecuador is done in collaboration with local scientists at Centro Jambatu de Investigación y Conservación de Anfibios. They knew the frogs in this particular location are quite variable as each frog has a different colour or pattern. This is confusing because most poison frog populations agree on a specific colour or pattern and then they all use that colour or pattern to advertise that they are unpalatable to predators and so, in theory, you don't want to vary that pattern, because predators might not learn to avoid you. This population was a mystery to us and so we began a collaboration to try to figure out what was going on. I believe it is critical to collaborate with local scientists in international field work.

Lauren O'Connell was interviewed by Kathryn Knight. The interview has been edited and condensed with the interviewee's approval.