

INTERVIEW

Transitions in development – an interview with Marie Monniaux

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Marie Monniaux is a permanent CNRS researcher in the 'Evo-devo of the flower' group at the Laboratory for Plant Reproduction and Development (RDP) at the École normale supérieure (ENS) in Lyon, France. Marie uses *Petunia* to understand the development and evolution of the flower petal. We met Marie over Teams for a virtual chat about her career path, finding a permanent position and her ideas for the future.

Let's start at the beginning: when did you first become interested in science?

I come from a family of scientists. My mother was a researcher working in cattle reproduction and my father was a biology teacher. So I grew up in an environment where it sounded almost normal to become a scientist but, when I was a kid, I was not particularly passionate about science. I had a lot of different interests, like kids do: watching TV, playing video games, reading, playing the piano...stuff like that. I actually liked animals and I wanted to be a vet at first. Then, when I was in high school, I continued towards the more scientific path because for me it was the standard path. I went to the 'classe préparatoire', which prepares you to join engineering schools. I then joined the ENS, which trains students to become researchers or teachers. When I joined the ENS in Lyon, my studies became more focussed on biology, and we could choose the lectures we wanted to attend; I was not so interested in immunology or virology – anything that was a bit medical. I liked development from the beginning, and I think this was when I became deeply interested in science, because the lectures became more and more interesting. I remember I had an evo-devo course and I was like, 'Wow, this is great. This is so interesting!' It came with so many new concepts; things that I had never heard about before. I think it was at this point that I realised I really would like to do this kind of research. Also, at ENS, we had the opportunity to do a lot of research internships. I did four of them during my studies, in different labs. I tried a bit of mammalian biology, but then the other internships were all on plant biology.

What was it about plants that captivated your interest?

I think it was more evo-devo as a field that captivated me. I turned to plants, and I think it is common for plant biology scientists, because I didn't want to experiment on animals. That was the initial motivation, but, at some point, I thought plants were a great system to tackle many things. They are a very good model for evo-devo, there is a tremendous diversity in their morphologies (particularly in the flower) and you have basically no ethics restriction, so you can have more freedom to experiment with plants than in animal biology.


Could you tell me the reasons behind obtaining your teaching qualification?

Yes, I got an agrégation, a qualification to become a secondary school teacher. It's part of the ENS training, but you're not obliged to do it. I was interested in teaching, although, of course, I had never taught before. I also knew that research was difficult, so I thought that it would be good to have a solid backup plan: if I couldn't make it in research, then I could teach (although it is not extremely easy to get the agrégation either). In the end, though, I never really used it. In France, you can decide to do some teaching during your PhD, 64 hours of teaching per year, which can give you a good impression of whether you like it or not. That's when I realised that it was not for me – I wasn't having so much fun doing it and I don't like being at the centre of attention. I realised that I was much happier in the lab than in the classes, but I'm really glad that I did it anyway. I still try to engage in a bit of teaching or outreach events, because I think it's extremely important. I truly admire the lecturers because it is a difficult job, and not always very rewarding, but they can make a great difference with students – as they did for me!

You then moved to the Laboratory for Cell and Plant Physiology in Grenoble, France, for your PhD studies. Why did you decide to go there and what did you research for your PhD thesis?

I went there because my future PhD advisor, François Parcy, gave a lecture at the ENS when I was a student there. He presented on floral development and regulatory networks (interactions between transcription factors and binding sites). I liked very much how he

Reviews Editor, Development

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presented things, and it was also something that I had not heard about before, because there was a strong biochemistry approach. François is really enthusiastic when he talks about science. I went to visit the lab and you could see that he was so passionate about what he was doing – I think that's how he got me! At that time it was still a small group, which I think I've always liked in a way, because I feel that it's easier to discuss things with members of the group. All of this convinced me to join this group.

I was working on the evolution of LEAFY: a key transcription factor for flower development. I was studying the evolution of its function and its DNA-binding specificity, in particular. It's a gene that didn't multiply during evolution so, from green algae to flowering plants, there is generally only one copy. But the function of LEAFY has changed quite a lot, because, of course, there are no flowers in algae. So, a lot of regulatory targets have likely changed, and we could see that the binding specificity of LEAFY changed. We could identify this change during evolution by a transient 'relaxed' state of specificity (Sayou et al., 2014). The project was mostly biochemistry, and some bioinformatics to try to predict targets of LEAFY in the genome.

You then went to the Max Planck Institute in Cologne, Germany. How did you find the transition moving from France to Germany?

It was not a great jump into the unknown because, culturally, Germany is not far from France. French people usually do their PhD in France, move abroad for their postdoc, and try to come back to France to get a position. It's not at all mandatory to move, but it's a path that many people follow. I started to learn German about 6 months in advance, so I knew a couple of words at least. I then continued to learn while I was there but, combined with the transition to another country and lab, I was struggling. People speak English at the institute, so that was okay, but just those first few weeks, when I had to open a bank account in German, for example, were a challenge! That said, having experience abroad is really great; it allows you to see how science is done in other countries, which can be really different in terms of positions or funding.

Was that one of the appeals for you to move there in the first place?

I had to decide with my partner to move together to a place where he could also have opportunities, because he's a researcher in mathematics. When I started looking, I really wanted to join Angela Hay's group, but she was in Oxford in the UK at that time. I knew that my partner didn't have so many opportunities there, but he had opportunities in Germany. Somehow, I learned that Angela Hay's group were going to move to Germany, which was perfect! So I got in touch with her and visited the lab. Angela's lab was very small at that time (two post-docs and one technician) but, as I was saying, this has always been a positive thing for me. One great thing at the Max Planck is that it's relatively easy to get starter funding for postdocs (for one year or so, before securing your own funding) so it worked out well. Cologne is a prestigious place for plant biology with lots of great speakers invited all the time, so I think it was a real career boost moving there.

What did you work on while in Angela Hay's group?

I was still working on flower development, but I started studying a species called *Cardamine hirsuta* (hairy bittercress), which is close to *Arabidopsis*. It has flowers with a variable number of petals, which means that on the same plant, flowers can have between zero and four petals. We wanted to understand what happened during

evolution between *Arabidopsis* and *Cardamine* to make a trait that's ancestrally robust become variable, involving investigations into the genetic, developmental and evolutionary basis of it. In particular, I did a lot of genetics and transgenics to look at the expression of reporter genes during petal development. We identified a regulatory change in the gene *APETALA1* that was responsible for decanalisation of petal number robustness (Monniaux et al., 2018). There was another postdoc in the lab using a quantitative genetics approach, so I got to learn about that (something I had absolutely not done before). It was quite a broad project and I could decide the direction in which I wanted it to develop – depending on what would work, of course!

At what point during your postdoc did you make the decision to look for permanent positions? How does a permanent researcher position differ from a group leader position?

I knew from my PhD that I wanted to try to get a permanent position. In France, we call them researcher positions, which are permanent positions usually within a group that already exists with a group leader. As a researcher, you join with your own project and you are a principal investigator. You can have students and postdocs working on your projects but most of the time, administratively, you're not the head of the group. At some point, you could choose to become head of the group (in France this is pretty flexible and group leaders tend to change over time) and you could also try and become a research director – but you don't necessarily have to.

I started to apply for positions two years into my postdoc. I applied to the CNRS (Centre national de la recherche scientifique) and INRAe (Institut national de recherche pour l'agriculture, l'alimentation et l'environnement), and for lecturer positions. I actually applied for an INRAe researcher position at the RDP lab – where I am now – but in a different group. This position had a precise profile about modelling hormonal networks in the shoot apical meristem; something that was not really my specialty. Still, it allowed me to get some experience of how an interview could go. I kept applying for another two years: I applied each year for CNRS researcher positions and I got one the second time.

The great thing about this job is that you can really adapt it to your ambitions. I think this is a great position if you don't necessarily want to be a group leader, which comes with a lot of administrative tasks and requires managing people. It also relieves a lot of pressure to have this permanent position, because you don't have to publish within two years or so. Of course, it's expected that you're still active in publishing, securing funding and supervising people, but there's less short-term pressure. Lately, the number of positions has been declining, more or less every year. Competition is incredibly hard. It's painful to see all those brilliant young researchers in the lab that would like – and have the skills – to stay permanently in science but fail to get a position.

How did you determine which position would be a good fit for you?

Of course, it needed to be related to my scientific expertise. I was hoping to keep this evolutionary aspect that I really like, but I was also realistic that I couldn't hope for the dream job. I was also applying for jobs that didn't exactly fit to my interests, because I think you can always manage to change or adapt to the position. The positions that I have now (CNRS research positions) are not positions with a precise profile; you create a research project from scratch to join a particular group and you can make a project that will fit your skills and interests. I was lucky enough that it worked.

There were also personal matters, of course. My partner had a position in Dijon but there was really not much for me there. In Lyon, about two hours away from Dijon, the RDP lab is really famous for development and I wanted to keep the evolutionary aspect, so I joined the group of ‘Evo-devo of the flower’. Part of the group is working with *Petunia* and I thought that it would be great to have this new model system that is not so widely used. It’s a historical model for petal pigmentation in particular, but there’s still many biological questions to tackle with this model, such as those related to floral morphology.

Do you have any advice for people that are looking for positions like yours?

You have to know that it’s difficult, so keep in mind that maybe it’s not going to work, but try as soon as possible – even if you don’t feel ready for it. In the best case, you will have an interview and it will be excellent practice. Also, don’t only apply for the dream job because there’s a high chance that you won’t get it. Apply to many different things, even if the job description is not exactly what you would like to do. I think you can always manage to do exciting science in any kind of position. Also, I know that people in research can feel guilty if they don’t work 60 hours per week. Just keep in mind that you can be a successful scientist, even if you work normal hours, and even if you consider science as a normal job – you don’t need to be absolutely passionate about it and think about it all the time! That is my case: I love my job, but when I come home, I have no problem disconnecting completely from work.

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What is your research project and how did you carve your niche?

It’s really difficult to carve your niche of research, actually, and it is still in progress for me. I contacted Michiel Vandenbussche, the head of the evo-devo group in the RDP lab, to say that I was interested in joining the group. I explained that I wanted to continue working on flower evo-devo and I proposed a few general topics, but I had nothing precise in mind. Michiel just said something like, ‘Well, if you want, I have a perfect project for you’. He had found, some years ago, some particular mutants in flower morphology that looked pretty exciting, but he never had a chance to continue working on them. We didn’t know much about these mutants at the time, so at the beginning the project was a bit vague, but over the years it’s become more precise. We have found that these mutants are actually coming from the source of expression of a petal-identity regulator (the MADS-box gene *PhDEF*, a B-class gene specifying petal and stamen identity), specifically in one layer of the petal, which is made of epidermis on the outside and mesophyll inside. When *PhDEF* is expressed only in epidermis, it only drives development of the pigmented parts of the petal (the limbs), whereas when it is expressed only in the mesophyll, it drives development of the tube (Chopy et al., 2021 preprint). So, you have this role of the different cell layers in morphogenesis of subdomains of the petal, which is really cool. It’s something that had been observed historically before in snapdragon flowers (*Antirrhinum*), which we could reinterpret with our *Petunia* flowers. So now I am

asking how cell layers participate in building up a complex organ, using the *Petunia* petal as a model.

How did you go about establishing a supervisor-mentor relationship?

I am really new to supervising, because my PhD student only started one year ago and I only had a short-term research engineer before that (plus a couple of undergraduate students over the years). I’m trying to learn about it. I try to take into consideration the personality of the person that I’m supervising, and to take into account that not everybody necessarily wants to be a researcher. If a PhD student comes and just wants to do a PhD, but he or she doesn’t know what they want to do after, and maybe they’re not as passionate as I am about the biological question but more about technical aspects, then it’s fine and I just have to design the PhD so that it fits both our interests. Maybe I’ll think differently in 10 years – we’ll see!

Have any mentors been instrumental to getting you where you are now?

I was pretty lucky that all my supervisors were very supportive. I was trying to think about what good mentorship qualities are, and I couldn’t manage to find any. It’s not because there are none, but I suppose it’s because I always had good mentorship, and it’s only when you don’t have this that you realise what you’re missing. Overall, I’ve been lucky that the environment was supportive in general and that I always felt integrated into the scientific discussions and encouraged to attend conferences, and my supervisors generally cared about my scientific future.

Recently, you’ve also sat on panels and committees. What has that experience been like?

Last year, I was asked to review a research unit for the German Research Foundation (DFG). It was the very first time I was taking part in a panel and I had to co-review three projects. I was quite happy that people asked me to do that, but also extremely nervous. The people who run the projects were people from my field that were middle or late-career researchers, who I had known (from conferences) since my PhD; I was not feeling scientifically mature enough to evaluate this! But, I think it went well and I was happy to see how it works. The whole panel did an excellent job in evaluating the projects with solid scientific arguments but also taking into account the human part of it, so that reassured me on how these kind of evaluations are running.

This year also, I took part in the CNRS researcher selection committee, selecting for the same position that I got four years ago. It was extremely interesting, but it’s also exhausting; it’s a full week while you evaluate research projects, something like 45 in total and I was assigned five of them to review in detail. There were only four research positions, and all the candidates were excellent. It’s extremely interesting, scientifically, and you also learn a lot about how things work and what you should put forward in your proposal or your CV when you’re applying for grants. It’s very frustrating also, because you get attached to the candidates whose project you are reviewing, so you almost feel like you are letting them down when in the end, they don’t get the position.

Could you tell me a bit about the outreach activities that you’ve been involved with and why you think outreach is an important part of being a scientist?

I started during my PhD. I was taking part in Fête de la science, a national event that takes place in France every year in the autumn.

Every lab can prepare an exhibit where you can perform small experiments, whatever you want, either for schools or for a general audience. It's very rewarding because people that come are generally excited about science and you can have stimulating discussions. I also did some presentations for high school students about research, to try to explain what research is and what we actually do every day in the lab. At the RDP lab, many people are very active in these outreach events, so it's quite easy to be involved in it if you want. Of course, it's very important. With all the fake information circulating everywhere, it's important to show what research and the scientific method really are, what we try to answer and why, and that we are not all bad scientists working for companies that want to make money.

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You are also a representative for gender equality. How did that come about?

Legally, there has been a decision from the government that there should be an equality plan in all public organisations, so the CNRS has asked all the laboratories for gender equality representatives. I, together with another colleague, decided to take part. It has been very interesting. We organised a seminar for the whole lab about the gender biases in science, including what we could see in our labs. For instance, we do not have a lot of female research directors or group leaders, while we have more or less 50% of men and women

at the PhD level, so the gap gets bigger and bigger after the PhD. I like to think that we have managed to raise awareness in the lab, and I have the impression that now people are questioning the gender equality problems. I was happy to see that all the members of the lab were generally receptive and ready to discuss it. Not everybody agrees, of course, so it's hard to come up with real solutions – that will be the next step!

Is there anything that Development readers would be surprised to learn about you?

We have discussed how I didn't always consider science as a career but, actually, I still have alternative life plans. First, I play the piano. When I was in high school, I seriously considered playing music professionally, such as becoming a music teacher. I still have this as a backup plan. The second is a plan with my partner. We thought that if we are fed up with science at some point, we can just go somewhere remote, like Scotland or Iceland, and then just open a cafe and lead a completely different lifestyle. That's the dream that I keep in the back of my mind – just in case!

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