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CELL SCIENTISTS TO WATCH

Cell scientist to watch – Britta Trappmann

Britta Trappmann studied chemistry at the University of Dortmund, Germany. She then moved to Cambridge, UK, for her PhD (2007–2011) with Wilhelm Huck and Fiona Watt, where she discovered that stem cell fate is regulated by extracellular matrix tethering. For her postdoc, she joined the lab of Christopher Chen in 2012, first at the University of Pennsylvania, USA, and then at Boston University and The Wyss Institute for Biologically Inspired Engineering at Harvard University; there, by developing *in vitro* models, she investigated how cells sense stiffness and also identified material properties that impact angiogenesis. In 2016, Britta became a group leader at the Max Planck Institute for Molecular Biomedicine, Münster, Germany, where her group studies how interactions between cells and their surrounding extracellular matrix regulate cell and tissue function.

Britta Trappmann (image credit: J. M. Tronquet).

What inspired you to become a scientist?

In high school, I took part in the German national selection for the International Chemistry Olympiad and attended a one-week workshop to prepare for it. The training was run by PhD students and they also gave us an insight into their research projects, which I thought was really exciting! I later went on to study chemistry at university and then did two internships in the R&D department at Bayer, where I was hosted by a lab that focused on the development of blood sugar test strips. That was the first time I realised that, as a scientist, you can really have an impact and improve the lives of people. So, I think these two experiences inspired me to pursue a scientific career.

After being trained as a chemist, how did you benefit from having two supervisors, Wilhelm Huck and Fiona Watt, during your PhD?

I actually started my PhD exclusively in the lab of Wilhelm Huck and worked on a very basic polymer chemistry question during my first year, but this didn't truly excite me. Then, a postdoc in my lab started a project, in collaboration with Fiona Watt, which focused on the generation of micropatterned surfaces to control stem cell fate. Having always been interested in applied polymer chemistry, I got extremely enthusiastic about this and asked my supervisor if I could switch directions and get involved. Since there were many open questions, both Wilhelm and Fiona agreed, so I started working part time in Fiona's lab. The guidance of two supervisors from very different fields then really enabled my next steps to move towards biomaterials designed for three-dimensional (3D) cell and tissue culture during my postdoc. I have to say that I am very grateful that Fiona invested in me as a chemist with zero experience in cell biology, and I was also very fortunate that a technician and postdoc in her lab, both of them extremely knowledgeable and patient, taught me how to work with stem cells.

What questions are your lab trying to answer just now?

Our overarching aim is to understand how biochemical and mechanical properties of the extracellular matrix (ECM) regulate angiogenesis. We are taking a highly interdisciplinary approach and combine mechanistic cell signalling studies with novel biomaterials chemistry and also platform engineering. We've recently developed the first biomimetic model that captures the most important steps of chemokine-guided angiogenic sprouting in synthetic hydrogels *in vitro*.

Could you give us some more insight into what hydrogels are and how they can be used in tissue engineering?

Hydrogels are 3D polymer networks that contain water. The polymer can be of natural origin, for example, composed of ECM proteins, such as collagen or fibrin, or it can be completely synthetic. We use synthetic hydrogels composed of methacrylated dextran, a protein-resistant and cell-inert polymer backbone, which can be crosslinked with matrix metalloproteinase (MMP)-cleavable peptide sequences. This renders the hydrogel suitable for 3D cellular remodelling. By tuning the concentration of these MMP-cleavable crosslinkers, we can change matrix stiffness, a property known to regulate cell function. Furthermore, we can couple different adhesive ligands involved in integrin signalling to the dextran backbone in different concentrations. Importantly, all such parameters can be independently tuned in synthetic hydrogels – unlike in natural hydrogels – so we can unambiguously probe their impact on cell function. We are hoping to then build on this knowledge to develop biomaterials that can be used for implantation.

What are the major challenges for implanting biomaterials, and what are you hoping to achieve using biomimetic platforms in the next five years?

A key limitation for implantation is designing materials that support blood vessel ingrowth from the surrounding healthy

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Training the next generation of scientists – Britta showing her son Niklas a microfluidic device.

tissues. Therefore, using our synthetic hydrogels, we first want to establish the design criteria for achieving this. We have started increasing the complexity of our models, for example by perfusing our microchips to mimic blood flow, or by including additional cell types. We'd also like to move more towards the tissue scale – together with the group of Ivan Bedzhov, we've recently developed a synthetic tissue model to study the first interactions between the embryo and maternal blood vessels, and would later like to combine our blood vessel model with organoid models.

Do you feel that there is a general push towards doing more applied science?

There's definitely a push towards more applied science by the funding agencies – that said, I feel very lucky to be funded by the Max Planck Society, which really still appreciates and strongly supports basic research. I think that basic and applied research need to go hand-in-hand; in order for translational research to be successful in designing targets and treatments for diseases, we really have to understand the basic mechanisms that control cell and tissue function. For example, in the tissue engineering field, the studies that focus on the implantation of novel materials are very much trial-and-error, so I believe progress could be much faster if we focused on first gaining a better understanding of parameters that regulate cell and tissue function.

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Going back to the time when you started your lab, what challenges did you face that you perhaps didn't expect? And what advice would you give to new PIs?

I think the biggest challenge for me, which I didn't foresee at all, was to find good trainees. Since my research is at the interface of cell biology, chemistry and engineering, I mostly attract students with an interdisciplinary degree, such as biomedical engineering. However, such programs are still very rare in Germany, as the faculties are very much set within the classical boundaries of disciplines. It took me almost a year to recruit my first students, but this also meant that I had a lot of time to set up my lab the way I wanted it to be, do some experiments myself and really lay out the questions that I wanted to address. In retrospect, this was a wise thing to do, so my advice to new PIs would be to take the start-up time as an opportunity to think about, and really define, the direction you want to take your lab – this is a unique opportunity to build something nearly from scratch!

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Now that you are more established, do you still have time for experiments?

Since our group has grown quite a lot, I unfortunately have very little time to spend on lab work. But I find it important to still do some experiments at least every once in a while so that I stay connected to the projects that we do, and I can also support my students better if I know the methods and their related problems. Something I do more on a regular basis is inspect the samples together with my students, especially for new projects. I think my experience can often help there to spot unexpected results, which could lead us into new directions.

What is the best science-related advice you have ever received?

To not take failures personally. This is something you often hear, but it's actually not easy to follow because we strongly identify with our own research – therefore, it can be very disappointing when papers or grants get rejected. As someone working on interdisciplinary topics, I often get evaluated by very different types of communities – biologists, bioengineers and biomaterials scientists. It's hard, if not impossible, to please everyone, so it's always good to keep this advice in mind. I should stress that negative feedback can also be very valuable, and it's much easier to learn from it if you don't take it personally.

You have collaborated a lot throughout your career. What do you think is key to establishing fruitful collaborations?

I think the most fruitful collaborations are where you work on a question that none of the individual labs would be able to address on their own. If people whose research is too close within a field collaborate, there can be competition for who made the bigger contribution in terms of impact. This is different when the expertise of the collaborating groups are complementary; in this case, it's easier to be completely open and put everything into the

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collaboration, as it will be clear, even to an outsider, what each side has contributed to the study.

How do you balance being a scientist and a mother?

It's not always easy to balance work and family life when you're a scientist – and before having a kid I was very nervous that it would not be possible at all. Family is very important to me, so I really separate my work and family life and make dedicated time for both – so when I play with my child I don't check emails. I've also become much more disciplined in scheduling my work tasks, and the nice thing about an academic position is that it gives you flexibility in doing this; I often leave the lab late afternoon to pick up my son from daycare and then continue my work after he is in bed. I also really try to keep my weekends free, but if this is not possible because of deadlines, I can take time off another day to compensate for any weekend work. Spending time with my family also gives me a lot of energy for my research – which of course is very important to me, too.

Finally, could you tell us an interesting fact about yourself that people wouldn't know by looking at your CV?

During my time as a high school student and undergraduate, I used to be an active member of the Social Democratic Party of Germany, so I spent most of my evenings and weekends with activities revolving around local politics. I think I learned quite a few skills there, including presenting and negotiating, which are also useful for my current job.

Britta Trappmann was interviewed by Máté Pálfy, Features & Reviews Editor at Journal of Cell Science. This piece has been edited and condensed with approval from the interviewee.