

CONVERSATION

JEB@100: an interview with Monitoring Editor Almut Kelber

Journal of Experimental Biology is celebrating 100 years of discovery in 2023 and, as part of our reflections, we are inviting Journal Editors to tell us their thoughts about the journal and to look to the future. In this Conversation, Monitoring Editor Almut Kelber talks about the incredible sensory worlds inhabited by other animals and how she would love to be able to communicate with them like Dr Dolittle.

What is your area of scientific expertise and how did that introduce you to JEB?

I'm a sensory biologist, predominantly working on vision, visual orientation and colour vision – all fields that are covered by JEB. I published my first paper in the journal when I started my project after my PhD, which included field-work with bees. When I had my children, I decided to go back into the lab, because that would allow me to organize my working hours around my family. I started working on hummingbird hawkmoths (*Macroglossum stellatarum*) at the University of Tübingen, Germany, because I wanted to know how and whether they could see colour. Nobody had done proper sensory biology on these 'flying teddy bears' before, except to understand their flight control. My Head of Department, biocybernetics professor Dezso Varju, let me work on this as a postdoc, even though it wasn't his field. When we had some results he said, 'I think the Journal of Experimental Biology takes short format papers', so I submitted my paper to the journal and ever since I've loved it. I also went to the library as a student and then as a postdoc in Australia and I used to look through the new journal issues. JEB was one of the journals I always scanned, looking for anything interesting. It has always been appealing to leaf through, even though nowadays we scan through the contents on the internet.

What do you think is the secret of JEB's longevity and success?

The journal has always been dedicated to publishing the best science, understanding the variety of solutions that animals have found to many problems, and that dedication is maintained by the Editors, the authors and the reviewers, which has created a community. I also think the fact that research papers are handled by active scientists in the field is a very important aspect of all of The Company of Biologists' journals. The Editors have not left the field and watched the science develop from the side-lines; that is a strength.

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What are the current big outstanding questions in your field?

We still don't really understand how colour vision is represented in the brains of animals. There's a new idea from people working on vertebrates that maybe colour vision evolved because the animals had several types of photoreceptors for some other purpose and that colour vision is just an epiphenomenon – a by-product. But currently we don't know how colour information is stored in the brain. We understand the receptor side of colour vision and we know the outcome – colour-guided behaviour – but there is still a black box in the middle that we need to colour in. Also, we don't know exactly what happens in the retina where the first colour calculations are performed and we don't really know how our perception of colour comes about, so there are many remaining unknowns. Recently, researchers have discovered that in insects and mammals the first calculation is done at the level of the photoreceptors, where different spectral photoreceptors inhibit each other at the first synapse; that's the start of colour perception. More generally, I think another burning question is how the neural mechanisms that we have identified in reductionist experiments in the laboratory have evolved and how they function in much more complex natural environments. To address this, we need to bring the lab to the field, or the field to the lab. There's still a large gap between those two parts of the story and that is reflected by a number of recent symposia discussing vision in the natural environment. I think that's a field where we hope to make progress in the coming years.

Where do you think research in your field is currently going and what are the most exciting current breakthroughs?

People are looking in more detail at the neural mechanisms analysing perception and neural processing in the brains of animals

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and how that is translated into a behavioural response. I remember when I was a student visiting the Max Planck Institute for Behavioural Physiology in Seewiesen, Germany, where the neurobiologist Franz Huber had just discovered the omega neuron in the cricket brain. That allowed him to describe the entire pathway, from a sound wave produced by a singing male cricket entering a female cricket's ear, being analysed and compared with the signal from the other ear to guide the female toward the male. At that time, it was a unique example; everything from the sensory inputs to the behavioural output could be mapped to specific neurons in a relatively simple system. Now, we have a neural model for path integration in the insect central complex which controls their spatial navigation. Imagine a bee flying over a meadow or an ant walking through the desert in a curved path. They look at landmarks, the sun or moon and polarized skylight, take into account the wind direction and any other sensory information. Then they return home in a straight path after they have found their food, because they have incorporated all of that information. Researchers can now reproduce this phenomenon in a computational model that is built on the wiring of the different cell types in the central complex and fed with the sensory information, which is really amazing. It is incredible to see how Barbara Webb (University of Edinburgh, UK), Stanley Heinze (Lund University, Sweden) and others have been able to integrate all of these components to reproduce the behaviour of the animal. My guess is that other similarly complex behaviours will be discovered and understood in the near future.

Where do you think the field of neuroethology will be in 100 years?

I hope that we will better understand how animals see, hear and sense the world and how they put that information together to understand how they act in their sensory world. I would like to be able to non-invasively place an electrode on their heads, record from their brains and read out what's going on in there. I don't think that will be too much to ask in 100 years' time. Of course, we are curious to understand how they think, but hopefully it will also help us to understand how our actions influence their world – how noise destroys their acoustic communication, how light pollution stops them from seeing the stars at night – so we can better take their needs into account.

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If you could time travel, what piece of future equipment would you like to bring back with you, what would it do and what questions would you like to answer with it?

I really want a translator tool that allows me to understand the languages of animals, a little like Dr Doolittle, so that I could understand them and ask them questions directly. That would be my dream. I'd love to ask a butterfly what the world looks like to them, why they make certain choices. I would definitely like to talk to an owl. It is magnificent how they find their way in the dark and sense where a mouse is. I am fascinated by nocturnal animals, partly because I've been working on them for more than 20 years. For

instance, bats have a different sensory world from us, they echolocate, which some blind humans have learned to do in a very rudimentary form. Bats live in a very different sensory world from us, even though they are mammals and more closely related to us than to butterflies or bees. Having an acoustic image of the world, like bats and dolphins do, must be so amazing and I would like to understand it better. Even if you look at the eyes of animals, the colour and spatial worlds are completely different from what we see. There's also another sensory world, the world of magnetic perception – where animals see and perceive, or feel, the Earth's magnetic lines – which is incredible and is still, as far as I'm aware, the only sense where we don't even understand the transduction mechanism. For me, all of these animals are like aliens and I'm much more interested in understanding them than in searching for life on other planets.

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If you had one piece of advice for your younger self, what would it be?

I would tell myself to claim my space and not to be shy about saying what I think, contradicting people who think they're more important. 'Be bolder', would be my advice. I think if I had asked more people for help, I would have made more progress. As PhD students, we weren't supervised much and although it helped us to become independent early, I think that my own students have become independent but they also got more help, because of supervision. In addition, I've never really made compromises about what I wanted to do; I've taken a lot of opportunities that opened up unexpectedly. That helped me to discover things I wouldn't have dreamt of otherwise. For example, I once went to an ornithology conference because I had a student working on birds, and we had organized a symposium on bird vision. While there, we met someone who had a new PhD student who was a falconer. I was able to help them to set up experiments on raptor vision and since then I've been working with the falconer. It's been so much fun! I would never have planned to work on falcons, buzzards and other birds of prey otherwise, because I thought it would be impossible. My advice is, if there is a chance, take it.

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If you had to sum up in one phrase what JEB means to you as an author and researcher, what would you say?

Well, it has always been, and always will be, my favourite journal to read and publish in. It's just the best for publishing mechanistic work in neuroethology, sensory biology and sensory ecology. Plus, it's the journal with the best team in the editorial office and it's so much fun to work for as an Editor, to publish in and even to review for. It's just my favourite.

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