A Conversation with David Ginty

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Kate Fehlhaber (KF): Hello, and welcome to this special edition of Knowing Neurons! I'm here with David Ginty, who is Professor of Neurobiology at Harvard Medical School and an investigator with the Howard Hughes Medical Institute. His lab is interested in the development, organization, and function of the neural circuits that underlie our sense of touch. In particular, he's interested in low-threshold mechanosensory neurons, which are the primary sensory neurons in our skin, which mediate our sense of touch. So, David, what kinds of questions are you trying to answer?

David Ginty (DG): We're trying to address the organization of what some people think are up to a dozen different types of sensory neurons that innervate the skin. We're interested in the different properties of these neurons and how their organized, both with regards to their projections into the skin, but in some ways more interestingly, their projections into the spinal cord and brainstem, and how that organization gives rise to the integration of different sensory modalities to give rise to the perception of touch.

[1:03] KF: What kinds of techniques do you use in your lab to study these sensory neurons?

DG: To study sensory biology, one really needs to use a large number of techniques. So, what we've been good at over the years has been using mouse genetics techniques, so we use the mouse as our model organism, and the reason we use that is because the ability to genetically label and manipulate different types of cells in the mouse has become something that's achievable. So, using the mouse, we're able to genetically label different types of sensory neurons, so we can visualize their processes as their project into the skin and the other end of the processes as their project into the spinal cord and brainstem. So, mouse genetics is a big component of our toolbox. The other thing we make use of quite a bit, in terms of techniques, is electrophysiology and imaging. So, we need to be able to record the electrical activity of these neurons as we stimulate the skin with different types of tactile stimuli, and we do that to understand the tuning properties of the various neurons, that is, how these neurons respond to different types of mechanical stimulation. Some respond better to indentation; some sensory neuron subtypes respond to stretching of the skin; some respond best to deflection of hair follicles in the skin. And so, we need to record their activities to ask questions about how the genetically labeled neuron we're looking at, with their particular morphologies, are tuned to different types of sensory inputs.

[2:31] KF: So it sounds like you're doing basic research here. We're just trying to understand how these neurons respond to stimuli?

DG: People have been studying this for many, many decades – how neurons respond to stimuli – and a number of different types of neurons and their response properties have been identified. We're trying to go a little bit further and ask how neurons of particular anatomical and morphological properties respond to stimuli. So, in other words, we're trying to match up the morphological features – the type of sensory ending in the skin, for example – with the physiological response properties of the neurons.

[3:08] KF: Does your research play any role in understanding neurodegenerative disorders or spinal cord injury and repair?

DG: Not directly, but indirectly, we think there's a really tremendous amount of insight that can be gleaned from the kind of work that we and others are doing. So, for example, when you think about spinal cord repair, really what you're talking about or aiming for is to repair the damaged spinal cord, and if this is the dorsal half of the spinal cord, for example, that part of the spinal cord is involved in sensory processing and carrying sensory information from the periphery up to the brain. And so for us to think about how we can repair the injured spinal cord, and for example the injured dorsal part of the spinal cord, one has to appreciate the complexities of the connections that are made there, and the type of sensory neurons that have their processes that ascend from the spinal cord into the brain. So, we are trying to understand the organization of the dorsal part of the spinal cord with regards to the sensory inputs, and we are trying to identify the neurons in the spinal cord that receive that input, how those neurons are organized and how the projection neurons that emanate from the spinal cord and project their processes all the way up to the brain, what kind of information they carry and what those projections look like and where they ascend in the spinal cord. So, we are trying to lay down fundamental understanding of the organization of neurons in the periphery and in the spinal cord, and I think that that information will help guide us to think of ways to repair the injured spinal cord because we have to think about ways to repair that normal organization, which we still don't understand. For diseases like neuropathies, that result for diabetes, diabetic neuropathy, or chemotherapy-induced neuropathy, things like where sensory neuron subtypes are thought to affected, we'd like to understand better their normal properties and their normal anatomical characteristics and physiological properties, and the hope is that by understanding these neurons better, we'll be in a position to prevent their degeneration in certain types of neuropathy. Everything that we do is basic, but we think that the foundational material necessary for addressing peripheral degenerative disorders and repair the injured sensory system, for example, in spinal cord injury, is going to rely on this kind of information to make educated attempts at repairing.

[5:38] KF: So, you're giving a Special Lecture on Wednesday, November 19th, at SfN. What are you going to speak about then?

DG: I'm going to speak about what I just mentioned, which is our strategies for molecularly identifying physiologically distinct types of sensory neurons and using molecular genetic tools then to provide a greater understand, we hope, of the anatomy, physiology, and organization of these neurons, both with regard to their endings in the skin and their projections into the central nervous system, into the spinal cord and brainstem. So, it's going to be a presentation of mouse genetic tools to study and visualize sensory neuron subtypes, and how those neurons are organized into circuits that we believe underlie processing of touch information.

[6:26] KF: That sounds really cool! We're looking forward to seeing it!

DG: Thanks!

[6:29] KF: So, now I kind of wanted to switch gears and ask you about how you got to where you are today. So, what was your professional development like?

DG: I think pretty straight-forward as far as academic scientists go. You know, I majored in Biology in college and went straight to Graduate School out of college to get a Doctorate; that was in Physiology. Quite conventional. Five year Ph.D. into a post-doc; I did two post-docs: a short one and then a longer one, where I studied molecular neurobiology. And went from there to my own independent faculty position, which was a Johns Hopkins, where I stayed for about 17 years, and just left there. I moved from Johns Hopkins to Harvard Medical School to join the Neurobiology Department here. So, on paper just a standard college, graduate school, post-doc, faculty position. No major detours from that. One seemed to flow seamlessly from the other.

[7:24] KF: Did you always want to be a scientist?

DG: Well, I did towards the end of my college years, but no, you know, I was a young person growing up or even in high school, I never thought about being a scientist, to be honest with you. When I went to college and we were required to declare a major, it seemed obvious to me that something in math and science made sense only because it just came a little easier to me than other disciplines. I won't want to say it was the path of least resistance, but – who knows, maybe it's the path of most resistance – but it was simple for me to think about because I enjoyed those classes in high school, and it just seemed like it was less challenging and more enjoyable because of that. But I never really thought, as a young person prior to college, that I'd be a scientist. I just thought, in choosing a major in college, that this is something I'm interested in and it makes more sense to me to be involved in something I'm interested in than something I'm not, like economics or business. I guess, you know, when I was in high school, if you asked me then what I wanted for myself, it would not have been a scientist. It was not obvious to me that that was the kind of career that would have been appealing to me. I was more interested in things like music, and motorcycles, and things like that. You know, we used to spend our time tearing apart motorcycles and rebuilding them and trying to get them to work, and cars and music. I played guitar and bass in bands, and I think if I had a choice back then when I was 16, 17, 18 years old, I would have said, "Yeah, you know, I'd love to be a musician or some sort of artist." It wouldn't have dawned on me that science would have been a career that I would have been cut out for. Although I did enjoy those classes in school, I didn't think of that as a career for myself. But, I was kind of fortunate because, it turns out that I really didn't have the talent to be an artist or a musician or anything like that, as much as I would have liked to have been. But, it turns out that being a scientist or spending your life, your career, as a scientist is much more… there's much more of an art component to it than one might think. Now, I sort of view myself as, or I strive to be, an artist in many ways. You know, I want to make something really beautiful. I want to do something that's not been done before, and learn something that hasn't been previously appreciated and paint a picture of it. Right? Describe it to the world, both in oral presentation and writing manuscripts. So, I feel like without thinking about it, I've found myself in a career, which really enables me to really have an artistic outlet for what I do. Science is an artistic outlet. The more creative you are, the more imaginative you are, the more you have the ability to think outside the box, I think the more likely it is you'll hit on something really new! Presenting what you've discovered has a huge artistic component to it, right? Just describing what you do, and how you describe it, and how you write about it, and how you speak about it, is fun and artistic, so I feel like that artist that I would have wanted to be when I was young has emerged in me, and I wouldn't have known, as a teenager, that that would have been the case. I'm in a really fortunate position, right? I get to choose what I want to study and how I want to study it. And there's a huge creative personal contribution, you know, your creativity and your personality brings to bear on a question that which is different from how anybody else would address a problem. And so I kind of view, I don't know, maybe "art" is not the right word there, but there's an artistic form that you engage not only to present your work, but also to decide, "What is it I want to do? What question do I want to address, and how do I want to address it?" That's different for all of us. And I think that people, who are more imaginative, more creative, in some ways more artistic, have the ability of addressing questions or problems that are unique! And so, it's both the way you present what you've discovered, but also really what you choose to work on and how you choose to address it, that really has an artistic, creative component to it that I more and more appreciate the longer I'm a scientist, the longer I'm in this business. And I really value that. For me, it's really important for me to be able to think deeply and creatively about something, to try to address, you know, a long-standing question. Maybe there are new ways of addressing things and you can bring in new approaches and try to develop new approaches or techniques to address a question. Yeah, there's a huge creative component to that, which I love. I love to be able to tap into that. And it's always new and different. You're constantly having to reinvent yourself and come up with new ways to address things. Almost like an artist creating something new that's never been seen before. You have that ability as a scientist to step out and do something that's never been done before, create something that's never been seen before.

[12:22] KF: The creative component is key to becoming a successful scientist, but how much do you think is luck and hard work involved?

DG: Yeah, of course, there's luck and hard work. I would say there's less luck than people might think. I think that, obviously it's the old adage, "Luck favors the prepared mind" really is true. I think in the end, people have similar amounts of luck, and it's whether or not you can appreciate what you see or find and move in the right direction with it is really the key. So, to me, obviously hard work is involved in any career you choose, and there is a linear relationship between hard work and output or success, but I think the most important thing is intuition. So, I would say, neither luck nor hard work. I think the most important thing that sets the most successful scientists apart from others is a great intuition, both in terms of, you know, identifying something that's meaningful and approachable, but also identifying or appreciating a result and knowing how to move forward with it. There's a tremendous amount of intuition that varies between individuals, and you can take the same result and present it to different people, and some people will have the intuition that this is meaningful and this is the way I have to go with it, and others will have little ability to do that. It's hard to know based on book smarts, who's going to be better at that. And so, there's this ill-defined level of intuition that I think in some ways sets apart the most successful scientists from the more average scientists. I think that's more important than luck or hard work. I think that hard work is clearly important, but I think that intuition is the key ingredient for success.

[14:11] KF: Did you key in on these skills when you were a grad student or during a post-doc? Was there a mentor that guided you with these ideas?

DG: Well, first of all, I'm not saying I have these skills! I would aspire to have these skills. I think that hard work is something we can all do. I do feel that, as a graduate student and as a post-doc, I did work hard and I did have focus. I think as a graduate student, in particular, and through my post-doc, I had the kind of mentors that allowed a degree of freedom, which is tough to allow because I think for developing scientists, one thing that's really essential is letting someone make their own mistakes and learn from that. That's the best way to learn. And, it's the best way to learn because if you make a mistake, you'll never make that mistake again, but, maybe more importantly is, if you have a little bit of freedom and you can make a discovery, even if it's incremental, there's something that happens inside you. Your confidence builds; you become a little more capable because of that. And that doesn't always happen. Some mentoring situations, there's strong guidance and the mentee is never allowed to come up with an idea, try it, and be successful or fail. Somebody that comes up with their own idea and is successful with it gains a tremendous amount, not just in the discovery, but in the development of that person as a scientist because they develop a confidence that allows them to, in the future, do that even more. And I guess I had really good mentors, who understand that.

[15:45] KF: So if you had to give one piece of advice to a young scientist today, what would it be?

DG: Try to find out what you're passionate about! If science is a passion, then go for it! There should be no reason that you should not go for it if that's your dream. People talk about the limited number of positions, funding lows, and things like that, and, you know, I never – for right or wrong – I never really paid attention to those things myself. You know, when I was a student and a post-doc, there were times of difficult funding and times when there was seemingly few jobs for a lot of people, but I think that if it's something that you love and you're passionate about it, I would go for it. I wouldn't even hesitate. I think another piece of advice I would have is, "Don't believe what any one person says." You're a unique individual, and the advice that people have is very personal and the result of very personal occurrences and very personal memories and events, and I think that you should of course take advice, but the advice from any one person should be integrated with advice from many. One person's experiences do not define the trajectory of another's. So, I think one has to be really careful about taking advice because we are all individuals, and advice from only one person isn't sufficient.

[17:01] KF: How were you in grad school? Were you in the lab all the time doing experiments, or did you got the beach?

DG: Yeah. So, I'm a sociable guy. I like to interact with people. My college Physiology professor said that he wasn't entirely sure about me becoming a scientist because I was possibly too gregarious to be stuck at a bench doing experiments and not really interacting with people, and I think he was really wrong. I loved being in graduate school. I loved being a post-doc. And what I really loved was working with my hands and doing experiments. I loved the fact that I was in a graduate program, and when I was a post-doc I was in a big lab, where there's lots of other people doing similar things. And I loved to not only do the experiments myself for my own project, but I really enjoyed interacting with the other students and the other post-docs and collaborating and thinking about other people's projects and getting to understand what those projects are and why they're addressing certain questions and how they're going about addressing them and how they're interpreting their projects, and… I think that, as a graduate student and as a post-doc, that's an incredible opportunity to interact with other people and learn about other scientific projects that are either parallel or, in some cases, not even related to your own. And it gives you the opportunity to learn how science is done 50 different ways if you interact with 50 different people with 50 different projects. You know, that requires a lot of social interaction with people. So, I loved being in graduate school, where there was just lots of projects going on in parallel with mine, and talking about them, and considering them, and in some cases even collaborating, and the same thing as a post-doc. I found it to be a remarkably enjoyable time just interpersonally, in addition to the challenge and joy of discovery of your own project in your own work with your own hands. You know, and then when I was fortunate enough to be hired as an Assistant Professor at Johns Hopkins, I realized I loved it even more to have students and post-docs in my own lab because those people that work with you are making discoveries, and those are your discoveries as much as they are theirs, of course, and so you have the same sense of joy of discovery even if one of your students or post-docs is making it. But on top of that, when you see that person moving to become an independent scientist, and there's a great joy associated with that as well, so it's like double joy! I think for me the personal interactions as a scientist have been really wonderful, and they've just suited my personality quite well. And so I, I love both the joy of discovery and the interactions with colleagues, and I always have, since the beginning of graduate school. My social life as a graduate student really sort of stemmed from that. We did a lot of things outside of the lab, and there's sort of a scientific overtone to much of what we did. Camping, traveling, beach, parties: I mean, we had great fun!

[19:52] KF: Looking back at all the people you've met and all the people you know now, is there a particular neuroscientist that you admire today?

DG: You know, there are just many, many, many scientists that I admire. I mean, I admire people who develop new technologies that enable whole new areas to be approachable. I admire role models. I admire people who just love science and love discovery. People who are not in it for self promotion or advancement but I love scientists who just loves what he or she does, and loves the beauty of science, the beauty of something revealed, something exposed for the first time, to see it in all its simplicity and elegance. I love scientists who appreciate that, and there's a lot of them! And I think my role models have been people in that category. Right from the beginning for me, which was my Organic Chemistry Professor in college, and I worked for him for two years. And he wasn't a great teacher; he just sort of stood in front of the class and spoke to his feet, and students really couldn't relate to him. But when I worked with him, I saw this thing in him, just this childlike love and appreciation of what he was doing, trying to figure out this tough problem and trying different approaches to synthesize these porforin rings. And I thought, "Wow! This guy is really into it and he really enjoys the challenge! And he gets so much joy out of making what seemed to me an incremental advance towards his goal!" I really admired that! That's really pretty cool! I didn't really see people in other areas doing that. I thought this is a career I could see for myself. He loves what he's doing, and so the people that I've been fortunate to work with like that have sort of been like that. They really enjoy the discovery process and just take great joy in finding something new, and those end up being my role models or my heroes.

[21:52] KF: Well, I can hear the passion in your voice when you talk about science, too, but if you weren't a neuroscientist, what would you be?

DG: I feel like there's just a lot of things I could be. If I had the skill, which I don't, I would have loved to have been an artist or a musician. I still feel that would be a wonderful way to live because, in some ways like being a scientist, a career where your job is to express yourself and where your job is your creative outlet, I think is the most wonderful career; it's the most wonderful way to live your life. So, something along those lines, I think would be most appealing to me.

[22:27] KF: Do you still play the guitar?

DG: I play the guitar. I take cello lessons. I don't have enough time to practice, unfortunately, so I'm really not that good, but I do love it.

[22:38] KF: So when you're not in the lab, is that what you can be seen doing?

DG: Uh, probably not that much. I think what I probably invest more of myself into outside of lab is – my kids are older now, but they've always been my biggest joy. Now that they're a little older and they're not as much involved in the day-to-day, hour-to-hour kind of basis, I play basketball a lot. I play basketball twice maybe three times a week. I love that.

[23:05] KF: Well, I think we've come to the lightening round!

DG: Okay.

KF: So let's start! Coffee or tea?

DG: Oh, tea.

KF: Go-to comfort food?

DG: (laughter) M&Ms!

KF: Hidden talent?

DG: Parallel parking.

KF: Favorite place in the whole world and why?

DG: Yellowstone National Park. I was there this summer, and I've never seen such natural beauty, and the wildlife is unbelievable.

KF: And, what dead person would you most like to meet or get advice from?

DG: My father.

KF: Well, that's all I have for you today. Thank you so much for speaking with me.

DG: My pleasure.

KF: Yeah, we look forward to hearing your Special Lecture at SfN this year!

DG: Yeah! Thank you! I look forward to giving it. I have to start thinking about that lecture right about now…

KF: Alright!

DG: Alright, thanks a lot.

KF: Bye!

DG: Bye bye, Kate.

KF: If you have any burning questions about the brain, leave us a message or tweet us @KnowingNeurons!