

Neuroendocrinology with Dr. Daniel Pfau

Ologies Podcast

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Oh hey, it's that uncle who swears you can cook fish in the dishwasher and you're like, "Oh that's okay, I'm okay," Alie Ward, back for an exciting, timely, proud episode of *Ologies*.

I loved seeing how much support was bandied about online for Black Birders' Week. What an amazing couple of episodes. If you have not heard it, go back, and listen. Get all those nature nerds in your timelines, including @BlackAFinSTEM and @ReelsonWheels on Instagram, who I'll have on for a bonus episode on macrophotography when he reaches 20,000 followers. He's halfway there, he's so close! Also, celebrate Juneteenth this week and read up on its significance.

Being June, it's also Pride Month and I wanted to spend a few episodes talking to scientists about sexuality, and gender identity, and neurobiology, and hormones, and evolution, and more. So, sit tight for Part 1 of a two parter.

But first, a few thanks. Thank you to everyone on Patreon who makes it possible for this podcast to happen from day one. Thanks to everyone who passes episodes around and makes new ologites. Thanks to everyone rating the podcast, it takes two seconds. Thanks for subscribing and keeping it up in the charts. And of course, thanks for leaving reviews like little happy word gnomes that make my day. I read them all so that I can pick one, like this recent one from LassKicking:

I especially enjoyed the special episode with all the amazing black scientists. As a mother of a biracial son, I was able to let my son know there is so much out there. And yes, I followed everyone on the episode.

Awesome LassKicking. Go bird it up!

Okay, neuroendocrinology. So, neuro comes from the Greek for 'nerve', which comes from a word for tendon, or sinew, or cord, or penis. So, we're in this. Endocrine means relating to hormones, which are secreted by different glands. It comes from the Greek for 'to separate' or 'to distinguish' because they needed to figure out which glands squirt which hormone juices. They were like *[shoulder shruggingly]* "Uh, who knows where this comes from." So, neuroendocrinology – the science of a bunch of cords in your body interacting with a bunch of squirty stuff no one understands *[splat]* in a nutshell.

So, what is biological sex versus gender? Why are people attracted to one gender over the others? How many genders are there? And what happens if we don't feel aligned with the one we were assigned at birth? When do you know if you're queer? What does queer even mean? Why is so much of it made political or religious?

I met this guest through a tweet. I tweeted out:

Happy Almost Pride Month! Any topics or -ologists you would looove to hear to celebrate #Pride2020? I'm all ears! And microphones.

And @EndoKweer tweeted back:

Just gonna shamelessly plug myself as a non-binary biologist studying hormones and the evolution of same-sex behavior in animals.

Five seconds later I was in their DMs like. “Heeey!”

This neuroscientist got a BS in Animal Sciences and a Master’s in Biological Sciences at California Polytechnic State University, San Luis Obispo. They did their PhD work at Michigan State University looking at how environmental signals contribute to sex differences in mouse brains. We talk alllll about it. In Part 2, we’re going to dive into the question bag and address all of your gender queries. In this week’s Part 1, we cover: the parts of the brain that could influence orientation; common myths; being queer in the science field; what percentage of older generations identified outside the man-woman gender binary; what percentage of younger folks do now and why; different gender terminology and what it means; the worst gender reveal parties; and the best cat meow ever with the charming, candid, patient, and lovely Neuroendocrinologist Dr. Daniel Pfau.

Alie Ward: I’m so excited to have gotten introduced to you on Twitter. I was like, [*excitedly*] “This is perfect. I have so many questions.”

Dr. Daniel Pfau: I was like, [*very excitedly*] “Oh my goodness.” I’d started listening to the planariology episode with the planarians. The professor who you were interviewing was talking about how you just got to get out there and do it when he was looking to publish his book. And I was like “Oh, hey, you know what? I should do that. I’m just going to shamelessly throw myself out there.” [*laughs*]

Alie: I love it.

Daniel: And then it works out sometimes. [*laughs*]

Alie: And then it works out. I would love to know, how did you get so interested in the brain and in hormones? Were you always interested in psychology or were you interested in biochemistry?

Daniel: When I was younger, my parents say that I didn’t really have first words. I was really quiet, and eventually I started having first sentences. And one of my first was saying “When I grow up, I’m going to work in a [*old timey snobbery accent*] laboratory [phonetic: lah-BOR-ah-tor-ee].” [*laughs*] I don’t remember actually ever saying this, but they tell me it’s what I said.

Alie: [*mimics Daniel*] A laboratory.

Aside: Daniel says they grew up in a devout religious house, and didn’t have cable or much media access, but they must have picked up the [*old timey snobbery accent*] ‘laboratory accent’ somewhere. Scientifically speaking, there is nothing cuter than a kid saying [British pronunciation] laboratory. Nothing.

Alie: Did you drop that interest when you were growing up or has it always been a focus for you?

Daniel: It’s actually interesting because when I was growing up, I struggled a lot with coming out as a queer individual because of the conservative community I was growing up with. Like I was saying, my family didn’t really have TV or media. There was this huge separation between me and the greater culture around me. I was isolated within this conservative church and, for a long time, I struggled with it. When I finally started talking to someone that happened to be a psychologist...

Aside: So, this psychologist cited some research in a recent “scientific” talk about conversion therapy.

Daniel: ...the talk was basically about ex-gay therapy and how some evidence supported its efficacy, suggesting it worked. I was like, “Oh, yes, this is a person who knows science and I'm really into science.” I was also really afraid of this thing that I know is a sin and all these things that I'd grown up with. He brought in this evidence coming from the scientific fields that supported the idea that I could fix myself and be what I thought was expected of me and what I thought would make me happy. So, when I had that experience, I really struggled for a long time to come out.

But when I finally did, I sort of rejected science quite a bit at first. I was like, “I am done with research. I'm just gonna do stuff with animals.” I wanted to become a veterinarian and I wanted to work at zoos where I'd just be working with animals. *[laughs]*

Alie: You were like, “People – I'm over you.” *[laughs]*

Daniel: Exactly. And you know, it was pretty difficult to get back into the fields because there's still a lot of both transphobia and homophobia in the scientific disciplines.

Aside: I asked what faith or denomination Daniel had grown up with, as someone raised Catholic who has plenty of years detangling those tendrils from my own psyche, I was curious. Also, I was going to say detangling tentacles of Catholic upbringing just then, but I had a moment where I was earnestly like, “That's not fair to cephalopods.”

But Daniel says it was a Christian church, and the kids raised in it would get bullied at school. Their mission may have changed since Daniel was a kid, it's been a couple of decades, but I googled them, and their motto is, unfortunately, “You Can Come As You Are, But You Won't Leave as You Came.” It is a great motto for a salon though. “Come as you are, you're not going to leave as you came.” A church though? *[questioningly]* Hmm?

Daniel: A lot of the kids at school would say things like, “The Grace Church Punch Kids” because they drank the Grace Church punch and they're brainwashed in a way. And it's very true. I remember I really didn't like going to hang out with the other kids because I just didn't fit in there. So, I begged my parents to allow me to come to ‘big church’, which is where the adults would go. I'd sit in there, but even in there, there'd be sermons with mentions of the evils of homosexuality.

There wasn't really any escaping it, whether or not I was with the kids who were definitely drinking that Grace Church punch and expressing homophobia and all those kinds of things. Or even with the adults, where that same sentiment is being expressed by the person in charge.

Alie: At what point did you feel like you were genderqueer, that you were not cis or straight? At what point did you feel like, “Hmm I feel like they're talking about people like me and that sucks.”?

Daniel: When I was really young, I had a very precarious notion of gender because I was convinced that at some point in my life, I would eventually be given another choice. I was planning for that choice in a way. But I also was dreading that choice.

I remember a lot of time when I was in childhood, we would play games like house, and I'd always prefer to be ungendered, like I'd be the baby or a pet. When I was young, my mom made me a costume for Halloween because I wanted to be a bat. [laughs] The costumes in the stores were *Batman* and I did not want to be dressed as *Batman*. When my mom made me the costume and I'd wear it out, people would be like, "Oh, are you *Batman*?" I'd get really upset about it.

Honestly, one of the sad things that happened too was way back when I had gone to a counsellor when I was very young. They had instilled on me this idea that if I am feeling the need to express myself in a unique way, that it's better to not do so because it makes other people uncomfortable.

Alie: [horried] Oh my God. Oh my God. Whaaat?!

Daniel: Yeah. It's difficult to say whether my parents understood what was going on. Because they'd send me to a therapist, and I was too afraid to share anything with my parents. I would continue to share with these therapists these things. The difficult thing was eventually separating what I had gleaned from being at church and being in these therapy sessions, and not receiving any other signals from my parents or from media, and trying to make sense of it all. For a long time, I just couldn't. There were no examples in my life.

I assumed absolutely the worst. I just assumed that there was no future for me, in a way. I think that really only started to change when I came out as queer. When I came out, I came out as gay. I had been attending a queer youth group for a really long time and I really identified with that word, but very few people actually know the word queer or understood what it meant. It was easier to say gay. For a long time now since then, I've been like, "You know what? No." I really want to say that that's how I identify because I've always very much felt a strong connection with that word.

Alie: How would you define those words separately, if someone wants to make sure that they're using them appropriately?

Daniel: I love the word queer because it's very radically affirming. Meaning that when you use that word, it doesn't necessarily mean that there's a strict set of queer identities. It's accepting of any future experiences that someone might be able to inhabit or it's very accepting of the fact that cultural differences make it so third gender options across the world varies.

In some countries you have this huge variation, like in the United States, where we have people who identify as genderqueer, we have people who identify as gender neutral, or transgender, people who identify along different spectrums like demimales and demifemales. When you look out at other cultures, you find that similar things exist.

Aside: Okay, so, soon we'll get into the science of this in a sec, or a few 'secs'. Get it, a few 'sex'? Okay, so I wanted to provide a primer for some different genders. In case anyone is like, "I'm not sure how many there are, or what they mean, or who to ask." So, Daniel sent me this really wonderful graphic. It's called the Gender Unicorn. It's this happy, goofy, purple unicorn and in a thought bubble with a rainbow it says: 'Gender Identity': female, woman, girl, or male, man, boy, or other genders.

There's 'Gender Expression': which is feminine, masculine, or other. There's 'Sex Assigned at Birth', that is like a DNA strand [*raised voice*] over the crotch area, and it's female, male or other/intersex.

Then in the heart area, it says, 'Physically Attracted to': women, men, or other genders and then another heart says, 'Emotionally Attracted to': women, men, or other genders. So, you can mix and match. That's a lot of options.

And intersex, just in case you're not sure, according to GLAAD, those are people born with reproductive or sexual anatomy and/or chromosome patterns that can't be classified typically as male or female. Because biologically there's more than two outcomes there. Nature is amazing.

Okay, now what about genders? Your gender identity, or your gender expression. Here are a few, but by no means a comprehensive list. There's genderqueer, gender neutral. There's transgender. Dememales or demifemales experience their gender as partly a girl or a boy, or partly another gender. Asexual folks are out there, they don't experience sexual attraction. Agender folks are out there, don't identify with any gender, or intentionally don't follow expectations of a gender.

Cis gender folks are not transgender, so they identify with the sex they were assigned with at birth. If the doctor said, "It's a boy!" and you're like, "Yeah, I feel like a boy, that tracks," then you're cis.

Non-binary friends don't feel their gender is best expressed in those man/women boxes. There's gender-questioning, a person exploring other identities or expressions or presentations. Gender-fluid pals experience their gender as a spectrum. They might fluctuate between presenting as feminine, masculine, neither, or both. It can change for them.

So, there's an awesome glossary of all these terms and more, compiled and written by GLAAD and Refinery29, and I am going to link on the show page at Alieward.com/Ologies/Neuroendocrinology. It's so helpful and it's so inspiring. I mean it's like entering an Ikea of genders. The choices, the beauty, the possibilities!

And sidenote, when you put your pronouns in your bio or in your email signature or your conference name tags or your Zoom meeting label, even if your cis and straight as an arrow, it helps normalize it for others. I'd personally love it if everyone in the future goes by 'they' if they wanted too.

Alie: I hope that we just transition to that for everyone.

Daniel: You know what I love? I've seen a few studies, and one specifically showing that when people shift to gender neutral language like that, the salience of female voices is actually increased within conversations, within media, and stuff like that.

Alie: Really?

Daniel: So, it's just funny to know that even just identifying as genderqueer instead of forcing this, like, "You have to use this gender-neutral language with me." Hopefully, maybe, then helping everyone else a little bit too.

Alie: Absolutely. It does seem so odd to structure a sentence based on what you think is in someone's pants. [*both laughing*] So invasive.

Aside: Daniel says different cultures express gender differently.

Daniel: So, in Samoan society they have these individuals and they're called fa'afafine. They are individuals who are assigned male at birth, and when you are in their society, within their culture, this is sort of the cultural option for individuals that are assigned male at birth but feel attracted to individuals of the same sex. This is sort of based in the idea of their identities.

So, it is more complicated in other areas where individuals might, like for example myself, I identify queer because it isn't necessarily that I am only attracted to individuals of the same sex because I see individuals that can be of a different sex but of a gender that I am still attracted to.

So, I identify as queer because I find that no matter what sex an individual has, the gender that they're expressing is of more importance to me and drives my attraction more.

Aside: So, some folks might be attracted to just a certain sex, or all of them, or just a certain gender, or all of them.

Alie: And we're seeing at least a little shift in language where I think for a long time gender and sex were used interchangeably. But even from a scientific standpoint, those are completely different labels. Correct?

Daniel: Absolutely. Yes. As I study sex differences in the brain... and that's something that's been an interest of mine for a long time and specifically for these sorts of reasons. So when I think of sex, I typically think of how people are going to be defining it in terms of culturally. People usually reduce it to things like you're saying, "What's inside someone's pants," or chromosomes, or hormone levels. And really one of the things about human sex is that we have a lot more variation in terms of our development because of how it's portioned off.

Our bodies develop at different times, as our brains develop, and the hormone levels may vary during those times. Even individuals within the same sex actually show a lot of variation amongst themselves. There's a few studies out there showing within the brains. So, this is Dr. Daphna Joel, and she does work on fMRI scans of the brain, looking at actual human brains.

Aside: So, this is Dr. Daphna Joel, and Dr. Joel is an Israeli neuroscientist at the School of Psychological Sciences and the School of Neuroscience at Tel Aviv University. And this part coming up is amazing.

Daniel: What her work suggests is basically that instead of there being, like, these two monolithic groups of the male brain and the female brain divided by sex, there's actually sort of more of a mosaic within every individual. So, each individual has both male and female regions, or masculinized or feminized regions.

One of the important implications of this, I think, is that rather than seeing differences between the sexes as huge and something of importance, we also really need to pay

attention to the fact that the differences between individuals are also very large within humans. [*large group shout: "Yes! WE ARE ALL DIFFERENT!"*]

The way I like to think about it is that any average difference between males and females is smaller than individual differences between any male and any other male, and any female and any other female. That's sort of getting to the idea of how gender can be developed in that it's not necessarily this black and white thing of man and woman.

There's sort of a spectrum and individuals might feel that their experiences go along more with a certain identity versus someone who maybe, like me, feels like oftentimes they're at odds. Like in some situations I'm absolutely seeing myself in a genderqueer light. I see myself as an individual who is working from this place of not necessarily having any restrictions based on my gender. Because of that, I'm able to more freely discuss my opinions in an authentic way.

Aside: Which is wonderful to express yourself without a filter of what culture tells you your gender is supposed to do. So, what would you do if people didn't see you as your gender assigned at birth? What would you do? Would you cry more openly? Would you buzz all your hair off? Would you ask different genders out on dates if you felt attracted to them? Would you stop waxing parts of your body that hurt? Would you apply for a higher-level job? Would you wear lipstick? Would you stand up to authority more? Would you be more nurturing? There's so many ways that expectations of ourselves change how we act.

Daniel: So, when I think about sex and gender, I really think about how humans are so much more complex than, for example, animals, where it's obvious that we can really measure some very distinct differences between male and female animals. Compared to humans those differences can be much greater than individual differences.

Alie: When an embryo, or a fetus is developing, there is a stage where the reproductive system is pretty much the same and then it can split off one way or the other. What's happening with brain development? I mean, this is a super stupid question, but is there an area of the brain that influences gender?

Daniel: So, that's a good question. One of the things I think has come from research looking into sort of a transgender brain, or the gendered brain is this idea of variety. And honestly, I feel like there these periods of development where, like you're saying, the gonads develop at a specific period and then the brain develops at a specific period. But, it's not just as simple as that. The gonads develop at a specific period and they release hormones at specific periods. The brain develops at a specific period, but also different regions within the brain are going to develop at different periods.

So, if you have variability with any number of those factors, you're going to end up with a lot more differences between individuals. Whereas, with animals you sort of have this much more strict aspect of development, because... like for us our brain development is very elongated and gender identity doesn't really solidify until we've actually developed a little past our natal periods. So, we actually, when we are born, there's likely no possibility for us to sort of express our gender, I would say.

Aside: So, gender reveal parties. Blue and fuchsia onesies are not an expression of gender. They're just clothes telling other people what you think your baby's gender will be, based on what is in their diaper. I have a really good friend, and he and his wife are

two of the smartest people I have ever met. Like true science geniuses. They have yet to announce their year-old child's gender because they say, "They don't know it." They call their baby they/them, or baby, or its name.

And they say if anyone's really curious about its sex, they can change its diaper. They slip up with pronouns and they're not upset if anyone else does, but they said it's an interesting experiment to not impose roles on a child. And also, it was a way to open their relative's eyes to gender expression and non-conformity. I applaud this and I love it. But what if you don't have a baby to run this trial on? Maybe look at lizards.

Alie: What about some of the neuroscience research you do? [*adorable purr-meow*] You've worked with western fence lizards, right?

Aside: I think that was their cat. Wait, let's hear it again. [*adorable purr-meow*] Dang, that was cute. Okay, western fence lizards, a critter we also talked about in Saurology with Earyn McGee, is a species Daniel's worked with.

Daniel: Yes. So, this goes back to my childhood actually, because I grew up right near sort of this really rocky field area. We had tons of these... they called them blue bellies in California.

Alie: Oh, yes, yes, yes! Wait, where about in California did you grow up?

Daniel: San Luis Obispo.

Alie: Oh, yeah. Yeah, okay. That's where you did your study too.

Daniel: Yes.

Alie: At Cal Poly, right?

Daniel: Yes.

Alie: Yes, okay, I know exactly what you're talking about. Yep.

Daniel: Yes, it was actually really awesome, because I loved watching them when I was younger. I'd spend hours outside. And that's another thing about me when I was younger, I just loved watching nature. I could sit outside and, like, stare at a plant and just [*Alie giggles*] stare at how it branches, and how the growth is happening, and which leaves are the most developed versus the ones that aren't, and where they are on the branch, yeah.

I would just sit there, and watch animals, and these blue bellies were absolutely one of my favorites to watch because they do these cute little push-ups. It's a territorial display when they see another male. These are the males performing pushups. You'll see them basking in the sun and if they see another male come nearby, they will do a territorial display. It helps to prevent physical interaction. If they can scare off this male with these pushups then neither of them has to go all the way to expend enough energy to get in a fight and possibly get hurt, which is a huge cost to the animal. [*"Do pushups!"*]

I just loved watching them, and when I got to Cal Poly and started working at a vet clinic, I realized I was really just enjoying my time in the lab there doing work on the microscope, and doing bloodwork, and things like that. So, when I was taking a biology course—it was basically just intro biology—and the professor Dr. Emily Taylor was giving a talk about these really cool studies where people looked at pheromones in humans.

What they were seeing is if these men wore these white t-shirts, and they didn't wear any deodorant or drink any alcohol or have any coffee, and then they took off the shirts and allowed women to smell them, and then allowed the women to rate the attractiveness of the men based on the t-shirts' smell, there's a positive relationship between how highly they score the scent and how highly they score the attractiveness of the male.

Afterwards, I walked up and I asked Dr. Taylor, sort of like, "Oh my goodness, has there ever been any research like this done in the homosexual community?" And she was like "Oh, well, there hasn't been, that is such an awesome question, and it's really cool that you're thinking about stuff like that. You know, there's a new professor here that's looking at the brain and actually hormones, which is sort of related." I had been sort of already thinking I really need to switch it up and when this opportunity appeared, I was like, "Okay, I'll check it out."

I started working in a lab and honestly... this was Dr. Christy Strand, and Dr. Strand's mentorship really just meant so much to me because in terms of feeling lost in the world of biology after what I had been through, it really helped to have someone like her, as well as Dr. Taylor, to really just provide me with a safe place to be queer and be a scientist.

Alie: And I know 500 Queer Scientists is great with helping people find that community. Do you find that when you were starting in science that it was kind of difficult to express your identity in academia?

Daniel: Oh, definitely. I was once advised to not put my volunteer work in the LGBTQ community on an application for grad school, because people might be biased against that. [*Alie groans*] So yes, absolutely, it was difficult. The school I attended, Cal Poly, is known for being somewhat more conservative, and during the time that I was there, actually, we got our first pride center, which started out as like, if you know those buildings that they bring in when they're doing construction?

Alie: [*laughs*] Yeah, like a trailer.

Daniel: And the other side of the building was actually the office for the construction worker. [*laughs*]

Alie: Oh my God.

Daniel: So we were in this little alley way...

Aside: But they say that that pride center, even though it was first situated in a portable building, was incredibly empowering, especially because in academia there can be pressure to conform to kind of older standards.

Alie: But I think the cool thing is, is that there's nothing more gender neutral than doctor.

Daniel: Oh yeah, that's my absolute one favorite thing. As soon as they told me I could call myself doctor, I was like, "*Everybody's going to call me doctor now!* [*as if through a megaphone: "Everybody's going to call me doctor now!"*]

Alie: Can you tell me a little bit about your PhD work or a little bit about the research? Like, what kind of questions did you really want to answer?

Daniel: I was actually really, really lucky. I worked with Dr. Cynthia Jordan, who typically does work on, sort of, a disease model that's looking at a disease called Kennedy's disease, which is based on hormone interactions with neurons. So, she's had this really cool discovery that interactions between the muscles and the neurons, looking at that specifically, you can sort of alter your methods of treating it and maybe interact with the muscle more rather than the neurons themselves.

Aside: Daniel says they struggled landing in the new territory of Lansing, Michigan. Looking back at the LGBTQ community at Cal Poly, they reflect:

"The community there really helped me to strengthen myself and really helped me find my power again."

But Daniel's PhD work at Michigan State University dealt with something they have been fascinated with since their early college days.

Daniel: When I was an undergrad, I learned about these mice that have lost this gene called the transient receptor potential cation channel two. [*laughs*]

Alie: Mhm, of course, rolls off the tongue. [*laughs*]

Daniel: Or TRPC2 is much easier. This protein is used by a sensory organ in the nose of rodents and other animals. It typically detects pheromones, and it's called the vomeronasal organ. And this organ basically specializes in detecting those pheromones. Pheromones are typically considered chemicals that are released by one animal that are supposed to be detected by an animal of the same species and enact a behavioral or chemical change within them. [*"You've got a nice smell about you."*]

So, when the vomeronasal organ senses a pheromone, it's able to send a signal to the brain that is sent to several regions. These signals are lost when the TRPC2 gene is taken out.

Alie: Oh!

Daniel: Yeah. I mean, there are very weak signals, but in general, the signal is lost. And so, these mice, they have a vomeronasal organ, but it cannot send signals to the brain mostly.

Alie: Wow.

Aside: Okay, so to recap, a vomeronasal organ aka a Jacobson Organ is in the snoots of a lot of reptiles and vertebrates and it's this patch of sexy sensory cells within the nasshole. That's a nose, and it detects 'heavy moisture-borne odor particles'. Humans have a little one too, but scientists don't even know if we use it past the fetal stage.

Also, a 'knockout mouse' is a genetically modified lab mouse that has had certain genes knocked out of it for research, in this case the TRPC2 gene. Without that gene, a line of communication between that organ and brain is lost. So, what happens?

Daniel: They show these fascinating behaviors. One of the really interesting ones is that the females that have lost this gene show male-typical mounting, meaning that they'll actually mount both males and females. So, it's really interesting to see just this female mouse that you typically would have to give a high amount of testosterone to in order to induce these

behaviors, to just simply be mounting any mouse that you put in there with it. The same thing is true for the males; they'll mount both male and female mice.

I was just fascinated by this when I was younger—well, an undergrad. When I was talking to Dr. Jordan about this, she had actually been very interested in looking at these mice as well. So, we decided that we would look at the brain because previous research sort of suggested that the reason why these behaviors existed was simply because the loss of these signals. So, the vomeronasal organ was gone, and without those signals the brain was acting differently.

I really thought that there must be something more to it, that it couldn't simply be that the signal is gone, and suddenly females are mounting. There had to be some more robust changes to something beyond just the vomeronasal organ. We decided to look into the brain of these animals, and I decided to look at these two regions associated with the behaviors that these knockout mice show that are altered. Not only did they show altered sexual behaviors, but they also show altered aggressive behavior.

Males that would typically aggress towards males, don't actually show any aggression towards males and they'll mount them. And then females, when they're nursing their pups, they have what's called a maternal aggression. This is really interesting, and it's actually related to another animal that I consider queer. Female mice in the wild, when they have a litter, want to protect it because if a male mouse comes along and those pups aren't his, he will kill them so that she will go back into cycling and can be impregnated because he wants her to have his babies.

Alie: Right, like literal toxic masculinity. [*both laugh*]

Daniel: Exactly. In action. Right here. And so, what the females do is, when they're nursing, they gain aggression and they only aggress towards males that are not the male that they mated it with. These females, which typically show aggression while nursing, when the gene is lost they don't. These big changes in behavior I've seen in these knockout animals, I felt like this idea that it was simply the loss of signals in the vomeronasal organ, it was too simple to explain it.

I feel like Cynthia really felt the same and she was like “Let's do it. Let's look at it. Let's get these mice and look at the brains.” I was really excited. We did it, and it was really cool. We did find that within these two regions, there are quite a lot of changes between the wild type animals, which are the ones that do have the gene, and the animals that don't. Actually, I'm working on the manuscript for that right now.

Aside: So, Daniel's working on a manuscript about those reproductive behavioral changes and they can't say much about it, but they were like, “I *can* tell you about more queer behavior in animals,” and I was like, “Hello, my ears are open!” So, remember the lady mice who will usually throw down if someone tries to eat their babies and then date them?

Daniel: The same exact paradigm actually happens in lions. When a pride is headed by a male, the females will mate with him and they'll have all their cubs. But if that male dies, then another male comes in and if there's cubs in the pride, he'll kill them, because that will cause the females to start cycling again and be able to have more cubs sooner. [*“What a dick.”*]

Now, some females have developed this ability to grow a mane and develop a really deep roar. And so if a female is in a pride, and all of her sisters have cubs, and that's really great genetics for her because she's still got her genes going on to the next generation. If the male dies, and another male comes in, it's definitely helpful if she's got a mane and she can roar like a male lion and she can protect the cubs for a little while longer.

Alie: Oh my God. [*“Life, uh, finds a way.”*]

Aside: Just want to say that as a child-free aunt with huge, untamed red hair, I am just fееееeling this vibe. To my niecephews, if you ever have a stepdad who sucks, God forbid, I will scream in his face!

Alie: I had no idea that was a thing. [*both laugh*]

Daniel: Yeah. I mean—this one specifically—I love it, but I don't believe there has been any specific work to make sure that's exactly what's happening, but it's definitely something that can occur based on the behavioral interactions in lion prides.

Alie: Mhmm, and in hyenas, there's a certain species of hyenas that have almost like a pseudo-phallus, right?

Daniel: Yes. The females who have this giant clitoris that the birth canal goes through. They are... like you said, they're pseudo-phalluses, and it's really interesting because of how not only is there this pseudo-phallus on the females, but what people would consider gender roles are switched up, in that the females are the ones that are really in charge and the males are very submissive to these females. [*both laugh*]

Alie: Is that hormonal too, do you think?

Daniel: One of the things that's really interesting, I think, in animals, is that hormones can have different effects in different species that are very related.

Aside: Did you click play on this podcast to gossip about the love lives of prairie voles and mountain voles? You know you did.

Daniel: Prairie voles, I believe, are monogamous and montane voles are polygamous, and the brain regions that they have that control pair bonding have receptors for oxytocin and vasopressin. And depending on the number of receptors, controls whether or not they are going to be expressing polygamy or monogamy behaviors.

Aside: Wow. So yes if a prairie vole—which is like a little meadow mouse—hangs out for a day or so after boning, they will bond for life, and groom, and cuddle, with each other, probably start wearing matching windbreakers, order the same salads, and they'll mate and raise babies together. Doesn't mean they won't occasionally get some on the side, but their brain chemicals act like an emotional epoxy and they are life partners.

Alie: That's so interesting that this is happening all over nature and that it's chemicals. I mean, all we are is a big bag of soupy chemicals in general, we're just a bunch of rearranged molecules, but that's so interesting to see how that behavior is in the wild too.

Daniel: Yeah. And another thing, deer that have low levels of androgens. Male deer that either have somehow had some testicular trauma, [*“Ow, my balls!”*] or they were born with androgen insensitivity, they might grow up to be what's called a 'velvet deer'. These are

the deer that have antlers, but they're still that fuzzy velvet. What they've shown in this one that has actually been studied, they looked at a population of deer that had these male queer deer in them and then they had another population that didn't. And they were looking during the mating season.

What they found is that in the populations that had these queer deer, the aggression that was directed towards females was reduced because males sort of directed it towards the queer deer, but because these velvet queer deer were like very wary of the males and didn't need to reproduce with them it just didn't affect them, but it had the effect of reducing aggression towards the females. The idea of these feminized males reducing aggression towards females has been put forth in a lot of different species actually.

Alie: It's sociological as well as neuroendocrinolo-- neuroendocrinologic-- I can't say that.

Daniel: Neuroendrog-- Blah! I can't either.

Alie: Yep. It's really hard [*both laugh*] to say. I don't know why.

Daniel: [*carefully enunciating*] Neuroendocrinologically.

Alie: Yes, thank you.

Aside: Neuroendocrinogi-- mm. Neuroendocrono logical. Fuu--! Neuroendocrino-- mm. Neuroendocrinol-- Neuroendocrinological. [*softly*] Yes.

Okay, it's a real mouthful. So while my face recovers from trying to pronounce that, let's take a quick break for some messages from sponsors. Each week our Ologist chooses an organization to get a donation, made possible by sponsors of the show. And this week Dr. Daniel Pfau chose the Marsha P. Johnson Institute. That's MarshaP.org, which we're going to talk about a little later in the episode.

This episode and the next are dedicated to her memory and to all of the strength and contributions that Black trans women, and men, and non-binary people who have made such huge sacrifices and leaps in establishing traditions of pride and the effects of that that it's had on our culture. So a donation was made to that wonderful institute, thanks to sponsors of the show.

[*Ad Break*]

Okay, we'll get back into conversation with Daniel, who—are you ready for this?—had a paper published just last year titled, “The De-Scent of Sexuality: Did Loss of a Pheromone Signaling Protein Permit the Evolution of Same-Sex Sexual Behavior in Primates?” And if you're listening to this in the car or somewhere with a low ceiling, watch out. Or open your sunroof, because you will definitely punch a fist in the air in a second.

Daniel: So this article is actually really interesting. So if you remember, I talked about how when I was in ex-gay therapy, or conversion therapy, the scientist who had given the talk at the conference talking about how ex-gay therapy could work actually published in this journal called the *Archives of Sexual Behavior*.

And it was this article that sorta was like, “These patients said it worked, and so we're saying that it might work.” And when I eventually came up with this theory, I was able to

actually publish it in that same journal. [*Alie gasps loudly and begins to laugh*] So that was sort of fun.

Alie: That's amazing. That's amazing.

Daniel: Yeah. I was really excited, too. Honestly, one of the things that I like about this format that I've been able to publish in, it's called a target article, is now experts are weighing in on it and I'm going to be able to go back in and be like, "Okay, let me clarify this." But it's been interesting, the general theory that I had. And this is something that I'd even started thinking about when I was an undergrad too, because when I was an undergrad, I found out that not only do these TRPC2 knockout mice show these same-sex sexual behaviors, but humans lost the TRPC2 gene a long time ago. [*"Wait, what?!"*]

Yes. And so I was like, to me, my young queer mind, I was like, "What?! How can no one be talking about this? How can no one be thinking about this? Why wasn't anyone being like, 'Oh my goodness?'" And I was just flipping out and everyone around me was just like, "Calm down."

Alie: [*squealing*] Yeah, no! You're like, "I'm not gonna calm down, this is amazing!" [*deeply inhales*] Oh my God.

Daniel: And so eventually, this target article came out of that. And it was really awesome to write, because I really had to look at a lot of different fields, everything from archeology to things like neuroscience and genetics. And I really just tried to focus on the basic science of it. What I think is really interesting, and what I sort of allude to in my article, is the idea that if we've been evolving with same-sex sexual behaviors for so long, then things like ex-gay therapy just simply don't make any scientific sense.

Alie: Right. And not to mention it's an incredibly emotionally invasive and traumatic experience, correct?

Daniel: Oh, absolutely. Absolutely. It's something that I still struggle with every day, honestly. It's not necessarily something that disrupts my day, but there are moments probably every day in which I think about that and think about how it hurt me.

Aside: If you are fortunate and privileged enough to not know what conversion therapy entails, consider yourself lucky. I'm not here to retraumatize anyone, so I won't go into some of the historical horrors—physically, surgically, emotionally—that have been exercised on people, but some of the lightweight techniques include so-called "therapies," prayer groups, and peer pressure and more.

Study after study has debunked it as the ultimate flimflam: changing a person's sexual orientation through outside pressure or medical techniques is not effective. It's pseudoscience, harmful, tragic and in my vernacular, it is extremely shitty and awful.

Alie: And to be able to publish something to contradict the tool that was used to do that, how empowering is that?

Daniel: Yeah. It's very cathartic. Yeah.

Alie: Yeah. Does that kind of mean genetically that humans as a species are more queer than other species? And is there something kind of affirming about that?

Daniel: Yeah, absolutely. I was just reading through a friend of mine's recent papers, Dr. Jay Bettergarcia, and they had a really interesting idea that when you have same-sex behaviors, it doesn't necessarily reduce the number of different sex interactions that can lead to offspring. So, not all different-sex interactions are actually going to lead to producing offspring.

Aside: I mean, anyone who's been on a dating app knows that, am I right? So how long have humans been functionally, biologically, wonderfully, a little queer? Or a lot queer?

Daniel: And so the idea is that this appeared 25 million years ago when the TRPC2 gene was lost. And that's part of what I suggest in my article, that same-sex sexual behavior appeared then and it's been evolving along with us that entire time. What that suggests is that both heterosexuality and homosexuality, or really just any queer identities, they developed in tandem. So when we have heterosexuality presumably developing, evolving, as individuals started to want to pair up in order to have offspring together or raise offspring, to express love, for sex, for emotional support, for resources, the whole time that the different-sex behavior was guiding that, same-sex behavior was present as well.

Aside: All through time, picture an era -- any era, any kind of hats or mustaches -- and many, many people in it were thinking [*crowd chanting: "We're here! We're queer! Get used to it!"*]

Daniel: This is where I like to go back to those really simplistic, basic ideas in science. We have this idea called parsimony, where the simplest explanation is the most sound. So, to me, it doesn't make sense to assume that heterosexuality and non-heterosexual identity is developed completely separately and somehow are exactly the same.

It boggles my mind. I'm like, "How could you possibly think that?" No, it has to have been that both of these things developed together. And all of these aspects are simply influenced by your attraction. But the heterosexual identity itself is very similar to non-heterosexual identities in all of these factors. And so to me, it just doesn't make sense to say, "Oh yeah, there's completely different evolutionary trajectory that would have had to happen to create non-heterosexual identities."

Alie: Right. And how are hormones affecting who we're attracted to?

Daniel: That's a really good question. Dr. Cynthia Jordan, she co-runs a lab and the other individual that is part of the lab is Dr. Breedlove. And he's shown these differences between finger digit ratios between lesbians and straight women. And this has been suggested to be influenced by the hormones themselves.

So the digit ratio could be influenced by the hormone levels in the development period. And so what we see in males is similar to what we see in lesbian women. So that suggests that the hormone levels that are influencing the digit ratio in males that are heterosexual is also influencing lesbians that are... It's also influencing lesbians. [*laughs*]

Alie: Lesbians who are lesbians.

Daniel: Yes, lesbians who are lesbians. [*both laugh*] It's interesting because I liked that he was very open about the idea that this is averages, huge averages. And I think, one of the

things that I learned from Dr. Jordan's work is the idea that different muscles in the body in different areas of the body are going to have different sensitivities to hormones.

Aside: For funsies, you can look up the paper, "What Neuromuscular Systems Tell Us about Hormones and Behavior." Also, just a fun fact: alongside Dr. Cynthia Jordan there's another author on the paper, a well-known biology of sexuality researcher, Dr. Marc Breedlove. Breed Love. Yeah. One of the world's experts on mating behaviors and sexual orientation is named BREED-LOVE. Is the world a simulation? Am I talking into a hairbrush and hallucinating that I have a podcast? We'll never know.

Daniel: Dr. Jordan had this cool study that looked at these two muscles in the body, and one related to sexual behaviors and one not so much. And the sensitivity to certain hormones like testosterone is different based on their function. And this can also vary between individuals. So, combining the work of Dr. Jordan and Dr. Breedlove, you can see that the idea is basically rather than one specific period of hormones leading to a lesbian identity, there's likely many variations of hormone levels available at specific periods, or the absence of hormones at different periods, all these different factors, or even how sensitive one individual is within a brain region versus another individual. And these all can influence the development of individuals far beyond, "Oh yeah, it's this one period that will make you gay if your hormones are this way."

Alie: Yeah. When it comes to the age-old nature versus nurture question, is that even a valid question?

Daniel: Oh, no. Not at all. I think that's just a silly question these days. Because it has just constantly been shown that and specifically for humans and our brains, absolutely. Our brains developed to work in the environment that we are in. So our brains are just super plastic, meaning that they're ready to be changed.

Alie: I've heard things about pregnant women who have had boys. If they've had a few boys that their body is trying to combat a certain amount of testosterone and that they're statistically more likely to have boys who are queer. Is that even a thing? Are maternal hormone levels even influential in the brain like that?

Aside: Agh, okay I asked about pregnant women and maternal testosterone. Hello? Hi, Ward, what? Trans men can have babies and so could non-binary folks. I looked back and was like, "Oh, darn it!" So I'm sorry for fumbling that question. Thank you all for letting me learn in front of you. I love you. Also, Daniel phrases it as "gestational parent," which I think is really cool and inclusive.

So Daniel and I emailed afterwards about these testosterone factors, and they said the evidence for testosterone exposure in the womb is all based on things like, "We see this in men and assume it's because of high testosterone in the womb. And we see it in lesbian women too, so maybe testosterone exposure makes some people gay. No one has actually measured testosterone levels," they say.

Daniel continues. "First evidence: for gay men, the more older brothers you have, the more likely you will be gay. Theory is pregnant people may gain anti-male factors from male pregnancies, leading younger brothers from the same gestational parent exposed to increasing levels of anti-male antibodies for each older brother, and these anti-male antibodies might prevent testosterone from masculinizing the fetus."

"Now, second evidence," Daniel continues, "Finger-digit ratios in homosexuals match different-sex heterosexual peers at the population levels. So theory: some evidence suggests testosterone level exposure in the womb changes finger-digit ratios. That's the length ratio between two different fingers, and this suggests that testosterone sets up "normal" attraction -normal is in quotes- in heterosexuals but the process appears "opposite" in homosexuals."

Daniel continues, "My own interpretation of these data is that sex and sexual orientation are partially uncoupled. Similar but very complex processes can lead to similar attractions regardless of sex assigned at birth. There's even variation within these processes as gay men show what might be considered hypermasculinization in some features. Fun fact," Daniel notes, "Studies suggest that cis gay men have longer penises than cis straight men on average." Daniel continued with some additional fun facts.

Daniel: So Dr. Ashlyn Swift-Gallant, she does really cool work on the androgen receptor, and this is another area where variation can occur. So individuals with specific types of androgen receptors actually show variability in the sex position they prefer in anal sex.

Alie: Huh, really?

Daniel: Yeah. I think what the study though really points to is this idea of, once again, a variation that, "Well, there is this sort of possible explanation." There still is just a lot of unexplained data. And I think Dr. Swift, she does just a phenomenal job of making sure that it's an important thing beyond the single factors that are within a research paper.

Alie: Right. And in your scientific opinion, perhaps, is everyone a little queer?

Daniel: I mean, I would say that I prefer to let people express their experiences, you know?

Alie: Mhmm, yeah. You're like, every single person, "Here's data." Yeah, that's a pretty broad question but are maybe more people more queer than they realize?

Daniel: Absolutely. I think absolutely. I think there are definitely people who are absolutely only attracted to the opposite sex or different sex individuals. And I think there are people who are absolutely attracted to same-sex individuals only. But I do think there are a lot of individuals who are in the middle there that, I mean, it's simply easier to live a heterosexual life.

It just is that way. And honestly, if I had been given that choice when I was younger, I would have taken it. And I mean, now obviously I'm glad that I didn't have that choice, but I think that there's a lot to be said for social change, bringing about more individuals feeling comfortable to express their identities. And honestly, there's been quite a few studies related to gender identity that have shown a huge increase in the number of individuals within younger populations that identify outside the gender binary.

One study even found something around like 12% of younger individuals, and I'm trying to remember the exact age range but I believe it was under 21, identify outside of the gender binary. And interestingly enough, the study also showed that looking at older populations, that was really low. So in older populations, it was only about like 1% or less. And so just to see that there is this large change really sort of makes the need to be reflective of this in science and be reflective of what kind of research we're doing in science as we gain a larger population.

Alie: Yeah, absolutely.

Aside: So how many people would choose an iced caramel macchiato when it's not on the menu and they didn't even know it's possible? But just because something isn't supported as an option in certain cultures, or religions, or institutions, doesn't mean that that thing doesn't exist somewhere, and that people wouldn't prefer them. So we've been given menu with two options for too long. There are a lot of other drinks out there and they're wonderful.

Also, I found myself at 1am researching YouTube compilations titled "Gender Reveal Parties Gone Wrong," in which balloons full of blue powder pop in people's eyes, and confetti guns hit toddlers, and rural fireworks [*several fireworks going off, "Wooo! It's a boy!"*] spark grass fires. But actually, I will be honest: the most disturbing part of all of it was just this weird consistent theme of the blue balloons getting cheers and shrieks of joy from the audience of the parties, and then the pink cake filling getting wails of mourning from soon-to-be siblings, and disappointed shrugs from dads, because in that split second of knowing the sex of their child they make a lifetime of assumptions about how that future child will behave and what they will offer them, based on centuries of entrenched roles that we're all supposed to play.

Little did they know, these gender reveals are just a misnomer. Who knows what your kid's gender will be? Only they do.

Daniel: Honestly, they're just revealing their sex. [*laughs*]

Alie: Yeah. Because you can't reveal someone's gender, it's really up to them. But can you imagine if they just had like a "Crotch Reveal Party"? Like it's really just a crotch reveal.

Daniel: [*laughing*] That's really what it is, yeah.

Alie: Yes! That's all it is. Like, "From the sonogram, we can tell you: the crotch of our baby." Okay. I have some questions from listeners. Is it okay to run through some like lightning round and ask you some?

Daniel: Yeah.

Alie: Is that cool?

Daniel: Of course.

Alie: Also for every episode, we donate to a charity.

Daniel: I was thinking of maybe donating to the Marsha P. Johnson Institute?

Alie: Great.

Daniel: I figured it was perfect for Pride Month. As you probably know, Pride started as a protest against police brutality. She was an amazing organizer, a brilliant activist. She basically saw that, white gay men were saying, "Hey, we need to be nice about this and calm and respectable." And she, and really the trans women of color, were facing the worst of it, you know? Even though police were raiding all gay bars, they were mostly targeting women of color and specifically trans women of color. And so these, sort of, respectability politics weren't gonna fly with individuals who were in the thick of it. And so when she took a

stand and she really started to organize it and she did this with another trans woman of color.

Sylvia Rivera was another individual that, with Marsha P. Johnson, really helped to build a social justice movement, and it is thanks to their efforts, really, and the police brutality that sort of changed the nation's view of the queer community as they saw these police sort of dehumanize this population, that really helped to sort of shift the nation, as well as really, just started the LGBT rights movement. And we really owe all that we have in terms of rights to these trans women of color that sort of started, basically, what's going on right now. I really like the idea of supporting this group because they are specifically looking to support trans women of color and the Black trans community.

Alie: That's awesome. Oh, that's amazing. Thank you for telling me about that foundation.

So since this is a two for one episode, we'll get to donate twice to the [Marsha P. Johnson Institute](#), and according to their site, the "P" in her name stood for "Pay It No Mind," which is what Marsha would say in response to questions about her gender. The Marsha P. Johnson Institute protects and defends the human rights of black transgender people, and they do this by organizing, advocating, creating an intentional community to heal, and developing transformative leadership, and also promoting their collective power. So they were founded both as a response to the murders of Black trans women and women of color and how that's connected to their exclusion from social justice issues; namely racial, gender, and reproductive justice, as well as gun violence. So a donation was made to MPJI to help keep funding their incredible community organizing and artists' fellowships. And stay tuned next week when Dr. Pfau takes all of your questions and there are some excellent ones! So you can follow them [@endokweer](#) on Twitter.

We are at @Ologies on [Twitter](#) and [Instagram](#). I'm at [Alie Ward](#) on [both](#), and there are gonna be more links up at [AlieWard.com/Ologies/Neuroendocrinology](#). And if there's anything you'd like to school me on, there's a contact form on my website. If there's a gender or orientation I glaringly overlooked, let me know. I'll make it up to you in the next episode. I just want to make sure that these episodes are as inclusive and correct in their representation because once again, I just love you all so much. So yes, that contact form is at [AlieWard.com](#).

And *Ologies* Merch is available at [AlieWard.com](#) as well. Thank you to Shannon Feltus and Boni Dutch of the comedy podcast, *You Are That*, for managing merch. We're still a few weeks behind our usual because of CoVID, so thanks for being patient. The warehouses just have limited staff for maximum safety. Thank you, Erin Campbell, for adminning the [Ologies Podcast Facebook Group](#). Thank you, Emily White, and the team of transcription heroes, making transcripts accessible for free at [AlieWard.com/Ologies-Extras](#). There are also bleeped episodes for kiddos up there, thank you to bleeper, Caleb Patton.

Thank you, Noel Dilworth, for all of your scheduling help. Kelly Dwyer updates the website. Thank you, Jarrett Sleeper of MindJam Media, who does initial edits and also sometimes carries me to bed when I fall asleep on the couch. And of course, to a flower-crowned gem, Steven Ray Morris, who lead edits and uploads these into your ears. The theme music was written and performed by Nick Thorburn of the band Islands.

If you stick around to the very end of the credits, end of the episode, I tell you a secret. And a lot of new listeners are like, "Why does this lady with the uncombed hair call herself our dad?" And it

started because I like to talk about old cars, and bugs, and give loving advice, but I have just never felt like a mom, like I was going to be a mom, or I should be a mom. I don't know, I think part of why I'm child free is that I just never felt like that role was right for me. I really wanted to be a dad, but I just never kinda wanted to be a mom, maybe I didn't think I can handle it. I don't know.

And I've always been pretty sure I'm straight but that doesn't mean I don't think ladies are hot, and that gets confusing, and honestly, I feel like a whole lot of people feel this way but just have not had words for it. So if you feel like you don't fit into one box or another, don't worry. You are not weird. Having two very rigid boxes to describe the nuances of humanity, and love, and self-expression is what's weird. So be patient and supportive of everyone being open and honest with themselves in the world. The people who are moving these discussions forward by being brave about themselves, they're the ones making it easier for the next generation to know themselves better and to be themselves fully, and I thank you all for that.

Okay, berbye. See you next week with part two. Okay, berbye again. I should have said that, yeah.

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Edits by Kaydee Coast, who reminds you don't lick toads, check your crevices, milk your thumbs, and to never apologize for asking questions. Kthxbi.

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[The Gender Unicorn](#)

[Amazing GLAAD + Refinery29 glossary of gender identities](#)

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