Research the Resonates
Villanova CLAS Podcast
Episode 1 Transcription
Genetics: Understanding Instinctual Behavior

HOST: Chelsea Gerrard
Guest 1(JD): Julia Duckhorn ’20 CLAS
Guest 2 (TS): Troy Shirangi, PhD

Intro Sound: *Fly buzzing*.

TS: Typically, what’ll end up happening is the male fly will encounter a female and he'll orient towards her, and he start basically chasing the female and while he does that, she's running away, and he'll extend the wing and vibrate it, and it’ll produce a song.

Sound: *Imitation of the male fly song*.

TS: What the female is basically doing is using that song in some ways to basically assess the quality of the male, you know if he's fit, and if he is she'll slow down and allow mating to happen. Then, what he'll do is bend his abdomen 180 degrees and attempt to mate with her.

HOST: You're listening to Research that Resonates, the podcast from Villanova University's College of Liberal Arts and Sciences, that takes you inside the labs and classrooms to learn from our distinguished faculty and students. I'm your host, Chelsea Gerrard.

In this miniseries, we're talking to research teams who studied genetics. I sat down with biology professor, Troy Shirangi, and Julia Duckhorn, who recently graduated from Villanova with a bachelor's in cognitive and behavioral neuroscience to learn about the research they've done in the fruit fly.

TS: I’m Troy Shirangi and I’m with the biology faculty here at Villanova and I've been here since 2016.

JD: Hi, I’m Julia Duckhorn and I'm from Napa Valley, California.

HOST: Dr. Shirangi and Julia have been studying courtship and fruit flies because it's an innate behavior, it's instinctual.

TS: If you took a male fly from the moment that it came out as a fly, and you kept it in isolation, days later, weeks later, if he encounters a female fly for the very first time in his in his life, all of the behaviors will unfold automatically. The reason why that's interesting is because it's not learned, he doesn't learn any of it. If he doesn't learn it, where does it come from? It has to come from genes. What we can do is we can basically try to find genes that contribute to either the male's behavior or the female's behavior in a way of trying to understand how exactly the genes build that potential for the instinct for the male and female behavior.

HOST: They have been studying a gene called the “dissatisfaction gene” in fruit flies because it has a direct effect on courtship behaviors. Here's Julia.

JD: Dissatisfaction is a gene that's important for development in the nervous system of fruit flies. One method that geneticists use to approach how to determine which genes are important is they will knock the gene out in the fly, and then you'll see what happens to the fly. How does their behavior change when they lose that gene? When dissatisfaction is lost it causes a number of courtship deficiencies in the male and females. The male's become unsuccessful when they attempt to court the female. What they found was that it's because he's not able to fully bend his abdomen 180 degrees to complete a successful mating. And when it's knocked out in the females, they become unreceptive to the males, and they will just run away. If mating eventually does happen. They're able to make eggs, but they're not able to lay them.

HOST: So, the dissatisfaction gene plays a critical role in a fruit flies courtship behavior. But it's also important to understand how this plays out neurologically. There are two general theories on how genes inform the neurological path. Dr. Shirangi explains.

TS: Originally, when we kind of were thinking about how instincts and where they come from, you can kind of think of it in two different models and two different ways. One, you could imagine that in the nervous system there would be specific and defined separate, distinct pathways in the brain that would be for that instinct. I was thinking of this metaphor of having apps on your phone where you can think of having a specific app for every behavior and instinct that an individual like an animal would produce. The alternative would be that there aren't different apps, but just one app that is multifunctional and has the ability to just get reprogrammed, depending upon the state to give you different behaviors. The work in the fly that's been going on for the last 15 years or so seems

to suggest that it's the individual specific app version that's working in the flies.

HOST: The fruit fly has close to 100,000 neurons and they've whittled things down to just three that appear to be important for this very specific behavior.

JD: So far, what we've done is we found a set of cells in the nervous system of the fly that's really important for this courtship behavior. That dissatisfaction is doing something in these cells to affect the behavior. There are about three sets of cells in male fly that's important for these behaviors and a bit more in the female, there about 10 types of cells.

TS: One of the things that's really cool is we can shut the cells off in the fly, that's behaving and what happens is he can't bend his abdomen anymore. So he'll court, but then he loses that ability to bend. And then the another set of experiments that Julie has done is we can have the ability to activate the cells to turn them on in response to light, so we can shine some light on it and then we can force those cells to fire, to get turned on. When that happens the male bends his abdomen.

HOST: For genetic researchers, there aren't a whole lot of animal systems that allow them to whittle down to the neurological circuits and specific cells. Fruit flies are one of the few model systems available for this type of research, which is why Dr. Shirangi uses them in his lab.

TS: So to be able to understand how genes build circuits, one of the challenges that we face is that we have to somehow not only find genes that affect behavior, but we have to figure out where those genes are expressed in the nervous system. Then, we have to figure out which of the cells in the nervous system that expressed the gene are the ones that are really important for the behavior. And then finally, we can then go back and say how does the gene contribute to those to those cells and those circuits to build the behavior? What we're hoping is that in time as we do our work, and then other labs and other places start to do their work and in the course of 15 to 20 years, a picture will begin to emerge of this as some basic textbook level, basic principles of how genes build circuits.

So, what we're hoping to do is we're not necessarily interested in dissatisfaction for dissatisfaction sake, as much as we're hoping that it's serving us as a model that we can kind of get very foundational understanding of how genes contribute to circuits, more generally. And

when we have that foundation, then when it comes down to down the line for trying to understand how genes contribute to like human behaviors or like neurological diseases, for instance, there will be that blueprint that that sort of that scaffold there where now the details can kind of get filled in.

HOST: Dr. Shirangi received a National Science Foundation CAREER Award to support this research. A CAREER award is a pretty selective and prestigious award given to faculty who are early in their career and have the potential to serve as academic role models in research and education. Thanks to the CAREER grant, Julia was able to continue working in Dr. Shirangi's lab for a year after her graduation, an experience that has been incredibly influential in her education.

JD: Coming to Villanova and having this experience, it just opened up this whole other idea of what my career could be like. And then also I think what's been really helpful about being in the lab is seeing the principles that I've been learning about in my psychology and neuroscience and biology classes, how those actually apply to the real world and being able to manipulate these things and see the changes myself, I find really interesting. It's helped shape clearer pictures of what's going on when I'm in those classes, having that hands-on, firsthand experience with using the tools and having to actually learn what the tools do in a deeper way.

HOST: Thanks for listening to Research that Resonates. We've produced two other miniseries: one on sustainability and one on the intersection of youth and identity. You can check those out on Apple podcasts, Google Play, and Spotify.