The Taproot podcast
Season 4, Episode 2
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Hosts: Ivan Baxter and Liz Haswell
Guest: Scott Barolo
Transcribed by Joe Stormer

[Instrumental theme music]

Ivan Baxter: Hello, everyone, and welcome to The Taproot podcast. This episode wraps up the first half of this season on cultivating your career. In the first half, we've been focusing on the process of deciding on, choosing, and applying to grad school. I'm Ivan Baxter.

Liz Haswell: And I'm Liz Haswell. Today's guest, Scott Barolo, brings a wealth of experience as the director of a graduate program. Be forewarned, our conversation was SO GOOD that we had to split it into two parts.

Ivan: So without any more delay, let's get on with the episode.

[Instrumental theme music]

Ivan: Hello, and welcome to The Taproot.

Liz: Today's guest is Scott Barolo – associate professor of Cell and Developmental Biology at University of Michigan's Medical School. He got his PhD at University of San Diego with Mike Levine and continued there to his post-doc work with James Posakony. He started his lab at University of Michigan in 2003 and they study all kinds of transcription pathways, repressors and enhancers in Drosophera. Scott is also the director of the graduate Program in Biological Sciences (also called PIBS) at University of Michigan. None of this may be familiar to our Taproot listeners *except* if you are at all engaged in scientific Twitter, you will definitely recognize his name. He's one of the founders of the Nine Reply Guys (we'll link to that in the show notes). He does something called *live tweeting* of Jane Austen novels and apparently also Star Wars; he just

regularly dispenses all kinds of advice and commentary on scientific culture. So welcome to The Taproot, Scott.

Scott Barolo: Hi! Thanks Lizz. Thanks Ivan.

Ivan: And let me just say what a huge fan I am of the Nine Reply Guys. Before going on to talk about today's paper -

Liz: Go ahead and say what that is.

Ivan: Oh yeah. So the Nine Reply Guys is a deeply-researched, highly-scientific classification of Twitter ********* (sorry) -

Liz: Harass-holes.

Ivan: Harass-holes. The way that men (mostly men) reply to people in unhelpful ways on Twitter and other social platforms.

Scott: Right, exactly. There are these patterns of behavior that if you spend time on Twitter or any online forum you see over and over again. It is gendered; very often you see these behaviors being used (not always but very often) being used by men who are responding to women in unhelpful ways to derail the conversation or center themselves or do any number of things that are not constructive to what the original poster wanted to talk about. And once you start paying attention (as you said, Ivan), you see these patterns of behavior over and over again. So what we wanted to do was simply list them, catalogue them, and name them. Some of them were already named and some of them we came up with our own names for. So if you are online trying to talk about your research or experience of – say – being sexually harassed in academia (just to pick an example), lots of people will chime in with their own takes on that and if they fall into one of these common patterns you can simply say, "I see what you're doing; you're number six - *the sea lion*," and in my experience these guys hate to be told that what they're doing is not original and falls into a pattern. They absolutely can't stand it, and lots of them just go away.

Liz: I love every part of it.

Ivan: And it's a great example of sort of the way that Scott is coming at some of the issues from a very different perspective. Another one is sort of the paper that we're going to be talking about today, which also shows how Scott's coming at something from a different perspective and that's how you can teach scientific principles. The paper that we're going to talk about today is *Using the Game of* Mastermind *to Teach, Practice, and Discuss Scientific Reasoning Skills* by Strom and Barolo, published in PLOS ONE in 2011. Scott, can you give us a quick summary of this paper?

Scott: Sure. So *Mastermind* is a game that we didn't invent; it's been around for a long time. I played it as a kid as a boardgame where you have a board with holes and you put colored pegs in those holes. It's a code breaking game so if I am the code maker, I will create a sequence of colors using colored pegs that is hidden from the other player. Their job is to try to crack the code and guess the sequence of colors. They do that by making guesses on the board. They will lay out a sequence of colors and I will give them a score that basically reflects how close their guess is to the right answer. You might get *red peg* is one of the colors is correct and in the right location, a *white peg* if one of the colors is correct but not in the right location – that kind of thing. From that information that you get from me, you devise a new guess and through an iterative process of getting feedback from me and making new guesses you get closer and closer to the answer. The goal is to crack the code in the fewest possible attempts. It's a pure logic game (or I thought it was a pure logic game, but actually I think there is a psychological aspect to it). But in any case it is certainly a logic game. I had forgotten about that game that I had played as a kid for many years and then I played it again at a departmental retreat about ten or eleven years ago here at Michigan and realized that lot of the same thought processes that I was using to try to break the code I use in the lab when designing and interpreting experiments and so that led to me forcing all of my students to play *Mastermind* with me. A lot more thought went into that and the parallels with critical thinking – what kinds of lessons can you learn from the game that relate to what we learn

in the lab. Together with an undergrad in the lab (Amy Strom, who's a post-doc at Berkeley) we co-wrote a little paper about *Mastermind* as a scientific teaching tool, which ended up somehow getting published in PLOS Biology.

Ivan: I love this paper, just the concepts of how you can use a game t talk about the importance of negative results and showing that if you design your experiment correctly, a negative result can tell you just as much as a positive result. Those kinds of simple concepts – I think that's just great. It's been a while; have you used this *Mastermind* now in classes over the last seven or eight years?

Scott: Absolutely. I teach a logic and reasoning course here at U of M and there's a day when we just play *Mastermind*. One of the homework assignments is for the students to play *Mastermind* with a friend and then analyze the results as they go. What hypotheses are ruled in and what hypotheses are ruled out from each new set of information?

Ivan: That's awesome.

Liz: I find this whole part of trying to teach (mostly just students in my own lab or trainees) concepts of logic and reasoning, sort of the same as trying to teach writing. I know what it is when I see it but I don't really have any sense of how to teach it. What I love about this paper is I feel like it gives me some sort of handle on how I can start teaching it, other than saying, "Just read more papers."

[Laughter]

Scott: I've been struck over and over again by how flexible we have to be as trainers to let trainees learn things in different ways – whatever way works for them. One moment in my career as a mentor that really blew my mind and made me rethink things – I was having a one-on-one meeting with one of my graduate students and I was going on and on as usual and I thought I was displaying my thinking process [laughs] for this student so that they could learn how I interpret data. We were going over her data and I was talking about it. She asked me very, very nicely (and I'm sure this was a scary thing for her to

say) if the next time that we met and she brought in new data, if I could not talk about it and give her some space to talk out loud about it without me chiming in because I tended to dominate that conversation as the senior person. She understood what I was saying but I wasn't allowing her to get there by herself or to go to a different place that I wouldn't have gone to. That really shook me up (I think in a positive way) and I think that teaching sometimes involves not doing anything at all.

Ivan: I think that the individualization is so important because depending on what the trainee is and how they are (how they process it) it's hard to detect sometimes -

Scott: Yes.

Ivan: If what you think is working is working for that particular person. It's usually a painful process to realize that something that you think has been working as a communication method for months/years was not actually working at all.

Scott: Exactly. So maybe more important than finding the best method for teaching is to build trust with someone until they can tell you what works best of them.

Liz: I think that's true but I also think that asking them . . . that's something that I definitely don't do enough of. I remember reading somewhere, "The first thing you should be saying in your weekly meetings is 'How can I help you?' not 'What have you done for me lately?'" [Laughter] I think that asking the trainee, "How can I help you?" is kind of a mental flip there for a lot of us. It is for me.

Scott: Yes. And it's not the way we were trained. I think as a trainee, you're encouraged or rewarded for being the first one to answer - displaying how smart you are. But displaying how smart you are doesn't serve any purpose as a mentor.

Liz: Yeah. I think it's just sort of self-selecting. If it's easy for you to operate in the system in the way that it already is, you'll stay in the system and then you

propagate it without really thinking hard about it. And I think this is one of the things that I like about what you're doing in all the different areas of your work, Scott - I like your asking (as a white man), "What am I not seeing? What about the system that has helped me is obscuring seeing what it's like from other people's perspectives. That brings me to why we REALLY brought you on here.

Ivan: Ulterior motive!

Liz: I know! I feel like we could do an episode on every one of the things that was just discussed. But when Ivan and I were thinking about who we wanted to bring on to give people advice about how to apply to graduate school, we thought of you automatically because we wanted the advice to be different, a little bit out of the box, and a little bit different from the advice they might be getting from everyone around them. So maybe as a start, imagine you're talking to a junior in college. What's the whole sort of timeline that they should be thinking of as they start thinking, "Maybe I want to go to graduate school somewhere in biology." When do they need to start thinking about all of this?

Scott: Yes, okay. So if you want to go to grad school in 2020 . . . [gasps] it's going to be 2020 next year!

Ivan: Don't worry about the age of those students and when they were born in relation to when we actually started grad school or finish grad school.

Liz: It will make you feel so sad.

[Laughter]

Scott: That way lies madness; I will not think about that. But if you want to start grad school in 2020, then you should send in your applications in the fall of 2019, which means that this summer is a good time to talk to people, research school, look around online, and figure out which schools you want to apply to, and try to learn something about the application process. The applications are generally accepted (in the case of our program) September through November; so December 1st is the deadline for submitting applications. We start looking at those as soon as the deadline passes and we start making invitations to students.

So the first step for us is to look through our stack of applications and decide who do we want to invite to fly out to Ann Arbor and visit with us and do some interviews. We invite a little over three hundred students a year to come out and visit. So that is actually the most difficult cut to get past; that's the toughest cut. We are forced (because we can only bring out so many people for budgetary and space reasons) to not invite a lot of outstanding applicants. So if you don't get an invitation from us, it doesn't mean that we weren't really interested in you. It just means that we can only invite so many people, so that's heartbreaking for us at that stage. But we get to invite three hundred some people to come and visit. The interviews weekends happen in the early part of the following year – from January through March. In our case we have one weekend we bring in half of our interviewees we bring in the last weekend of January, the other half in the following weekend, the first weekend in February. After those interview weekends we make admissions decisions. We will make offers to most but not all of the students we have invited out for interviews. It's somewhere in the 70-75% (something like that) of the students we interview will get an offer. I'm giving you our numbers for the PIBS program; those numbers are going to vary from program to program and school to school. Then we have a deadline across (how should I say this) . . . biomedical PhD programs have a general agreement that we will give students until April 15th to make their decision. In general, we don't pressure students to decide early or we're going to withdraw the offer. If you have the offer, you can hold onto it until April 15th. Many, many students don't decide which school they're going to go to until pretty close to that deadline, so we don't know how big our class is going to be until April 15th because we make a certain number of offers and a certain proportion of those offers are accepted and some of those students choose to go to another school. The admissions process itself is all over by April 15th and then we switch to what we call *on-boarding*, which is giving our incoming class of students all the information they need to start the school year with us in the summer or the fall.

Liz: And then it's just papers, grants, fellowships, classes, and then a route to the

Nobel Prize.

[Chuckles]

Scott: Basically. That's what we expect.

Liz: So that's the overview – it's basically a year. If you want to go to grad school right after college, you need to start your junior year; the summer after your junior year you need to start preparing basically. Is that right?

Scott: That's right. But we have plenty of applicants and plenty of successful applicants who are well beyond that, who have been out of college for a number of years.

Liz: Yeah, I took a year off between.

Ivan: That's a good place to start. The first decision you have to make is, "Should I go to grad school?" And if I do want to go to grad school, do I wanna go right after undergraduate? One of the things that I felt, sort of wish I had taken a year. I didn't. Partially just because I think it would have been good for me to get a job as a technician in a lab to really see what the whole process actually looks like in terms of being in a research environment that isn't a summer REU program or undergraduate research where I was – which was a small college.

Scott: Yes. I think there's a lot of emphasis on students getting research experience – especially students who didn't have a tremendous number of research opportunities in college. There's a lot of emphasis on those students doing summer programs and post-baccs, other internships, other kinds of programs to get research experience. But I think there's a lot of value in working in a lab and getting paid – not through a program but just as a technician in a lab. It's a great way to ease into the research experience, figure out what it's all about, figure out whether that work environment feels good to you (if it's enjoyable to you). But eventually you're going to need to do more than wash bottles in the lab. You're going to need to get some experience as a researcher doing experiments in the lab. In many cases, getting a technician job is a

wonderful gateway to that. If you prove yourself as a competent technician in the lab or even washer of bottles or (in the fly world) a flipper of flies, you can often either transition to a research position or continue in your lab's support work while you're also doing experiments.

Liz: Do you feel like when you see graduate students coming into your program, do you feel like you have a sense of who has some research experience and who doesn't? I mean everybody has SOME but I certainly feel like there's a palpable difference between the incoming students who are coming off of one, two, or three years as a research associate and those who are coming right out of undergrad, kind of in terms of sophistication about what the whole enterprise is about.

Scott: Absolutely. I think that's true and I also think that students that have spent some time after college working after coming to graduate school – I would say in general they have a very good reputation among faculty (among trainers) because the stereotype of that group is that being older and more experienced, they are not here to mess around. They want to work efficient, get the job done, do a good job, and move on to the next thing where they'll get paid more.

Liz: So what's the draw back? Why doesn't everybody . . . like, Ivan, why did you go straight to grad school?

Ivan: The simplest answer is that it was the default. It was the next step and I hadn't thought it through very well. As a result, I made some decisions and ended up being in grad school for eight years – which *suboptimal* is sort of the word that I would use for that. I had that same stereotype of the people who got a masters or were technicians (coming in and really knowing what they wanted, being focused, getting stuff done quickly) seemed to apply to the programs that I was in as well. Whereas I had been an undergrad and I'd been taking classes and this was like college-extended. It took a while to get the habits of doing research down. That's not necessarily a bad thing (that's part of what grad school should teach you) but I do think that students feel like they want to get on to the next step. Grad school can be a long process and so if you want to be

done with grad school before you do X or Y or Z in your life, the sooner you start the better.

Liz: Although, you might get out soon if you spend a year in -

Ivan: That's true, but I also think there are probably people who get a job (thinking they're going to grad school) as a technician, and realize that's not what they want to do and for those people that's incredibly valuable because getting a PhD in the sciences is a long commitment – much longer than anything that someone graduating from undergrad has ever committed to (and I think that's important to remember).

Liz: Scott, what other things can you tell somebody who's trying to decide, "Grad school sounds cool. I bet I could do that." What do they need to be thinking about?

Scott: Well, I think the idea of graduate school and the reality of graduate school are different enough that it's important to have some significant time under your belt spent in the lab or at the computer if you're doing computational work (actually doing research) because the reality of it is very different from the idea of it or our vision of it. And there's nothing wrong with you if you think science sounds great, you try it out by working in the lab, and you hate it. That's called *being normal,* and there's lots of normal people in the world.

Liz: There's lots of ways to be a scientist without going to grad school, right?

Scott: Absolutely. Absolutely. Quickly referring back to the conversation we were having a minute ago, whether you go right out of school or you wait five or ten years after college to go to grad school, there's no right way to do that either. There's just what's right for you. If you're a junior in college and thinking about applying to grad school, we are not saying that you're not ready. You might be ready. It just all depends on the individual person. It's not at all unusual to try lab research and dislike it. It's a very particular kind of work and it's just not for everybody. It's not really so much about being smart enough; it's just having a taste for that type of work. There's a huge amount of uncertainty involved and

that is what drives a lot of people away. Uncertainty in general is unpleasant and for some people it's not something they want to spend their entire career dealing with. Uncertainty at one level or another never leaves you as an academic researcher.

Liz: Okay, so let's move on to the next part which is trying to decide which graduate programs to apply to. Let's get in a time machine [laughs]; I'll tell you how I decided. I was an undergraduate at the University of Washington in Seattle and I went to the big library Suzzallo (I swear I did this) and there was a book there that was like *The Best Graduate Programs* or something – I don't know. I looked it up in a book and it had a list of the top ten graduate programs in biomedical sciences (I don't know what it was) and [laughing] I just applied to those programs.

Scott: Wow.

Liz: Yeah! Don't do what I just said.

Ivan: Should we just go around and come up with three different ways of NOT doing it, cuz I have one that's almost as bad?

Scott: [Laughs]

Ivan: I was a chemistry major in college and so when I looked at grad schools I looked at chemistry programs. In hindsight, that was incredibly narrow because I should have been looking at biochemistry programs and mixed programs. It just never occurred to me. Since I'm younger than Liz, I went on the brand-new-spanking World Wide Web [Liz laughs] and started looking at graduate program websites (mostly in text-based browsers so this was pretty early) just sort of looking for people who looked interesting and used that as my way to pick schools.

Scott: So my process of selecting a graduate school is pretty haphazard. I don't remember how I ended up choosing the ones that I ended up applying to except in one case, which is the place I ended up going which is UC San Diego (which I had never heard of). But in any case UCSD came to mind because I was

researching a term paper for a class as a junior (this was a developmental biology course at Penn State) and I read a paper about enhancers in *Drosophila* (how does the early *Drosophila* turn on these genes in stripes in these beautiful circles around the embryo) and that paper blew my mind. That was the first paper – definitely the first paper to blow my mind. I thought, "Well where are they doing this? I want to go there." It was the lab at UCSD so I applied there and I ended up joining that lab. I was very lucky in a lot of ways to get away with being so simpleminded.

Liz: So in 2019 what should people be doing?

Scott: Well, it's a lot easier to find out about what kinds of research are available at schools now. Even departmental website (as simplistic as they usually are) will give you a basic run-down of who the faculty are and what they do. If you hear about a piece of research that interests you, you can follow up on that basically the way that I did but it's a little easier to do that now. If you have the opportunity to go to meetings (whether they're regional meetings or national meetings), keep your eyes open, pay attention to what sounds interesting to you. Even if you don't understand it at all, if it seems intriguing follow up on it and figure out where that research is happening. Talk to more senior students. If you're a first-year or second-year student, talk to students who are applying if you know.

Ivan: I think casting your net as wide as possible while doing your research is really good. I think obviously that's maybe building off my own mistakes of not thinking broadly about what I could be interested in, I came to regret. Especially these days as our definition of what a field is and what a major is and what that prepares you for is pretty fluid.

Scott: It can be pretty intimidating to see this barrage of information out there and so many people studying things that you don't understand. I would say at this point as you're looking for grad schools and choose which ones you want to apply to, what's important is your interest - not your mastery. You don't have to understand every detail of bacterial genetics if that's what you want to do or any

particular field that sounds intriguing if the basic questions sound interesting to you; that's a good enough reason to look into it. We don't expect our incoming students to be experts in the fields that they're going to end up studying.

Liz: The other thing I was thinking about what how most molecular research programs now (molecular biology in both plants and animals) are rotation-based.

Scott: Yes.

Liz: I think it's pretty rare in molecular biology programs for somebody to need to know exactly what they want to do. They really need be be looking at the PROGRAM level for the kind of training they want and to make sure that there are a couple of labs that look interesting to them. But they don't need to know, "I want to work on this project with this professor," prior to application.

Ivan: I think that's generally true, although there are significant numbers of programs that still do direct admits into labs.

Scott: Also caveat that you're talking to three U.S.-based researchers and I think in Europe it's much more direct-apply and less rotations. So if you're direct applying, I think that's a moment to take some time to really make sure that that is the right situations whereas if you're looking for a program (what Liz said) of finding places with interesting questions, interesting approaches, and multiple people who look like they would be somewhere that you wanted to work are really good and important things to think about.

Scott: I don't know enough about direct-admit programs to know how you should choose. I have a lot of experience with a program that requires rotations and I've never been more sold on the benefits of research rotations. It's expensive for a program to support that because you're supporting the student while they're rotating through your different labs. That requires in our case a big financial commitment from the medical school to allow us to support students while they're rotation for ten months, but we see the benefits every single year as students come in and they know exactly what they want to do and then they end up falling in love with a different area of research. Or they join a lab (perfect fit for them)

but they aren't comfortable with the lab environment or the mentor or there's poor communication in some way that lets them know (just from a rotation of two or four months) this is not going to be a productive atmosphere for them. It's an opportunity to learn that without putting your entire graduate career at stake.

Ivan: Well let's put a pin in that question of fit in the lab and go through the next couple steps cuz I think that's something that's super important for us to dig deeper in. So let's say you've done your research, you've narrowed yourself down to five to ten programs, and one of the things that probably matters for a lot of students is how many they should apply to because there's fees involved and so that can be very limiting. It is important to do a lot of research and really target: you think you can get into, you want to go to, and really focus on those.

Liz: How many places do people normally apply to?

Scott: I don't have any numbers on that. My anecdotal impression is five or six is very common.

Ivan: But I have heard of students doing fifteen which sounds insane [sic] to me.

Liz: Cuz it's like fifty dollars to apply or something, right?

Scott: It can be. Students should definitely look into the possibility of getting an application fee waver. Many students who especially have done any sort of research program that's centered on diversity will very likely qualify for application fee wavers.

Ivan: So it cannot hurt to ask.

Scott: It cannot hurt to pick up the phone and call the phone number for the admissions office in a program that you're interested in or email them. You can get a lot of valuable information that way.

Ivan: That's probably a good filtering step in the decision process is to do that. So now you have to come up with an application. As we talked about on our most recent episode with Zen Faulkes, there's a lot of things that go into an application. There's your GPA, there's research statements, there's your GREs

(maybe), there's recommendation letters -

Scott: Students write a personal statement and sometimes a description of their research.

Ivan: If you had to give advice to students applying to PIBES at Michigan, what are the one or two things that they should really focus on in their application that they frequently don't.

Scott: We get a lot of applications at Michigan and many other big programs get a lot of applications. The ones that I remember are applications where I can get some sense of the person writing it. I would say it's perfectly okay and in fact a good idea to let some sense of *you* come through, especially in your statements. I suppose there's a little bit of you there in your transcript, but where your personality is really going to come out is in your personal statement and even your research statement because how you interpret and how you dealt with your research experiences is going to be filtered through your personality. So like anything else where you're being evaluated by a group of people you don't know, it can be very valuable to have an advocate – have someone who will advocate for you in the selection process. I'm not talking about knowing somebody in the room. What I'm talking about is what somebody who is reading your application can go to the admissions meeting and fight for you and say, "This is a student who I think would be really interesting to talk to and we should invite them out for an interview." Most likely when somebody says that, the applicant is going to get an invitation.

Liz: To me that just sounds like code for "sound just like the people who are already running the show". I guess one of the things that I'm really worried about with respect to our application process is that we're weeding out the people that would bring new ideas, new approaches, new ways of thinking, new personalities into our graduate programs. If there's gonna to be some intangible, like be the person the people on the admissions committee already like, then how are we ever gonna get past always just recruiting the same people?

Scott: Absolutely. I agree with you 100%. When I say, "Let them get to know you," that doesn't necessarily mean, "Pretend that you're exactly like this person you're imagining," or what you think a successful scientist is like. But those biases absolutely exist in every single step of the process – not least during the interview process. I won't say that there's a lot of ableism in the interview process but I would say that there's a lot of opportunity for ableism in the interview process (especially regarding mental health and neurodiversity) because certainly some people that participate in admissions view it as a screening mechanism to keep out people that aren't like us. That can mean a lot of different things, but it can also mean behaviorally. There is definitely that aspect. In an interview, my sense is that people will tend to score an interviewee higher if they seem comfortable in the conversation with them. And it's natural for us to want to work with people that we feel comfortable with, but there's a danger there too.

Liz: What's your advice to people as they're trying to weigh out . . . I mean, being yourself is fine if you're a nerdy person, but if you have other interests is it best to present yourself fully or not?

Scott: Being a standard nerdy overachiever is great and a lot of the people that read your application are going to identify with that but it's not going to stand out from the stack of applications. I think there's a trade-off. The people whose applications I remember are people that are different in some way. The numbers dictate that we have to reject a huge number of people that are very well-qualified for graduate school and no doubt would do very well here, just because of the large number of applicants and the small numbers of people we can accept. What stands out is not being qualified. We see plenty of qualified people, right. Now that's important and it's necessary, but what stands out, you know we definitely do accept plenty of applicants who are outstanding but appear unremarkable, you know? But there certainly are times and you see it every year in admissions committee meetings where one faculty member will speak up on one student who maybe seems week on a certain area but there's just certainly

something about this applicant that has caught the attention of this faculty member and they fight for them. When that happens, more often than not that person will get invited.

Liz: That's encouraging.

Ivan: So Scott, if a program still requires the GRE, should that be a knock against it? What should students do when thinking about programs that require the GRE?

Scott: I won't badmouth programs that continue to require the GRE. After reading every paper I can get my hands on, I have made the personal decision that because of its inability to predict success, because of the well-documented biases against underrepresented and disadvantaged/less-privileged students, and because we require students to pay for it, that the GRE is not a good deal. I'm very proud that my program was one of the first major biomedical programs to drop that requirement.

Ivan: Okay.

Scott: If you have great GRE scores, then use that to get yourself into graduate school. Use your advantages.

Liz: Okay, so you send your application into five place that you're very excited about, you've written this beautiful essay (or two essays) and you get a bunch of invitations. Those invitations are probably coming in December, right?

Scott: I can't speak for all schools but in our case we make our invitations in December.

Liz: Okay, so starting in December the whole process of grad school application starts a new phase. And there is still so much to discuss in regards to interviews and so on that we're going to have to keep all of that for another episode. We should have that to listeners later this fall.

Ivan: So you can hear more from Scott then. But for now, Scott, how can people reach you?

Scott: Sure! You can email me at my *first-initial-last-name* sbarolo@umich.edu. That's also my Twitter handle if you want to contact me on Twitter, @sbarolo.

Ivan: And Liz, how can people contact you to follow your steps through grad school?

Liz: [Laughs] They can follow me on Twitter at @EHaswell.

Ivan: You can contact me at @BaxterTwi and you can follow the podcast at @TaprootPodcast. Scott, thank you so much.

Scott: Thank you!

Ivan: We also want to take a second before we leave to thank Juniper Kiss, who has been a fantastic editor in the last year as well as helping out with social media and blog posts. Juniper is heading off to graduate school and we wish her the very best.

[Instrumental theme music]

Ivan: The Taproot is brought to you by the American Society of Plant Biologists and the Plantae website. It is cohosted and edited by Ivan Baxter and Liz Haswell, and produced by Mary Williams and Katie Rogers. We get editing help from ASPB Convirons scholar Juniper Kiss. We are very excited to have Joe Stormer help us out with transcripts. If you like this episode, tell your friends and colleagues and be sure to subscribe on Apple Podcasts or in your podcast player of choice. Thanks for listening, and we'll bring you another story behind the science next week.

[Instrumental theme music]