

S3 E2 Thore Bergman

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SPEAKERS

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Matthew Zippel 00:08

Hello and welcome to another episode of the Animal Behavior Podcast. I'm Matthew Zippel. This week we are continuing our Foundations of Animal Behavior mini series. And this time we're talking about Niko Tinbergen, and his 1963 article on "Aims and Methods of Ethology". And just like the episode that we did with William Kimler on chapter seven of the Origin, this episode is designed to be paired with reading the text either before or after listening. Tinbergen's four questions are the organizing principle for many animal behavior classes. They were certainly one of the first things that I learned and they're one of the first things that I teach. So today, I'm very glad to have Thore Bergman joining us to talk about not just those questions themselves, but the scientific context in which ethology was maturing in the mid 20th century. Thore is a Professor of Evolutionary Biology and Psychology at the University of Michigan. And he co-directs two long term studies of wild primates, the Simien Mountains Gelada Research Project in Ethiopia, and the Capuchinos de Taboga Research Project in Costa Rica. And today, he's also going to tell us about how we may have been misunderstanding Tinbergen's questions, or at least the connections between them in our minds, and perhaps in our teaching. Along with Jacinta Beehner, last year, Thore published a thought piece in the journal Evolutionary Anthropology in which the two of them argue that we should essentially banish the terms ultimate and proximate mechanism from our vocabulary. So I'm eager to dive in. Thore Bergman, thanks so much for joining us today.

Thore Bergman 01:29

Thanks for having me.

Matthew Zippel 01:31

Before we get to the text itself, let's start with Niko Tinbergen. Can you briefly introduce us to Tinbergen? And who was he? And what do we owe him?

Thore Bergman 01:39

He's really one of the founders of the field of the ethology or animal behavior. He was just curious about animals and liked to watch animals. Someone who was interested in why animals do what they do. And I think he came up with different methods, different ideas, different approaches for doing this in a really rigorous way. Something that I think just hadn't been done before.

Matthew Zipple 02:03

And we started this season talking about Darwin and chapter seven of the Origin. And you know, that naturalist approach, studying animals where they are comes through so strongly in that chapter, and so to to a naive reader, right, that introduction, sounds like there would have been an obvious and continuous scientific thread from Darwin to Tinbergen, over the 100 years from the Origin to his work, but between when Darwin wrote the Origin and when Tinbergen is doing the work that he's doing, there's this period when the dominant approach within animal behavior research was completely divorced from animals natural environment.

Thore Bergman 02:34

Yeah, I think of it starting kind of with Pavlov, but this idea that the way to learn about animals was to bring them into the lab and do strange things to them and see how that change their behavior. And so that is a very experimental approach and very sort of artificial approach to understanding what animals did. And it was really, I think, appealing because of this control that it gave the researcher over the situation, you know, you... you had certain questions about what animals did in certain situations, you just put the animals in those situations, and you see what they did. Whereas the naturalist is stuck out there in the wild, hoping and waiting for certain things to happen. Yeah, that became really the dominant approach through Watson and Skinner, who popularized the term and the science of behaviorism. And this idea that, that so much of what animals do was a product of their environment and their experiences and can be shaped and sort of affected by the things they do. And so Skinner has this famous quote of, you know, "give me a child and I can produce anything with them".

Matthew Zipple 03:35

And so from that perspective, the difference between studying the behavior of a child or a rat, or a cat, or a dog is really not very different. Right, the particular features that they've evolved to deal with they're not relevant to the question.

Thore Bergman 03:50

Yeah, exactly. And this is, I think, one of the core differences, I think, between a psychological approach and... and biological approach to behaviors that psychologists tend to be interested in the same, the similarities, the commonalities across things, because they want to understand how things work. And so it makes sense to look at the sort of basic, foundational structural similarities across animals, and so that you can learn about humans by studying a mouse so you can make these sort of

inferences across species, because you're, you are looking at these core similarities. Whereas biologists are inherently interested in this sort of variation and the differences across species and across contexts and situations and environments. And so it's just, you know, this fundamental sort of difference and what's interesting even

Matthew Zippel 04:31

Do you see the, the legacy of behaviorism in psychological research?

Thore Bergman 04:35

Yeah, definitely. I mean, methodologically there's a lot of... it's happened I mean. A lot of the research that happens in the building I'm in right now, which is a leading neuroscience you know, bio psychology department. Involves putting mice in boxes and having them respond to stimuli and do some operant conditioning tasks. Of course, we're getting a much more detailed information about what's going on in their brain and things than Skinner was ever able to do nowadays. Modern techniques. But a lot of the methods are very much similar. And I think, you know, a lot of our science is kind of driven and constrained and shaped by the methods that we have available to us. And so definitely that legacy is, is strong.

Matthew Zippel 05:15

And none of that's to say that lab studies can't translate to ecologically relevant conclusions, necessarily, but anytime there's this divergence between the environment that an animal evolved to deal with, and the one in which we study it, there's that risk that we should be keeping at the front of our mind. Do you see people kind of incorporating that, that thought process and trying to ask more kind of ecologically relevant questions within the lab?

Thore Bergman 05:39

I think so. And I think that's, I think one of the strengths of our bio psychology area is that it sort of melds together the sort of classic neuroscience approach and sort of more evolutionary theological approaches with a common theme of behavior. So we're all sort of interested behavior from different directions. And so I think it's a useful approach if you're in the lab and doing the artificial things to be thinking about, well, how does this relate to what animals do in the wild? How does this relate to survival and reproduction and things like that? And for us, it's always working with wild animals, the opposite of like, sort of how can we get a better understanding of what's going on inside the animal that's producing these behaviors?

Matthew Zippel 06:20

Okay, let's dive into Tinbergen paper now. 1963 on "Aims and Methods of Ethology", I hadn't looked at this paper since my first semester in graduate school till I reread it. And in returning to it now something that I'd forgotten is how he really focuses on observation as the starting point for ecological studies.

And I've heard behavioral ecologists complain that there's no room for pure behavioral observational work anymore. And that natural history descriptions of behavior are often unpublishable, and anything that isn't hypothesis driven, is treated with diminished importance. And so it's interesting that 60 years ago, Tinbergen was really saying that same thing.

Thore Bergman 06:54

Yeah, yeah, that seems to be like a continual theme of like, each generation has kind of a moaning, the fact that we're no longer allowed to just go and observe animals. So the pressure is always sort of pushing us in this direction to go, you know, more artificial, more experimental, let's just, let's just see what's happening first, and then we'll come up with some interesting ways to explore that.

Matthew Zippel 07:16

And so really, like, you know, so me, personally, honestly, I'm a pretty poor naturalist. And that's something that I've grown to accept. And I so I end up, I'm having a pretty strong bias towards hypothesis based work. How do you think about the value of natural history observation versus hypothesis based work?

Thore Bergman 07:33

Yeah, that's funny. So I would probably say the same thing about myself that I'm not a natural naturalist, like, I just, I really enjoy being out with animals and doing those things. But I'm not someone who can name all the birds I encounter, I can, you know, I'm not good at like, categorizing, organizing the things I see. I just, I enjoy it and I'm curious about things, but I'm not a great sort of recorded observer of the natural world. And so yeah, I do like to do experiments. And to mess with things. You obviously can't have one without the other. And I think Tinbergen he sort of talked about it in developmental sort of framework, in terms of developing a field of, you know, you have to go through this observational phase before you can get to the next phase of doing experiments and hypothesis testing. So if you don't know anything about a system, you can't obviously ask questions about it. You can't experiment on it. So he, he was arguing back then. And I think it's still true that we have so much more to learn about just the basics of the system that we need to collect more data about what's going on out there before we want to jump right into the next phase of, okay, how can we manipulate it?

Matthew Zippel 08:37

So let's turn to the four problems of biology that that Tinbergen addresses. What we now know as Tinbergen's four questions, so physiology, function, development, and evolution. And I want to touch briefly on each of those starting with physiology, which he calls causation rather than physiology. Maybe I should just start by asking you what you think we should take from this section.

Thore Bergman 09:00

I think it to me, what's important was the sort of linking of what we're seeing, as I think sort of different approaches. The more psychological approach to what's going on inside the animal, that it was a valid important part of the same question of like, why is this animal doing this thing in nature? And so that it was the really the connection that this what seems like maybe a different approach to studying animals was part of the same thing.

Matthew Zippel 09:25

And I think he'd be really overjoyed to see the revolution in endocrinology and various kinds of omics methodologies that have been integrated into the field. And you all have done a lot of endocrinology, at your field sites. Have you seen kind of that linkage between what started out as kind of lab assays of physiology get really well integrated into field studies?

Thore Bergman 09:47

Yeah, I think that's been one of the sort of exciting ways that we've been able to bridge some of these different approaches as a field. You know that we've been able to take some of these lab methods and bring them to the wild because of the more non invasive ways of assaying things that are going on inside the body. So, you know, hormones from fecal samples or urine samples are really giving us from a field perspective, really exciting kind of ability to monitor the physiology of animals doing like cool things like, you know, becoming the new, or, you know, having their first child or doing all the things that are really important to wild animals.

Matthew Zippel 10:20

Another thing that he talks about at length in this section is the analogy of behavior as an organ, what do you think we gained by thinking of behavior in that way?

Thore Bergman 10:30

First of all, I think it is useful to think about the way natural selection and evolutionary forces act on organs and applying that kind of thinking to behavior is, is obviously the point of his analogy. And that's, I think, is still has value as a way of thinking. And it also I think, helps you sort of reduce it to its basic components and think about it that way. But also to appreciate it as a the behavior the complexity of it as something that's not some magical byproduct or something outside the realm of biology. It is, it is biology, it is directly comparable to these other things.

Matthew Zippel 11:06

Okay, let's... let's talk about what Tinbergen calls survival value, or the function of a behavior.

Thore Bergman 11:11

Yeah, like it was it sort of was one fourth of the pie for him. But it's, I think it's really half the pie. It's really one of the key things. And it is, you know, to all behavioral ecologists really is that's the first question they ask are the main question that they go after so.

Matthew Zipple 11:28

And something that struck me in the section is his discussion of experimentation? So, you know, we talked about observation earlier, and he emphasizes here, that observation can really only be the starting point for understanding function, that experimentation is really necessary to confirm kind of the putative function of a of a trait.

Thore Bergman 11:49

Yeah, so I think it's definitely true that you need an experimental approach here. And the, it's because you're so likely to get these spurious correlations or, you know, correlations between things that may have nothing to do with each other. And so to really get out, if positing that this is the function of a certain behavior, you need to sort of tinker with it and see what happens. And he's definitely, I think, aware of this idea of, of just so stories, and... and, you know, that old adaptive storytelling kind of things? And he wants to counter that and say that no, it is it's, it's a scientific question or hypothesis that we can study and test just like any others. And that's, it's important to ask and test those questions.

Matthew Zipple 12:31

And you do a lot of experimentation in the field, do you feel like there's an example that you can give us where there's, you know, kind of a putative function of a behavior that you all then kind of tested to see if that was actually what was happening?

Thore Bergman 12:43

Yeah, we do a lot of experiments. And some of it is to get at the function of things. Some of it is to just to simulate situations to try and get at what animals know about these situations, or how they react to these situations. So some of it is getting at some more like sort of cognitive questions, I guess. But sometimes we are interested in, the function that's true, and some of the work with the vocalizations we've done. So I guess one thing would be the Geladas, which are these baboon, like primates in Ethiopia. And one reason I wanted to study Geladas, and I got excited about them was that they, they make lots of different sounds. And so they're more vocal, they vocalize more often, and they have more different vocalizations than their close relatives. And so one of our main questions is, you know, why do they have these extra vocalizations? What are they doing with these other sounds? Why is it that these other monkeys are just fine with 10 vocalizations? Why does Gelada need 15? You know, so that was one of our basic questions. And so one way to do that is to experimentally manipulate the presence of the sounds. And so we record them and then do playback experiments. And then we see how the animals respond to those situations. And so doing that helps us get at the function of that. And so one

thing we did was we played some of the weird sounds Geladas make and some of the strangest sounds they make are mainly made by males. And so it's dimorphic, which is interesting. And so we played these calls to females. And it turns out, even if it's a stranger making the sounds if they're these sort of elaborate, strange sounds, she'll hang up on the speaker longer, and she'll see you sort of be seemed kind of curious about the sounds, and they seem to be sort of attractive, in some sense to the females. And so that helped us think about the function of these calls in terms of attraction or probably more, you know, maintenance of bonds between males and females.

Matthew Zippel 14:24

Yeah. Okay. That's great. I want to turn to ontogeny next, which Tinbergen defines as, quote, "a change in behavior, machinery during development". So in other words, how does behavior which we're thinking of as an organ, right, and how does it develop like other organs, there's a real severity of tone regarding a term that you're I would probably not use, but that remains quite common colloquially, which is innate. So Tinbergen writes, quote, the application of the adjective innate to behavior characters, and to do this on the basis of elimination of different kinds, is heuristically harmful. So talk a little bit about. About the fight that Tinbergen is kind of throwing himself in into there, who's he's speaking to?

Thore Bergman 15:03

I mean, on the one hand, you're in the era of sort of peak behaviorism, where nothing is innate, in a sense, like, you know, everything is shapeable everything can be shaped by experience. And so I think Lorenz especially had been an advocate of saying, maybe not everything, you know, is shaped by experience, animals come into the world with some pre existing biases and tendencies and, and, you know, their classic studies on sort of imprinting, were cool in the sense that, you know, this is a really sort of, in some ways, rigid and inflexible behavior in the sense that once they imprint on something they're locked in. And that's it, but it's also really open ended, they can imprint on anything, they can imprint on a researcher on an airplane, we know now, like they can imprint on lots of things. And so it's this weird mix of being, like, open to experience, but really sort of rigid and limited. And so I think, that kind of behavior, I think they found interesting because it showed, first of all, some of the differences across species, some species don't imprint on anything, some species imprint wants him, that's it for for a year and some animals kind of fuzzy. So like that variation, I think was interesting to them. And so this idea that things are either rigidly innate or completely flexible and open ended, and the put them in the Skinner box, and eventually, they'll be typing Shakespeare kind of idea that it's, you know, it's not either one of those, let's, just those extreme viewpoints are just not good ways of thinking about the way behavior emerges.

Matthew Zippel 16:23

And finally, let's talk about evolution of behavior, which Tinbergen writes, quote, "has, of course, two major aims, the elucidation of the course evolution must be assumed to have taken and the unraveling of its dynamics". And we'll return to the unraveling of dynamics when we talk about the problems you see in interpreting Tinbergen. So for now, let's focus on that first goal, the elucidation of the course of

evolution. And one way that we study evolutionary history is through comparative studies. And one of your main research focuses is social cognition, right? You've studied kind of similar questions in different species. So I'm hoping you can tell us some of some of what you've learned using the comparative approach thinking about, you know, individual recognition and social cognition.

Thore Bergman 17:04

Yeah, so that's one thing, you know, one thing we really liked to do is try to apply the comparative approach, which I think traditionally, are often is done in broad multi species comparisons using pretty simple characteristics. With cognition, which is one of my main research interests, it's a little trickier because often, you know, doing the sort of simplest cognitive experiment on wild animals can take two years. And so getting a broad comparative data set was just not possible. And that was another one of the reasons we got very excited to study Geladas is because they are close relatives of baboons who had been intensively studied. So we could sort of draw on this history of work on them, and immediately put our Gelada work in this comparative framework. So what are they doing? It's different from what baboons do, and what are they, you know, keeping track of or not keeping track of, in ways that baboons do. And so one of the things we learned pretty quickly was that Geladas they live in this seemingly really complicated society of nested groups of parents come together into bands, bands joined together into herds. And so by the time you're up in the herds, you're talking hundreds or 1000s of animals. And so we were interested in what did they pay attention to in the society and because we come from this baboon world, where you live in a sort of not single level, but it's sort of much simpler group of 60, to 80 baboons. And we knew from a lot of the history of the work from Cheney and Seyfarth. Baboons know pretty much everything about each other in that situation, they know, you know, who's kin with who who's high ranking, low ranking, who's had a fight that day, those they just keeping track of everything in this group. With Geladas, we've reasoned that they might not be able to keep track of everything in the herd of 1000 Geladas. But we sort of thought they might keep track of 100 or so animals kind of like baboons do, but they don't, they really just focus on their harem or their reproductive unit, which is really a family of females, with some males who come and go. And so it's really just about that family of about 10 animals. And that was interesting for us to see. And it was mainly though interesting in this comparative context. It's different from what baboons do. And so I think, as a biologist, sort of anytime you find these differences, that's what's exciting and interesting,

Matthew Zippel 19:11

For sure. So that's fabulous. We'll leave Tinbergen original article there for now. And we'll take a quick break. And when we come back, we're going to transition to this article that you and Jacinta wrote last year, asking us to rethink the ways in which we imagined Tinbergen four problems to be connected. But first, here's a two minute takeaway.

Erin Wall 19:33

For those of us that are dedicated listeners to podcasts like this one, we often form an idea of the person we're listening to, and maybe feel a connection to them despite never meeting in person. Their voice is familiar to us, and we could probably recognize it from unfamiliar voices. But the voices of our

friends, family or partners, people we interact with in person and have developed bonds with those voices carry a lot of meaning for us, as social species we are driven by our motivation to form social bonds, and these bonds profoundly influence how we perceive sensory signals like communication signals. I'm Erin Wall. I'm finishing up my PhD at McGill University with Dr. Sarah Woolley studying auditory perception through the model of female songbirds. In my thesis, I approached the study of how experience shapes perception holistically with the understanding that experiences during development and adulthood interact to form an individual's perception through interconnected pathways in the brain. How do experiences early in life constrain or facilitate learning in adulthood? And how does the social context of our interactions influence perception? I found that social bonding profoundly impacts female songbirds preferences for male song regardless of their developmental experience. Even if females never heard song during development, they could still pair bond with the male and form a preference for his song if they spent time together. The social context in which songs were heard heavily factored into perception, as listening alone was not sufficient to lead to song preference. I also used whole brain imaging to reveal changes in brain activation, as an auditory signal becomes familiar through social interactions, and the role of dopamine in shaping that activation. Together, these results helped identify a potential circuit model where social bonding impacts perception and preference and guides behavior. So next time you hear your best friend's voice, I hope it gives you warm fuzzy feelings, and maybe a new perspective on how that's happening. You can find part of this workout now on bioRxiv, and I'm excited to share more with you later this year.

Matthew Zippel 21:40

Welcome back, I'm here talking with Thore Bergman about Niko Tinbergen's 1963 paper on "Aims and Methods of Ethology". On this side of the break, I want to talk about a contribution that you and Jacinta wrote last year in the Journal Evolutionary Anthropology: Issues, News and Reviews. And it's titled "Leveling with Tinbergen: four levels simplified to causes and consequences". So many listeners have been taught or perhaps have taught that Tinbergen's four problems can be broken into proximate and ultimate mechanisms that shape our behavior. And if you go to the Wikipedia page, titled "Tinbergen's four questions" right there at the top of the page, we have them split into proximate and ultimate mechanisms. And to get us all on the same page. Can you just explain what what we've all meant when we say proximate versus ultimate mechanisms or explanations?

Thore Bergman 22:28

Yeah, so I, my take on it is proximate are sort of immediate or short term or small scale and ultimate are sort of longer term big picture, big scale explanations for things. So the proximate being the development in the mechanism, and the ultimate being the evolutionary history and the function.

Matthew Zippel 22:48

So. So where in the article do the words proximate and ultimate appear? Because I struggled to find them? And he doesn't seem to mention them anywhere.

Thore Bergman 22:55

Yeah, and this is, I think, part of the legacy of this paper is that you don't one of the things he didn't do was tried to organize a structure among these four levels, which maybe it's just it was apparent to him, and he didn't think he needed to or just because it was such a, he's just laying the foundation, the groundwork for this field, as you know, is in such early stages of conceptualizing, but it just, you know, wouldn't have made sense to try and put a structure on them. But other people did. And so it pretty quickly, well actually I don't know how quickly, but it's, you know, by the time I was introduced to animal behavior was already sort of locked in. These were either proximate or ultimate explanations. And that was, became the prevailing terminology.

Matthew Zippel 23:34

So if those terms didn't come from, from Tinbergen, how did we get the terms kind of proximate and ultimate explanations? Where did they come from? Who introduced them?

Thore Bergman 23:44

I think it was really Ernst Mayr who came up with the term ultimate causation. And that was something that an idea that he was a proponent of, and I think, I'm not sure if how much he played a role in the proximate side, but I think it just sort of became natural to talk about proximate is in contrast to the ultimate causation, which Mayr is really focused on. Evolution as an ultimate causal agent.

Matthew Zippel 24:08

And evolution is caused makes make sense to us. It's intuitive, but the central argument that you will make in this article is that, you know, we're making a logical fallacy when we're thinking about function as... as cause. And, and so I think if I've understood correctly, your argument is that function is not a causal phenomenon, that function doesn't cause behavior. But instead, as a consequence, can you kind of flesh that out for us?

Thore Bergman 24:34

In this case, here, I think, for me, the issue is that when we're talking about function, we're talking about sort of survival value or adaptive value, how it helps animals survive and reproduce. And so that obviously leads into natural selection. One issue, sort of with function, we're talking about the current utility of what's happening now. So we're like. This animal is alive, it's doing these things. It does this thing. What's the consequence of that? So that obviously doesn't have to have anything to do with how it came to be. And so, like there can be mismatches between the evolutionary history and the current situation. So that's one issue with, with thinking about it as a cause. But for me, the bigger issue is that selection is a filter. And so it sorts things, it's, you know, it acts as a sort of population level. And it sort of is a process where some do better and some do worse, the ones that do better have these traits already. And so selection doesn't cause those traits, it acts on existing variation. And so I think the

problem that when we start thinking about selection as a causal agent, is that we give it too much power and actually creating the variation that it acts on which it doesn't and can't.

Matthew Zipple 25:45

Okay, so if we're thinking about the mechanisms by which evolution occurs, which ones of them are actually causal of changes in behavior, it's not selection, it could be mutation, right? Mutation is much more the cause. Is that right?

Thore Bergman 25:59

Yes, exactly. That's the... the actual, you know, real cause of variation of the behavior. It does get complicated because of this iterative nature of evolution and natural selection. And so things change across generations. And so if you think about the evolution of a giraffe's neck, from an ancestor, with a sort of normal length, neck, that at each generation, or each, you know, in time, some animals do a little better, and some do worse. And the reason they do better is maybe they had a little bit longer neck. And the reason they have a longer neck is because of some mutations that they have, that enables that growth. And so at each generation selection is just filtering them out. But what happens is, you get this sort of ratcheting or cumulative effect, because in this generation, the longer necks get kind of locked in, and then over time, some new mutations might happen, that pushes them a little further, and then those get locked in. And it pushes it further. And so in hindsight, it's really hard to explain the giraffe's neck without saying it was, you know, caused by selection, or selection pushed it or drove this. Even though, you know, at any generation, any point in time, it's all selection is doing is filtering. And so, in some sense at a population level, or, you know, the sense that it maybe does make sense to think about selection as a causal agent. But I think we want to be really careful in realizing that it didn't create the variation, it's just sorted it out. And cumulatively, yes, it has these impacts. But if you took a giraffe today, and if you somehow were able to trace its whole history of all of its ancestors back to the normal neck ancestor, where would you see selection, like you, if you could watch everything that happened, that animal selection, you wouldn't be able to detect it because it didn't do anything to this animal? It did something to some other animals that happened to be near behind that animal, you know, it filtered them out. This other animal didn't survive the drought because I couldn't quite reach the things up there. But that's not you wouldn't want to think about that fact that this other animal died as a causal agent on why this current giraffe has a long neck?

Matthew Zipple 27:59

Yeah, I think that helps a lot. And because of the way that I think we were trained to think about evolution as changes in population, right, we then it's easy to then kind of transfer that meaning to changes at the individual level, right? And you're saying selection can't cause that, because selection happens after the behavior, right?

Thore Bergman 28:18

The behavior has to be there for selection to act on it. And if the behavior is there, it wasn't created by selection.

Matthew Zippel 28:25

So that that helps me a lot. So let's just lay out for listeners, the one level that you want people to understand these kind of four different questions. And kind of lay out the idea of causes and consequences, in contrast to proximate and ultimate mechanisms.

Thore Bergman 28:42

Yeah. So for me it, it makes much more sense to think about these in a temporal fashion. And so to arrange them on a timescale. And this was something it turned out that Tinbergen himself had actually thought about and then said, you know, really, it's just, you have two things that happen, things that come before the behavior and things that come after. And those are sort of the two main questions we have about biology. And on the before side, those can be broken down into the three categories of mechanism, ontogeny, and evolution, and sort of increasing distance from the present. And then on the other side, you just have function, which is, you know, how does it contribute to or what what happens to the animal after they perform this behavior? Does it help their survival hurt their survival? All those kinds of questions. And so thinking about it from ancient history of evolutionary past, to recent history of developmental past, to what's going on immediately before the behavior is produced, I think, to me that sort of clarifies the relationship among those three levels, but then also thinking about causes leading up to the behavior and then switching gear into consequences once the behavior happens to me helps clarify some of these confusions around when we're asking mechanistic questions when we're asking functional questions.

Matthew Zippel 29:57

Right, and that makes sense to me. And so then before we end, I just want to give you a chance to talk a little bit about what you're up to research wise right now. So what project or question are you most excited about right now?

Thore Bergman 30:09

So we've been working a lot with our newer Capuchin project in Costa Rica. And one thing we're excited about with that project is what we're able to do more invasive stuff. And so coming back to this idea of observation versus experimentation is that one frustration of working with wild primates is that we're often quite limited, you know, ethically and logistically and the kinds of things we can do. This population of capuchins that we work with is very isolated and doesn't encounter tourists and other people and things in ways that lots of primates do. And when primates encounter tourists, there's always a problem of food, and feeding. And as soon as primates learn that humans are a source of food, all kinds of problems ensue. And often the animals end up having to be killed or, or things to, you

know, because they become dangerous. And there are lots of places in Costa Rica, where capuchins are a dangerous nuisance. So luckily for us, we're very isolated. And so we can do things like bait them to platforms and have them perform experiments and tasks and things like that, on these platforms. And so we know we use natural foods, and we do it at low rates, we're not affecting their overall energy balance and things like that. But it is really exciting that we're able to do some of these more invasive experimental things on a wild population.

Matthew Zippel 31:22

And so what are the kinds of questions that you're asking with that kind of baiting setup?

Thore Bergman 31:26

Well, so this is work with Marcela Benitez at Emory. And so she's really interested in the evolution of cooperation. And so how these animals might work together to solve problems. And so we're starting them out, training them on sort of simple puzzle boxes, you have to pull a rope to get a reward. But then we're right now, she's in the process of sort of graduating them to a cooperative paradigm where you have two adjacent boxes, and they have to simultaneously, two animals have to simultaneously pull on the ropes in order to get the reward. And so seeing if they can make that next step. And so there's interesting questions, I think about cooperation and who cooperates with who there's also, before the cooperation phase, interesting questions about how they learn to solve these tasks, like how much social observation and social learning is going on is, is once one animal solves it, all their best friends solve it immediately, or is it? How is it transmitted through lines? Or what's the you know, the route of information transfer there?

Matthew Zippel 32:17

Very cool. And listeners, you can hear more about Marcela's work. If you go back to Season one, Episode five, which was a couple of years ago now. So it's, it's cool to hear that that that work is progressing in the field.

Thore Bergman 32:30

Yeah

Matthew Zippel 32:30

Well, great, thanks Thore. So much. We might have to have you back on the show to hear more about your research in particular, but for now, thanks so much for being here and helping us think differently about Tinbergen's four questions.

Thore Bergman 32:40

Thanks for having me. This was great.

Matthew Zipple 32:43

The Animal Behavior Podcast is created by talented team of animal behavior researchers. We have three excellent content editors, Niko Hensley an NSF, postdoctoral fellow studying the evolution of neuro sensory systems and their impact on animal communication and speciation at Cornell University. Camilla Cenni, who studies tool use, object play, and animal innovation in non human primates. And Logan James, a postdoctoral fellow at the Smithsonian Tropical Research Institute, studying acoustic communication in frogs and birds. Our communications director is Casey Patmore, a PhD student at the University of Edinburgh studying the behavior of burying beetles. You can follow us on Twitter @AnimalBehavPod, or check out our website at animalbehaviorpod.com. Our education team makes lesson plans and classroom materials that you can incorporate into your undergraduate classes. You can find those materials on our website. The Education Team is Emily McLean, an assistant professor of biology at Oxford college at Emory University, Georgia Lambert, a PhD candidate studying parental cooperation in burying beetles at the University of Edinburgh, and Smile Choudhary, a recent Master of Research graduate in Biological Sciences from the University of Exeter, who works on camouflage and escape responses and green shore crabs. Our sound director is Brian Leavell, a PhD candidate studying the evolution of acoustic signals in Ximena Burnal's lab at Purdue University. This season, I'll be recording my side of most conversations in the Cornell Broadcast Studios with engineering support from Bert Odom-Reed. Our art is all produced by animal behavior researchers. Our logo was designed by Adeline Durand-Monteil. Our theme music is by Sally Street, and transitions are by André Gonçalves. I direct and host the show along with my co host, Amy Strauss, we received financial support from the Animal Behavior Society. Finally, if you liked the show, then please help us by telling someone else about the show. And leave us a rating or review on Spotify or Apple podcasts. Thanks for listening. See you next time.