Brain Stories Ep2

Mon, 6/28 2:18PM • 37:12

**SUMMARY KEYWORDS**

fish, cooperation, behaviour, cleaner, people, individuals, field, human, bit, genes, client, scale, evolution, nest, cooperate, kinds, society, cooperative, called, work

**SPEAKERS**

Steve Flemming, Caswell Barry, Nichola Raihani

**Steve Flemming** 00:01

Hello, and welcome to brain stories. I'm Steve Fleming and I'm here with my co host, Caswell Berry.

**Caswell Barry** 00:06

On brain stories, we aim to provide a behind the scenes profile of the latest and greatest work in neuroscience, highlighting the stories and the scientists who are making this field tick.

**Steve Flemming** 00:16

We don't just ask about the science, we ask how the scientists got to where they are today, and where they think their field is going in the future.

**Caswell Barry** 00:27

Today, we're joined by Professor Nicola rihani. She's professor of evolution behaviour at UCL, she's a Royal Society and University Research Fellow, and a Fellow of the Royal Society of biology. We're very lucky to have you here. And so I'm going to start with a few easy questions to ease you in so could you start by telling us a bit about who you are and what your research is about?

**Nichola Raihani** 00:50

Sure. So I am Nicola rihani. And I'm a professor of evolution and behaviour, and also a Royal Society Research Fellow in the department of Experimental Psychology at UCL. And the big question that sort of keeps me going and has kept me going for the last too long now is, why do individuals pay costs to help other individuals to whom they might not be related? And so essentially, I'm interested in the evolution of helping behaviour, the evolution of pro sociality, and the psychological mechanisms that underpin social behaviour in humans and some non human species.

**Caswell Barry** 01:35

And is that is this a sort of a lifelong interest? Or is there something specific that sort of triggered this for you? Could you point to the moment that you thought cooperation was important.

**Nichola Raihani** 01:45

And so it's always been the focus of my research, although I think my, the different projects I've done, I have bounced around a little bit. So I've worked on family living species. I've worked on a species of bird that lives in the Kalahari Desert that lives in tight knit family groups, I've worked on a fish that helps other fish to him, it's not even related by removing ectoparasites. So a lot of what I've done has been quite sort of diverse in terms of the model organism and the type of social behaviour that you see. But I think that that kind of like thread that's running through all the research that I've done has always, that's always just been the thing that I've been super interested in is why why should individuals ever pay costs to help one another? Because, in some respects, it seems to be a little bit at odds with our understanding of evolution by natural selection.

**Caswell Barry** 02:42

When you say pay a cost, what do you mean? You mean, for a second, I imagine your fish there with its wallet app sort of paying to eat the parasites, but I'm guessing that's not not what you mean at all?

**Nichola Raihani** 02:51

Yeah, so we tend to think about ecological costs most of the time. So for example, for the fish, actually, the cost is a little bit strange. So with the cleaner fish that I worked on, they will remove these x parasites from the surface of the client's skin, but what they would actually rather eat is the client's living tissues. So the thing that the cleaner fish phones, delicious, is mucus. That's a living tissue and scales. And so in some sense, you can say the cleaner fish is feeding against his preference, if it chooses to remove parasites, rather than the thing that it would actually like to eat, which is the delicious mucus and scales of the flesh that is cleaning. With the babyliss. The cost, you know, there's costs babyliss live in these family groups where two individuals breed and everybody else is relegated to the status of being a non reproductive helper. And in that society, the non reproductive helpers pay very real energetic costs and food costs by foraging around in the desert for, you know, scraps of food and then donating these items to the offspring of the breeding pair. And so there really is sort of real, measurable costs there that you can quantify.

**Caswell Barry** 04:10

And, and I guess, so an example that people are sort of familiar with this, would this be sort of similar scenario to say, bees in a hive where you have like, a single breeding queen? Or is that a bad sort of public example that I might have heard of?

**Nichola Raihani** 04:23

No, that's exactly that's exactly it, basically. I mean, I guess with social insects for a lot of social insects, which we actually refer to as being used social, which kind of means Truly Social. That kind of cooperation is taken to really the extreme and it's a much more extreme form of cooperation than we see in a lot of vertebrate societies like babblers and meerkats, but the underlying principle of there being large family groups with a small number of breeding individuals And a larger number of non reproductive workers is kind of exactly the same.

**Steve Flemming** 05:06

And on. I mean, we should also say that you, Nicola, you have a new book out the social instincts, and we'll get onto that a bit later. And congratulations on that. It's a fascinating read. I was reading some of it over the weekend. And one example that came to mind that I was wondering if you could unpack this a bit for us is this amazing notion of aunt suicide. And that seems like almost like the ultimate cost that these insects have pay.

**Nichola Raihani** 05:35

Yeah, it's actually a really lovely story, in some ways, quite poignant. So there's a species of resilient that called for religious views that this and they live in a nest underground, but they they forage above ground during the day. So when it's time to go back to bed at night time the colony or makes its way back to the nest, and a few of them, a few of the workers will stay at the surface, and they will wait for everybody else to go into the nest. And once everyone's in, they will then start to gather sand and other debris to conceal the nest entrance completely from the outside. So they seal off the nest entrance. And in doing so they sort of seal their own fate because they can't survive in isolation above ground overnight. But it's kind of there's even one more step to this kind of altruism, which is particularly poignant, I think, which is, once they've done this job of closing off the nest, and everyone inside is safe, they don't just want to die right by the nest, because that is also potentially going to attract predators or unwanted things to where the nest entrances, so they sort of turn off and march away into the, into the desert. And I read one paper that I really felt the turn of phrase was so apt, it's like, they go outside. And evidently, they may be sometime.

**Steve Flemming** 06:53

And this happens every single night, new new ants they do every single night.

**Nichola Raihani** 06:56

Yeah, so it would usually be like the older individuals in the colony that would sacrifice themselves. So the sisters and on the face of it, you know, that seems like a really puzzling thing and something which from a really narrow reading of Darwinian theory of evolution by natural selection, a bit of a head scratcher in a way that obviously, you can reconcile those kinds of extreme altruistic acts with the Darwinian view by appreciating that these individuals live in giant family groups, and that by doing these kinds of acts of altruism, those the altruistic individuals help copies of the genes that are in their bodies, because those genes are also found in the bodies of all the individuals that they help to protect.

**Caswell Barry** 07:45

And so is this, are we right to sort of look at this through the lens of sort of the sort of Dawkins ideas of The Selfish Gene? Or if we move beyond those, is that still a sort of a valid interpretation of this sort of altruism?

**Nichola Raihani** 07:59

Yeah, I mean, nowadays, people, I mean, people do still use The Selfish Gene on the genes I view framework. And I think it is still valid, I think, in the field, we tend to talk about inclusive fitness. So we tend to think about the direct and indirect fitness consequences of behaviour. And direct physical fitness consequences are those which impact your own personal reproductive success. And then indirect consequences are when your actions can impact the reproductive success of your relatives. And one of the main insights of evolutionary biology in the sort of last, I don't know, like 50 or 60 years was provided by Hamilton and in sort of providing this inclusive fitness framework for understanding the evolution of social behaviour and how we can reconcile that with the Darwinian view. Because, of course, Darwin had no concept of a gene, you know, the, the idea of the gene wasn't known really, at the time that Darwin wrote his book, which, in some ways makes it all the more impressive just how able he was to sort of foresee all these developments that came much later in the field.

**Caswell Barry** 09:12

That kind of makes sense to me how why altruism works within some family group or at least with a group of animals, the shared genes to a greater or lesser extent, and how about your fish there are you know, they're picking parasites of an entirely different species? And like you said, they're they're not eating the the tasting mucus, they're eating the nasty parasites. What what's driving that? Presumably, it must be different.

**Nichola Raihani** 09:35

Yeah. So the reason why the cleaner fish are really interesting is that even though you might not think that cleaner fish and humans have got much in common, I mean, we have lived such wildly different lives, you know, they're underwater, we're not they're kind of small, little fashion, or that kind of thing, but in some respects they do. The structure of their social worlds has some similarities with the structure of The social worlds that humans inhabit in the sense that they have 1000s of interactions per day with complete strangers, fish they don't know they haven't met, they might never meet again. And somehow in this underwater cleaning system, cooperation is maintained, even without the ability to be able to talk about it to enforce rules and norms. And, you know, to sign contracts, like I promise, I promise not to exploit you by eating mucus and things like that. So one of the really interesting questions in a way is how do these fish resolve this underwater social dilemma? And are there any similarities in the way that we resolve social dilemmas in our interactions with strangers? And it turns out that there are a few similarities. So two of the key things that helped to sustain cooperation in the cleaner fish system, where we know that there are analogues in our own societies, our punishment, and a form of reputation based partner choice.

**Caswell Barry** 11:08

This sounds like it has direct analogues with both against that culture where people sort of Garner you know, likes or kudos, or, or is that correct, so we just we basically living out the fish world writ large,

**Nichola Raihani** 11:21

in a way that I mean, so I think the, the cognition supporting reputation based cooperation and cleaner fish is obviously going to be quite different to the cognition that humans use to assess and also strategically manage our own reputation. But the way it works in cleaner fish is that they have broadly speaking two different kinds of client. And you can think of them as being fussy clients, and not fussy. So basically, the not fussy ones, don't have a very big home range. And they don't have very many cleaning stations within where they live. And what that means is that they don't really have, they haven't got many options, it's like they only have one cleaning station, they have to go there, there's no choice for them, really, the first thing of clients are usually a bit bigger, and they have a bigger home range. And as a result, they it's a bit for them, like as if they live in a city with lots of different restaurants. And they kind of do have choice in a way. So if they what happens when a fussy cleaner fish arrives at a cleaning station is that they will often watch how the current interaction with the current fish ends. And if it ends badly, which you can see it's very easy to observe because a fish that's better and very clean a fish will visibly jolt and then often either swim away or chase the cleaner fish. So if it ends badly, then sometimes these visitor these fussy species, they just don't stick around and they see if they think it looks bad. What if they think, Okay, that looks like a bad place where I might not get a good service, they just go to somewhere else. And what we also know based on a series of really clever experiments that were not done by me, actually, is that the cleaner fish are really aware also of whether they're being watched by these fussy clients. And they they kind of put on their best behaviour when they're watched by the fussier clients, and they they behave nicer to their current client, to try to make sure that the fussy client doesn't swim away,

**Steve Flemming** 13:25

is so fascinating. I'm wondering like what, you know, if you go back, if you can imagine that you're kind of cast yourself back in time to when you were an undergraduate or a, you know, kind of just starting out your scientific career. And then thinking like, this is what you'll be working on now. I'm just wondering, you know, where were the first seeds of that, that interest in this in this area of research? And, you know, what was your journey throughout from a PhD to to becoming the scientist you are now

**Nichola Raihani** 14:01

it's my, I think my answer to this is a bit embarrassing, because I don't think I was particularly strategic. The truthful answer is that I'd done my PhD on the bachelors in the Kalahari and I was attending a conference called the International Society for behavioural ecology, which is basically all the field biologists doing weird and wonderful animal behaviour. And at the conference, I attended a talk by a guy called Red Wine bashary and he is my collaborator who has worked on the cleaner fish for a really long time. And the way we do the cleaner fish research, it's it is kind of like out of a high end holiday magazine. I mean, there are there actually is a high end holiday resort there. So it's not you know, that that is kind of the place. It's a tiny little island. It's, it's just off the east coast of Australia. If you Google it, it's called lizard Island. It you just kind of if you're going to Google perfect tropical island, if you have that image in your mind. That's what it looks like. It's a tiny island in the middle. of the Indian Ocean surrounded by coral reefs, white sand, you know, you name it, it's got it. So anyway, read one gave this talk. And obviously one of his slides was, this is where we do the fieldwork. And later on, I kind of knew him already. So I bumped into him and kind of more as a joke than anything I just said, I wouldn't mind doing field work at your place. And he was like, Well, do you really want to? Because I think that it would be really interesting for us to work on this punishment question and blah, blah, blah. And that was kind of it was just one of those throwaway things that then turned into a really, really fruitful collaboration. And actually, as it turned out, the fieldwork, there was nowhere near as glamorous as I wasn't quite what I had imagined. But

**Steve Flemming** 15:46

it is it is really important to hear, I think, for people who are maybe starting out in science that a lot of these decisions are not strategic. And I think that's the case for more is probably more common that the lessman sees it, then then then last comment. But so when when you say that the reality was not quite as tropical and exotic, as it turned out, what what exactly can you give us a sense of like, why that work is like day to day?

**Nichola Raihani** 16:11

Yeah, so well for the cleaner fish. So some of the researchers that do underwater observations, and so they're out on the boat, and they're doing a lot of diving. And that also sounds quite glamorous. But in the end, you get, you kind of get really tired of doing that even, that wasn't what I was doing. So for the work, we were doing, a lot of it was quite x, we were doing really tightly controlled experiments. And so we would bring the cleaner fish off the reef and have them in house and aquaria were that we had, there's a dedicated Field Station for doing these kinds of things on lizard Island. And essentially, my day would be wake up, get the frozen prawns out of the freezer, spend about 20 minutes mashing them into a prawn paste, which was it really puts you off pros, I can tell you, so do that for a bit, make this other paste that we have. So we're basically creating these two food types. One is the mashed prawn, which cleaner fish I think is delicious. And then another food type is fish flakes. mashed up, which they don't think is delicious. And we're trying to recreate the scenario they face on the reef, which is do you eat the food that you'd like? Or do you eat food? Do you feel good, it's your preference and eat the food that you're not so keen on. So we prepare these foods, and then just be doing experiments basically all day in the in a tiny little aquaria. It's incredibly repetitive. And I I always say that I think that one of the things about I don't know if this is true of science in general, but definitely anything involving field biology or experimentation of that sort. You need like really opposite character traits, like you need to be really excited, you know, interested and excited by the question that you're doing. But you kind of need a really, really high boredom threshold as well, because a lot of it is just super tedious, just collecting the data. So yeah, that was the kind of day to day at lizard Island.

**Caswell Barry** 18:16

Are you still I'm curious. So you're based in the UK? Now? Does this mean you still get sort of intermittent trips to Australia to do what I'm going to classify as not entirely boring field work? Or, or can can the cooperative science come to you? How does this work?

**Nichola Raihani** 18:33

I The last time I went to lizard island was in 2016. I think, and I haven't been back since although it's not completely off the cards. But most of the work I do nowadays, because I know work quite a bit on humans is sort of very desk based and behind the screen and probably a lot more boring in some respects than going to lizard Island. But once I started reproducing myself and having my own children, just doing like really long stints in the field is kind of less and less compatible with with that in a way.

**Caswell Barry** 19:14

So how easy is it to sort of extend the sort of strategies, there is ways of working these are developed working with bubblers, fish, etc to to the human world. Is it? Is it? Is it just a straight extension or they're sort of different questions that have sort of thrown themselves up.

**Nichola Raihani** 19:33

I think largely There are loads of similarities. And so I guess my work on humans, I come at it from a really broad evolutionary perspective and that that kind of reflects my background as having been an evolutionary biologist working on non human species. I think the one one of the main differences with humans in a way is that they there's just a way higher chance for a human to mess up your experiment because they are Just so much cleverer and they do understand, you know, there's a lot more chance for them to guess what the experiment is about or to basically just to use the cognition we have in a way to which in a way that messes up results, I think. And that's been one of the key, that is really like a key difference between working on humans versus working on non human species, just like the cognition you're trying to tap into is obviously so much more complex.

**Caswell Barry** 20:27

Actually, related to that, there was a question I was gonna ask you earlier, and it's more relevant. Now, when you were describing the, the, the fish feeding, it sounds like they might be sort of a given fish might have one of two strategies, you could be like a very fastidious fish doing like a really good job and get like the high quality clients. Or you could just be like, the naughty fish and sort of game the system and like, take a nibble every now and then sort of these seem like kind of stable strategies. And if that's true, but it seems even more likely that that might exist in sort of more complex human cultures where you can sort of play multiple sort of roles. Is that true? Do I mean, I guess the first bit Do you get sort of good and naughty fish using different different strategies.

**Nichola Raihani** 21:05

And I don't know if we've got enough data on individual cleaner fish to know about the repeatability of corporate cooperative behaviour in that system. But I know that one thing, I think a lot of it is quite state dependent. So one of the things we do know with the cleaner fish is that when they're hungry, or versus when they're more when they're better fed affects the level of service they provide to a client. And another thing that is sort of related in some respects to what you said is that they the cleaner fish do have a way of kind of policing the behaviour of one another in when they're interacting with clients. So the clean fish is a bit of a weird fit a weird fish, or loss official like this, but it can be a bit strange if you're not used to fish, which is that every individual starts out when it's born, is born as a female. And at some point in their life, they can change sex and become male. And for cleaner fish, it depends on the kind of group that they live in. So usually, you'll have a group of cleaner fish living on a territory, and the biggest fish is the male, and everybody else is a female that is subordinate to that male, and he aggressively enforces that kind of dominance hierarchy. And what happens with sometimes a male and a female on the same territory will inspect a client together. And when they do that, if the female cheats, if she bites the client and makes the client swim away, then the male will aggressively reprimand her and punish her. And we've explored that behaviour in the lab in much more controlled settings and showing that actually, that punishment from the male fish causes the female to change her behaviour, she is more cooperative in the next interaction after she's been punished. Other poor females can never punish the males because they're subordinate. So they just kind of is a very asymmetric power structure.

**Steve Flemming** 23:07

So talking about, like going from bridging between the animal work and the human work and having this broader evolutionary perspective, on behaviour, and this is something I think you do amazingly well in the book, which goes from genes all the way to, to politics and COVID, and, you know, challenges for humanity. I'm just wondering how you see this, because the book is all about cooperation, and how that's, you know, a foundational force, I'm just wondering how you see this tension with competition, and especially in light of things like COVID. And, and, and climate change, like when we need to cooperate more than ever before? How do you? What are the lessons can we draw from the this research that can tell us about the balance between cooperation and competition.

**Nichola Raihani** 23:57

But one key insight in some respects, not from my research, but just from the whole from like, the whole field of social evolution is that cooperation and competition are two sides of the same coin. And that cooperation is a means by which it entities, whether the genes of cells or individuals improve their position in the world. And so one of the one of the things that I think is not necessarily that intuitive, is that sometimes cooperation at one scale can actually be harmful, or can undermine the production of a public good or, or cooperation at a larger scale. And so a really classic example of that inside our bodies would be something like cancer, where you have many different cell lineages that can sometimes start working together to proliferate inside the host organism, but with an obvious detriment at the higher level of the end, The visual or the the organismal level. And we see that also in human societies where you can, there's a kind of now more or less accepted sort of result in the field, which is that sometimes family based cooperation, or nepotism, or sort of cooperation within a small social circle, can actually undermine the ability to then scale up cooperation to, you know, societal or broader levels, essentially. And so I think there is this sense in which cooperation is something we sometimes think like, Oh, we have to aim for cooperation. And it's this good thing. And it is imbued with like positive language, but it needn't be I mean, some some forms of cooperation are probably, you know, depending on the scale at which we want cooperation to occur, some forms of cooperation are bad in a way, and they are they prevent that transition to a higher scale of cooperation.

**Steve Flemming** 25:54

And do you think that's that kind of cuts along? Oh, it gives us another angle on what political dimensions mean, like going from liberal to conservative, it feels like liberals are more willing to entertain the idea we should cooperate, like a higher level, whereas conservatives are about the family. Does that make sense? Yeah,

**Nichola Raihani** 26:15

yeah, I mean, that's so that's not I've done a bit of work in that space, I did work, I did a paper with Lee DeWitt, who's at University of Cambridge. But this was based on established findings that political conservatives have what we call a smaller scope of moral regard, essentially means they have a different, and this is obviously we're talking about averages here, you're not kind of, you're not kind of you wouldn't be able to guess someone's scope of moral regard, just because you knew that they were conservative, but if you think about averages, political conservatives will tend to think that cooperation should be centred around a smaller, closest circle of individuals than the than political liberals will. And when we did actually paper on COVID, and looking at the scope of concern about COVID, for you know, whether, if we ask people, how concerned are you? This was right, in the, you know, the start of the pandemic, but how, how concerned? Are you for yourself? How concerned? Are you for your friends and family? And how concerned are you for everyone in society? What we found is that the answers to those questions of how concerned people felt, were really, we could kind of predict those by by asking people about their political ideology. And essentially, everyone expressed concern about themselves and their friends and family. But that where we really started to see things pulling apart was in the scope of concern for everyone in society. And that was really where political liberals were less concerned and sorry, were more concerned and political conservatives were less concerned and that scope of concern then also predict self reported support for various policy measures and, you know, willingness to adopt preventive measures that help to stem the spread of COVID, and things like that. So I think that there are some, we can sort of, there are some sort of big picture things we can start to unpick through this kind of worldview,

**Caswell Barry** 28:17

it seems to me this, we're now more than ever, we're sort of faced with world problems that require cooperation on larger and larger scales mean things like climate change, for instance, it's going to take a global effort. Do we know whether based on what you were just saying, do we know whether there's any sort of trends in are people more cooperative now or less cooperative? Or is it just impossible to say? I mean, I guess what I'm saying is, should we be optimistic for the future or not?

**Nichola Raihani** 28:42

It's hard to be optimistic, isn't it? I think so with the rise of Western democracy and the institutions that underpin the western model of democracy. What has happened is that cooperation has become less centred on family groups and on intimate close relationships, and has scaled up in some ways whereby, you know, the western model is to endorse more or less impartial norms of fairness and to cooperate in a wider circle and with a larger number of people, including people that you might never have met. And so in some senses, you could say that the scale at which we cooperate, in some societies has changed and has increased. I don't know if I would argue that, like we have become more cooperative, though I think that it's more a question of like the scale at which individuals feel they ought to cooperate, whether they ought to keep this keep it within this tight family unit or whether it ought to be spread more around to to other people in society. And I guess I am. I don't know whether I'm optimistic, I think. I'd like to think that something like Climate change is a problem that we can resolve. But having watched how the response to the COVID pandemic has played out, I just feel it. I mean, like, in so many ways, the pandemics should be a way easier social dilemma to solve them something like climate change, because it's happening now, it's happening more or less to in all countries in the world, everyone's affected. It's a disease that people kind of don't want to catch. By and large, it has, there's a real economic benefit of, you know, stopping it, you know, so like, there's so many things which are just like, it's in the here, and now there's an economic incentive to deal with it. And yet still, we've kind of struggled in a way to, to appreciate our interdependence, and to actually collaborate in a way on this larger scale in, you know, nations cooperating with nations. And I think, sir, I guess not to be depressing, but like, I don't know, really how optimistic I am, to be honest,

**Steve Flemming** 31:02

is there? I mean, not to want to label on the pessimism. But is there I was just thinking, then that potentially the perspective from evolutionary behaviour, is that under threat is this idea that in some sense, it is rational to shrink your circle of moral concern, because if the threat level goes up, eventually you want to protect the genes that you share with your family group. Is that is that? Does that make sense? Does

**Nichola Raihani** 31:28

Yes, sort of, although potentially not for that reason. So one of the one another, like really interesting result from social evolution is that when threat is increased, or as the technical term that people use is when material security goes down, and people tend to shrink their social circles. And in part that might be because when it's not, when it's not guaranteed that your immediate needs are going to be met, you kind of you might need to rely on a small number of highly interdependent interaction partners to ensure that you can, you can kind of make it through the hard period. And you might need to ask more of those individuals than you would ask of just some random stranger on the street, right. And so those kinds of highly interdependent relationships are something that you see in lots of other human societies most famous example that I think is really nice, as among the Maasai, pastoralists who live in Kenya. And they have, they basically categorise people into more or less two kinds of relationship types. One is the Sal, which is very much like we would interact with strangers, it's quite transactional, there's no special obligation to help, but they have a smaller number of what they call us or to our partners, and also to a translates more or less into being umbilical cord. So and those individuals that they have these really interdependent relationships with the expectation there is that if I need help, I can ask you for it, and you, you'll give it to me, and then I don't have to pay you back. But if you need help, then I will also help you and like, that's kind of that's how, as a species, in some sense, we have prevailed, you know, over a long period of evolution is by having these interdependent relationships where we could rely on one another to get by. And I think that what we saw in the wake of COVID, in some senses was it was a reversion to those kinds of small scale networks where you saw like mutual aid groups springing up in neighbourhoods that you know, people would still go panic, buy stuff at the supermarket, but like, you might go and find it, buy it at the supermarket, and then give it to your next door neighbour, do you know, I mean? So it's like, in a way, it seems a bit off, you know, it's a bit sort of paradoxical. But if you think about the, what's the point of those interdependent relationships, that kind of makes sense?

**Caswell Barry** 33:53

It just imagine Steve in the supermarket with trolley full of toilet roll now

**Steve Flemming** 33:57

is coming over to give it to you as well.

**Caswell Barry** 34:00

So what sorts looking forwards into the future? Sort of, we've gone from sort of fish up to sort of human culture. And what's what's the future? What are the big questions that you're sort of thinking about in the next 510 years where's where's your sort of field looking to move to all these sorts of problems that need to be addressed

**Nichola Raihani** 34:19

kind of in the same area as the things we've just been discussing? Really. So what I'm, I'm interested in is understanding variation in the scales at which people cooperate, and what predicts that and how. So I think like, quite for quite a long time the the sort of received wisdom in the field has been that variation in the scale of cooperation has varies between countries. So you might have heard of terms like individualism and collectivism and where people think that collectivism or people that live in collectivist societies tend to have very small tight social networks. And they cooperate that tight scale, whereas people living in more individualist societies have larger, looser networks with many weak connections. And I think that that approach, you know, has a lot of promise. But I also think there is scope for understanding how those patterns in the shape of our social networks and the scale at which we cooperate, might vary not just between countries, but within them. And whether that whether we can start to understand some of the differences in values and opinions that people have within a society and things like polarisation and political polarisation in particular, can we understand those through understanding this kind of scale at which people cooperate? And so I I'm quite interested now in exploring these tensions between what we call local and global cooperation and how, where they come from in the first place, and also potentially, what would you need to do to try to resolve them?

**Steve Flemming** 36:05

So Nicola, we end every episode of those stories by asking everyone what is their favourite, most unusual facts about the brain?

**Nichola Raihani** 36:16

So I'm actually going to just plagiarise one from my book, which I found that while I was writing my book, which is that although human infants are born with a massive head and a massive brain and having given birth to them, I definitely know that that is the case. Most of the human baby's brain growth is actually deferred to the postnatal period. And for a human baby to have the same cognitive and motor skills as a chimpanzee. A human baby would probably have to be born nine months later, so they would come out when they're about 18 months old, so we're born pretty undercooked.

**Steve Flemming** 36:54

That was absolutely fascinating and nuclear. So thanks so much for joining us on this episode of brain stories and see everybody next time