Aman Saleem

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**SPEAKERS**

Steve Flemming, Caswell Barry, Aman Saleem

**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** 00:07

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** 00:17

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

**Caswell Barry** 00:25

So today, we are lucky to be joined by am unsleep. Welcome, Ellen. So, Amazon is currently based at the institute behavioural neuroscience, which is at UCL. But he has a longer illustrious career, I've just been updating myself and what he's been doing, it's quite exciting and diverse. So he did his undergrad at the Indian Institute of Technology Bombay, which was material science and metallurgical engineering, before moving to Imperial College in London to do bioengineering. Then he did a postdoc at UCL with Matteo Kieran Dini and Kenneth Harris, before setting up his own lab at the Ibn, and your lab uses a combination of experimental and computational approaches to investigate brain function. I know that you work on a combination of brain regions as well. So at least visual cortex, hippocampus centre aisle, so perceptual to spatial representations in rodents, and maybe beyond that. So welcome, Aaron. Thank you very much. So we've got loads to get through today, I can see and I'm going to start by asking you why these brain regions This is you've cast your net pretty wide, like most people are happy with just visual cortex or just hippocampus. But you're greedy for both? What's the what's the scientific thinking behind this?

**Aman Saleem** 01:44

Well, in general, I think well, first of all, thank you very much for the invitation, I'm excited to be talking about my work and how I got here. So why these two regions. And so I think in general, people have studied how single areas work, and we've spent a lot of time looking at individual brain areas. So I think it's time we started looking at how things work together rather than as individuals. I think that just goes beyond even brain areas. But in general, I think it's something it's the new direction that I think the field needs to move into, and started off working in some of these two of these areas, because the two areas that are quite well studied, so we've got a nice base to start off with, and explore how multiple areas work together. So that's my motivation to study these two brain areas. So vision and navigation in general.

**Caswell Barry** 02:40

And is this something that is only recently becoming possible? I mean, I'm guessing possibly incorrectly, that until recently, that limit was may be our sort of technological competence. And you know, you had one set of electrodes and they were going to one place, is that what's changed? Or is it just ambition or theory? What do you think's made this possible? Now, I

**Aman Saleem** 03:02

think over the last decade, there's definitely been a lot more, there's been an explosion of different techniques in neuroscience, one of them being rodent virtual reality, which is probably one of the deciding factors, at least for me to get into this area, because when we're studying vision, we really want to know what the eyes are looking at. So we can like very carefully and quantitatively measure various things as to how things are changing in the brain with respect to the image that's being presented on the screen, or in display device. While when it goes to navigation, we really want to know we want to have the animal, move around, explore, find new places. And for that, we kind of need the animal to walk around and it needs a 3d Moving condition. So Virtual Reality kind of enabled us to bring these two fields together. So where we can have so rather than virtual reality is a system where you can have an animal over wheel and a head restraint condition. And by running on a wheel or a ball, the animal can explore a virtual reality. So this brings the two things together where the animal we can create a virtual environment. And also, new computers allow us to do better and faster virtual environments. By by bringing the by putting the animal in this head restraint condition, we can present very controlled visual stimuli while the animal is exploring environment. So that's the main thing that brought me into the field. And I think it is also bringing in other people into this field of being able to study vision and the navigation system together.

**Steve Flemming** 04:48

And, and to the to the rodents get it straightaway when you put them into VR because I knew, you know, humans might find VR slightly disorienting when you first put it on I'm just wondering, do they have to be trained to recognise that this is a new environment for them? Or do they just find it quite natural?

**Aman Saleem** 05:09

I wish I could ask them. So I think in general, when you put them in the environment, the first thing that at least what I noticed is that they seem to like the feedback of an action that they do, causing something had changed in the world. So as they work and run this, the environment is moving across their eyes. And we actually tried this out, we quantified it and looked at like two animals with feedback and without feedback, how they behave. And they just tend to run faster and more when there is this feedback. Whether they like the weather, they understand the environment, is something that's it's hard to actually quantify. Because what we can't ask the mouse, but what we can measure is we can measure whether there is a representation of the environment in the brain. And we do start seeing the representation develop over the first day itself, and then it builds up over the first two or three days. And actually, in five days or so it's pretty stable.

**Steve Flemming** 06:24

And so just to give, I guess, our listeners a sense of what kinds of environments you're talking about here. So are these mazes are they rooms, what kind of things do you code up to present them in VR?

**Aman Saleem** 06:40

So when I started off, I made these like, really nice rooms, which the animals could explore two dimensional rooms, with lots of features on the walls. And then we went in and recorded from the brain, and was just too messy to analyse from the visual cortex. Because, as I mentioned before, for vision, you want to have very controlled visual stimuli. So then we dial back our ambitions a little bit. And now, most of our recordings have been in linear and linear tracks. So they're kind of like a corridor, or a tunnel, if you want to try and think of it in mouse terms, a tunnel that they go through that has various visual features along the way. So it's quite simple in general. And that's just to make it easy for ourselves. So we can understand a bit more. And then the idea now is to try and make environments a lot more complicated.

**Caswell Barry** 07:34

How important. I mean, I guess the thing people have said to me in the past is all you know, mice, they can't really see very well, they're basically blind. I'm guessing people have said this to you a lot, given the things you work on. How do you answer them? I mean, I suppose there's a set of questions here is how do you answer that question? And also, do you think there's scope in the future to add other things to the VR? Like, I mean, something tactile whiskers are obviously super important to rodents.

**Aman Saleem** 08:02

So when I first started working in mouse vision, I very often had an existential crisis as to why the hell am I doing mass vision? They don't use vision for anything. What's the point? They're nocturnal. So the reason I moved into this field as well, is one observation, which is that play cells in the hippocampus and generally, the spatial representation of the environment, is very strongly controlled by visual cues. So there's a lot of observations in the literature, over decades of research, where if you have very prominent landmarks around the room, so just features on the wall, far away or close to the animal. And if you rotate these landmarks, in a symmetric way, so if you've kind of got a circular environment, and you rotate things, the whole spatial representation just to visual landmarks, the whole spatial representation of the of the animal actually rotates with the visual landmarks. So that at least gives us a hint that the spatial representation is quite strongly controlled by these visual cues. So whether or not they're using vision directly for every precise thing, I'm not sure, but at least this one gave us a hint that there's definitely some very strong control of the navigation system using visual landmarks. Another thing is, and this was, you know, do they actually use them in behaviour? And for this, we actually ran a few there's been there's been multiple labs now and also I was involved in some studies where we looked at, can we elicit some innate responses from a mouse based on visual stimuli and we can very, very reliably induce some elicits and very A strong responses. So two examples are if you present a dot that's rapidly expanding, which is something that's maybe something that's comparable to like a bird that's approaching the animal, for example, that causes the mice to flee, or it causes a flight response. And animals run away to their nest straightaway. And, but then, if you present a slightly different stimulus, which is you have a small dog that's moving slowly across the field across the visual field in the overhead of the animal. And this is something which would be considers mimicking a bird that just flying across, but not really approaching the animal. When we present a stimulus like that, the mice tend to freeze. So there's a very different behaviour, depending on what visual stimulus you present, again, suggesting that, you know, mice can use that vision to do various behaviours. So in general, there are various now, over time, we've shown lots of different behaviours, as a field, a lot of different behave, visual behaviours have been established in mice. So they do use vision quite effectively, for various behaviours, they might not be just purely visual, there's other sensory systems as well, that they use quite a lot, especially olfaction seems to be a very strong driver for a lot of behaviours. So, so yeah, they definitely use the visual system. It's unclear as to how strong how dominant it is, as a sensory system compared to the other sensory systems. Your other question was about whether we can now introduce other features. And that's something that a lot of labs have started doing. So not just using vision, but then adding in some sensory, some somatosensory features or adding some auditory tones every now and then just to simulate some kind of movement of an auditory object. So there's, there's other things we can now add on, I think it's all a question of like, once you've got a decent idea about how one sensory system works in a navigation framework, we can start adding more,

**Steve Flemming** 12:18

you're already you're already into brain areas, you don't necessarily want to go to three straightaway. So So you have this lovely system for controlling the visual input and the environment for the mouse. And you also have this ability to then record cells in both the visual cortex and the hippocampus. So I'm wondering if you could tell us what your questions are that you're currently trying to address using that setup.

**Aman Saleem** 12:52

So when I started around the time when I started the lab, it's slightly before that my main interest was to try and understand how do we go from visual images that we see on the eye to a map of the environment or a cognitive map? So how will the transformation of this was the title of my grant, actually, the transformation of visual images through cognitive maps? And the idea when

**Steve Flemming** 13:18

and just so just when you use that phrase, map of the environment, maybe you can just give a line or two on what that means from the point of view of the brain?

**Aman Saleem** 13:27

Yeah. So this is related to play cells in the hippocampus that were discovered by John OKeefe, for which he won the Nobel Prize, and John Mackey from UCL. And they came up with this theory that by having a group of places representing the entire environment, you can actually get a map of the external world, in the hippocampus or capital formation. And that's what they refer to as the cognitive map. So the idea was, how do you go from the sensory visual images to a cognitive map? And the way I designed these experiments originally was, or at least, the hypothesis to begin with was really simple. You start off with a very purely visual representation in visual areas of the brain. And as you move downstream into the hippocampal, areas of the cognitive areas, you get a more spatial representation. So that's how we started off. I think the first thing that we came across was like, okay, the animals in our running and all of vision was done in stationary animals. So the first challenge and actually it was quite productive because got a whole bunch of papers based on that. Understanding how vision works while an animal is moving, and it turned out it wasn't exactly the same. It wasn't like you've just got the same activity as you had when The animal was stationary, which was what the original prediction would have been that we just, you know, it's just a camera, it just works, it just captures images in there, at least in the primary visual cortex. So first of all, we said, finding things just with local motion, and we had to characterise that.

**Steve Flemming** 15:17

And is that is that just is that related to motion sensitive circuits in the visual cortex, or is there because I could imagine just naively, when I'm thinking about what the image looks like when you're running, it's moving quickly. So I'm just wondering how that that intersects with more classical work on things moving in our visual field.

**Aman Saleem** 15:39

So So when we started off, we actually started off in virtual environments. And so we did have this thing where they could be either just moving visually or the animal running. So the first control experiment we ran was just run the app had the animals wandering the dark world, like absolute darkness. And we found that even in darkness, you get very strong modulation of visual cortical neurons, based on the speed at which the animal ran. So we could get quite strong responses even in the absence of any visual inputs. And these were kind of these kind of get integrated when you get into visual when you combine them with the visual speed signals. So it wasn't just about the visual, the optic flow, kind of stimuli that are generated when you move to an environment, it's actually the running speed, the act of running itself as modulating activity. So once we kind of got a slightly better idea about what running did, we then could move into, okay, what's happening in the environment. And we were recording from visual cortex and hippocampus. And kind of To our surprise, what we found was that we were actually able to do so the design of the stimulus was that we had two parts of an environment, which had identical images in two parts. And the intention was that visual cortex should look at these as two identical images that just mirrored and so you should have identical responses to these two parts, while hippocampus should have a purely visual represent a certain spatial representation. So it should be able to identify exactly where the animal is, while if you look at visual cortex, you should be confused as to like, Am I in Part A or Part B, because they look the same? If you just took an image and presented it, it would look exactly the same. But to our surprise, we started seeing that actually, when you look at visual cortex, you can tell where the animal was, even if the images were identical. So visual cortex was, surprisingly, representing information beyond just a purely visual representation, and actually had quite a strong spatial modulation of responses as well. So

**Caswell Barry** 18:04

Did that surprise you? I mean, I guess I'm not so up to date on what the state of the art thinking of visual cortex was five years ago, but like, I guess, most we did know, there were top down some top down control, but maybe not that sort of detailed. Like isn't, it sounds quite surprising to me,

**Aman Saleem** 18:23

it was quite surprising we, we kind of didn't believe it for a long time and had to run a whole bunch of controls just to make sure that, you know, it's not just something like the animal was running faster in one part versus the other, or something was brighter in one part versus the other week. So we were quite surprised and didn't believe it at first, because it was just, as you said, we didn't know that there was some top down influence on the one. But we didn't expect such a strong influence, and especially of such a cognitive map, rather than just something simpler, like history of STEM something immediate history of the stimulus stimulus, or we know a lot about surround suppression, which is that if you present a stimulus in the centre of the receptive field, where the neuron is looking, and present things on the outside, you get, like a suppression of activity or excitation, but you get effects of what's happening on the outside of where the neuron is looking. And that's been known to be kind of top down inference. So a lot of these things were not really explored at the level of these higher order functions like cognition in general.

**Caswell Barry** 19:43

And how just sort of give people a sense of the the effect or we talk like what sort of strength modulation we talk you always sort of in the realm of fMRI where you could detect a really small I shouldn't say there's always a Steve looking at me like, that's a strength that's not a weakness, definitely. You know, but we could detect a sort of small percentage change because you're averaging across 10,000 neurons per voxel? were you seeing something like, you know, 30% change in firing rates of individual neurons? Is it sort of like, what's the sort of effect we're dealing with?

**Aman Saleem** 20:14

So the way we characterise it was we looked at, because we've got two parts of the room. And usually neurons kind of get activated by one or two features in one of the parts of the room, we kind of looked at it as the difference between the two peaks, that we could get in the two parts of the room. So in some neurons, actually, we just got one peak, there wasn't a second peak at all, which means that it's a really strong effect in those neurons. And then you went from that range to having like equal peaks, which is like what, what the null hypothesis expectation was. So we had a whole range of things. And I think in general, the median or the mode of the distribution is probably around half the effect. So at least one of the peaks would be half the height of the other something, something around that.

**Caswell Barry** 21:08

I mean, massive,

**Steve Flemming** 21:10

huge, huge result.

**Aman Saleem** 21:12

Yeah, it was, it was quite surprising. Yeah. I'm just

**Steve Flemming** 21:17

wondering, I mean, this is a bit of an ill formed question. But I'm trying to think about this in psychological terms. So if I'm walking around an environment, and I've got two stimuli, or two bits of the room that are identical, but I, in a sense, develop an expectation that I'm going to see that thing over there. And I'm also going to see it over there. And I guess it makes sense that those those expectations need to be distinguished, maybe for memory or for what I'm going to do with that stimulus. Another way. So I'm just wondering, I guess my question is, do you think that top down modulation is purely spatial? Or do you think it's like about the expectation of that stimulus in that context?

**Aman Saleem** 22:03

That's a great question. I wish I had an answer, I think so I can just say what I think it is, I would agree with you, I think it's it, I would feel it's about the expectation of the context in which something is presented. So more than just a multi sensory thing. So for example, if you were looking at an image with, you know, and there's a bad smell in the room, you will probably have a different response to it. I guess we don't expect it in primary visual cortex, but maybe it's going going across. So something like that, where you've got an expectation of, of what you're gonna see in that room and back, Mike, I think it's it, I do think it's some kind of expectation, affecting the responses in the primary visual cortex. Yeah.

**Caswell Barry** 22:55

Do you know, if that's hippocampal in origin? If he didn't have a hippocampus? Would these effects disappear? Or is it something that is dealt with? I mean, what do you what do you think what's going on there?

**Aman Saleem** 23:09

So far, what we've done is we've recorded hippocampus and visual cortex together, to see if they're doing the same thing. And they make the same mistakes, which is suggesting that they're representing the same information. Because they make this they shouldn't be making the same mistakes, if there's if they do make a mistake. So the correlated now, whether it is coming from the hippocampus, or somewhere else I was still exploring that was that's still an open question that we don't have an answer to. So we'll have to do some kind of inactivation experiments. To just say that, okay, you've got activity now. You've got spatial modulation now. And you've lost it when you've been activated certain projections coming into the visual cortex. And this is these are ongoing experiments.

**Steve Flemming** 24:06

So we say we'll come back in a few minutes, we'll ask you about what you're excited to do next in the future. But before we do that, what we also like to do on brave stories is find out a bit about how you got into this in the first place. So Caswell gave some of your bio earlier, and it sounded like you came from not from neuroscience, more from the engineering side. So can you say when you first got an inkling that you might want to go into neuroscience, and why did that? Why did that happen?

**Aman Saleem** 24:39

Right, so as Carol mentioned, I did metallurgical engineering and material science, which is like very far from what we do now. It's a bit of a combination of physics and chemistry. And, honestly, quite boring. It was to me. I was still

**Caswell Barry** 24:56

I've got to say it sounds.

**Steve Flemming** 24:58

We've not got any metallurgist Listening.

**Caswell Barry** 25:00

I'm thinking it was a modern day alchemy basically.

**Aman Saleem** 25:04

Yeah, I think I think it was just the fact that I think we learned in every, every year we learned a different aspect about how a blast furnace works, which was to me very annoying. Because it was like metallurgical engineering and material science. I think it was the metallurgical engineering, but that was a bit dated, it felt a bit dated, because things are pretty well established there. So think the material science aspect of it was a little bit more interesting. And that's kind of why I went to Imperial, to do a master's in bioengineering with the idea that maybe I want to do this your career in biomaterials, which was one of the topics that the master's programme covered. But then it had a bunch of other topics alongside biomaterials. And that was just

**Steve Flemming** 26:00

Just what is what is biomaterials? Or what will be an example of where, right.

**Aman Saleem** 26:04

So if you've got stitches, that that you using, if you've got like artificial hip replacement, that will be a material biomaterial, right? Or various materials that go into as a heart valve valve or a stent. They're all by examples of biomaterials. And you can go to the extent of you can do targeted drug delivery using materials that would get attracted to the cancer cells, and then they you do something there. So there's this interesting stuff there. But then, when I got to, that I started doing bio engineering, I got exposed to some one of the topics was just very basic anatomy and physiology. And that was my favourite course. So I just went up to the lecture that point and was like, I really want to do physiology. Who the people doing physiology in the department because I know I need to do a project soon. So I'd like to try and do some physiology. And he, at that point, Imperial was was a smallish department and there were two new recruits. Simon Scholes, who is a neuroscientist and Peter Weinberg, who is a cardiovascular physiology personally. I wasn't quite into cardiovascular physiology. So I went assignment and someone gave me a book, which I think I have a copy of even now of a different push myself new one, which was it's called a vision of the brain by semi psyche. And

**Steve Flemming** 27:48

I know the UCL UCS. Yeah.

**Aman Saleem** 27:53

And I just loved the book, and I loved reading about vision. So I was like, I want to do a project with you. And the other thing that was weird was like, I was like, I wanted to experiment. I didn't want to do any theory stuff like so. So yeah, that's how I started. That's how I delved into neuroscience. I actually.

**Steve Flemming** 28:13

So you then came to work with Semir. Zeki at UCL. No,

**Aman Saleem** 28:16

no, I was. I was just with Simon show. I see. I see. I just did a master's Master's project with Simon at that point.

**Caswell Barry** 28:28

What was interject about? I mean, this is this was the moment I want to know what what it was.

**Aman Saleem** 28:35

One thing I wanted to mention that like I didn't even finish the course on biomaterials. I just said like, I'm not doing that anymore. I was. I was I was sold as soon as I just got exposed to it. So you ask what was the moment that was, I think, I think actually, that book was probably the one that it was not just about the book, but also got exposed to other aspects of neuroscience. But that was kind of a turning point for me.

**Caswell Barry** 28:59

I saw I love this. I just want to get back to that a second. So this is really nice here that actually it was the key moment basically was was ditching this MSC halfway through the did the math,

**Aman Saleem** 29:13

okay, it was a bio engineering Master's, which had lots of optional courses. I see. And I did the biomaterials option, because I was like, I'm not going back to material science. Like I knew that. Like I might not do academia but a marine activity.

**Caswell Barry** 29:29

I still like It's like burning the boats. You arrived somewhere new and you burn the boats. There's no going back. Okay, nice. And, and then did you did you stay and do your PhD with with Simon?

**Aman Saleem** 29:40

Yes, I did, actually. Yeah, and the project you were asking. So I was like, I wanted to experiment Simon had just started his lab. Didn't have a licence to do most experiments but like, okay, what can we do? I know this guy up in Cambridge who does flies let's see what we can do. You're, which was Simon Laflin. And then I went up to Cambridge, there was someone else Holger crap at that point and was new at Cambridge and was like, Okay, here's how you do fly experiments. So I went back and tried to set up a fly lab in

**Steve Flemming** 30:17

Oh, wow. So you were the one who went and learned the techniques and just brought them back and set them up.

**Aman Saleem** 30:23

That was I tried to put Yes. But then I went on to do a PhD. And I actually did. I did get two papers with fly work. Wow. Out of that. So it was it was actually productive. It was useful to have done that.

**Caswell Barry** 30:42

That's pretty demanding, though. I mean, being the first PhD, one of the first PhD students into a lab and setting up a new technique is far from trivial. Okay.

**Aman Saleem** 30:56

Yes. And it was, I loved it, though. It was something that I really enjoyed.

**Steve Flemming** 31:04

Do you think I'm wondering whether that because I've, I guess, come from in human Imaging Research, we share facilities, there's a lot of kind of core staff, we don't usually have to build things ourselves so much. But I'm wondering whether that experience might have given you the confidence to then I guess, do what you do now in your lab, which is seems like setting up a lot of new things, building things from scratch.

**Aman Saleem** 31:32

Yeah, I think the so there was, it wasn't. So there was, it wasn't just to make things harder.

**Caswell Barry** 31:42

Did you recall from multiple places in the library, and

**Aman Saleem** 31:45

Simon's lab was next to the aerospace engineering windtunnel, which was terrible in terms of doing electrophysiology. So after having de noised, the setup, and a fly brain is really like, it picks up any kind of noise that's around. So after de noising, a rake, wherein I was able to get some recordings from a fly brain, next to a wind tunnel. I know I can get recordings from wherever, put me wherever I get some recordings, and I'm fine. So it definitely gave me that kind of confidence that I can do that. And so half of my PhD was in flies, and then I transitioned to mice, and also, kind of Simon and I built the mouse stuff. So I was, again, one of the few PhD students around so yeah, I just, like definitely got a lot of confidence in terms of building new things, trying new techniques, just going with it. So just yeah, my advice and style was like throwing you in the deep end. And like, you know, some people hate it, but I actually thrived on it. I really liked it definitely helped me a lot. Moving on to my postdoc, where I think that's what Matteo found interesting that I set up these things. So I can now go and set up rich maths virtual reality, which I, which I managed to do. And even now we keep developing new things. And so I definitely have the confidence that I can figure it out, eventually, it might take a while, but we'll get there.

**Caswell Barry** 33:32

This is, it's really interesting. I'm sort of really conscious of the fact that quite a lot of people who listen to this podcast, sort of maybe better make decisions about PhDs themselves. One thing that strikes me is there's really no typical roots. And yours is and I thought we'd heard most of yours is, I guess, yes, again, different in that this. You've changed so many times across so many different places, so many different fields, different groups, different techniques. It's incredible. It's and actually, the really interesting thing is that you see that strongly as soundware. It sounds like you see that as a positive advantage rather than something where you're like, oh, there's been some, you know, there's some time less switching, but actually, it's furnish you with a set of skills that are now paying dividends. So, that's not a question. That's just a statement.

**Aman Saleem** 34:21

Yeah, I guess. And also, while I was doing my PhD, because Simon Simon's lab was kind of half theory and half experiments. I was sitting next to someone who did astrophysics and was doing entropy and stars, before he came into neuroscience and said, doing entropy and neural systems. And so, that was another very valuable exposure that I had where, you know, thinking about the theory, as well as the experiment was was quite useful. Even if I didn't, I didn't always do as much theory during my PhD but you know, I Again, it's a question of confidence, I can talk to people about that. And that helps with collaborations and just just being able to, like, at least understand some of the things that are that are happening out there. Even if I don't do them myself necessarily.

**Caswell Barry** 35:15

That's gonna say what looking at looking at the timeline, it seems that you switch every few years is the next big one coming? Is this like waiting for the next big earthquake? Do you think you will? I guess really, rather being facetious what I should say is, do you think you'll switch again? Or do you think you found a home now at both academically, technique wise?

**Aman Saleem** 35:36

So technique wise, I don't think we should limit ourselves to like what we know. I think like, depending on what the question is, I might pick a new technique. It's not something that I don't think any one of us should be doing that because it's it clouds are the directions we can take and the questions we can ask. So I'd rather drive the techniques based on the questions that we have.

**Steve Flemming** 36:04

I think that's inspiring to hear. Right. So I think that because I think people would maybe like to do that, but they don't feel they have the confidence to go through with it. And so I think that is an inspiring message that we should be getting out of our comfort zone. And trying new things.

**Aman Saleem** 36:23

Definitely. And I'm, and I'm also, I, myself, don't always follow that, like, I do, take advantage of the techniques that I know to do big, collect more data, using that credit and doing something slightly different. But ideally, I would like to not restrict myself based on that. It's, it's also like, when it comes to experimental work, it's like when something's running, don't change it kind of attitude. So you know, the stuff running in the lab, we definitely want to take the most advantage of what's working and then extended from that. But yeah, ideally, be should be like, at least that's what I tell the students like, at least, at the planning phase, let's not restrict ourselves. And then we can go back and like, cut our ambitions a little bit later. But at least it shouldn't really cloud our judgement as to like what we can do.

**Steve Flemming** 37:21

So this brings us nicely on to the question, then, of what you want to do in the next five years, 10 years? Where do you see this research programme going?

**Aman Saleem** 37:31

So I've been asking myself this a lot, because it's about five years in, since I first started the lab, and we've kind of we've got a bunch of papers out, a lot of studies have now come to closure. We're about to start a whole new set of experiments. So I'm even more confident that looking at multiple brain regions is the way forward. And that's something that now I'm trying to do, pretty much every project in the lab will be recording from multiple brain regions, to will maybe more and different combinations, potentially, not just restricting to v one and hippocampus, but a few other regions. So multiple brain regions. And the other thing I'm really keen on is the dynamics of neural activity. So a lot of the studies that we've been doing are looking at spiking activity or neural activity in time windows of like about a second or two seconds, something like that, like you could send a stimulus look at what the response is like in the second that follows while the stimulus is on and then you look at it afterwards. I think it's also the question of like, now we have a lot more data. And we're we've got better precision. I'm very keen now on understanding how does this activity evolves across time in the order of 10s of milliseconds, because there seems to be some, a lot of interesting things happening at that kind of timescale. We've been observing things between like stationary and running animals that when the animals are running, things get faster there, the the encoding of information is more precise, and things like that. So I'd say the two, two main directions that the lab would be going in, actually three main directions. So the first one is multiple areas, looking at dynamics. And the third one is making things more complicated for ourselves by trying to do freely moving animals trying to do vision and freely moving animals in parallel with the navigation. So we've now developed some new software tools that are able to generate augmented reality environments and very complex environments to mice and humans as well. So try and exploit that and actually do some more interesting experiments in the visual system.

**Steve Flemming** 40:05

And these, when you say augmented reality, this is in like a real box or room, but you're projecting things on on the walls.

**Aman Saleem** 40:15

Yeah, it's kind of like you have a window, and you've got objects beyond the window that are changing so that you can interact with. So the scene, like if you look out of a window and move your head around, things outside move on the window relative to based on your head movement. And so we're able to replicate that by tracking the animal in real time, and updating what's happening on the display device. And so we're able to generate these more realistic environments where you can have three dimensional objects that update the, you're changing the viewpoint of an object based on where the animal is.

**Steve Flemming** 40:56

Super cool. All right, well, we are almost out of time. So we're going to need to wrap up but before we do, as regular listeners will know we like to ask each of our guests the same final question. So imagine what is your favourite facts about the brain?

**Aman Saleem** 41:14

I'd say the weird fact not a favourite. Really tasty.

**Caswell Barry** 41:21

Oh my god.

**Steve Flemming** 41:25

I have to name the species.

**Aman Saleem** 41:28

So I noticed my best thing to talk about but in in Bombay, where I did my, my undergrad. This It's a popular street food dish. It's called beta fry. Which is fried brain.

**Caswell Barry** 41:48

What? What sort of rain?

**Aman Saleem** 41:51

It's lamb and sheep.

41:52

Wow. Okay,

41:55

interesting.

**Aman Saleem** 41:56

Not sure it's for everyone's palate. Good. The fact but it's, yeah,

**Caswell Barry** 42:02

I think it's the best fact we've had. So hands down.

**Steve Flemming** 42:06

Yeah, yeah, absolutely.

**Caswell Barry** 42:09

So on the next episode, are we getting for some fried brains and eating them live? Is that what we can do?

**Steve Flemming** 42:16

Screenshot coming.

**Aman Saleem** 42:18

You can actually. So this room is Bombay street food, and one of their dishes, you can have the option of having

**Caswell Barry** 42:28

they go. Wow. Okay, I'm, I'm game if you are. That was fantastic. Man. Thank you so much for joining us on this episode of brain stories across the board. That was just really super interesting and inspiring. So thank you for joining us. To the audience. See you next time.

**Steve Flemming** 42:48

We'd like to thank Matt Wakelin, Maya Sapir and Trevor smarts for their roles in taking break stories from an idea to a fully fledged podcast. We'd also like to thank Patrick Robinson and UCL digital education for editing and mixing. Follow us on Twitter at UCL Bray stories for updates and information about forthcoming episodes.