Episode 15 - Peter Kok

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SPEAKERS

Steve Flemming, Selina Wray

S Selina Wray 00:02

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

S Steve Flemming 00:08

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.

S Selina Wray 00:18

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

S Steve Flemming 00:27

And today, we're very excited to be joined by Peter Kok, who is a principal research fellow at University College London. He's based at the Phil the functional imaging laboratory in Queens square. He's cognitive neuroscientists interested in how our prior knowledge of the world influences our perception. And Peter did his PhD with florastor Langer at the Donders. And then went to the States for a postdoc with nikto, at Brown at both Princeton and Yale. And then he came to UCL a few years ago to set up his own lab in Queens square. And he's been pioneering the use of high field imaging, such as seven Tesla functional MRI to look at, deconstruct the circuits involved in perception. And so we're really excited to have you on the podcast. Peter, thanks for joining us.

01:20

Thanks very much for the invite.

Steve Flemming 01:22

So perhaps we could start by maybe you could say in your own words, a bit about the focus of your research and what you've been working on recently.

01:31

Yeah, sure. Yeah. So what I'm really interested in at heart is how does the brain determine what we see what we experience, you know, our visual awareness of the world. And what we've been trying to do, as you say, is kind of, to get at the neural circuit on the line that so the high field work helps there. Because usually with with newer imaging, human neuroimaging, we've treated the brain as kind of a two dimensional sheet. But as we know, it's much more than that there's a three dimensional structure where the depth is really important as well, the cortical layers, and the high field imaging helps us dissect the circuit, because we can now try to dissect signals, signals that flow in different directions. So signals that flow from the eyes up to the visual cortex up to visual hierarchy to other regions, versus signals that flow the other way around signals coming from memory, for instance, reflecting prior knowledge that influence visual cortical processing, if you treat the brain as a 2d sheet, you cannot detect the Dissectors. But you can if you look into cortical depth. So that's one of the things that we're very excited about, trying to figure out how the brain combined these different signals coming from the eyes and coming from memory and prior knowledge, have combines those and then ends up with the precepts of the world. Another important argument that research is looking at the temporal dynamics of how these signals are combined using methods like M EG, to get a fine temporal resolution. And looking at memory structures, as well as visual cortex to see where these prior knowledge signals coming from. Roughly those are kind of the three main kind of wishes lines in a lab.

Steve Flemming 03:21

Fantastic.

Selina Wray 03:23

It's really exciting. And on a on a kind of practical level. I wonder if you could describe a bit for listeners, what did these experiments look like? Presumably you are working with human participants in the scanner and did that you're showing them a variety of of images? How do you test how somebody's prior knowledge influences their perception?

03:45

Yeah, so it needed this is all human neuroimaging work. That's my my field my expertise. That's what I do. And what we used what I used to do a lot during my PhD, and also my postdoc, is show people images. And those images are either expected or unexpected. And then we look at how does the brain activity different between those sets of images? Is there more activity for one than the other is one type of image better represented than another type of image based on expectations, etc. But we always kind of purposely ignored how people perceive the images. So we always give people a kind of distracting tasks to do that still involve the images but wasn't really related to expectations or anything. So we did that to try to avoid any kind of confounds where people might use these expectations that they have not to necessarily guide their perception, but to make strategic guesses. So we make the images for instance, difficult to see. So if we give people an expectation about what the image is going to be, they could just And to go extreme, close their eyes and just respond to what they thought they should be seeing. So to avoid that we always had them do boring, distracting tasks, meaning that we couldn't really actually measure what they were seeing. And what we're doing now is trying to use the knowledge that we've gained from those tasks and try to actually study subjective perception by asking people in the scanner, what did you see? How sure are you about what you saw, and then try to relate their subjective reports to the neural activity. And that's something that we've just started doing the last few years and something I'm very excited about.

S Steve Flemming 05:35

And your work has this clinical angle to it as well, because I, as I understand it, part of what you're interested in is why people might suffer from subjectively very vivid hallucinations, for instance, in schizophrenia. And I'm just wondering whether you could say a few words about how you see that connection being built? Like what what would you aspire to in terms of an explanation of something like a hallucination?

06:05

Yeah, that's a good question. So my research has always been basic science testing, like normative participants are usually students in the scanner. And try to understand, let's say, a normal, healthy brain. But there's the things we find here, the things we learned do have implications for clinical disorders, like hallucinations, a clear point where perhaps, if those, the combination of external and internal signals I mentioned earlier memories and signals from the eye, if that balance is off, then you might expect perception to be off as well. So if the internal signals are too strong, then perhaps what you see is driven by internal signals, like memories or prior knowledge. So rather than what actually is coming into the eyes, and that might be a hallucination. And the flip side of that is, if you don't use your prior knowledge to guide your perception, your perception might be overwhelming, because you don't have a way of constraining the inputs. And the theories about both those ends of the scales. One, blinking potentially dollars donations, and the other may be potentially looking into sensory overstimulation in, for instance, Autism Spectrum Disorder. Those are things that I'm very interested in that I don't work on directly myself, but through collaborations. So for instance, Ramana, while it was working on hallucinations in Parkinson's disease, and we have a collaboration using this high field scanning, to try to see whether those hallucinations might arise from internal top down signals, or from aberrant bottom up signals. And then we can use the layers to try to dissociate that. So my core pre programme is about basic science, but I'm very eager to collaborate with colleagues investigating these clinical disorders as well.

S Selina Wray 08:04

I think it's fascinating and I was going to mention the example of Parkinson's disease actually, will our audios our understanding of how these hallucinations occur? Does that give us any insights into how people living with these conditions can better manage those hallucinations? Presumably, sometimes they're quite disruptive to the individuals.

08:26

Yeah. So I think it might do, again, I don't have much personal experience from working with these patients, from what I understand from colleagues who do, for instance, a postdoc in my lab, who does a lot of this work. Yost has Maya is has worked with psychosis patients before and is very interested in this. I think, the way that some people including yose, I think look at it is that giving patients and understanding of that this is kind of a combination of ink memories and incoming signals is something that happens with everyone. And the balance might just be a bit, you know, different in some than others. Maybe take some of the stigma away from it being something completely alien that's occurring in our brain. So I think the way that he looks at it is that it makes it seem more like that everyone's kind of on some point on the spectrum. And, you know, but but the basic mechanism is there and everyone and hopefully, knowing that will take some of the give some comfort, I guess,

S Selina Wray 09:38

would this be and this may be a really naive question, and so forgive me if so, but would when you say this mechanism is there in everyone? Would this then also be the same pathways that play with thinking of the famous dress that was doing the rounds a few years ago where some people saw it as blue some people saw it as gold Old? Is this the same kind of pathway that that's kind of involved in, in the kind of perceptions that we're all susceptible to having differences between us? Yeah,

10:09

I think so I think there are these kind of internal influences on what we see something that happens in everyone. And it's so automatic. And it happens all the time says that we don't even really notice it. But if you think about the actual visual inputs that we get, where we take a snapshot by moving our eyes, but every 200 milliseconds, and get completely different input, and if you then compare that to the visual experience we have, which is more of a smooth world, and and things stay in the same place, even though our eyes move so much, there must be a lot of internal compensation for to make sense of that chaotic, overwhelming input. So I think everyone has this mechanism. The question is just what's the right balance? And I think that's yeah, I think that is that is right. And I think, in these tests that we do, we can try to dissociate those two streams of information to some extent, because we know that these signals from the eyes arrive in different cortical layers from these internal signals coming from memory, for instance. So there with that way, we can try to study how these two signals affect visual processing and how the two are, are integrated. And potentially that can be used also to study how this might be different in, for instance, patients with Parkinson's, or psychosis, or, or even autism.

S Steve Flemming 11:43

So can I ask you a little more about the theory behind this. So I remember studying psychology as an undergraduate. And when we were taught vision, essentially, it was this process of taking in information from the outside world, building some increasingly more abstract picture of what's out there. But it was very much a feed forward process, things were coming in and being processed. And what's kind of remarkable with taking the long view of neuroscience is that over the past 20 years or so, there's really been somewhat like a revolution in the sense that we now understand the brain much more as having these top down signals, and they shape perception in your work has shown you really beautifully that those those are being shaped at fine grain level. And so I'm wondering how much we don't know about that still, like what, what kind of mechanistic model is out there? And what what what are the questions you're asking about, like how those mechanisms might might work that we don't yet know the answer to?

12:48

Yeah, yeah, I think I think there's a enormous amount we don't know, I think the the role of feedback, internal signals, top down signals, or whatever you want to call them has been is recognised now, as you say, a lot more than 10 or 20 years ago, I remember the first studies I did do my PhD and we tried to publish, we'd often get pushback from at least one reviewer saying all feedback autochthonous just attention their own expectations or predictions, it doesn't mean anything, it's just another term we don't need. And that we don't get that as much anymore. No, no, I think that's the, you can see that change. It's almost sometimes going a bit to find the other direction, where there is a particular theory of of these top down signals and how they influence perception known as predictive coding, where these top down signals provide prediction, which is then compared to the inputs, and then an error is computed by the mismatch between what you expected to see him but you did see that especially specific theory, and now, it's sometimes cited, whenever there's any evidence of some kind of feedbacks ignore a prediction, regardless of whether there is actually error computation going on. So I think that's the part we don't know. We don't know at all yet. I would say how these top down signals interact with these bottom up signals, what the computations are, how they are integrated. And one candidate is predictive coding is is an attractive candidate, but there are also other theories and dissociating them, I think, is an important endeavour for the next, the next phase in this research, and I think that is also a place where these kinds of things like high field imaging and also high temporal resolution studies can give a give us something extra because we can try to now look for these error computations to see if they're there or not.

S Selina Wray 14:55

And so I wonder, kind of following on from that, if you could context for as well. is, you know, in the next five years, where do you think the most exciting developments will be in this area? And also, I'm interested in, it seems like for all of us, even myself as a cell biology, a lot of limitations around our understanding how good the technology is to really enable us to kind of seeing the details. So should we be expecting even kind of better and more sophisticated imaging techniques to come online in the near future

15:26

to? Yeah, I think that's a very good question, I think it's excited to see where the where this will go. Next. One thing that I, as I just mentioned, that we really don't know enough about is the computations that by which the brain integrates these two sources of information. So most studies, also the studies that we've done, we try to isolate, for instance, one of those sources, so we try to isolate in one condition, a signal that's purely driven by the eyes to present an image that's that's not not expected. And then in another condition, try to look at a pure expectation signal where people expect to see something, but it's not shown. But and that's given us from very valuable insights. But it doesn't tell us anything about how those two sources are combined, which is what normal perception is like. And the challenge there, of course, is that now you have these two signals mixing in the different cortical layers over time, if you're looking at energy. And I think that's where the real challenge to alive for the next phase of this research. How can we link subjective perception to the integration of these sources of information? And do we see errors? Or is it is it more an integration of some of the signals rather than an error of computation. And that's a big challenge, because now you're looking at signals that are flowing through a circuit at the same time, and combining. But I think with the techniques that we have, we can now and the knowledge that we've gained from isolating the two signals in previous research, we can try to make some headway there. Another important thing that I think will be to collaborate with people who test the circuits in animal models, where we have a lot more even fine grained spatial and temporal resolution than we do in human neuroimaging. And I have, I find that also people doing animal research are now getting more interested in these ideas of prediction and expectation where they weren't maybe 10 years ago. So I think that's another promising development.

S Steve Flemming 17:35

So just in terms of the alternative models, you're testing here. So you mentioned that I think in earlier on, you said something about how there might not actually be error computations in the way that say, a predictive coding model would would lay it out. So I'm just wondering what if there was kind of a dream experiment you could do to pull apart different possible mechanisms by how memory and input are combined? Like what would that look like if you had kind of a limited access to the to the circuit?

18:13

Yeah, I think that's a question I think you would want to measure, ideally, a bunch of individual neurons in different cortical layers, and then measure the activity in those neurons, after you've presented a coupon that elicits an expectation about what's going to happen, and then measure in that period when there's just an expectation, and then you present something that either matches the expectation or it doesn't. And then can you continue measuring, and see how the representation of that stimulus is affected by the expectation. If they're, if predictive coding is true, then there should be separate neurons that encode the prediction or hypothesis about what's likely to be out there in the world, probably in the deep cortical layers, and neurons that encode purely the mismatch between the two. So you will get, quote unquote, qualitatively very different responses. If, on the other hand, theories are through that, for instance, that say that what feedback is doing is not inhibit expected information, but enhance it, then you should see the opposite profile in those neurons. So you shouldn't see any neurons that and code mismatch explicitly. So I think this is something that people are starting to do now in some rodent models, for instance, there's still a lot to be worked out because it's a new kind of development in animal research, especially. But we can also try to do this now with these high field experiments by trying to do this experiment it just described and look at the different cortical layers where we would expect that the feedback would be in the deep cortical layers. and feed forward the error being signalled up the hierarchy and the superficial cortical layers. And we're doing some of these experiments now to try to see if we can see any signature of such an error. That's

S Steve Flemming 20:12

cool. And it's just a relation to animal models. Do you think mice hallucinate in the same way that? I mean, in the sense that you can create these experiments and look at the interaction, but I'm just wondering like, because your work is, in humans is nicely connected to these subjective aspects of experience? Yeah. I'm just wondering, do you think that or is there any evidence that you have individual differences in say, other animals that they just have this these vivid hallucinations in the same way that humans might?

20:48

Yeah, it's a very good question. I think that some people, especially Katrina smack have is one researcher who is really arguing for this initiative has shown very convincing data that at least there are some high confidence, false alarms, which you could call hallucinations. He does. But we don't know. Of course, you know, we can we can introspect about our own precepts, but not about a rodents. But at least she's making a very convincing empirical case that there are these iconference False precepts. The question then is, is the circuit ultimate ultimately going to be the same as in humans? And of course, I think on some level, yes. But in other aspects, probably not. The visual cortex of rodents is organised by differently than that of humans. Of course, it's in the in the human visual cortex as its organisation of features orientation in a way that it maps that isn't present in rodents, as far as I'm aware. So I think there will be important differences as well, which is why it's great that now we're starting to get to a stage where we can bridge some of the gap. It used to be very close measurements in humans, and very fine grained in animals with a huge gap between them. And also, a lack at some point, sometimes have common interests do, like I said, expectation predictions weren't of interest in animal research, and maybe 1020 years ago. But now we're starting to close the gap a little bit in terms of the resolution of the signals we're looking at. And we're starting to have these common interests. So I think, now, we can start to see what is the same or what is different in these different organisms.

S Selina Wray 22:39

Fascinating, and it gives us a chance to plug our previous episode of Caterina shmack. If any of our listeners didn't have a chance, you can go back and listen to episode 11. To find out more,

22:50

we recommend that one.

Selina Wray 22:52

So actually, Peter, I wondered if I could ask you a little bit about how you became interested in this area. And what your training path was, through your career. What did you do as an undergraduate? And how did you end up where you are now?

23:07

Yeah, sure, yeah. Initially, it was a little bit stopping state because after secondary school, I had no idea what I wanted to do. And a lot of my friends were going into computer science and I didn't know what to do. So I thought, I'll do that as well. But it turned out initially to be quite enjoyable, some of the maths and logic and those kinds of courses, but at the more computer science he got, the more I started hating it. And after a year and a half, I I quit that, which gave me a half year to wait till next year to start and start to figure out what what do I want to do. And that took me a while to decide. And I ended up choosing psychology doing a psychology, bachelor degree, which was originally something I was interested in as well. I remember my high school like counsellor advisor, right where it is, at the end of secondary school. When I brought up psychology saying that would be a waste of your degree of your, your high your high grades in physics and chemistry and stuff. And don't do that psychology is too soft to topic. So eventually, I ended up there anyway. And I'm very glad I did because then I started really enjoying University. I found it very interesting. I really loved the biology as well, the courses of the different receptors and the cells involved and started really enjoying it, especially as the degree went on it I'm wondering

Steve Flemming 24:39

that stage did you the computer science start is interesting given now or the? Yeah, convergence, I guess between your work now and computer vision, artificial neural networks and so on. I'm wondering whether at that stage did you notice some of the commonalities Dad, did you did you think? Yeah, no, this is good. But I wanted to look at it from another perspective, or was it just a complete shift?

25:08

For me, it was really a complete shift. So in hindsight, I think, Oh, I wish I remember more from I got some, I learned some programming, which was useful. And of course, but I feel like a lot of this stuff, if I remember the maths that I was taught, there better would have been great. But I, for me, it was such a complete break. Personally, I really, there was so much I didn't like about that degree. And that it felt felt a complete break to me. And then in the psychology, the things I found most interesting, were there more biological courses, so I can mention the receptors in the cells, etc. So very different level, also very different from why I ended up, ultimately. So it felt like a complete break. And with hindsight, I wish I remember a bit more from my computer science days. But because yeah, that is definitely a useful skill set to have as well. But yeah, and I, in the third year of my bachelor in psychology, I didn't get enough the, the credits to graduate that needed a few more of them. Didn't have the best year, personally. And then I needed just for a few credits, do a whole other year. So then I figured I'll use that year to do some philosophy. So I did a year philosophy courses as well, which I really enjoyed. There was some general philosophy courses, but also a few specifically, like philosophy of mind type courses. And that really kind of latched on to my guess the question I had I already had, how does this clump of cells in our skull lead to consciousness? How is it possible that we can have an experience of colour blue or something, something so subjective, from a clump of cells, It's unfathomable kind of courses, talking about the the hard problem, versus the easy problems, etc. So I found all of that. Very interesting. And then I had to decide at the end of that, which way do I want to go? Do I want to go this one's for like, the philosophy route? Do I want to do pursue that? Or a science? What do I want to do? Like a research Master, I knew I wanted to go for either one quite like seriously, I'm either gonna go for it for a good, there was a two year research Master programme that I was considering or this two year philosophy master. And in the end, I chose the science obviously, given where I end up now, because I felt like that would be a way where I might be able to contribute some new knowledge, whereas I didn't have as much confidence that we'll be able to do that down the philosophy route. And that, from then on things getting more linear or smooth, I guess I would say in my because then, I really enjoyed that Master, I got to two neuroscience projects during the master where I got a lot of free rein as well, which was maybe not the best for the projects themselves, but really learn a lot and get a lot of experience with EEG and first year, TMS a second year. And there was a lot of a lot of fun, I learned, I learned a lot. So from then on, I really was hooked in, like the cognitive neuroscience programme.

S Steve Flemming 28:22

And the philosophy. In k, I hadn't realised this heavy despite sharing a building with you for a few years, I hadn't realised your your choice point with philosophy before. So I'm intrigued now, whether you still feel like there's a hard problem, are you still do you still feel the pole of that problem? Now, do you know about the way the visual system works? And so on?

28:52

Yeah, I do. Yeah. So it's, again, something where I wish I would have kept track of the philosophy more but I kind of made this destroys for science. And then I went went for that. And I still think about these topics. But the way I thought about it at the time, and I still kind of do, is that the hard problem? I have no idea how to solve that. And it feels intuitively to me, like there is a hard problem. But the easy problems, maybe that's a way of starting to bridge the gap a little bit. So that's what I the way I started thinking about it, maybe through science, doing experiments, we can solve some of the easy problems, like what kind of computations does the brain do to you know, as we just discussed earlier, to combine sensory signals and memory, etc. And maybe if we understand that, maybe the hyperbola will shrink, because that was kind of my way of thinking about it. And I think I still feel like I said, I still feel like that there's some there's a gap to bridge that and I'm not sure how to how to bridge that gap. But of course that's, you know, that's a topic that Every one wonders about, I guess,

S Selina Wray 30:01

seems from from what you've just said that the real sort of key to putting you on this path was those first experiences of actually doing practical research. And that's kind of what solidified the decision for you. And I just wondered if you could maybe tell us a little bit more about your kind of foot, you've mentioned briefly, but your your first research experiences and how that then sort of guided you onto this path of being interested in visual perception?

30:29

Yeah, sure. Yeah, I think so visual consciousness was always the thing I wanted about most housing, you know, I was possible. And what I decided to do for my first research project in my, in my in my master's was, I just wrote to basically my favourite professor and department from the courses that I had, it's gonna yell at experimental psychology. And I just asked him if he would be willing to supervise a project from me and I, I got really interested through both psychology and philosophy in binocular rivalry. So what I asked if he would be willing to supervise a project where we're doing binocular rivalry, and also actually two other kinds of paradigms while recording EEG. And that's basically he, he said, Yes, which was great. So I basically got to do what I wanted to do, which as I said, probably wasn't the best for the project itself. And we didn't really, I didn't really have a super clear like, hypothesis, this theory versus that theory, I just was so curious how these kinds of subjective fluctuations in consciousness relate to brain signals. So I did some binocular rivalry with frequency tagging. So let the present one stimulus to each eye. And then what you see is that you're you're either aware of one stimulus that's built into the left eye, say, or the one that's presented to the right eye, but never both at the same time, it fluctuates. And by letting the two images flicker at different frequencies, you can try to track in the brain signals using eg if you if there's more activity for the flicker rate of the stimulus you're aware of, than the symbols you're not aware of. So that's, that's one of the things I did during that first project. And I find it so interesting that you could actually track this, that that really got me. And it was also, I got so much sort of free rein from a professor, there was a PhD student who helped me a lot in the daily supervision, who helped me programme the experiment, and helped me with code to EEG. And he was a very, also very relaxed and super helpful guy. And that really just gave me such an appetite to do more of this research, because it was so enjoyable, even if the project itself wasn't, you know, world shattering. It was it was really fun.

S Steve Flemming 32:51

And I'm intrigued then, like how you think about supervising your own students now, in light of like, what's best for the project? What's best for the person? I feel like a lot of it's often hard as a PI to know how to strike that balance. Yeah, I'm just wondering what your, your thoughts are on that in light? Yeah,

33:14

that's a good way. It's something I'm very much still trying to figure out, I guess I haven't been a PA for that long. Right. So it's something I do think about. So my second year was very different is of what much more of a hypothesis and a project that was kind of there to do as a follow up on an existing project, etc. And this was the DMS study, which also shaped me in a lot of ways because this was kind of already about expectation. So people were looking at arrows on the screen, and sometimes it'd be one arrow and sometimes two in succession. And then those would suddenly be paired with TMS pulses. And then there would be trials where they would, for instance, be two TMS pulses, but only one arrow, and people would sometimes actually see two arrows induced by the TMS pulses to their visual cortex. So they kind of hallucinated the expected stimulus induced by TMS ball. So that was, I found that, again, super interesting, but that was and then the project I did was just a variant of that with different kinds of visual stimuli more than just left and right to the arrow sets of 246 or eight images and see if the hallucination becomes less if you have less of an expectation, because for instance, has eight possibilities instead of two. And that's that, so that was very clear cut experiment where it was much more top down direction about what the project is going to be. And therefore also the results were much more informative. You know, you know, so I think there's definitely a balance to be struck there. And a guest, you know, definitely depends on Korea stage as well. So what I've been doing so far, guess what it was also my own PC experience. Is that often For a, b, and c, the first project is fairly top down the idea that ideas is a basic idea of the supervisors. And that as you complete that first cycle of a full study, analysing the data thinking about how to write it up how to frame it, then you're much more better equipped as a student to have a lot more input in what the next study is going to be. So for now, that's kind of the way I think about it. Like there's a change from one top down to more bottom up over the course of a PhD.

S

Selina Wray 35:33

And a lot of our listeners, undergraduates are people who might just be thinking about setting out on their research career. And I think we've heard a lot of valuable themes from you about, you know, maybe not initially, knowing what you want to do the importance of securing that first kind of research experience, would you have any advice to anyone who is listening and thinks they might want to pursue research, but doesn't really know how to make that decision? Or where to start?

36:00

Yeah, I mean, I think the one thing that I've always been guided by is to try to do something I'm generally curious about, I'm excited about. So if you're trying to decide, do I want to do a project and what kind of project there's different factors to weigh, for instance, how how well known is the pie how, you know, how big a profile do they have, etc. But those kinds of things I have tried to not really take into account myself, I've always just been guided by, what am I excited about? What is the the research that they're doing? Is it creative? Am I curious about what they'll find? And I really remember this from after my PhD, visiting Nick to a brand's lab to explore ideas about maybe doing a poster together, I had meetings with people in his lab, and they all had such creative and fun research ideas that really got me excited, there was Julie Phan doing drawing on a tablet, having people draw images on a tablet, and then analysing those images using deep neural nets. To try to see how drawing influences visual representations. There was someone who was doing what he called a Harry Potter stimulus study where he, you started with one image, and then there's a kind of magic word and it changes into a different image and see how that works in the brain. This is also creative and fun. And I'm so curious about the results. That's what I want to do, you know, so, in general, I guess there'll be my main advice, be excited about what what you're doing, because that's the thing that will probably make the difference between whether you end up doing it and keep doing it or not, you're always going to have some setbacks. But if you're really driven to, to find the answers to your questions, then you're more likely to overcome those setbacks.

Steve Flemming 37:58

And it's interesting, you mentioned creativity, because I feel like that's often a something that overlooks in science as an important factor, and also one that keeps things interesting, right. So like we, one of the amazing things about do science is that you do have the freedom to wake up one day and say, Let's try something completely different. Or let's think about a new way of doing things. So yeah, pointing that out as a driving factor in into going into research, I think is very helpful.

38:31

Yeah, exactly. I think there also everyone has to kind of find that balance between being on solid ground and doing something really new. So I have found that we're doing this studying this height field imaging. Initially, we've been fairly conservative using paradigms we've used before, because we're using we're doing a really new measurement. Right? Right. So now I'm feeling like we're getting to the point where we've done multiple of these kinds of studies, we're starting to have more confidence in these signals, these measurements. Now we can hopefully, you know, try to be more creative and test some more creative ideas using these methods.

Selina Wray 39:06

So thank you so much for joining us. We're almost out of time. So we need to start wrapping up the episode now. But before we do that, we always finish by asking everyone the same question. So this is a neuroscience podcast. Could you tell us what is your favourite fact about the brain?

39:24

Yeah. So I mean, so many things that are fascinating about the brain. But one thing that came to mind to meet particularly thinking about this question is the bold response. So if all these fMRI studies we do functional magnetic resonance imaging relies on the fact that when there's a lot of neural activity in a part of the brain, then more oxygenated blood is provided to that part of the brain. And that's basically creates the the neural phenomenon that we measure using fMRI. But why does the brain send a lot more oxygenated blood than needed. So one professor at the donors Institute where we're before David Norris used to call this in his lectures, if I recall correctly, you should call this God's gift to neuroscientists. Because if the brain would just provide just enough oxygenated blood, we wouldn't measure anything, there would be no signal. And, and also, it's so precise. So we it's not just this lobe of the brain gets more oxygenated blood is at the level where we can use this signal to differentiate different images from each other different neural computations. It's a very fine grained kind of blood supply. And it's, but still, it's overturned, in a way. So the the fact that the board was bronze exists is such a lucky Marvel for us. Human are images.

Steve Flemming 40:49

Yeah, I mean, it's such a great point. And it's also I guess, we often forget. And also speaking

Yeah, I mean, it's such a great point. And it's also I guess, we often forget. And also speaking, as someone who uses these techniques all the time, we often forget that the ability to say, like in your work, pizza decode, using machine learning techniques, the orientation of line on the screen that you're sharing. I mean, we think of that as kind of like applying machine learning to a pattern of a pattern in the brain image. But really what you're doing is applying machine learning to these incredibly fine grained oxygen level dependent signals.

41:25

Yeah, exactly. I think this is just something that with every new study that we started, where we get some pilot data and start analysing and then just looking at these images and, and decoding, like you say, the orientation of a line. I think usually every new study, we start, I think, at some point, at least, it's remarkable that we can even do this, that we get such a reliable blood signal basically reflecting the neural activity in such a fine spatial scale. Yeah,

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Steve Flemming 42:00

there we go. God's gift to neuroscientists love it. All right. Well, we that was such a great discussion. Peter, thank you so much for joining us on this episode of brain stories. We'd like to thank Matt Wakelin, Maya Sapir and Travis mark for their roles in taking brain stories from an idea to a fully fledged podcast. We'd like to thank Patrick Robinson and UCL digital education for editing and mixing. Please follow us on Twitter at UCL brave stories for updates and information about forthcoming episodes, and see you all next time.