Episode 9 – Emotion at Work in Neuroscience
Chatting with Matt Wall

Phil: Hello and welcome to the Emotion at Work Podcast where we take a deep dive into the human condition and my inner geek is incredibly excited today because neuroscience is a much-used term, some would say it is a bit of a buzzword and I was speaking to somebody at a conference last year who told me that if you want to get on The Bill you need to put neuroscience in the title of your talk and then that will get you on the list of speakers. I have been wanting to speak to somebody who has a real in-depth knowledge around neuroscience and research that we can then get on the podcast so we can unpick some of the stuff around neuroscience and I guess today comes from well outside the realms of our normal guest pool, he is the head of MRI Applications at the Imanova Centre for Imaging Sciences and is someone who is passionate about both the world of research and practice and I am so excited to chat with our guest Matt today because I think for me there is some misconceptions, some misunderstandings and some misrepresentations of what neuroscience is and what it is not and also I am curious as to what we can genuinely learn from neuroscience research. I would like to welcome our guest to the podcast this week and that is Matt Wall. Good Morning Matt.

Matt: Hello, how are you?

Phil: I am really well thank you, what about you?

Matt: Yeah not bad thanks.

Phil: Good, Good. So normally on a podcast like this, I should ask the guest to tell us a bit more about themselves but we will get to do that during the podcast because one of my previous guests I had on the podcast we talked about the rituals of conversation and how if you start a conversation off in a different way it can take you down a whole new route that you weren't necessarily planning, so now we have got the ritual greeting of hello out of the way I thought I would go for a bit of a different question. Is that okay?

Matt: Absolutely fair enough.

Phil: Wonderful, so let's go for what has got you excited in the last week?

Matt: Ooh, so I think it is one of the things I am currently working on actually, one of the things that I am helping to set up at the moment. So a lot of my research at the moment focuses on the effect of drugs on the brain and we are setting up a big new project at the moment which is going to be looking at the effect of cannabis on the brain and doing some MRI scans of cannabis users and also people who have just smoked cannabis - we are actually going to give people cannabis and put them in the scanner.

Phil: Oh wow.

Matt: Which is going to be interesting.

Phil: How did you get that through ethics?

Matt: It's actually fine, it's difficult but it is doable.

Phil: Okay.

Matt: Yeah you have to have special licenses from the Home Office and things like that in order to store drugs like that and dispense them and use them in research and there is only a few of those licenses around, it's not easy but it is possible.

Phil: Wow, that sounds really exciting.

Matt: There is a lot of concern at the moment around high strength kinds of cannabis, some people call them skunk and things like that and we are seeing a lot of increase in people reporting problems with cannabis use like addiction and cannabis-induced psychosis and things like that. There has been a huge rise in those kinds of things in the last ten years or so and a lot of people think it is related to these very high strains that are around now so we are going to be comparing a couple of different strengths of cannabis - a high strength one and a lower strength one to see what different effects it has on the brain. Which is for these questions around the addiction and psychosis and things that is kind of important to know.

Phil: Absolutely, so is there going to be a longitudinal aspect to it then?

Matt: Yeah, so there are two aspects. One is we are going to put people in the scanner while they are stoned and see what their brains are doing and the other one is we are going to follow people over a year, we are going to scan them at the beginning and at the end and have a couple of other visits in between and track their cannabis usage and we expect some people will increase their usage, some people will decrease it and some people will stay much the same over that year and we hope to try and relate those usage effects to brain differences.

Phil: And are you going to be reliant on self-report for them, for them to say quantities and frequencies and so on?

Matt: Yeah pretty much and there are issues with that of course because people lie about these things or don't remember or whatever but there is not much else that you can do, to be honest.

Phil: No, no absolutely. I was thinking just that in terms of if I had ever been stoned could I remember what I had consumed or the quality of what I had consumed over the course of that occasion might be a challenge. But as you say there are issues with any sort of research that you do and there is always going to be pitfalls and downsides because you can't control every single variable every bit of the time can you?

Matt: Sure.

Phil: Okay, so for me then what has got me excited in the last week, so there is a bit of a personal and professional within this really - personal is I have been struggling with some health stuff recently and I have…

Matt: Sorry to hear that.

Phil: That's okay, thank you. But I have been told that I should hear more when I will be able to get fixed or when I will be not in as much discomfort as I currently am by the middle of September and that is quicker than I was expecting it to be, so that's got me excited this week and then also I was reading some research this morning about behavioural economics.
So behavioural economics is a field that interests me greatly in terms of some of the cognitive biases and heuristics and mental shortcuts that we use and I found what was described as a must read list of behavioural and economics resources and someone had curated this list of really interesting books and articles and so on together. That got me really excited until I finished reading the list and realised it was about 40 items long so I was both excited and then overwhelmed at the end of it.

Matt: Yeah that happens.

Phil: It does. That's the thing with reading it just never ends there is always more.

Matt: You can always fall down a rabbit hole.

Phil: Yeah I fall down those quite regularly. So you mentioned that at the moment your current research is looking at cannabis and the effects on the brain - what other areas do you get involved in, what other areas do you research in?

Matt: So mostly my research now is on various kinds of drugs. In the past I have spent a lot of time at quite low-level vision processes in the brain, I did a few years at UCL doing pain research but since I started working at Imanova which is a private company but we are owned by a University so we do a lot of academic work with Universities like the cannabis project that I mentioned and we also do a lot of work with drug companies as well testing out new drugs basically. I have been working on projects recently that include schizophrenia drugs and possible treatments for Alzheimer's, some work with sex hormones actually. It is quite varied to be honest which is why I like this job at the moment, I get to do a lot of different things.

Phil: One of the things that really interest me about the brain is that often people talk about different parts of the brain holding different things, so people might talk about the amygdala being the heart of emotion as I am particularly interested in emotion but also think the hippocampus has a lot to do with memory as well if I remember correctly but how singular are those different parts of the brain? You have talked about pain earlier on as part of your previous research and that made me think well pain is for me associated in some way with emotion so there must be, are there overlaps in what these different parts of the brain do or do they work in a very singular way?

Matt: Pain is a really interesting one to talk about actually because pain is a very difficult one to pin down in the brain so I spent a lot of time working on vision and the whole kind of back quarter of the brain, the bit right at the back of your head is all your visual cortex and that's the bit that allows you to see. If you have an injury to that bit of the brain, even if your eyes might be working absolutely perfectly then you go at least partially blind.

Phil: So you are talking about the occipital stuff then?

Matt: The occipital lobe, yeah that's right. And the visual cortex works very coherently. If you shine a light in somebodies eyes you get a little blip in the visual cortex and if you shine a really

bright light in somebodies eyes you get a stronger blip in the visual cortex, it makes sense in that way right?

Phil: Yeah.

Matt: So once people have worked that out they then started looking for a similar area that worked the same with pain.

Phil: Okay.

Matt: But it turns out that pain is a bit different. There doesn't appear to be, or at least nobody has found it yet and we have looked a lot, there does not appear to be an area that works the same way with pain. If you give somebody a little electric shock and then you give somebody a whacking great big electric shock there is no area that responds in that nice logical coherent way. What you have instead is a whole network of areas, there are always areas that respond to a painful stimulus but they are also areas that respond to other things. The visual cortex just does vision, that's all it does if you play a sound to somebody the visual cortex doesn't respond but the auditory cortex does and vice versa right. It's just specialised for that. For pain, there is a whole network of areas but they also light up when you are doing other things as well, so there is no pain specific region or there appears not to be and that has been a bit of a puzzle for a long time. You know ideally if we could find a pain region that was responding in that way and for instance people that have a lot of problems with chronic pain conditions where they are in pain all the time and there does not appear to be an easily classifiable problem if you like, a good diagnosis, some people just have constant pain which is very unfortunate. If we could find the right brain area and try and manipulate it and turn that off that would be a wonderful thing but unfortunately, pain seems to be a bit more complicated than things like vision or sound and other things.

Phil: Are we talking about individual differences there so does it differ by individual? This is where I am testing my own knowledge of the brain now, so it might be that the near-cortex and the hypothalamus because the hypothalamus is involved with the HPA access which is to do with regulating chemical imbalances if I have remembered that correctly?

Matt: Exactly.

Phil: So do they always fear up at different degrees or fear or not fear depending on the individual that you are scanning.

Matt: It's probably not so much individual differences, you still have the same network of areas in different people. There may be some individual differences in people that have these chronic pain problems compared to controls or healthy people but it seems to be that pain is represented in a more complex way in the brain as some kind of emergent property of the activity of these network of areas that makes it very difficult to pin down. So your original question was about areas like the amygdala and the hippocampus is it right to say that the amygdala is the fear area and the hippocampus is the memory area and it is right to an extent but one thing I have learned when talking about the brain and trying to think about the brain is that if you have a nice simple story like that it is almost always wrong, the brain is always ten times more complicated than you can possibly think it is, so the amygdala does respond to fear-related stimuli absolutely but it also responds to a lot of other things and the

hippocampus is definitely involved in memory but is also involved in spacial navigation and a lot of other functions and probably a load of other functions that we haven't figured out yet. There is always this tendency to try and create these nice simple explanations and you know me as a scientist I like nice simple explanations as well, that would make my life so much easier believe me, but there is a thing that, you know Terry Pratchett the guy who did the Disc World books?

Phil: Yep.

Matt: So he wrote a couple of books with a guy called Jack Cohen about the science of the Disc World which are pretty good and they are basically kind of popular science books but using some of his Disc World fantasy silliness to hook the science ideas on if you like. In these books, they came up with this thing called lies to children which is...

Phil: I haven't heard of that.

Matt: No, it's basically when you try and explain something complicated and you try and reduce it down and reduce it down and reduce it down and reduce it down eventually it becomes so simplified that it just becomes wrong, you know?

Phil: Yeah okay.

Matt: Think about the model of an atom - you have a nucleus and the electron spinning around it that's our simple model of how it works but that's not correct, that's a very poor approximation of the actual thing and so they were imagining explaining something to a child and basically you have to end up lying, you have to say the wrong things in order to make it understandable basically. Does that make sense?

Phil: Yes absolutely. So this week we were in the car listening to the radio - I listen to Radio 1 because I like to think I'm younger than I actually am, but we were listening to the news and there were talks of the terror attacks in Spain so my son who is 4 and my middle child who is 7 were both like what's a terror attack, oh God where do we go with this then and I remember we went through a number of iterations in response and the one that he was willing to accept was wrong and I was like it's not really like that though is it? Which I think was, “There are some people in the world who want to do some nasty stuff and they believe things that seem wrong to us, they are not willing to listen so instead they try and get us to change our minds by doing nasty things”. So I ended up just thinking is that really right, is that accurate because it is not as simple as that but is it simple enough for a 4-year-old to accept. Does that make sense?

Matt: I think that sounds pretty good, my son is only 2 so I haven't encountered that one yet but I will remember it for when it comes up.

Phil: I often hear people talk about serotonin and dopamine as chemicals to do with happiness and how if we do this in the workplace then people will have more, I should have had an example but I didn't prepare all of the things I was going to say, so a piece of research that says when people were asked of their thoughts on freedom in the workplace whilst in an MRI scanner there was increased dopamine, they wouldn't actually test dopamine in the scanner.

Matt: No.

Phil: But anyway do you know what I mean, the idea of we do this, that will create more of that chemical which means people will be happier, for me it's just not that simple.

Matt: No, it's really not I'm afraid. That example actually points to a kind of conceptual issue that I see a lot in this kind of thing and it doesn't make a lot of sense to me. So it's kind of shoehorning neurosciency things in where they don't necessarily really belong or are not that useful. Okay, if you do this in the workplace then people will be happier isn't that enough? Do you need to know the mechanism in their brain by which they will become happier, is it useful to know that? It's a thing that the evolutionary guys like to call proximate and ultimate explanation, so explanations that kind of are close to what you are studying and explanations that are very far from what you are studying. If you think about why does a lion chase a zebra the proximate explanation would be, well because he's hungry and that's a perfectly good explanation and the ultimate explanation would be that millions of years ago the lions ancestors developed traits that led them to eventually become lions and hunt zebras and both of those explanations work, they are both good explanations of why the lion chases the zebra and they are both interesting and good to know but the one which is most useful to you depends on the problem that you are addressing at the time I guess. If you want to increase happiness in the workplace do things that make people happy and the ultimate explanation of why they are happy and what's happening in their brain is interesting sure, that's what I do, this is what I research - I think it's very interesting but is it that useful? I'm not sure, I think what you care about, I remember reading something by a guy called David Rock, who you may have come across.

Phil: No it's a new one on me.

Matt: He runs this thing called the neuro leadership institute.

Phil: Okay.

Matt: So they have a big conference every year and he is one of the guys who has been pushing neuroscience explanations in the workplace and things like that and I remember reading one of his things and he said brains are social and I thought at the time no, people are social.

Phil: Being human is social.

Matt: Yeah, it sounds an odd thing for me to say because I am a neuroscientist and that's what I do but I don't thinking invoking neuroscience explanations is necessarily always useful, to be honest.

Phil: I'm with you and partly because I'm biased I guess because of my personal preferences and academic background, what makes an individual happy is often very different, there are very few universal things that will make everybody happy. If I look at some psychology in emotion research then it's reported that the universal trigger for happiness is pleasure and that pleasure can come through any one of the five senses and it can also be imagined and it can be relived so you can remember something that has given you pleasure in the past or you can imagine something that will give you pleasure or you can experience something that will give you pleasure. Still, to me, the smell of Jean Paul Gautier perfume takes me back to my first girlfriend and that does a combination of things - it both allows me to relive and then I get the pleasure

from the smell and just because that will make me happy doesn't necessarily mean it will make other people happy. I don't buy it.

Matt: And that actually speaks to another issue with this kind of thing. I feel like I'm being very negative but bear with me for a little while longer.

Phil: I don't think you are, so you go ahead.

Matt: That example about individual differences in what makes people happy that goes back to another issue with trying to apply neuroscience research. Neuroscience research is always done on groups of people and you get an average result across this group because people vary so much. If you want to know something very very simple, like are men taller than women you don't go and measure just one man and one woman because you might end up with a particularly tall woman and a particularly short man and then you reach the wrong conclusion, you go out and measure 100 men and 100 women and then you would get something approximating to the right answer. This is true, I am sure you know this is true, in all science, you don't just make one measurement because your ruler might have slipped when you were doing that measurement or something, all kinds of things might happen or you might just have a particularly weird subject. When we do experiments and try and look at amygdala function to fearful stimuli and things like that we might scan a group of 20/30 people and a couple of them will just show, usually, really weird looking results. Maybe they fell asleep in the scanner or something like that, maybe they just have weird amygdala for whatever reason, maybe they were distracted, I don't know. We always make these claims or make these inferences about the average of a group and what that means is that when you want to start talking individuals it becomes very difficult because like you said any particular individual is going to have different things that make them happy and if you take a big enough group you might find some common things that make most of that group happy but you can't necessarily apply those findings to a particular individual, you are always talking about at a group level.

Phil: And I think in the workplace that is a perineal issue whether you are talking about happiness or whatever, there is always an argument for whatever you do someone is always going to be unhappy and I get that but I guess I then am going back to your point earlier on that we don't need to go neuroscience research to find that out, we can just ask people, we don't need to go and find some way of measuring someone's chemical responses at a particular point in time to find that out, we can just ask them and yes they might lie or yes they might change their mind but there is only so much that we can do before we lose the validity of what it is we are trying to do in the first place. So things like chemical stuff so some of the chemicals that often get banded around are cortisol, glucose, there is another glucose one that I'll come back to in a minute, serotonin and dopamine, so how would those sorts of things be tested for and is the testing of those things still sit within the neuroscience research. I suppose actually I need to take us back before I ask that question.

Matt: Okay.

Phil: What is neuroscience research, what does it involve, what does it encapsulate?

Matt: It is a very broad area of research. Neuroscience really goes from people that do stuff in little glass dishes with microscopes and individual brain cells or sometimes peripheral nerve cells, that is still neuroscience, or figuring out how it works at a molecular level or a cellular level

like that and then there is a whole bunch of people in the middle who do work with animals doing various things usually trying to change the animals brain some way through drugs or electrical stimulation or a number of other methods and looking at the effect on the brain of the animal and then up to the kind of work that I do which is on people where we don't often damage people's brains too much, well we try not to, we do sometimes give them drugs and using technologies like MRI and positron emission tomography as well to look at working brains if you like. Brains in vivo, in the organism, and there is a whole lot of other things as well, it's a very broad area of research. What I do tends to be called cognitive neuroscience meaning neuroscience of cognition, more kind of human level brain processes rather than looking at the low-level cellular stuff. Positron Emission Tomography, PET scanning that I just mentioned is a technique for looking at brain chemistry, actually, where I work we have PET scanners and MRI scanners and the two techniques complement each other. MRI, which is my speciality is nice because it uses huge magnets to get images of the inside of the body and the brain and look at brain activity and that's basically harmless - you can go in an MRI scanner as many times as you like, I have been in there hundreds of times, and it's not a problem, doesn't seem to have any bad effects at all. The other technology that we have here, PET is quite different and involves being injected with a radioactive tracer substance and then you basically radioactivity goes in the body or in the brain. So that's a bit of a different proposition, you don't want to do more than one or two PET scans a year, you don't want to be exposed to more than one level of radiation and it is a much more kind of medical experience generally, you need to have doctors hanging around and things like that. But what PET does give you is really great information about the brain chemistry that you can't get with MRI, you can inject a radioactive substance say that specifically binds to dopamine receptors and then you can get a nice map of the brain that shows you where all the dopamine receptors are and the activity at those receptors or you can do the same with serotonin or a number of other different brain chemicals. The way that we work it is we get some information, normally when we are testing out a new drug or something like that for a drug company, we would say right okay we think this drug hits say dopamine receptors, we would do a dopamine PET scan, first of all, that confirms that the drug is getting into the brain because the membrane that protects the brain from the rest of the body is only semi-permeable, only some things go through, so, first of all, it confirms that it gets into the brain, second it confirms that it hits the right receptors that we think it does and then we might put people in an MRI scanner and do some dopamine-related task in the MRI scanner, some task that is related to rewarding stimuli, so we might get them to play a game where they can win money and then we see that the dopaminergic areas in the brain are responding when they are doing that kind of thing, maybe they are responding a bit more when they have this new drug compared to a placebo and we can show that there is some kind of functional response as well so that the drug is getting into the brain, it's hitting the receptors and it's actually doing something when it's there as well related to how they are feeling or their psychological functions if you like. So, your question was about the neurochemistry - we can with those two techniques, that is the kind of studies that we like to do, pulling all it altogether, with those two techniques we can say something quite powerful about the brain neuro-transmits things like dopamine and serotonin and how those translate into behaviour if you like.

Phil: Yeah, okay. So one of the reasons that I am interested in getting into all of this stuff is because that's a nice general phrase isn't it, all of this stuff, so the reason I am asking and really trying to dig into some of the how do you measure, how do you test these things is because one of the things, I wouldn't say it's sweeping the field that I work in, so I work in mainly people related fields so leadership or human resources or learning and development type stuff and there is big sort of swirl for people to be more evidence-based in their approach, so rather than

just going with the standard what's sexy or what's current or what's shiny actually going and digging some of the evidence behind it. One of the challenges I think is that people don't know what they are looking for and partly it's because a lot of the academic research is pay walled so unless you want to buy things you can't get to it but also for listeners to know what sort of things should they be looking for because as you just said neuroscience is a really big thing so it can include MRI and PET and as far as I am aware there are also others, you've got EEG as well and there are lots of different ways of testing what is going on in the brain and knowing what they all do I think can be really helpful because it then allows you to take quite a critical approach to what you are reading to say well actually is there validity in linking this research to this context or not.

Phil: And it is so opaque a lot of it as well. It took me when I first started working with the functional MRI it took me a couple of years to get into the field and start reading stuff and really understanding it. If you just look at academic papers and you don't have that kind of background I think it's incredibly difficult. Even now if I try and read PET papers or EEG papers, things that are a little bit out of my specialty, I struggle I have to go and ask the PET guys to explain it to me. I can imagine that somebody coming in with a more HR or leadership background and just looking at the real primary academic literature might really struggle and I think that might not be that useful, to be honest. Have you found that there is a lot of jargon and technical language which is necessary, you write these things with the intention of talking to other people who work in the same area really.

Phil: I remember when one of the modules I did when I was studying was on memory and in particular then looking at the stress response in memory and I am trying to get a memory researcher on the podcast because again I think it is a massive field that is misrepresented and misunderstood in the learning sphere. I am going to go off on a slight rant and then come back. You know the idea if you make content memorable then people are more likely to remember that and therefore they will learn it and therefore they will apply it and I am like well, that's not actually what memory research does. What memory research does is it will look at the capacity of working memory, it will look at encoding, it will look at retrieval, and it won't look at application. If I ask them to remember these things and I put them through stressful simulation and then I ask them to recall those things what impact does that have on recall? All you are assessing there is recall, you are not testing application, you are not testing sense-making, you're just saying I have asked them to remember these things. I remember we read one study which was of firefighters going into the classic kind of aircraft submergent machine, remember this, go in, get ducked in water, get turned upside down, get disorientated, be scared and then come out the other side and try and recall this list of things. I was like well that's of no use to learning, that just tests how well can I recall information after going through stress, it doesn't test learning per say. Sorry, rant over, off of soapbox. You mentioned when you were talking just now MRI, fMRI, now from my interpretation they are two slightly different things, is that right?

Matt: That's right yes.

Phil: Okay, so can you tell me the difference?

Matt: An MRI is kind of family of techniques really.

Phil: Oh okay.

Matt: So an MRI scan is quite a flexible tool and there is a lot of different things that you can do with it. You can use it to get very nice high-quality images of the structure of the inside of the body, whether that's the brain or the lungs or whatever and that is very useful in medical situation diagnosing, you can see tumours and other problems and things like that. You can use it as a spectroscope, so you can do a little bit of limited looking at different metaboli, at things like glucose and creatinine and things like that, and you can use functional MRI which is looking at brain function. So functional MRI is kind of a subset of MRI in general if you like. It is one of the techniques that people use MRI scanners for and there are lots and lots of different ways of using them.

Phil: And an fMRI that looks at blood flow, I know of it in terms of monitoring blood flow in the brain is that right? In the example, you used earlier you shine a light in someone's eye and their occipital lobe will light up, that lighting up is monitoring the blood flow to that particular part of the brain is that right?

Matt: Yes exactly. When a brain region becomes more active when the cells start firing they need more oxygen and glucose so there is a response in the brain, and oxygen and glucose is supplied by the blood supply which goes all through the brain, so there is a local response in that particular area where the blood vessels dilate and dump more oxygen and glucose there and that's what we can see. As that happens the magnetic properties of that area change a little bit and that's the signal that we pick up with the MRI scanner.

Phil: Okay, and it is the same scanner? It's not a different scanner like you said an MRI is quite flexible.

Matt: Yes it is exactly the same scanner. Normally when we do experiments we might have several different kinds of scans, so we might start off by doing a simple anatomical scan just to get a good image of the head of whoever we are scanning and then do some functional scans and then maybe a couple of other different scans at the end or something like that. You can do it all at the same time on the same patient.

Phil: Okay. Other things that I have noted down as you have been going because I have chucked some jargon in. So earlier on I mentioned EEG but I didn't really explain what EEG was and I could give what I think an EEG was but I wonder if you might be better placed to give a more accurate description of what an EEG is.

Matt: EEG is interesting currently because it fell out of favour a lot. EEG was probably the first technical brain recording technique that was developed. Early 20th century people realised that the brain gives off electrical signals. EEG stands for electroencephalography which means electric in head writing.

Phil: Thank you for the translation as well.

Matt: The early EEGs used basically pens on paper with wiggly lines, you know the kind of thing?

Phil: So like you get from a polygraph?

Matt: Yes exactly. A lot of work was done on EEG in the 20th century and then it kind of fell out of favour a bit, a lot of important work done in identifying different stages of sleep and things like that - in REM sleep you get big EEG signals and things like that. Then other techniques came along and EEG kind of reduced its importance if you like and then the last 10-15 years there has been a resurgence of interest in it, so in the last ten years or so people have come up with these very light, very quiet simple EEG headsets, plastic things that you just stick on your head with dry contact electrodes, so previously to get really good EEG data you had to use this conductive gel on the electrodes and stick them on to people.

Phil: Skull cap type thing, whole head?

Matt: Yes whole head cap filled with electrodes with this jelly stuff and it's incredibly messy and to get really good EEG data you basically have to shave somebodies head and people don't tend to like that. You get all this jelly in your hair and it takes ages to put the electrodes on and stuff and it's a big mess. Anyway, about ten years ago people came up with these dry contact electrodes and these very lightweight wireless EEG headsets and people started using them for all kinds of things, so there has been a big push in the neuromarketing world using these things on people whilst they are walking around supermarkets and making product choices and things like that. They don't give you brilliant quality data and I'm a bit suspect about a lot of that kind of research, I mean EEG is a tricky technique anyway. EEG gives you really good information about the timing of events that you are measuring but it doesn't give you information about where the events are happening because you are listening for these very very tiny electrical signals of the brain, you are listening through the skull and all the muscle and all the other stuff that's in between your brain and the outside air. It's kind of like if you live in a block of flats and you can hear somebody in the next flat or even the flat beyond that having an argument and you can't quite make out what they're saying, you don't know where it's coming from or there's a pipe knocking in the walls or something like that. You can hear something but you don't know what it is or exactly where it is coming from basically. EEG is an interesting technique and these lightweight headsets are getting better and they might be quite good at some point and they are interesting in that you can start doing things with them out in the world which is always nice rather than lying in a little metal coffin which is what MRI scanners are like which is not very related to the real world.

Phil: And I think that is something that I alluded to earlier but I think I stepped back from saying it in terms of one of the big challenges that I have with neuroscience research in particular because it really isn't very portable at all, so you're right, portable EEG exists, actually I don't know if the polygraph will fit within neuroscience as a field but anyway because it is measuring autonomic nervous system changes.

Matt: Well, more or less, yeah.

Phil: So it might do. But the majority of scanners that you would use they are not portable out into the field so you are not, and even then you can't do any, somebody wouldn't want to wear an EEG all day to be monitored for their interactions all day.

Matt: No.

Phil: So, therefore, the generalised ability of neuroscience research beyond the lab is tough.

Matt: Oh yes definitely.

Phil: It is the same with deception research where people set up mock theft experiments especially as often they are using undergraduate students and so on and so on. Okay, we have established what the accuracy of deception detection is for undergraduate students in a lab but that doesn't tell us the whole story and therefore is not generalisable across the whole.

Matt: Deception research is really tough because it is so hard to engineer a situation where people are genuinely lying and even if you managed to come up with some way of getting people to lie to you in a lab-based situation it's just not going to be the same as somebody who is picked up by the police and is lying about where they were on a particular night. The motivation is just so different, yeah deception research is incredibly tough.

Phil: So I have taken us down a road so I will finish that off. One of the things that I know is popular in the states is the use of brain fingerprinting which is using an EEG and actually, there have been some studies done using an MRI as well, but the format is, what it tries to do is find out if somebody is hiding knowledge, so the underlying hypothesis is that if you are presented with a stimulus that you are familiar with, so using an EEG for example, the orienting response which was also known as the P300 wave will fire if you see something that you are familiar with versus something you are not familiar with. So what it tries to do, let's say in a forensic setting, let's say there was a weapon involved in an assault or a murder, they will show images of lots of different types of weapons and then interspersed in there will be a picture of the actual weapon and the EEG will therefore pick up the orienting response with something that they recognise versus something that they don't recognise if that makes sense?

Matt: Yes. That's pretty controversial. So it's almost exactly the same kind of conceptual technique as the polygraph right that's based on people having a response to something that they feel guilty about or whatever. Yeah, I struggle to believe that that is very reliable, to be honest. I mean the polygraph is not as reliable as people think either.

Phil: No it's not.

Matt: By a long shot.

Phil: So it's reliable at detecting changes in your nervous system but is it good at detecting lies?

Matt: Yes, and I think that's why we've never really used it in the UK, it's always been regarded as too unreliable and I think the same about more brain-based techniques as well I think. Again, it's extrapolating from a group to an individual. You might do an experiment where, and I am sure people have done this, where you do exactly what you describe, show people a list of things some of which are familiar and some of which are not and you might see a difference in the EEG signal on the familiar things in that group as a whole but then applying that to an individual is really problematic because some of the individuals in that group will be doing something completely different probably.

Phil: And again it's back to the motivation, even if you said you went for a big sample size, you had 100 undergraduate students and let's say you tried to put some motivation in play which was if you trick the EEG, so if you don't show the emitting response then you will get a reward or if you try to and you fail then we will give you some punishment. Well A) it's unlikely to get

through ethics if there is going to be some form of punishment, yes there might be a reward but it is only ever going to be minimal whereas if you are talking about somebody orienting that they have committed a crime or whether they have committed some horrible deed the motivation to hide it is so much stronger and therefore other countermeasures can be deployed to do it.

Matt: Yes, exactly there are some quite well-known countermeasures for the polygraph and I think the same would apply for the EEG as well.

Phil: Anyway, I suppose where I was going with that was just the generalised ability, how appropriate is it to generalise neuroscience research across into work-life or individual life and I know that is a really big broad question so it might be an unfair question for me to ask but it is a question I want to ask nonetheless if I may?

Matt: Yes sure, I think it's a really important question. As a neuroscientist, it would be really nice if something that we did actually makes people's lives better, that would be great. There are some things that translate, it tends to be more clinical oriented things so you know I worked on projects that are testing out new drugs for Schizophrenia and Alzheimer's and things like that and that's a clear application but more everyday things it gets more difficult I think and there is so much interest around at the moment in doing this, like you said at the beginning the guy you met at the conference said you have to have neuroscience to get on the bill, people are really interested in it and not just in the business world but in the teaching world as well there is a hell of a lot of interest in it. Unfortunately, I think there is just not too much substance behind it at the moment, it's very difficult and a lot of it is conceptual problems so going from a group result to an individual result is one big one, another big problem is that a lot of, I would probably say most scientists, just aren't that interested in getting involved in that kind of translational work if you like, they have their little problems that they want to work on and that they are interested in and that's it really.

Phil: I was having a discussion with a guy on Twitter called Rob Briner, who used to be at the University of Bath and is now at one of the London Universities and he and I were discussing, and often academics are doing research for academic purposes as a basis of applied purposes whether that be a personal interest or a question that they want to answer or to be published in a AAA rated journal or whatever that might be but they are doing it for academic reasons rather than applied reasons so as much as the world might want to take research and apply it in the real world often that is not the intent behind the research that was done in the first place.

Matt: No, and there is value in doing basic research, you never know what it is going to lead to some 10/20 years down the line. Working out all the tiny little features of how the visual cortex works might not seem like there are any particular applications of it but who knows in the future we might be teaching machines to see as we do and things like that and it might be useful. There is value in basic research, it's not always obvious at the time what the value might be but history has taught us that basic research leads to applied things eventually sometimes and you never know which basic research is going to be useful but the people that do the basic research don't necessarily have their eyes on that bigger picture if you like and it is difficult to get them to engage with the wider world which I think is a shame because there is appetite out there, people find it, I mean I find this whole thing interesting because that's what I do but I think generally people find the brain and neuroscience just generally interesting, they want to hear about it which is nice and if you are somebody like you who obviously reads quite a lot

around this area that's an interesting nice thing to do regardless of whether it ends up changing your life or your business practices or whatever. It would be nice if it could do that as well but I don't think we're there yet and a lot of it is kind of conceptual issues about going from groups to individuals and the other things that we mentioned and a lot of it is honestly I think the fault lies with the scientists because there is this appetite out there and a lot of the scientists are just not really engaging with it, to be honest. I honestly don't, people talk about this a lot and people ask me quite a lot so I run a blog and I have written a couple of articles online about this kind of thing and so people often get in touch and ask me well what's some good stuff, because I am often quite critical online about these things, we want to implement neuroscience in our organisation or neuroscience derived principles tell me what I need to read and I always struggle because I don't know what to suggest for them to read because honestly there are not many really useful applications out there and I wish there were that would be great if some aspect of my work could be applied and was useful but at the moment it's really difficult to recommend anything.

Phil: If you are okay to Matt would you mind sending me links to your blog and all of those articles so that I can put them in the show notes so if people want to go and find out more than they have got somewhere to go if that's okay?

Matt: Absolutely, yes.

Phil: You've also kind of stolen one of my questions for later because I was going to ask you what books or videos or articles would you recommend for people to go, so is there anything that you would suggest if they want to know more?

Matt: I probably wouldn't recommend just diving straight into the scientific literature because you are just going to get turned off immediately. There are two good books out recently actually. One of them is by a guy called Moheb Costandi who writes a brain blog for The Guardian and it's called 50 human brain Ideas you really need to know which is a really good introductory text and another nice book is by a guy called Christian Jarrett called Great Myths of the Brain, so he covers things like we only use 10% of our brain and some people are left brain and some people are right brain so he debunks all that stuff but along the way he actually explains well okay this is not correct but this is what we now think, you know what I mean so again it's a really good kind of introductory way into that kind of thing.

Phil: And what was that called again sorry?

Matt: Great Myths of the Brain.

Phil: And are there any, so we have done right brain left brain and 10% aspect so are there any other big myths that really frustrate you or get you going like oh not that again.

Matt: Well yeah the left brain right brain one is a constant nightmare.

Phil: What about male-female?

Matt: Yeah, there is not really that much difference to be honest. Female brains tend to be a little bit smaller on average but then female bodies are a little bit smaller on average so that doesn't necessarily mean anything and people have looked very very hard to find strong

consistent differences in the anatomy or function and differences that have been found are relatively small to be honest.

Phil: Okay, any other myths?

Matt: Let me think, actually the kind of dopamine serotonin thing I see a lot. Dopamine and serotonin are what makes you happy, well yeah that's true kind of but there are other things that make you happy so we have a lot of other brain chemicals things like opioids, morphine that we have indigenously inside our brains as well they make you pretty happy too and dopamine is heavily involved in a lot of other things like coordinating movement and things like that so patient's that have Parkinson's disease have a particular problem with a dopamine-rich area in the brain and they end up having these very difficult movements and things like that. So the whole dopamine serotonin myth kind of winds me up a bit as well.

Phil: Okay, I did not know that I did not know that dopamine had additional kind of functions and uses.

Matt: Like I said before it's always more complicated than you can imagine.

Phil: I can't remember how I found it but I found a company in the States who were offering I think it was serotonin level testing with a view to telling you how happy you were. As in if your serotonin levels were high then you were happy and they were doing it through urine testing as the way of doing it and they would actually post you out a kit which you would then put some urine in and send it back and they test it for you. Actually, it might have been a dipstick, it might have been that they will send you a dipstick to use for it but I was like why.

Matt: No that's terrible. Serotonin is found all over the place, you have loads of serotonin receptors, one of the highest concentration of serotonin receptors is in the visual cortex at the back of the brain and we think that's why when you take drugs like LSD which is a hallucinogenic which tends to be serotonin active molecules we think that's why you get the visual hallucinations. There is also tons and tons of serotonin in the gut so there is loads of serotonin neurons in the stomach and the bowels so yeah serotonin is not just a happy molecule either, it does a lot of different things.

Phil: I can imagine. Okay, I am highly conscious of time as much I am enjoying talking with you I could keep you chatting all morning. Is there anything else that you think is important for me/the listeners to know around applying neuroscience in to say the workplace that we haven't talked about already?

Matt: I think it's important not to kind of push it too hard if you like. A lot of people are understandably very keen on this idea of applying neuroscience in various settings, in schools, in the workplace and so on. I think if it is something that you are interested in just start reading about it, start getting into it but don't force it if you like. So, I think once you start forcing things into boxes that they are not supposed to fit in that's when you start going wrong really. If it is something that you are interested in great go and read about it, go to conferences, think about it, watch Ted talks or whatever and really think about if some of this stuff is useful to you or not but I see a lot of people just kind of shoehorning in neuroscience, like you said the guy at the conference, you have got to have neuroscience in your title. When it may not be that useful for the problem that you have you know it may just be that you have a work problem it's probably

more useful to think about your problem person as a person rather than as a brain floating in a vat you know. You are not going to get any particularly strong insights from knowing that their dopamine receptors are firing off or whatever at that particular point I think. So, yeah, think about it, read about it, think about it critically and when you see people talking about these things think is this really useful or are they just putting a whizzy new spin on something.

Phil: Yeah, wonderful thank you. And one of the things, I would say I ask all of my guests but that would be a lie, is there anyone that you would recommend that we seek out to get on the podcast, anyone that you think based on the conversations that we've had and what we're trying to do I think this would be an interesting question for you to find or talk to?

Matt: That's a tricky one. Well, I mentioned a guy earlier called David Rock.

Phil: Yes, the neuro-leadership guy.

Matt: Yeah so, I don't agree with a lot of what he does, so a lot of what he does kind of falls into that thing that I just mentioned where you try and shoehorn neuroscience into something but I think he is one of the guys that is genuinely interested in the whole area and is trying to move it forward, he is trying to push it forward which I think is great. I would maybe recommend seeing if you could get him on the line.

Phil: Okay, alright, wonderful. Thank you. Anything else that you are thinking, anything else that you are feeling, anything else that you want to say to kind of bring us together to a close?

Matt: I just want to reiterate what I think I said earlier, I find neuroscience fascinating, it's really gratifying to me that a lot of other people who are in very different fields find it intrinsically interesting as well and I really hope that we can find ways of applying these things in the future and think it's an important objective and me as a scientist I try and encourage my colleagues to engage more with this stuff and hopefully we can find some good applications.

Phil: Wonderful, thank you very much for your time today Matt we could have carried on all morning but thank you very much for your time and if you could send me the links to your blog and the articles that are there then that would be great. I will make sure all of the other things that we have discussed as we have gone along, so I will make sure we put links in to what PET is, what EEG is and so on, I will just put some links in so that if people want to go and find out more information about that sort of stuff then they can. If it is alright I will get you to do a quick vet of those links before I put them in as I don't want to send people off to some sort of hooky place if that's okay?

Matt: Sure.

Phil: Thoroughly enjoyed our conversation today and thank you for helping pull apart I suppose in a way what neuroscience is and my favourite sort of summary quote is going to be it's just not as simple as that because that has been a regular theme. So wonderful, thank you very much for your time I really appreciate it.

Matt: My pleasure.