ISMRM podcast transcription

Narrator: Sarah Bonnell is a state-run school for girls just two miles north of the conference centre where this year's annual meeting of the ISMRM is held. With thousands of scientists coming to London to share ideas, we invited nine students in to quiz some of our scientists and what they do, why they do it, and why meeting with colleagues from all over the world is so important to their work. First up, Raghad, Layla, and Zarifa interview Pete from Imperial College in London.

Student: Firstly, what do you like most about working in the MRI field?

Pete: The thing that I really love about what I do is that I can talk to people who are much smarter than me who have ideas, and we can talk about shared interests and someone can say something that sets a lightbulb going in my head about how we could come up with a new technique or we could try to solve a problem in a different way, or by talking to people they have a completely different idea of how we can solve the problem that I would never have thought about in a million years. And even though I'm not a doctor I can help try to come up with techniques that can maybe help spot diseases earlier help measure treatments a little bit earlier or better and I really love the work that I do 'cause I just find it really fun.

Student: I think the last time we met you mentioned a conference between all MRI researchers, has that happened yet?

Pete: No, so all researchers from all over the world will come over to just near here at the Excel Centre and we'll have people we'll have thousands of people here who will be talking about the research that they've been doing and you get to meet these people that you might have only met over zoom or might have only read about from the work they've done and you get to talk to them about their work and it's more of this chatting about ideas and having fun thinking about science and how we can solve these problems and it's a really exciting experience to meet all these people and to talk to them about their work so everybody is super excited about that.

Student: What recent research have you done that you think that's very helpful?

Pete: So at the moment I'm working on techniques particularly aimed at Parkinson's disease and trying to find out ways that we can measure the disease in the very earliest stages and the way that I'm trying to do that at the moment is a technique that we called super resolution so we take low resolution images and we try and find the way that we can, after acquiring those low resolution images, increase the resolution afterwards.

Student: Like you said you look for you know early recognition for diseases like Parkinson's disease in MRI, so what exactly are you looking for when you do the actual MRI in the imaging, what would you sort of look for in the picture?

Pete: Particularly in Parkinson's disease what happens is this a specific region in the brain called the substantia nigra so if you think of the brain as a giant sphere the substantia nigra is right at the centre of a sphere and what happens at the start of Parkinson's disease is that iron builds up in the nerve cells there and so MRI is actually one of the best tools that we could use to measure those early changes, because it's sensitive to those changes in iron in the neurons. So there's lots of people just like me who are trying to come up with ways of using MRI to measure that early iron deposition at the centre of the brain of Parkinson's patients.

Student: Could you explain to us about T2 values and how they relate to MRI imaging?

Pete: Oh that's a that's a great question as well. So T2 is a fundamental property of any tissue in the body when it's in a magnetic field so different types of brain tissues will have different T2 values which describes how they're reacting in the magnetic field and actually that's one source of information; so not only the different issues have different T2 values, but if someone has a disease like in Parkinson's the substantia nigra, as the iron builds up, the T2 value changes. So you could design some kind of clinical study where you have a group of people who we call “control subjects”, they’re healthy volunteers, and you have a group who have some kind of disease and you can measure differences in the T2 values in a specific region to test how much their diseases develop. It’s a physics quantity that comes from how they react in the magnetic field but it’s actually got tonnes of potential value as a diagnosis tool as well.

Student: Going back to Parkinson's disease with iron accumulation, could a person feel the iron accumulation like what would be the first symptom?

Pete: The silver bullet of solving Parkinson's would be to be able to identify it really early and one of the big problems at the moment is that by the time that people recognise that they might have Parkinson's they've already had the disease for quite a long time so they would come to the GP and notice that they have some problems with movement they might have a slight tremor or they might be less stable when they're walking around and that's a big problem to solve because you can’t feel that it's happened. So maybe one way that MRI could help is that if those people had an MRI scan before they felt those symptoms coming on, they might be at high risk of developing Parkinson's, they might have an MRI scan that spotted that they have something that's starting to cause problems without having symptoms. That would be ideal so that then you could try treatments earlier on and hopefully prevent that as much as possible.

Student: Have you ever had like, have you ever done in MRI scan where something maybe went, like, really wrong?

Pete: As a scientist you get very used to things going wrong from a from a scientific point of view you might have a great idea but when you actually try it out doesn't work; that's a really important part of doing science, we don't know all the answers beforehand and it can be frustrating at the time but you learn from it so there's been tonnes of occasions where I've wanted to get something working it just doesn't work. But the other side, if you're thinking about things going wrong, the point that we see most patients in the hospital is where something has gone wrong and really what we aim to do in MRI research is to solve those problems. As a researcher it can be hard to digest and then move on and then think OK I need to come up with a new idea, but the bigger picture of what we'd like to do is solve the problems for people where it has gone quite wrong, and maybe we can offer a better opportunity for the future for them.

Student: In regards to the future, do you think that the research that you do now will have a potential impact for you know saving people or reducing the damage that people have?

Pete: So we're in a really lucky position as scientists because we come up with ideas and we all hope that the ideas that we're working on are going to make a big impact on different health conditions. So in my case I'm really interested in neurodegeneration so things like Parkinson's disease and I feel really lucky that every morning I get to wake up and think oh hopefully what I'm working on could potentially make a difference, and that's part of the reason why I really love my job is that everybody around me that I work with every day is just as passionate as I am about whatever they are working on, and when you get something like the conference that's coming up now you get people from all

over the world who are just as passionate about solving these kinds of problems. So it's a really exciting job to have. One of the other really exciting things is that we always get new people coming through so the next generation of young scientists like yourselves will undoubtedly make an impact if you decide to pursue medical research. And it just keeps going, so what you might have predicted for medical science 20 years ago and what you might predict for today might be completely different. In the same way when you're all scientists I'm really excited to see what you bring to the world of medical research.

Student: That's great to hear because you know I also think it's very good to work collaboratively and learn from everyone else's ideas, and also like you said to have that drive to you know when you wake up in the morning that you enjoy the field that you're working in knowing that you're helping people everyday. I think that's very valuable. Thank you for sharing your experience, it was great to go and see everything and to learn from you now, it was great.

Pete: It's been really great fun to have you visit it's been a great experience for us and hopefully you've taken something away from it too.

Narrator: Pete finishing that interview by Raghad, Layla, and Zarifa. Next, Shaima and Imani visited Jonny and Ciara at Kings College London. They wanted to find out more about the way we use MRI to look at how the brain develops and ages.

Student: So the other day me and Imani were both watching Grey's Anatomy, they go into MRI room someone had like something wrong with their head I don't know and I was just like, "that seems so accurate this is so going to help us in our interview tomorrow" but then Imani was just like,

Student: I was confused because I was told so many times that it's not actually accurate so I really wanted to know, what's your point of view on it?

Jonny: I guess my question would be, what were they getting the scan for?

Student: I think someone had been in the car accident and like they were wearing radiation vests or something.

Student: Yeah it was quite confusing, I think it was a brain scan actually.

Jonny: OK so an MRI probably isn't super accurate but compared to all the other imaging techniques we have, it is very good at picking up tissue damage or tissue anatomy and so if someone has a head injury they might go in to get a brain scan just to see if there are any bleeds or there's any obvious damage that happened to the brain; but it would really only be if they're showing signs that they need the brain scan.

Student: So do you think the film industry accurately represent MRI scanners? 'Cause I was told there was random equipment everywhere.

Jonny: Well for one thing, I guess the television show you saw had a radiation vest whereas you don't need and there's no radiation used in MRI. Another thing you often see is someone's inside in the scanner with nothing around their head and they're chatting away very casually. MRI as you saw - I think I was in the scanner while you were there - is very motion sensitive, so even a couple of motion means that the scan may not be of high enough quality and also you have the head coil that's around so you might have seen it looks like a little cage over your head and that's never on TV so in that sense is very inaccurate.

Student: So I'm never going to see Grey's Anatomy the same again, you know thank you for ruining that for me, anyway what about foetuses? Because personally one of the reasons I'm interested in things to do with medicine and hospitals is because I've been thinking about being a midwife or OB or something and I was just wondering how do you scan the brains of foetuses.

Ciara: Well, you put the mum in and you use I guess techniques that are targeted to imaging videos.

Jonny: The head coil you see on adults going into this scanner or child going into the scanner isn't there anymore so you put a kind of a flexible coil over the mother and also the way they acquire the image is slightly different so while I was in there a single scan might take seven or eight minutes but on a foetus they collect lots and lots of scans that each take a couple of 100 milliseconds at the most and they put them together at the end using software. So you'll have because the foetus is floating almost freely as it's inside the mother, they're moving all the way through and you've no control over that so instead you collect loads and loads and loads and loads of images and use software to put them together at the end.

Student: After the baby is born, the brain, I was told that it develops once the baby is born and so how long does the like brain develop like to what age?

Ciara: You will get the brain developing until you're in adulthood but I guess when you are, when you are a kid that's when you see the biggest changes. And in the first three or four years of life that's when you see the biggest impact on developments.

Jonny: So the brain starts at birth at about 20% of the size as it will be in an adult and there's a kind of a limitation on the size of your brain. So in the first two years it quadruples in size so the brain gets much much much much bigger but a lot of it is actually to do with the wiring so if you think of a connection between a computer and a plug socket, the wire isn't bare, so it's covered by insulation so a lot of the scanning we do looks at a thing called myelin which insulates the connections between neurons. But actually that takes up huge amounts of space. There isn't that much when you're born so a child can't do much coordinated activity. In theory our brains are developing up until 24,25 and that's now seen as the top end of what an adolescence is. But actually so it seems like the brain is shrinking after that age, and it does it gets smaller and smaller to a small degree, but some of that can be seen as increasing efficiency. So you have established things you do every day and some of those connections that you have between neurons probably aren't relevant anymore and maybe never were; so they get cropped back and that's called pruning. That happens all the way through development and in older adulthood we see it as a positive thing.

Student: So you just talked about how connections between neurons and how like day-to-day tasks that you do you kind of remember them. What about old people because a lot of them end up getting Alzheimer's or dementia and so what happens to their brain then, what happens to those connections?

Ciara: So in some of these diseases like Alzheimer's or Parkinson's or Huntington's disease you have some pathological processes that affect the myelin which is the kind of fatty tissue that surrounds axons, so your main connections. And therefore the signals that normally are transmitted across axons cannot be transmitted as efficiently. So when you're ageing the biggest effect you see is usually on the white matter and grey matter. So the grey matter tends to shrink and the connections between the different grey matter areas which are made by the white matter tend to be affected. So you can see, you can use specific techniques to for example look at myelin and how this deteriorates over time.

Student: So a few days ago I actually went to see an MRI scanner and it was quite huge, and so I wanted to know with people with autism or maybe mental health disorders or maybe even claustrophobia, how do you deal with them and if they really need MRI scan what do you do?

Ciara: I think an important part of the process is to prepare them very well. So for example if you have a very young kid or a kid with autism or a kid that is just very afraid of going into the MRI you have to be very careful and take them through the process very slowly. So what we do, we show them a video when they're home with their parents to just introduce them to how the experience is going to be, then when they come in we talk them through the process we show them the scanner and we also sometimes we show them the scanner at work with maybe a teddy bear inside or we scan a melon or whatever and we show that they, basically the noises the scanner makes are not dangerous, and we show more or less what to expect.

Student: Covid has affected lots of workspaces. I really want to know, how did it affect your research like personally?

Jonny: Because we're in a hospital, as you might imagine, the hospital was kind of one of the first to shut down all extra activities and any research would have been one of the first but. Because they're so good at infection control, everyone is working within the constraints of the hospital had lots and lots of training, and for instance you get a mask as you walk in, things like that, it meant we were able to start up a little sooner than some other research centres. So we were lucky in that sense by being in a hospital, it - we were in a better position to start back up.

Ciara: I don't think I was badly affected as much as other people. I think the pandemic was quite OK both because of the project I'm working on and also because it gave me the chance to focus a little bit more on my research.

Student: Are there any ethical issues with MRI scanners?

Ciara: The first thing that comes to mind is if, when I scan my patients I might see something that I'm, I don't expect to see, um and have incidental finding (it's called), and I guess it's very hard after the scan to look into this kid's face and not say anything. I'm not allowed to tell them that something is wrong, I have to wait for the proper procedures and for medical doctors to review the scan to get back in touch with the family.

Student: what made you passionate about MRIs?

Jonny: One of the things that's really unique about seeing the brain in someone who is alive is you can look at two different types of things. So you can look at how someone responds or how their brain responds to speaking for instance or hearing words and you can make out the area of the brain that's associated with listening, but you can also just by looking at anatomy you can see some of these circuits. So you're kind of looking at the endpoint of millions of years of evolution and you can see circuits kind of coming from the inside out and you can visually see them and I find that incredible and some of these circuits are the ones that are targeted for treatments for things like Parkinson's. And because you can visually see them a surgeon can visually see them and they can put in an electrode for instance that helps with symptoms. I just find it fascinating.

Student: I've learnt so much, thank you.

Student: yeah same here thank you so much I'm probably definitely going to go to a good sixth form now so yeah thanks a tonne.

Jonny: I'm glad you can go to a good sixth form! No this has been incredibly interesting.

Ciara: Yeah again I think that your questions make us also reflect on ourselves and our experiences so thank you very much.

Narrator: Ciara ending that interview by Shaima and Imani. Finally, Sophia, Meerub, and Mysha went to UCL and interrogated Sharon and Tom about the ups and the downs of being a scientist. Here's Sofia.

Student: OK so we've done some research about UCL and something that really stuck out to us is that its world leading, it's world leading university and labs, so we wanted to ask what exactly makes you world leading?

Tom: From my perspective I'm a clinician as well as a scientist so there is a hospital attached to the centre we work in called the National Hospital for Neurology and Neurosurgery and it's one of the most famous neurology hospitals in the world, lots of diseases being characterised there, lots of very famous neurologists and neurosurgeons have come through there so that gives it a really important foundation for the patient base. So then I then do my research in patients with a very particular brain condition that affects their memory and at UCL in the imaging centre, the Wellcome Centre, it's really benefited from having some very famous psychologists and neuroscientists go through there but particularly for the work that we do, people who have created the software that helps us analyse MRI scans and functional MRI scans, which you saw a little bit of, that software is used all throughout the world by most people who do research in our area so it's great to be at the cutting edge of creating that new technology.

Student: I'm guessing you do get generously funded for research which led us to wonder do you think it's ethically reasonable to use large sums of money for your research purely because of curiosity when you know there won't be a sure outcome.

Sharon: I think the first thing is that when you do science you never know what would come out of it really and I think it's therefore sometimes very difficult to judge how the money will benefit society in a way. I do think as a scientist that curiosity is important and that there is reason to do research which is not necessarily clinically applicable. As I said both because we don't know where it will take us but just for the sake of knowledge and for the sake of human society.

Student: So, we know it must be a stressful job especially with the large funding a lot of pressure. So what drives you to really get up in the morning and do what you do?

Sharon: Throughout my studies and throughout my research I've been working with patients and always trying to communicate back my research findings to both patients, and maybe as importantly, their carers, and people find it usually very interesting and also helpful. So I think this feeling that that you *are* contributing to patients' management and rehabilitation has been a big drive for me, on top of the curiosity and fascination with language and with the brain.

Tom: Pretty similar with me, so even the patients I mainly do my research on, when I first started my research no one thought they had memory problems; it turns out they had really bad memory problems. So having discovered that and characterised that for them was really cool and it was a really important part of the research. And you know I still get emails of thanks from them and stuff saying you know thanks for helping us out with this 'cause my family didn't believe us.

Student: You guys have already touched upon what you guys do but is there, have you always been doing work in language and working with the brain or have you changed your path?

Sharon: So I've been working in the area of a neuroscience since I guess my master's degree and I've been interested in languages since my undergrad. When I came to England to do my masters degree I, to begin with, really struggled with the English and this feeling that something so basic like language and communication is such a struggle really pushed me to be interested in people with language disorders so I have been in that area. I worked with children with developmental language disorders and children who had cardiac problems and as a result had brain damage that affected language in memory, and as I said also with adults with a stroke.

Tom: So I'm a doctor and so I started off medical school, I thought I was going to end up being an orthopaedic surgeon. When we're doing our neuroscience in my early years of medical school I got really into the brain, I thought this is incredible, then I did a degree halfway through my medicine and I was able to work with one of the world's most famous memory researchers which was just incredible, and I got to do a little bit more stuff with him during my time at medical school and I knew that I wanted to do the brain, I just didn't know what that meant. But then I had to work for four years just as a junior doctor which meant I didn't have any time to do anything else to be honest and then eventually was able to kind of specialise into doing, to doing stuff with the brain. So I did my PhD and things and then ended up get- training as a neurologist then finally became a consultant a couple years ago. So it did change a little bit about what - I thought I'd still want to be a surgeon but I realised I found it really boring, surgery, so I thought I didn't want to do that anymore and I actually enjoyed the medicine more. So I think that I was kind of always interested in memory but my, the stuff I've been interested in memory's definitely changed as times gone on and stuff so yeah I think you start off with the plan and it just changes as the opportunities come past.

Student: So do you think that you've ultimately pursued where you'd want to be as like your career or do you think that you still have a long way to go?

Tom: Definitely a long way to go because what's exciting about science, we've sort of touched upon, that stuff I'm doing now I'm pretty sure I won't be doing you know hopefully ten, fifteen, twenty years down the line because the questions will change, we'll have different answers and we'll know different things and then different technologies will come along and so I don't know necessarily I hope to still be doing memory because I think it's interesting part of neuroscience but whether it's doing the questions I'm doing at the moment I don't know.

Sharon: I think that there is a lot of change as you go even when you start a small project you kind of never know where it's going to take you. If I look back at the last ten years there's been massive change in the techniques we've been using, in the analysis that we've been using, and in kind of the fundamental questions that have been asked; so I think a lot of times something kind of pops up and then it becomes really popular and everyone starts thinking about it and looking at it. Maybe one example which wasn't quite there when I started my undergrad is the use of big data which now is really the thing or one of the big things definitely in neuroscience and it hasn't been there so when I would read papers as an undergrad you know a paper with 30 participants would be massive data set you know, and today it almost looks ridiculous; you know we have hundreds and thousands of participants in studies and we can ask such different questions so it's really interesting and it's something that you can't foresee.

Student: As you previously said Covid has impacted a lot of scientists across the world and because you both work in different fields, has it affected you differently or in the same way?

Tom: So it affected me 'cause I was in the hospital. I didn't do any research at all so yeah we just were helping look after neurology patients and some Covid patients and things so no research for me.

Sharon: We were in the group in the middle of a few studies when lockdown started and because we work with adult stroke patients who are vulnerable adults obviously the research had to stop; and actually still two years in hasn't been resumed in large; its obviously hasn't been reasonable and feasible to bring vulnerable adults into central London in the last couple of years. So that affected things massively but it also pushed me and everyone I've been working with to go back to studies that we've done before that were kind of neglected, that we thought maybe there is nothing really there, trying to put data sets together with other labs who didn't manage to finish their research but actually together we have enough data, it did spark I think some creativity because we had to start thinking of the way we work very differently.

Student: So we've collected that communication and collaboration is key in the research you do and that's led us to wonder whether maybe any data you've shared or published has been used in another scientist's work and just generally about the tension between scientists trying to breakthrough on the same things.

Sharon: There is one thing I've done doing my PhD, I was working with stroke patients with language disorders and I was curious to see whether some of these patients who struggle to speak have preserved inner speech so whether they can hear their voice in their head, whether they can retrieve words that they can't say out loud but they can retrieve them and hear them internally and we developed kind of a test battery that will check whether patients have inner speech and we published this battery in a kind of a small journal that publishes that type of material and throughout the years I had a lot of people who emailed me and asked for the test and used it and then published it with other populations. So I think that has been really nice that it was really simple piece of work, just something that was really fun to do, but informative and has been used by other people.

Student: As you know there are many different factors that can affect the quality of research such as like money and communication. So what do you think is the most important factor?

Tom: I think actually experimental design, so how you design your experiment to answer the questions. So the most important thing so you formulate your question, what is it you want to ask, and you have your hypothesis, you know what is it you're testing and testing against, and then how you design the experiments to answer that question. So without functional MRI research, FMRI research, what you want to, kind of - changes in blood flow that happen in the brain when you're doing any task, me talking to you now, is probably only changed by one or two maybe three, four percent the activity of the speech areas of my brain. That's tiny and you got to think about how to collect that tiny amount of difference in a small number of people, you know a few number of people, over a particular task. So it's often about how do you make sure that you collect the data so that when you put it through the best, the best analysis software packages there are that you're actually going to find what is your looking for. So yeah I think actually experiment design really is kind of the key thing.

Student: Do you enjoy your job overall, like do you see that really makes an impact in people's lives?

Tom: To me the answer is yes I think it is, because you know the populations I work with and will work with in the future, you know they need answers; need the right questions being answered in them. I really love what I do, you know it means that every few years I have to worry about funding which is stressful in and of itself but I think that's worth it.

Sharon: Yeah I'll join that. I do love doing science, I really enjoy being a scientist, I'm happy that this is where kind of life took me. I think that there are a lot of difficulties, it's not an easy career in many ways, but I think if I remind myself why I'm doing it then yeah it's definitely worth it and I enjoy it.

Narrator: Sharon ending that interview. It was great to meet the scientists of the future and find out about their perspective on our research. Thanks to them and thank you for listening. The interviewers were Imani Chaudhury, Shaima Razali, Meerub Anjum Mir, Raghad Abdin, Layla Abed, Mysha Vohra, Tahiyyah Patel, Zarifa Mir and Sophia Mechouar. They interviewed Pete Lally, Jonny O'Muircheartaigh, Ciara Casella, Sharon Geva, and Thomas Miller with production help from Hanna Smyth, Salma Adel, Ray Potter, and produced by Carinne Piekema. I'm Stuart Clare, thanks for listening.