

When Science Finds a Way

Season 2, Episode 3

Working it out: exercise, the brain and mental health

Show notes

Episode description:

Exercise is more than just fitness – it can be a powerful tool for mental health.

But what actually occurs in the brain during a workout, and how can it help in treating mental health issues? Alisha meets Dr Jonathan Roiser and his team of researchers to uncover insights from a groundbreaking pilot study exploring brain activity during exercise, including how it could transform the diagnosis and treatment of conditions like depression.

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Mentioned in this episode:

[Rose Trees](#) - a UK charity supporting medical research

Transcript

Alisha Wainwright - 00:00

Hey, Alisha here. Just letting you know, this episode contains personal accounts of symptoms caused by depression.

(Music starts)

JONATHAN CLIP – 00:10 *“What we're really interested in is not the effects in the immediate aftermath of your bout of exercise, but actually the long-term cumulative effects - what's changing over the weeks and over the months. This kind of research, you can't really do it if you don't use a cross disciplinary approach. We kind of all have to work together to trust each other to make sure that everything is working properly.”*

Alisha Wainwright 00:33

Welcome to When Science Finds a Way. A podcast about the science changing the world. I'm Alisha Wainwright. And on this series, I'm talking to the global experts who are making a difference as well as the people who have inspired and contributed to their work.

Today we're going to work up a sweat and talk about exercise - specifically exercise and mental health.

You've probably heard of physical activity being recommended as a remedy for symptoms of depression - it's simple, accessible and there aren't really any downsides apart from the sweat I mentioned.

The thing is, while we know that exercise is effective at reducing the symptoms of depression, we don't fully understand why. And here's where it can get complicated. Because right now, there is a changing understanding of mental health that affects how we diagnose and even define things like depression. And there's one team in the UK who is doing ground-breaking work in the field which could have significance around the world.

So, today we've got a cognitive neuroscientist to explain. Dr Jonathan Roiser is a professor of neuroscience and mental health at the Institute of Cognitive Neuroscience, University College London. In 2024, Jonathan's team presented the results of a pilot study looking at exactly how physical activity affects depression.

Today, we'll hear more about this trial from the participants and the researchers, and also get an idea of how the research is expanding.

Jonathan, welcome to the show.

Dr. Jonathan Roiser 02:08

Thanks so much, Alisha. It's great to be here.

(Music Ends)

Alisha Wainwright 02:09

Before we delve into research, I want to get an insight into your approach on researching mental health - which is studying the brain to understand depression and other mental health problems.

In our research for this episode, we found this interesting quote from Marvin Minsky, who was a cognitive scientist: "*The mind is what the brain does*". Can you explain how that relationship works and how it might affect the way we think about mental health?

Dr. Jonathan Roiser 02:35

Sure, so I love that quote from Marvin Minsky because it basically sums up the whole of my field - cognitive neuroscience. So, we think that everything that you feel, everything that you perceive, everything that you think, everything that you believe, all has a basis in the operation of the brain. Electrical signals, the chemical signals that are constantly going on, those neurons firing, you know - millions upon millions at any given time - to actually create what that mental experience is. And so this is obviously the materialist perspective.

All of mental health is basically changes in the way that we think and the way that we feel, in the things that we believe. And so, at least to me as a cognitive neuroscientist, it just seems like a natural approach.

Alisha Wainwright 03:20

So what other frameworks are there for studying mental health in addition to cognitive neuroscience?

Dr. Jonathan Roiser 03:25

In the past, lots of people didn't really take into account the, you know, the brain circuit perspective. So, in the era of the psychopharmacological revolution - which is when the new drugs for mental health started coming on board - people were very interested in these

chemical changes and, I guess to a certain extent, almost treated them like hormones, which they're really not. Um, they play a very important role in actually causing the brain signals directly.

They pitched the solution to the problem as, well, maybe there's an imbalance in this neurochemical...

Alisha Wainwright 03:56

This one specific thing.

Dr. Jonathan Roiser 03:58

Yeah, exactly. But actually, from a cognitive neuroscience perspective, what we know that these neurochemicals do, is that they change the balance of activation in other circuits. And they have these very broad effects all the way throughout the brain. So from that perspective, the neurochemical explanations can be, really be thought of in terms of the brain circuits as well.

Or, to think about another perspective, people think that social influences, you know, socioeconomic influences have a really important impact on mental health. And of course, that's true. If you look in epidemiological data, we know that people who are less well off - for example, they experience more stress in their everyday life - maybe greater exposure to inequality, greater exposure to discrimination or racism - they're much more likely to experience mental health problems. But again, that's just a descriptive relationship really. It doesn't explain the mechanism which is actually driving at the proximal level - so the immediate level - actually how this is happening. So, in order to do that, we have to then look to see how those social influences, for example, actually have an effect on the brain.

Whatever approach you take, if you really believe that the brain and the mind have this fundamental relationship with each other then, at the end of the day, you're always going to come back to trying to understand how the effects are actually transmitted through the effects on the brain.

Alisha Wainwright 05:15

There's been a changing understanding in recent years of how we even think about categories of mental health problems like depression or anxiety. Can you explain how medical researchers and clinicians have a different perspective on diagnosing and defining what we might commonly call depression?

Dr. Jonathan Roiser 05:33

Yeah, so that's a, that's a big area and it's something that's really developed over the last decade or so. What we really need to do is initially take a step back - just ask: 'What are these diagnoses?' 'What are they based on?' and 'How are they defined?'

And diagnoses like depression or anxiety or, you know, schizophrenia, obsessive compulsive disorder, they're basically descriptive diagnoses. So what that means is that we have a set of symptoms which a patient might experience. And they don't have to experience all of them. And then the definition of the diagnosis is that you have some subset of these symptoms. So, for example with depression you have to either have low mood or loss of interest. And then you'll very likely have changes in sleep, appetite, weight, concentration difficulties, negative self thoughts - you know - maybe it's something severe as thoughts about suicide.

Alisha Wainwright 06:22

That's also how I think about depression. I think about depression in the form of symptoms as well.

Dr. Jonathan Roiser 06:27

Exactly. And that's, and that's because that's actually how it is defined. So it's not just the diagnosis, it's actually, the definition of what the, what the syndrome is.

But actually, in the rest of medical research, we don't define disorders along those lines. So if you have a cough, for example, you don't say 'I've got a cough disorder.' What you say is, you know, 'Oh, I think I might have a virus,' or 'Maybe it's a bacterial infection,' or 'Maybe it's different types of virus', 'Maybe I've just got a cold,' or 'Maybe it's COVID.' And depending on what that diagnosis is, that underlying mechanism that's driving the symptoms that you're experiencing, you might take different actions. So, for example, if you had COVID, you might self-isolate. Whereas if you have a cold, it's going to be different. And, if you have a bacterial infection, then you need a different type of treatment.

So, this is quite important because from a neuroscientific perspective, it's quite possible that, for example, the same underlying mechanism might cause different types of symptoms in different individuals, even though people have got the same thing going on under the hood as it were.

And so, when we're thinking about mental health problems, defining them at the level of the symptoms kind of muddies the waters a bit. Because if we want to try and understand what the underlying mechanisms are, we have to take into account this possibility that we've got differences between individuals, which could potentially cause the same symptoms or, similarities between different individuals, that are causing different symptoms. And so that makes the whole endeavour much more complicated.

So for the time being, we have these diagnoses, which basically everybody agrees on. But when we're trying to think about what the underlying processes that are driving them are, we really tend to think about these from a, from a bit of a different perspective at the level of the brain.

So at the moment we're working in a very descriptive level of diagnosis. And of course that makes finding differences between groups, you know, quite difficult. It means that we're never really going to be able to find if you like a biomarker for a particular mental health condition, because they're not really just one thing. They are sort of more like umbrella terms for probably a set of different underlying mechanisms. And so that's, you know, that's what neuroscientific research in this field, a lot of it is really aiming to try and understand.

Alisha Wainwright 08:34

Well, let's meet one of the participants in the pilot study. Her name is Olivia, and she told us about why she signed up.

Olivia 08:41

I think what made me want to take part in the study...I was going through, um, a, breakup, a divorce, and there was a lot of things that was really affecting me at the time. So, I understandably got quite depressed, um, lost my job, and was generally struggling a bit in life. And I really struggled, um, with a lot of things emotionally, physically, getting out of bed, being quite depressed, low moods, and I was trying everything and anything to get myself out of there when I came across the study and I thought I'm gonna try to get, yeah, any help I can.

I tend to think of myself as quite a fit person. Um, I like quite active physical sports - skating, climbing, snowboarding. And I notice when I say all these things, it's like, oh yeah, 'But when was the last time you climbed, snowboarded, skateboarded, Olivia?' And I'm like, oh yeah, like, I can't even think when that happened.

So I kind of had a couple of years where I was, struggling to find time for myself and exercise was one of those things that dropped away. I was doing very little to nothing before I started this, this research study, which is probably one of the ways I thought, this is going to force me to be accountable and do this.

Alisha Wainwright 10:16

When Olivia talks about her exercise background, she thinks of herself as a fit person and, uh, having enjoyed all these activities. But she also realises that she hasn't found the time to do them for herself. So what are the challenges for people with depression engaging with exercise? I mean, especially when she added the financial component as well, you know, and the time and and resources it might take to exercise.

Dr. Jonathan Roiser 10:41

Yeah, I think that's totally relatable. And I think we could all understand the challenges in trying to fit in exercise into everyday schedules. I think it's not unique to depressed people. I think for many people, it's a struggle to fit it in. Everyone's got lots of commitments - gotta go to work, look after the family, keep our social networks up, etc.

But there are additional challenges for people who have depression. A big part of what depression is is actually a loss of motivation, loss of interest or enjoyment in previously enjoyable activities. That's a symptom called anhedonia. So it's almost like a vicious cycle because people feel like they don't have the motivation to go and do this. And then the fact that they don't have the motivation to go and do the exercise probably then feeds into not really feeling that motivation in the future and people can easily end up in a downward spiral.

Alisha Wainwright 11:30

Well, I know that if I work out, I work out like a handful of times a week and my workout of choice is indoor bouldering. I feel great afterwards and I have that post workout high.

But thinking specifically about exercise, I was surprised to hear that we kind of know what works as a treatment for depression, but we don't fully understand *why* it works. So what do we understand about the relationship between exercise and mental health at this point?

Dr. Jonathan Roiser 11:58

Yeah, that's a great question. And there's actually a ton of research on this topic. So much of the research in this area comes from observational work, longitudinal epidemiology studies, which take a big group of people and then follow them over time for many years. And there are numerous examples in extremely confident level of results, that people who exercise more, tend to have a lower level of a variety of mental health symptoms, most particularly depression and anxiety.

So that's just an association. It doesn't help us distinguish between what's the cause and what's the consequence of course, because it's perfectly possible that if you're just depressed, then you're less likely to go out and exercise.

So that was the kind of initial, uh, initial data.

There are other types of studies that you can do to try and establish causation. And probably the most important ones are the randomised controlled trials. So this is when you take a group of people say with depression and you randomise them, you say, okay, these individuals are going to get some kind of exercise intervention. These individuals aren't going to get any exercise intervention. And then you look after several weeks of the intervention and you look to see how the symptoms have changed. And there are probably about 200 studies of this type that have tried to take this randomised controlled trial approach.

And on average, they show a pretty substantial reduction in depression when people are doing various different types of physical activity. It's not just vigorous exercise like running, also stuff that people do in the gym, even slightly more mild forms of exercise like yoga. There's lots of evidence across all of these different interventions that it seems to have this antidepressant effect.

But so far that the real mystery is actually why it works.

Alisha Wainwright 13:37
Right.

Dr. Jonathan Roiser 13:37
So that's what we don't have a good handle on at the moment.

Alisha Wainwright 13:40
When you were planning the pilot study, what was your hypothesis, uh, that you were working with?

Dr. Jonathan Roiser 13:45
Yeah, so we came up with a new idea, actually. So for the past 10 years or so, my group has been studying motivational changes in depression, more broadly speaking.

So understanding the psychological processes that feed into what motivation is. And then trying to understand how those differ between groups of depressed people and people who don't have depression. And then looking at different symptoms and correlations with those.

And we found some interesting initial findings. And one of those was around the tendency for people to exert effort. So we can do an, an experiment where we ask people, would you like to engage in some kind of effortful challenge, physical effort. Where they squeeze a grip force - measure a hand. We found that people with depression are less willing to do that. And, in general, it doesn't really matter, you know, what, what the stakes are or how much effort they have to put in, there's this general reduction in their propensity to exert effort.

So we started with that and then I started looking at the exercise literature and got really interested in trying to think about where this difference in effort processing might come from.

And one idea is that there's this very important brain chemical system called the dopamine system. And, uh, people have heard of dopamine, I'm sure. And it's got a big reputation as being like the pleasure hormone, which it really isn't. Dopamine is not really that important in making you feel happy.

But it's probably very important in making you feel excited about something or motivated to do something.

Alisha Wainwright 15:12

Motivated...

Dr. Jonathan Roiser 15:12

And it's very important in actually performing actions as well. When people lose their dopamine, for example, in Parkinson's disease, they have real problems with movement. So this idea of, you know, motivation and action

Alisha Wainwright 15:25

literally, literally like just the literal physical movement. That's so interesting. I didn't know that.

Dr. Jonathan Roiser 15:28

They're intrinsically linked with each other - motivation and action - because that's what motivation is for. Motivation is to make you do action, right.

Alisha Wainwright 15:33

Yeah.

Dr. Jonathan Roiser 15:34

Anyway, so, I kind of had this idea and then I started looking into the effects of exercise. And, I guess to put it simply in terms of thinking about the symptoms, our idea is that actually when people start exercising and there's an antidepressant effect, probably the first thing to change are symptoms that are really related to motivation.

And also in that category comes things like fatigue and also sort of cognitive problems. So people experience, like, brain fog often in depression, they find it very difficult to concentrate or make decisions. And so all of, these, this cluster of symptoms might be important. And it's, you know, it's just one dimension of function in depression.

And it comes back to that point we were talking about before, the depression probably just isn't one thing at the level of the brain. It's lots of different processes. And so we're really focusing on this particular dimension of function which is around motivation.

Alisha Wainwright 16:22

And, and so it was a randomised controlled study.

Can you just tell me how that actually worked for the participant? What did that look like? What did they have to do?

Dr. Jonathan Roiser 16:31

So, the design, the typical design of a randomised controlled trial or study, is that you take a group of participants - they've all got a particular diagnosis. And then you say, okay, some people are going to go and take this kind of intervention and other people are going to take this kind of intervention. In a typical drug study that would be like, you know, an active drug versus a placebo.

Here it's a bit more complicated. Here we're actually interested in understanding how different types of physical activity work. So one of our groups is doing a workout in the gym - aerobic exercise, moderate to vigorous intensity. And the other group is doing a much milder stretching and relaxation intervention – a little bit like yoga.

And so they actually have to turn up three times a week at the gym in my university. And then we measure various things at the beginning and at the end.

Julia Gillard 17:23

Hello! I'm Julia Gillard, chair of Wellcome. Thanks for listening to our podcast, When Science Finds a Way. Wellcome supports researchers around the world to make discoveries and help solve urgent health challenges. We believe in the power of science to build a healthier future, and the need for inclusive collaborative action to ensure that everyone can benefit. To get involved, visit wellcome.org, that's Wellcome with two l's. Now, back to the story.

Alisha Wainwright 17:56

Okay, well let's hear back from the gym. We put on our sweatbands and headed down for a session with research assistant and trainer Ashley.

Ashley Slanina-Davies 18:04

So, I'm Ashley. I'm the research assistant and that means I work as the trainer on the project, so I run the activity sessions.

ASHLEY CLIP – 18:12 “Okay, are we ready?”

Ashley Slanina-Davies 18:15

So we're doing an activity session today. We are in the fourth week of the intervention. So now we're going to play with some interval training.

ASHLEY CLIP – 18:24 “Nice! Alright, soften through the legs. Shoulders nice and low, okay?”

Ashley Slanina-Davies 18:31

There's some sections where we're doing things like squat jumps on and off for 20 seconds. And then there's other stuff where we bring it back down with like a chest press and using more resistance type weights.

So we're trying to aim for, overall, moderate intensity. But we build up to a fourth week that's a little bit more intense just to see if we can get those cardiovascular changes right at the end.

ASHLEY CLIP – 18:55 “We're here for three, two, one, pause!”

Ashley Slanina-Davies 19:00

As our participants move around the different circuits, I ask them to fill out this workout sheet that they've got.

So they write down how hard they felt it was. We use the Borg scale. So it's a scale from 6 to 20. And they're aiming to work around about 13, 14 - occasionally up higher. So I wouldn't be surprised if today we got a few, maybe, 17s creeping in there. We also log that data so we can go through it. I personally can check how our participants are responding. But also

for the study we can compare that with, you know, for example, attendance data and then changes in fitness and changes in mood, and we can see which elements are important.

They're attending the activity sessions, they're doing that three times a week. They're also constantly wearing an accelerometer, so their activity levels are constantly being monitored throughout. They're rating their mood every day - they do this twice a day - in the morning and in the evening. And then every weekend they play cognitive games and they answer a more in-depth battery of questionnaires.

ASHLEY CLIP – 20:08 *“Okay, so you can use a bit of momentum. Bring it down, bring it down, bring it down, bring it down, bring it down.”*

Ashley Slanina-Davies 20:13

All of our participants have at least low mood. But low mood is a huge spectrum.

So, some of our participants are just having a bad day when they fill out the screening form. Other of our participants are really quite poorly. And we're very mindful of that. So we do a welfare check.

You might want to do an extra check of is there anything I can do to make you comfortable in this room? For example, we've had like OCD, and obviously using shared equipment isn't the easiest thing for those participants. So we've done stuff like have them have their own separate equipment that only they use for the duration of the study. So there's lots of different elements that you can be mindful of.

ASHLEY CLIP – 20:57 *“All right. As soon as we are ready, join me in the centre and we'll just do a little quick stretch out.”*

Alisha Wainwright 21:06

Ashley is a saint. I love her. She seems so nice and I would do any workout she put me to cause she just - you could hear the smile and the consideration in her voice. What a fantastic coach that you had as part of your study. Wow.

So does the right exercise regimen look different for different people? I'll just speak for myself. I find high intensity interval training just so hard. I think it makes me so anxious and gets my heart rate up through the day. I don't really care for it. But something like a more of a meditative jog or, like I said, indoor bouldering, it tends to have more of a smoothing effect on my mood for me.

So I'm just wondering if participants felt similarly.

Dr. Jonathan Roiser 21:53

Yeah. So the first thing to say is broadly speaking, we're looking at two different approaches in the different groups. So one group are doing aerobic and moderate intensity or to high intensity - a little bit of high intensity interval, as Ashley said, right at the end of the intervention. But mostly that's you know jogging or cycling or floor work, jumps, etc. And then there's another group who's doing more of like a yoga intervention where they're doing relaxation and stretching.

It's really important to understand that we titrate it to each individual's ability. We're starting with a group of people, some of whom have exercised before, some of whom have never

exercised really in their life. So we really need to make sure that each person can actually do it.

And then it's a progressive approach that you have to build up over time. And then across the interventions, we actually try to match the particular movements and the muscle groups that we're using. So if you're doing a lot of leg work in the gym, in the aerobic session, we would try to match that in the stretching and relaxation as well.

And then to improve the sort of cohesion amongst the group, which really helps people come back to the sessions to make sure we get good turnout. We have people work in partners when they're doing floor exercises. We do actually use quite high repetition rate. Um, and that helps keeping an aerobic range.

So we're trying to get more of like a constant moderate to vigorous intensity throughout the challenge. Um, and the most important thing, I guess, is that we make sure people are happy with what they're doing. We use an empowerment model to make sure the participant is actually making the choice.

And we're checking in on them - Ashley's checking on them - to make sure, you know, whether they can actually go faster or whether they need to tone it down a bit to bring it back into the range that we're looking at. So there's quite a lot of thought in the exact type of exercises and repetitions, um, that Ashley's actually put into this.

And, you know, it's a huge amount of work, just that aspect.

Alisha Wainwright 23:38

So, your study uses a very cross disciplinary approach. Can you explain in more detail how that worked and why that is so important to the pilot study?

Dr. Jonathan Roiser 23:48

What we're really interested in is not the effects in the immediate aftermath of your bout of exercise, but actually the long term cumulative effects - what's changing over the weeks and over the months in the brain and in people's cognition, also in the biochemistry as well.

So, this kind of research, you can't really do it if you don't use a cross disciplinary approach. And that's because we've got so many different aspects to the study in order to answer the research questions. So, we're very interested, obviously, in the psychological or cognitive aspects, also the symptoms of depression, and then also the brain circuits. But even to study those, we need to collaborate with other people who are expert in physics, for example.

But then if we're gonna to do the intervention using the sports science approach, using an exercise intervention, and we've also got a yoga intervention, we actually have to design those. So then we work with our colleagues in a totally different department at my university, the Institute of Sports and Exercise Health. And, so they help us design what those interventions are actually going to look like, what we're actually going to get people to do in the gym.

But then we're also very interested in understanding this in the context of an intervention. And so for that, we actually need to run something like a randomised controlled trial. And, so, in order to do that, we need someone who's got expertise in actually running those trials. So we collaborate with people in our psychiatry department.

And it's one of those kinds of studies where there isn't really one person who could actually tell you in detail about all the different moving parts of the study. We kind of all have to work together, trust each other, to make sure that everything is working properly. So yeah, really, we couldn't run the study without taking that approach.

Alisha Wainwright 25:21

Of course, you can't study the brain without a brain scan. At the end of the pilot, participants got into an fMRI machine - that's a Functional Magnetic Resonance Imaging machine - and played some cognitive testing games while their brains were scanned.

Here's Emily to explain how it works.

(Sound of fMRI machine)

Emily Hird 25:43

We're at the fMRI scanner now and that stands for Functional Magnetic Resonance Imaging.

My name's Emily Hird, I'm a Postdoctoral Research Associate, here, at University College London. The scanner is a big metal tube, it's actually an electromagnet, and it has a bed on it that the participant lays on and then gets scooted into the metal tube. And so then we can turn on the magnet and look at the participant's brain and what's happening in the brain

The participant is holding a gripper in each hand and they're deciding whether or not to squeeze a gripper to get points.

EMILY CLIP – 26:20 *“Okay, so squeeze the right gripper. That's it. Squeeze as hard as you can. Keep squeezing.”*

Emily Hird 26:26

So, what you can see on the screen is the output of the scanner. You can see slices of the brain going from the bottom of the brain to the top. And we take these images every couple of seconds, which allows us to look at how oxygen levels in the blood in the brain changes over the course of these different computer games.

And where there's sort of more blood flow happening, that means that the brain is activating more in that area. Um, and in particular, a brain area called the cingulate cortex, which is involved in emotion and decision making and cognitive control.

And so what we can do, is use the fMRI to look at changes in blood flow in this particular area of the brain, and whether that's changed by different types of physical activity.

EMILY CLIP - 27:04 *“Okay, I'll talk to you from outside.”*

Emily Hird 27:13

So the study that we're running at the moment is the pilot study - so this is like preliminary work. But next we're going to be running a whole trial, and we'll actually be taking another measure of brain function, and this is called Positron Emission Tomography, or PET for short. And in PET we're looking at dopamine function, which we think might be boosted by the different types of physical activity.

And it's just really exciting to be part of such a big study, which could have such a potential impact on mental health.

Alisha Wainwright 27:44

Can you talk us through the results of your pilot study?

Dr. Jonathan Roiser 27:47

Yeah, happy to. So interestingly we do see, importantly, symptoms reduce with the intervention, and in particular, we see these motivational symptoms like loss of interest and fatigue are changing - and that's very important - which is in line with our hypotheses - but a much stronger effect. And this is probably because our participants were not particularly depressed to begin with. They had to have at least mild symptoms, but most of them are really in the mild, you know, to moderate range, so that didn't change so much.

But in the effort task that Emily was talking about, where people are making choices about whether they're willing to exert effort or not for different amounts of reward we really see quite impressive differences, uh, in that the people who are undergoing the aerobic exercise intervention seem to be more willing to exert effort. And interestingly, we're really seeing this in the data that we've analysed so far in terms of cognitive effort. So, you know, you can squeeze hard and that's effortful, but sometimes if you have to think hard, that can be really effortful.

And that's actually a very mysterious idea - what does it mean for something to be cognitively effortful? So we have a cognitive game, which we've developed, which allows us...

Alisha Wainwright 28:55

Like doing your taxes.

Dr. Jonathan Roiser 28:56

Yeah, exactly. Or doing tough mental arithmetic or actually switching between different tasks - that's really mentally effortful. And actually that's what we use.

So if, you know, if you're looking at a computer screen and you've got a million different channels of information coming in, then that's actually very, very tiring for your brain. So that's the, actually the approach that we use. And we, we've got a game where we have different amounts of switches in the tasks that people have to attend to.

We find that people are less willing to put in the cognitive effort when they have depression, of course. And then when people have undergone the exercise intervention, that makes them more willing, than in the other intervention - the stretching and relaxation - to put in that cognitive effort. So that's really exciting.

Alisha Wainwright 29:34

Well, let's hear how it impacted Olivia, who tells us what she learned from participating in the study and how she's taken that into her everyday life.

Olivia 29:41

What Ashley taught me in my exercises with her is, when I was doing this, I was thinking, 'I can't do this. I can't do this. Why can't I do this?' And she'd say to me, your body and your muscle has that capacity. I can see that in you. So, what it is, is that brain to muscle connection that hasn't been made, and it's those neural connections that is going to help you with your cognitive and mental wellbeing that helps with depression.

So when I hear her voice in my head, when I do things that are challenging for me - that area of friction - I tell myself, this is where the growth is going to occur. So, I throw in challenges for myself in general.

What the exercises did do was make me realise that I needed to work on my kind of cognition – and my practices there - and my physical - and my practices there - in order to help support my mental and my physical wellbeing going into my fifties and sixties. And I think for sure the exercises definitely helped out what I was going through at the time.

I felt like I was really working on finding time for myself. Um, and kind of, self-care, quite intense self-care, but self-care. It was quite nourishing just having this routine, knowing that I was turning up for myself, but it was, it was a super great experience.

Alisha Wainwright 31:00

As a researcher, how does it feel to hear how even just participating in this study changed things for a participant like Olivia?

Dr. Jonathan Roiser 31:08

I mean, it's just wonderful to hear, isn't it? And, you know, you can really, you can really hear it in Olivia's voice even. And, you know, I have to give credit to Ashley. She is an amazing coach as well as being an amazing research assistant. And, it's fantastic that Olivia has had such a good experience.

Uh, I think it's important though, to understand that, you know, other people might respond differently. Olivia's had a great experience. Other people don't have such a big response to exercise. That is, actually, something that we're also very interested in understanding in the study as well.

Alisha Wainwright 31:40

With the pilot finished, you now have funding from Wellcome for this expanded version of this research. And what do you think you're going to do differently?

Dr. Jonathan Roiser 31:49

Yeah, so previously we kind of ran the study on a bit of a shoestring. You know, we had a limited amount of funding. Uh, we had a fantastic funder - they're called Rose Trees - in the UK. They're a small medical charity. Now with the Wellcome trust, uh, we have, a much larger amount of money to play with, so we can do a much bigger sample. So, probably about twice as big. We're gonna have about 250 depressed participants coming into this study.

Alisha Wainwright 32:15

Will the depressed participants have the mild symptoms like in the pilot study or will they have more moderate symptoms?

Dr. Jonathan Roiser 32:22

Yeah. In the main trial, because it's really a clinical trial in an ill population, they're going to have a much higher level of depressive symptoms - so at least moderate or getting into the moderate to severe range. So, these are people who a doctor would really be considering treating if they were to turn up to the clinic. And so, we'll have about 250 people randomised to the different activities that we talked about before, and in order to do that, we have to have much more time to complete the studies. So, it's going to take three years, but also, they're going to be in the intervention longer.

So previously, this was a four-week intervention. Now we're doing an eight-week intervention, which we actually think will be more effective. And then the other thing that's different in the new study is that we can really start to look at these different types of measurement through the different levels of explanation about how these physical activities might be working.

So, we've got much more in the way of biological measurements. We're taking blood samples to look at the immune system and how inflammation might be affected by exercise, because we really do think there's a big anti-inflammatory effect there. And in addition, using this positron emission tomography brain scanning to get a direct measure of dopamine levels, because we think that's very important to actually driving some of these motivational changes that we're already even seeing in the pilot study.

Alisha Wainwright 33:34

Okay, so what do you hope these results from the expanded study will be used for?

Dr. Jonathan Roiser 33:38

So that's a great question, and it really puts into context why we even tried to do this mechanistic research in the first place.

So, I spend a lot of my career just looking at group differences between depressed people and non-depressed people, but I always thought, well, what difference is this actually going to make to someone who's just turning up to the clinic?

And probably the most important thing is really trying to understand if we understand how the intervention works, then we might be able to understand for whom it's going to work as well. At the moment, when a patient turns up to a doctor and, you know, the doctor's trying to think, well, what shall I prescribe? There's actually no logical way to say, well, you know, this treatment's right for this person, this treatment's right for the other person. So we might really be able to identify using this approach, because, especially with the randomised design, we have the power to look at this from a causal perspective - which people are going to be most likely to respond to exercise and antidepressants. Because there'll be nothing more demoralising than saying, 'Oh, I'm going to give you this, you know, course of going to the gym three times a week for the next eight-weeks,' then you show up and do it and it doesn't make any difference. We would like to be able to avoid that. So understanding that's very important.

I guess the other thing is really thinking about exercise more broadly, and in our medical culture, is about whether people are really willing to prescribe it or really willing to do exercise for their mental health, because it hasn't really been studied that much at a mechanistic level, much less than other types of treatments. And so that could be really important as well.

And just generally boost the amount of physical activity that people are doing for their mental health, which certainly in the UK really isn't a big focus right now. People tend to get prescribed either some pharmacological therapy like an antidepressant drug or psychological therapy and, you know, physical activity doesn't seem to be on - quite on the radar in the same way.

Alisha Wainwright 35:19

Right, right. What kinds of new interventions or treatments result from knowing more about how exercise affects the brain?

Dr. Jonathan Roiser 35:25

It's hard to speculate exactly, but we have lots of different types of drugs and lots of different types of ways of manipulating the brain. Actually, you can have a treatment that affects the brain directly just through electrical activity, for example.

So, if we've to understand how these brain circuits work, I can imagine we might end up with combination therapies, for example, where maybe you've got some non-invasive brain stimulation and somebody is, you know, doing exercise. Or maybe they're not - they don't even need to do the exercise and we can just manipulate this circuit directly.

And then the other interesting thing to think about is the synergies. So, when we're thinking about motivation and people getting up and around and doing things, well, that's actually a common kind of intervention, psychological therapy as well - especially the behavioural part of cognitive behavioural therapy.

And so I can imagine there's some kind of potential there for a combination with physical activity where maybe we can boost people's motivation at the same time as doing this kind of psychological intervention and, you know, they could really have some kind of synergistic effect.

Alisha Wainwright 36:23

So, it sounds like we need a more holistic approach to mental health where different approaches and disciplines can work together, right?

Dr. Jonathan Roiser 36:32

Yeah, absolutely. And I think that is one of the things that we really need to start thinking about more broadly in mental health. So, for example, even just leaving exercise aside, people often think about this kind of dichotomy. You know, 'Am I going to take antidepressant drugs or am I going to go to psychological therapy?'

But if you look at the results for trials, actually, the best results clearly come from when people do both of those things. And so doing these kinds of combination treatments is probably really important. And I can certainly imagine that's the case for exercise as well. I would never want to say, you know, exercise is an either or, if someone's going to start taking an antidepressant drug, which might well be the right thing for them. Maybe they could do exercise at the same time and they could have some kind of synergistic effect.

And I think that's a really important cultural change in the way that we think about mental health. And it's a bit too polarised at the moment, even in the public conversation. You know, there's some people thinking, 'Oh, it's really biological,' and other people think, 'Oh, it's really psychological,' but actually, when you boil it down to the level of the brain, it doesn't really matter. It's all just affecting these brain circuits and all of these interventions are having effects in brain circuits - sometimes they're common effects and sometimes they're distinct effects. And mapping on how those change symptoms, in particular ways, is really the important thing that's going to help improve outcomes for people.

Alisha Wainwright 37:46

Dr Jonathan Roiser, thank you so much for joining us today.

Dr. Jonathan Roiser 37:51

Yeah, thank you so much. It was really a pleasure to be here.

Alisha Wainwright 37:56

Thanks for listening to this episode of When Science Finds a Way. Thanks also to Dr Jonathan Roiser, Ashley Slanina-Davies, and Emily Hird from the team at UCL. And to Olivia for sharing her experience with us.

Ooh, this was a fun one. Research happening in a gym, not a lab. And I feel like this study on exercise was a good way to get into that broader conversation about the relationship between our brains and mental health. It's interesting to hear about how the way we think about things like depression is shifting. And there's so much potential there for more personalised diagnoses or targeted treatments. It's just really exciting.

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Next time, we'll be talking about a simple solution to the problem of extreme heat. It's called, a cool roof.

Aditi Bunker 39:42

For us it's about using the best science and the methods that are available. Does having a cool roof mean that you have better health, environmental and economic outcomes? And health there for us is the key thing, because we want to make health and people's wellbeing and comfort the centre point of everything.

Alisha Wainwright 39:58

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