# 20 Christ Striemer - Edited Audio

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**SPEAKERS**

Dylan Cave, Chris Striemer, Brittany Ekelund

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D Dylan Cave 00:00

We'd like to first acknowledge that we are on Treaty Six territory, the traditional gathering grounds for many diverse First Nations, MÃ©tis and Inuit whose footsteps have marked this land and whose presence continue to enrich our vibrant community.

B Brittany Ekelund 00:12

[Intro music plays] Hello and welcome back to Research Recast(ed), the knowledge mobilization podcast. I'm Brittany Ekelund and I am here with Dylan Cave and our guest today, Dr. Chris Streimer.

D Dylan Cave 00:25

Dr. streamer completed his Master's and PhD in behavioral and cognitive neuroscience at the University of Waterloo, and his postdoctoral fellowship at the Brain and Mind Institute at the University of Western Ontario. Currently, He's an associate professor at MacEwan University psychology department, and his focus is on how the brain controls various aspects of attention, perception, and movement.

B Brittany Ekelund 00:49

Thank you so much for joining us, we really do appreciate it.

C Chris Striemer 00:52

Thanks for inviting me.

B Brittany Ekelund 00:52

Yeah. So I guess before we dive into the science, first, we want to learn a little bit more about you. So can you tell us what attracted you to psychology?

C Chris Striemer 01:03

Really, what it came down to was, one summer after high school and a really terrible job realized-- I realized that, you know, I don't know what I want to do for the rest of my life, but I certainly don't want to do this. I need to go back to school. My brother was in university at the time, my older brother, and so he helped me enroll and get get into into the program, into arts and science, took an intro psychology class with an amazing professor who really kind of sparked my interest in the field. And that kind of started from there.

B Brittany Ekelund 01:31

Mmhm.

C Chris Striemer 01:32

You know, I started off, like most psychology students do thinking they're going to help everyone and save the world. I say that tongue in cheek - that that's an important job, and-- There's good people that do that, but I quickly realized that that really wasn't my my strong suit. You know, I took a variety of different psychology courses, and was taking some more on the clinical end of psychology like personality and clinical psychology, abnormal psychology. And I wasn't as interested in those courses as I thought I would be. And then took my first course, in the more kind of experimental end of psychology and cognitive psychology. And I just did a really good job in the course. I really enjoyed it. My professor actually, you know, wanted to talk to me after the class about the paper that I wrote, she thought it did an excellent job. And she recommended that I kind of get involved in in maybe taking some higher level research courses. And so I took those higher level research courses, I found out that, you know, I really enjoyed it, I was pretty good at it - in fact, my first publication came out of a third-year undergraduate project that I did in that class. So you know, that just-- you go in expecting sort of one thing, you know, thinking you want to do clinical thinking, you want to do more the kind of counseling end of it.

B Brittany Ekelund 01:41

[crosstalk]Yeah. Yeah.

C Chris Striemer 02:42

And then you find just through the university experience, right, taking different courses, you find out what your strengths are, what your interests are. And it took me to a totally different direction.

B Brittany Ekelund 02:51

Yeah, all the way to neuroscience, which is quite a big topic, right?

C Chris Striemer 02:56

Yeah. Actually, you know, one other part of the undergrad experience that really sparked specifically my interest in neuroscience, was I started off kind of more in cognitive psychology - trying to understand how the mind worked. And then at that time, cognitive neuroscience was a really new emerging field that was really kind of taking shape. This would have been the kind of the mid- to late-90s. And one of my most kind of formative experience as an undergrad, other than those research courses I took was at University of Saskatchewan, where I did my undergrad. Some of my professors were just starting to delve into fMRI, functional magnetic resonance imaging. And so as an undergrad, as a fourth year student, because I knew some of these professors, I was volunteering in their labs. They said, Hey, do you want to be a volunteer to test out this equipment? I'm like, Of course I do. You get to see pictures of your own brain, right? Um--

B Brittany Ekelund 03:43

Yeah. Dylan wants to see pictures of his own brain? [laughter]

D Dylan Cave 03:46

Yeah, we, on one of our last guests on the podcast, I mentioned that I just want to go get my brain checked. Because you know, sometimes I'm not all there. [laughter]

C Chris Striemer 03:54

Proof of life, right? [laughter]

B Brittany Ekelund 03:55

Yeah. [laughter] But no, that's really interesting. So, this episode is part of our month of scholarship, so I do want to talk a little bit about your board of governors tenure. So can you tell us about that experience so far?

C Chris Striemer 04:13

So for someone like myself, who works most of my research is what I would call in person research where you're working directly with human participants, whether they're, you know, healthy undergraduate students, or adults or patients with brain injuries or what have you. And so, you know, a pandemic, where where people aren't allowed to meet anywhere close face to face for a better part of two years is not conducive to any any kind of research. And so it was part of my part of my kind of focus for this research chair was to apply for a couple of major grants. I've applied for one of those. I'm waiting to hear back on it right now. So those are major undertakings that take a lot of time. I've also wanted to get started again with in person research. That's been stalled again because of just the ongoing situation-- [crosstalk] Of what we're experiencing here-- [crosstalk] Yeah, like ongoing and ongoing-- [crosstalk] Ongoing and ongoing. Yeah. [laughter] Yeah, so-- but, you know, one thing that's been pretty interesting that that I've been able to get going is, is you using, I would say, different collaborations and different technology to actually have an opportunity to offer my students different research experiences. So I have collaborators in Ontario, I have collaborators in France, I have collaborators in, in University of Calgary University of Alberta. And so because of that, sometimes you can get access to different resources.

D Dylan Cave 05:26

I've been applying for a lot of grants myself, but with the pandemic, it's like, okay, so these are what we would like to do. And then you have to, like, try and get contingency plans that if, you know, maybe we can't get back to in person learning. So you mentioned some of the pros that you had, having all these extra collaborators, and things like that. So I just want to know, like, is there has this kind of changed the path of your research on how you can interact with more people? Or is face to face still, like a more preferred method of doing your research?

C Chris Striemer 06:00

I guess what I would say is, you know, there's there's certain things I think you can only really do properly face to face. And that depends a lot on the techniques that you're using as a researcher, what types of technology you need to do the work, what types of responses you're trying to record, right. So for example, if I'm doing non invasive brain stimulation with with tDCS, transcranial direct current stimulation, it's a small brain stimulator you can use with saline soaked sponges and a nine volt battery, basically. So it's a really low current, kind of two milliamps-ish is what we use. That's the kind of thing that we do in the lab that we want to trained people doing in the lab. We don't want people to do a DIY tDCS at home--

B Brittany Ekelund 06:37

[crosstalk] Yeah over Zoom.

C Chris Striemer 06:38

[crosstalk] And then talk to us over Zoom or something, right? [laughter] I mean, hey, there's may be a market for that, but I don't-- you know, there's there's a whole kinds of things that could go wrong with that. And I don't wanna be the one that finds out that it does.

B Brittany Ekelund 06:46

Brittany Ekelund

Mmhm.

Dylan Cave 06:47

Yeah.

Chris Striemer 06:48

But so so the in person stuff, there are certain things you can only really do in person. But but there, I think it has forced me to explore other options. And one of them being with, you know, collaborators. You know, my colleague at University of Calgary, he's running a major rehabilitation project there where they have, it's one of the Calgary is one of the largest stroke programs in, in North America.

Dylan Cave 07:12

Wow.

Chris Striemer 07:12

At the foothills hospital. The catchment area and the number of stroke patients they see is massive. And so he studies you know, motor problems, movement problems after stroke. And so he's got people, any patient that comes into his into the ward there that he's working with, he'll ask them if they want to be in a study. And if they are, he'll get them, you know, two weeks after a stroke, four weeks, six weeks, and then I think 12 weeks, and take a look at their initial motor problems, and then take a look at recovery over time. And at the same time, he's collecting all those motor responses, he collecting a bunch of different clinical measures as well. And so he's got this database of hundreds and hundreds of patients with these different measures. And so, you know, my interest in the cerebellum I asked him, Well, do you have any patients with cerebellar injuries, he said, we actually do have some, and he doesn't really study the cerebellum.

Brittany Ekelund 07:54

Yeah.

Chris Striemer 07:54

So because of that, we're now working together when taking some of those cerebellar lesion patients and taking a look at the data and seeing what we can learn from it. That gives my students a great opportunity, because now they get the opportunity to work with patient data, not to work directly with patients because a lot of that research has been stalled to because of the pandemic.

B

Brittany Ekelund 08:12

So the first project we want to talk about is all about attention, prism adaptation, and spatial neglect. And I do see that you brought some prisms in.

C

Chris Striemer 08:24

I did.

B

Brittany Ekelund 08:24

And we'll throw some pictures up on our Instagram, if you guys want to--

C

Chris Striemer 08:27

[crosstalk] Sure.

D

Dylan Cave 08:28

[crosstalk] Yeah.

B

Brittany Ekelund 08:28

Just check them out in a bit. But before that, can you explain this project--

C

Chris Striemer 08:37

[crosstalk] Okay.

B

Brittany Ekelund 08:37

To us.

C

Chris Striemer 08:39

So there's, you know, there's a whole set of different things that I'm interested in with this project. At the fundamental basis of it, prisms allow us to study how the motor system can learn to adjust for errors that you make and the brain regions involved in correcting for those errors, and how correcting from those errors can have other benefits, like altering our attention. So--

B

Brittany Ekelund 09:04

And like what is, like I can see the prism because it's here with us, but can you describe, I guess, like what is a prism and how does it do that?

C

Chris Striemer 09:14

Right. So in a basic sense, prisms, the ones I use in my lab-- prism adaptation as a kind of field of study has been going on for you know, almost a couple 100 years already, started with Hermann von Helmholtz back in the 1860s trying us out. Basically, these are special pair of glasses that you put on that have lenses in them that shift your vision in a particular direction. So the ones that I have in front of me here, and the ones that we often use in patients with spatial neglect, which we'll talk about in a minute, are what we call rightward-shifting prisms. So these are these kind of thick lenses that have a thick base on the left and a thin base on the right. And what happens is the light that's reflecting off of surfaces in the environment, they come in through the lenses into your eyes, and then because of the way the lenses created, it shifts everything right where to where it actually is. Kind of like the effect that like water has, you know, you if you look in water and you see a fish in water, if you like go to reach for that fish, it's not actually in that position. It's-- Yeah, it disturbs the light a little bit or perturbs the light as it's as it's entering the eye. And so these lenses are doing that a similar sort of thing, but in a way that you can you can control and calibrate in terms of which direction and also how big of a shift, right? So these ones here, these are what are called a 25 diopter prism. So these are about a 12-degree visual shift to the right. So you know, if you put these on basically, imagine that you're-- I think the easiest analogy to kind of do with this is a dartboard, and they actually did this in one of the old studies that looked at this. So imagine you're wearing these prisms-- before prisms, you have people throw darts at a dartboard. They're not trying to hit bull's eye, they're just trying to hit the board, right? So basically, if you hit the board, you hit the target. So you're throwing darts, and you're hitting the board just fine because your eye-hand coordination is working just fine, right? You get people to put these glasses on that shift your vision, let's say you know, 12 degrees to the right, and now their hand is still calibrated to where their eye was before they put the prisms on. It's calibrated to the old setting. And so when they go to throw the dart at the dartboard they miss really far to the right. [Brittany laughs] It's like missing the board entirely over to the right. And so you know, typically, if you were doing this, if you were throwing darts, and you're like, Oh crap I missed really far to the right, the first thing you do is like, Wow, I gotta throw further leftward, to make sure I hit the board. And so what you find with these prisms is that for the first few throws, they're missing really, really far to the right. But eventually, they learn, the participant learns, through feedback, to correct for those errors to adjust their movements further leftward to compensate for that rightward visual shift.

D

Dylan Cave 11:50

Right.

C

Chris Striemer 11:51

And so it's this learning process that the brain goes through, to have to learn through through trial and error, through feedback, to adjust your movements to compensate for this new eye-hand coordination setting that's been forced on them with these prisms, right? And so, you know, after let's say, five or so throws, they might start hitting the board. If you have to throw about 50 times, at that point you've had a lot of learning that's gone on. And if you ask the participant to take the glasses off at that point, and then throw the dart at the dartboard again, with the glasses off, what do you think would happen in that case?

Dylan Cave 12:26

I think they'd probably have to readjust.

Brittany Ekelund 12:28

Do they? Because like, I want a gut-instinct say they wouldn't, because the glasses changed the perception of what they're seeing. But if you took them off-- [crosstalk] I think it's like a muscle memory thing. [crosstalk] It's not the perception because you're seeing what's actually there.

Dylan Cave 12:46

But I think [Brittany laughs] your muscles are used to seeing it and throwing it.

Brittany Ekelund 12:50

All right, Dylan says they miss, I say they hit.

Chris Striemer 12:55

So tip-- if a person has actually adapted to the prisms, usually they would miss.

Dylan Cave 13:00

Aha! [laughter]

Brittany Ekelund 13:00

Oh.

Chris Striemer 13:02

So think about it this way, right? So people get confused with prisons, because they say it's a

So think about it this way, right? So people get confused with prisons, because they say it's a rightward shift, they're gonna, they're gonna miss to the right. Well, what ends up happening is, because of this rightward shift with the prisms, people miss to the right, miss to the right, and then through more and more throws, they have to learn to adjust leftward to compensate for that right visual shift. And so they've learned this new eye-hand calibration, right? To adjust further leftwards. And when you take the glasses off, the vision isn't disturbed anymore, but their old memory of linking the eye in the hand with that rightward shift is still there. And so when they go to throw the dartboard they actually miss to the left.

Brittany Ekelund 13:36

Ah.

Chris Striemer 13:37

Because they had to learn to adjust left for to compensate for that, rightward visual shift. It's about the learning process that goes into that.

Dylan Cave 13:43

You know, every-- the entire time we've been thinking about this prison thing, I've just been thinking about Mario Party. And that's might be a weird thing. But there's this one mini-game in Mario Party where your character spins on a record player real fast. I have kids, I've played it. [laughter] Yeah, of course. And then you you have your your, it seems like you're drunk, right? Like it's your your character is moving in every different direction and you have to try and steer in the opposite directions and things like that.

Chris Striemer 14:09

Yeah.

Dylan Cave 14:09

It's like a moving target of this prism.

Chris Striemer 14:11

Yeah. And so so you know-- and there's similar mechanisms involved in learning something like that. So basically, prisms is a tool that researchers can use as a way of trying to understand how the brain learns to compensate for movement errors. It's just it's just a specific tool that they can use to understand that in the lab.

Brittany Ekelund 14:31

Now that we know what the prism is, can you explain to us how you have been looking at them in regards to spatial neglect and spatial bias? And first, we probably need to know what those are.

C Chris Striemer 14:47

Sure, yeah. So So it's funny. There's, you know, prism-adaptation was a whole area of research that was going on for well over 100 years before before it ever got applied to spatial neglect. But I came into it from the spacial neglect side, because as a graduate student, I started the University of Waterloo, I was working with Dr. James Danckert - he's a neuropsychologist - who is really interested in studying patients with spatial neglect. And and there's really amazing work that came out in the late 90s and early 2000s as I was starting graduate school, that showed that prism adaptation can actually be used to help patients with neglect. And so, just so we're clear on what how this kind of links up here, spatial neglect is a disorder that arises following brain damage. It's much more common after a right-hemisphere brain injury than a left-hemisphere brain injury. And so these patients with spatial neglect, typically, it's a lesion in the right side of the brain, typically around the temporal and kind of parietal lobes where those two lobes meet. If people kind of know their neuroanatomy at all, if not, you can look it up. But you know, so those right temporal parietal lesions, these patients often behave after the lesion, especially, you know, shortly after the lesion as if the left half of the world just doesn't exist anymore. And so these patients, if you ask them to, you know-- in cases where they're severely neglecting, if they're sitting, if they're laying on their hospital bed and the door for the room is on the left side, and the family member comes in, they'll say, you know, to try to say hello to them, they'll try to interact with them, and the patient will ignore them. They'll act like they're not there. It's not because they can't see. They're not blind. It's not because they can't hear, their auditory system's working fine. But they're unable to process information on the side opposite deletion - it's an attentional deficit where a patient is not able to be visually aware--

B Brittany Ekelund 16:26

[crosstalk] So visual and Audible?

C Chris Striemer 16:27

It can be multiple modalities.

B Brittany Ekelund 16:29

Okay.

C Chris Striemer 16:29

So it's most commonly studied in the visual modality. But you know, it's well known that you can have multimodal neglect. So there's patients who will basically ignore anything to the side opposite their lesions. So if they have a right hemisphere lesion, they will be unable to, you know, be aware of things visually on the left side, auditorily. Even touch sensations on that site will be ignored, even if their somatosensory system is working fine - they don't have any problem with their with their sensation.

B Brittany Ekelund 16:54

[crosstalk] Okay.

D Dylan Cave 16:54

What a scary feeling.

C Chris Striemer 16:55

It's weird. Yeah. And it's hard to, it's hard to explain it to to people who don't know it. And it's actually hard for the patients to describe what that deficit is--

B Brittany Ekelund 17:03

Mmhm.

C Chris Striemer 17:03

To people who don't understand it. So, when you work with these patients, you ask them, you know, have you noticed anything? You know, what's the what's the biggest problem you're having following your - typically it's a stroke that leads to it - and they say, You know, I don't really see good on the left side. And their vision is actually fine. There's no blind spots. Some of the patients will have visual deficits as well, but the visual deficit alone won't explain the size of the deficit they have. And so they say, I don't really see well on the left, but it's actually not really a visual deficit. It's an attentional deficit, where their attention system isn't able to process anything on that contralesional side. And so you know, as a disorder, I find that incredibly fascinating to to try to understand how this operates in the brain, to try to understand what this tells us about how the brain is organized. You know, when you see these patients at the bedside, it's so obvious too. So you can do something like, give them a sheet of paper with a line on it - with just a big long black line on it - and you tell them, I want you to take a look at this line. So you put it right in front of their body midline, and you say, I want you to mark where you think the center of the line is with this pen. It's easiest job in the world, right? They will mark it way over to the right side, because they're neglecting the left side of the line. So they believe it's, you know, halfway on the right side.

D Dylan Cave 18:13

Wow.

C Chris Striemer 18:14

If you give them you know, a drawing like a, you know, a picture that someone's drawn and say, I want you to draw this. I want you to copy this. That's actually a pretty common test you can do with neurological patients to take a look at how they see the world. Here's an image, you know, like a outline of a five pointed star or a cube or a flower or something. And I want you to copy it just by drawing on this sheet of paper for me. And you'll find out that these patients, they might draw the right side of the image totally fine, but the left side of the image is totally missing.

B Brittany Ekelund 18:42

Mmhm.

C Chris Striemer 18:42

And it looks-- and you ask them, are you done? Does it look good? Oh, yes, I'm done. It's fine. And then you point it out to them, Well you're you're missing everything on the left side. And there they seem like surprised, Oh, yeah, I guess I am. And they'll start drawing it again, then they'll just again, stop. It's exactly as if it doesn't exist to them at all on that side. And so the thing that makes this disorder fascinating, in addition to the fact that it's weird, right?

B Brittany Ekelund 18:42

Yeah.

C Chris Striemer 18:42

And it's hard to really even imagine having that problem, is the fact that it's incredibly common after right hemisphere stroke. So, you know, stroke is the leading cause of adult neurological disability worldwide.

B Brittany Ekelund 19:14

Yeah.

C Chris Striemer 19:15

And, you know, depending on the studies, you look at anywhere from 50 to 70% of patients who have a right middle cerebral artery stroke, which are one of the more common strokes to have, will experience symptoms of neglect at least at some point after their stroke. So it's, it's a really debilitating disorder. As you can imagine these people, you know, they start-- they can't really navigate the world very easily, right?

B

Brittany Ekelund 19:36

Yeah.

C

Chris Striemer 19:37

You know, they won't even eat food on the left side of their plate sometimes. They won't dress the left side of their body. They try to go through a door and they'll hit their left side on the door, for example. So they're not really independent in that sense. Um-

D

Dylan Cave 19:47

This is why I think I need to get an MRI. Sometimes I just bump into things.

C

Chris Striemer 19:52

Maybe? Yeah, and so getting back to prisms-- Yeah. So so the reason I got interested in prisms initially was that there was some work coming out of in France from from a person who's a colleague of mine now, Yves Rossetti, in Leon. And what they found was that, you know, you can actually use rightward-shifting prisms to try to rehabilitate, or at least reduce, the symptoms of neglect. And that sounds counterintuitive, and I'll try to unpack the logic of it for you.

B

Brittany Ekelund 20:18

Mmhm.

C

Chris Striemer 20:18

So, in patients with neglect, as I mentioned, they they ignore the left side of the world.

B

Brittany Ekelund 20:23

Yeah.

C

Chris Striemer 20:24

And so if you ask a patient with neglect to, if you ask-- Well, let's start with healthy people first, right? So if you ask a typical individual without brain injury--

B

Brittany Ekelund 20:32

Me!

C

Chris Striemer 20:32

Yeah, to close your eyes and point straight ahead, so you can't see. If you point, close your eyes and point straight ahead, you tend to point you know, straight ahead of your body - midline. So if you imagine where your sternum is in your body--

B

Brittany Ekelund 20:42

Mmhm.

C

Chris Striemer 20:43

That's your body midline. We call that the egocentric reference frame, if you want to use a really complicated term--

B

Brittany Ekelund 20:46

[crosstalk] Okay. I like that. [laughter] [crosstalk] To explain something simple. [laughter]

C

Chris Striemer 20:48

Yeah. You got to make up complicated words for things that sounds sciency.

B

Brittany Ekelund 20:51

Yes.

C

Chris Striemer 20:51

So yeah. So egocentric reference frame is basically you know, the center of your body and how everything is aligned to that, right? So if you close your eyes and ask someone to point straight ahead, they tend to point straight ahead from that, that center point of their body. Because that's where the center of the world is, right?

B

Brittany Ekelund 21:04

Mmhm.

C

Chris Striemer 21:05

If you ask a patient with spatial neglect with a right hemisphere injury, who ignores the left side, where do you think they're going to point if they have to close their eyes and point straight ahead? [pause]

B

Brittany Ekelund 21:15

To the right?

C

Chris Striemer 21:17

Exactly. To the right, because they're ignoring the left side. So their entire world has been shifted to the right side.

D

Dylan Cave 21:24

I'm starting to see these prisms. These prisms, I'm getting it.

B

Brittany Ekelund 21:27

Yeah [inaudible].

C

Chris Striemer 21:27

You're getting it? So, So these patients are, you know, they're ignoring the left side, their bias to attending to the right side, they're over attending to the right side too much. That's where that attentional bias comes from. What's called a rightward attentional bias. And so, you know, part of the issue is that not only are they ignoring the left side, which is a big problem for them functionally, but they're almost over-attending to the right side. And part of it might be this shift in their egocentric reference frame, this shift in the way they believe the center of the world is according to their body over to the right side. So they point really far to the right, when you ask them to close their eyes and point straight. And so well, how can we adjust that? Well, one of the things you can do is you can get them to use prisms that shift their vision to the right into their good field or non-neglected field. And when they reach to, let's say, a target like this, or you know, throw a dart at a dartboard, they're initially going to miss to the right, just like the healthy person did before that I was talking about--

B

Brittany Ekelund 21:40

Yeah. [crosstalk] Yeah.

C

Chris Striemer 21:43

For the first few throws, those first few reaches to the target. But then after, let's say, you know, 40, or 50 movements, they're going to learn to adjust their movements leftward, to compensate for that rightward shift. So they're adjusting their movements left or towards their neglected field to adjust for that rightward shift. So what's really amazing is after you adjust these patients, after you adapt them to these rightward-shifting prisms, you ask them to close their eyes after they've done these reaches, let's say 50 times, and you ask them to point straight ahead again. And now where do you think they point? [pause]

B

Brittany Ekelund 22:56

To the center?

C

Chris Striemer 22:57

Yes, further leftward closer to the center, because they've had to learn to adjust leftward to compensate for that rightward visual shift. And so if you do that, what you find is that following prisms, after you take the prisms off, you give the people the same test as before, where you give them the line to mark or you give them the--

B

Brittany Ekelund 23:14

[crosstalk] Yeah.

C

Chris Striemer 23:15

Targets to cancel on the sheet of paper. And now what you find is that the start marking the line in the center of the line or closer to the center. They start canceling all those targets on the left side they were previously omitting. They start drawing the left side of those figures that they were missing beforehand.

D

Dylan Cave 23:29

[crosstalk] [inaudible]

C

Chris Striemer 23:30

It's as if you recalibrate their attention leftward and now you've brought that kind of back into their awareness for some short period of time.

D

Dylan Cave 23:36

Dylan Cave

This is so interesting, like, it seems like such a simple concept. They are shifting everything to the right. So let's shift their vision to the left or you know, like counterbalance what they're doing. That seems like such a-- but it's so not simple, but it's simple.

Chris Striemer 23:52

Yeah, I mean, you know, so neglect is is, you know, something that's notoriously difficult to rehabilitate. And one of the key reasons is because of the fact that patients, as I sort of alluded to earlier, they're really unaware of their deficit in most cases, right? So that's another part of the deficit is that not only are they ignoring things on the contralesional side, in this case, you know, the side opposite the lesion was what that means. So they're, if they have a right hemisphere lesion, they're ignoring things on the left side. Not only are they doing that, they tend to in most cases be-- have little insight to the fact that they're ignoring things on the left side because the left side just doesn't exist to them anymore. And so if they don't even know what their problem is, or that they're not, they're ignoring the left side, it's really hard for them to compensate for that. So--

Brittany Ekelund 24:32

Yeah.

Chris Striemer 24:33

You could tell them - and there's types of training that do this - where they say, Look to the left, look to the left, look to the left; they try to get them to consciously kind of shift their attention to the left. But as soon as they do that for a while, they forget about it. Again, they shift back to the right. With prisms, what you're doing is you're changing how the information gets processed as it's coming into the brain from the bottom up. And they don't need to be aware of the fact that that's what's going on. So you adjust their vision rightward into their good field--

Brittany Ekelund 24:59

Mmhm.

Chris Striemer 24:59

They have to learn through those movements to adjust further left or to compensate for the misses they're making to the right. And now their egocentric reference frame, the way they believe the center of the world is according to their body midline, also gets shifted leftward towards their bad side to their affected side. And so now you start seeing these symptoms of neglect get reduced.

Dylan Cave 25:18

And so what-- would a person who is experiencing this wear these glasses all the time, or is this like a training that and then they would wear them just a little bit a day or something like that?

Brittany Ekelund 25:28

Mmhm.

Chris Striemer 25:28

Yeah, it's a training that people do. So typically, because it's not really wearing the glasses that helps, it's the adjustment you make in response to wearing the glasses that helps. And so the after effect, we call the after effect the learning effect of it, is when you take the glasses off and you have that that setting that you know, before - the healthy participant I was talking about, when they were, when they were wearing the glasses and we're shifting them to the right with a dartboard and they're missing to the right, you take the glasses off after 50 throws, and then they throw again, they missed to the left. In this case, that effect - that after effect - the midst of the left is what we're going for with with patients with neglect. So you take the prisms off, and then they've again had to learn to adjust left. But that after effect, how long it lasts tends to be quite a bit longer in neglect patients than it does in healthy adults. And it's not exactly clear why that's the case. Part of it might be the lack of awareness. They have the fact that they're even being shifted in some cases. Wow. So if you put in-- I've seen this in my own eyes. Again, it's anecdotal, but I've seen it at least, you know, the couple dozen patients I've worked with over the years. If you put these glasses on a healthy adult, as soon as you go to make a reach, you're like, Oh, my God, like something's really off. You notice right away, it's not subtle. In patients with neglect, many of them don't have that same response. They seem to be unaware of the fact that they're missing or that they're even having to adjust for it. So it seems to be done almost more, unconsciously, more more implicitly.

Dylan Cave 26:47

Which works better for them.

Chris Striemer 26:49

And that's, yeah. And that's one of the one of the theories as to why it might work better for them is because it's there, the theory is that there's different parts of the brain that are involved in that more implicit type of motor learning as opposed to that more conscious kind of supervised type of motor learning.

Dylan Cave 27:04

Wow.

C Chris Striemer 27:04

The cerebellum is thought to be involved in that more kind of, cerebellum and basal ganglia, involved in that more implicit kind of automatic non-conscious type of motor motor learning.

B Brittany Ekelund 27:15

Okay.

D Dylan Cave 27:15

Unreal.

B Brittany Ekelund 27:16

Yeah, no, that's really interesting to me, um-- [crosstalk] and to anyone.

C Chris Striemer 27:19

[crosstalk] I'm hoping I'm not going into too much depth here. [laughter] [crosstalk] Oh, no, no.

B Brittany Ekelund 27:22

Because I feel like I'm understanding everything that you're saying.

C Chris Striemer 27:25

Okay.

B Brittany Ekelund 27:25

And that's perfect.

C Chris Striemer 27:26

Well, if you don't please, please ask because-- [crosstalk] Oh I will. [laughter] I want you I want you to be able to understand.

B Brittany Ekelund 27:30

So yeah, we've talked a little bit about the task. So this kind of research, how does it fit into the larger body of research on this topic? Like what-- why choose to work with prisms in this larger body of research on this topic? Like what-- why choose to work with prisms in this particular context?

C Chris Striemer 27:50

Right. So initially, as a graduate student, I got started using prisms, because I was really interested in learning about how they could be used to try to reduce some of the symptoms of neglect. I should point out that they're not a cure for neglect. They don't make neglect go away like waving a magic wand. That's not really -- nothing really works that that way with neglect. But you know, there is some good evidence that it does reduce the symptoms of neglect in these patients, and if you have more and more treatments that can have a longer lasting effect.

B Brittany Ekelund 28:16

Yeah.

C Chris Striemer 28:18

So that's where my interest started, where it kind of grew into was trying to understand, you know, how the, how the brain is being affected by the prisms that leads to these beneficial effects. And also, what we can use from this to learn about how attention and motor control work in the healthy, undamaged brain. Okay. And so, another caveat to this is the, you know, the opposite of this, right? So in healthy adults without any brain injury, we have a phenomenon on average, what people call pseudo neglect. So a sort of false neglect, in the sense that healthy adults typically, in mostly - with stronger effect inn right handers which are 90% of the population - so what they find is that, you know, in that line bisection test that was telling you about earlier - we have a line on a sheet of paper, and you just have to mark the center of it - you don't just do that once. You usually do it 10 or 20 times-- [crosstalk] Mmhm. To get a kind of a good measure of an average response. So in patients with neglect, with a right hemisphere brain injury, they missed or they bisected really too far to the right-- Yeah.

B Brittany Ekelund 29:18

Yeah.

C Chris Striemer 29:18

Because they're ignoring the left side. In healthy adults, what you find is the somewhat opposite of that, where healthy adults will tend to bisect the line instead of right in the center, they'll bisect it a few millimeters to the left of the center-- On average. And that's thought to be reflective of the fact that we have this right hemisphere of the brain that's dominant for spatial and attentional processing. So the left hemisphere of the brain, or some people call the dominant hemisphere - I don't really like that term, but I study the right hemisphere more so I'm-- I guess I just get sensitive. [laughter]

B

Brittany Ekelund 29:46

Yeah. [laughter]

C

Chris Striemer 29:48

But you know, the left hemisphere of the brain is known to be involved in things like language and mathematics, right? Fine motor control, whereas the right hemisphere of the brain is thought to be involved in a lot of those nonverbal types of skills like spatial processing, face processing, attention. And so the theory behind pseudoneglect, why we have that leftward bias on those things like line bisection, is that our right hemisphere is dominant for our attention. And so because of that, we're always paying maybe slightly more attention to the left side than we are to the right even if we don't know it.

B

Brittany Ekelund 30:15

Mmhm.

C

Chris Striemer 30:15

And so what's happening, they they're suggesting is that the left side of that line, because we're paying more attention to it, it's almost like our brain sort of exaggerates the length of it a little bit in our mind. I mean, if you've ever tried to cut a cake, and you're like, Oh, I really thought that that was going to be nine even pieces. and--

B

Brittany Ekelund 30:24

Yeah.

C

Chris Striemer 30:24

So we think it's further away to the left than it really isn't. So that's why we bisect the line to the left of center. And so-- [crosstalk] Yeah, exactly.

B

Brittany Ekelund 30:37

[crosstalk] It's truly crazy.

C

Chris Striemer 30:38

Yeah. Especially when, especially when you've got people that are relying on you to try to be fair too. [laughter] fair too. [laughter]

B

Brittany Ekelund 30:42

Yeah. [laughter]

C

Chris Striemer 30:43

So my kids will always let me know how poorly I've cut something and how unfairly scaled the slices are. [laughter]

B

Brittany Ekelund 30:48

[crosstalk] I thought it was even! Honestly! [laughter]

C

Chris Striemer 30:49

Exactly.

D

Dylan Cave 30:50

That's why I'm really happy that other people have to cut my pizza, you know, otherwise, my my pieces would be all over the place. [laughter]

B

Brittany Ekelund 30:57

[crosstalk] Sure.

C

Chris Striemer 30:57

Get one of those miter saws with the laser? [laughter] So--

D

Dylan Cave 31:02

Protractor set.

C

Chris Striemer 31:03

Yeah, so with-- so in healthy adults we tend to have this slightly leftward bias, right? And so what you can do in healthy adults is you can adapt them to prisms and create almost a small kind of neglect-like behavior in them.

B

Brittany Ekelund 31:17

Mmhm.

C

Chris Striemer 31:17

So what you can do is in healthy adults that have no brain injury, you can give them a leftward shifting prism. So if you ask healthy adults that again, have no brain injury, like I mentioned before, we ask them to close their eyes and point straight ahead, they point pretty much right straight ahead of the body midline. But if you give them a leftward shifting prism on the opposite direction, and you have them like reach to a target or your dartboard analogy again, they're gonna miss to the left. So the opposite of what we did before, because now we're using a leftward shifting prism instead of a right one.

B

Brittany Ekelund 31:45

Yeah.

C

Chris Striemer 31:46

So now they're missing to the left. And so in order to compensate for that, you have to adjust rightward in the direction that neglect patients move point before prisms, right? So if you ask them to, let's say, do 50 throws or 50 reaches with leftward shifting prisms on and they learn to adjust rightward to compensate for that leftward shift, and you ask them to close their eyes after those 50 movements and point straight ahead - now where do you think they're gonna point?

B

Brittany Ekelund 32:10

To the right? [laughter]

C

Chris Striemer 32:11

To the right, opposite the prism, right?

B

Brittany Ekelund 32:13

Yeah.

C

Chris Striemer 32:13

It's always in the direction opposite the prism. So now, these healthy adults have adjusted rightward to compensate for that leftward visual shift. And after prisms they're pointing to the right is where they think the center is. Just like the neglect patient did before they had prisms. And so if you test healthy adults with these rightward-- with the left shifting prisms, you can adjust people rightward. And then you can see that, when you get them to do things like line bisection, their bisection of the line will also go further to the right.

B Brittany Ekelund 32:40

Further to the right.

C Chris Striemer 32:40

Um, not like, not not nearly as big as a neglect patient would obviously--

B Brittany Ekelund 32:43

[crosstalk] Yeah, but--

C Chris Striemer 32:43

They have a brain injury - but a statistically significant shift to the right. You can do different types of attention tasks that look at, you know, reaction times for left versus right side of targets and find that patients can sometimes change how quick they are to react to things on the left versus the right side following prisms.

B Brittany Ekelund 32:58

Mmhm.

C Chris Striemer 32:58

So it allows you to actually look at how the attention system and the motor system are linked. And by altering one of those two, the motor system through this prism adaptation procedure, how that can carry over into actually influencing the attention system as well. So it allows you to take a look at how those two-- because the brain networks that are involved in attention, many of those same brain areas are also involved in movement.

D Dylan Cave 33:21

Yeah.

C

Chris Striemer 33:22

In fact, you know, one of the theories behind what attention is - some some researchers will say that attention is not even really a thing. [laughter] That we just make up terms for what we want to study. But some researchers will argue and I think, you know, I'm not sure if I agree wholeheartedly with them, but I think they have a good point is that, you know, attention is really what they call intention. Right? So the only reason that you attend to something in the environment is because you intend to act on that object.

B

Brittany Ekelund 33:49

Mmhm.

C

Chris Striemer 33:49

And so basically, the idea is that if I'm, you know, because we're because it's-- because it's still in the throes of the pandemic here, I've got a, I've got a bottle of hand sanitizer just in front of me. So, you know, the theory would be that, you know, if I'm looking at this hand sanitizer, I'm attending to it. But I'm really attending to it because I want to reach out and pick it up. And so the attention part is really the motor system's preparation to act, but we've just divided into something that we call attention. And so there's different people that have different theories about whether that's, you know, whether that's correct or incorrect. But there is a good reason to believe that attention started as the intention to act and that we just have more conscious control over it.

B

Brittany Ekelund 34:28

Mmhm.

C

Chris Striemer 34:29

Which is explaining why a lot of those same brain areas are involved in both movement and attention because they're, you know, serving a lot of the same purposes or a precursor to the same purpose.

B

Brittany Ekelund 34:37

Why wouldn't you just make prism glasses then? Like, sometimes they have corrective shoes where one's bigger than the other? Why not prism glasses that people could wear forever.

C

Chris Striemer 34:49

So they do-- you can purchase prism glasses, usually you have to be a quote unquote, professional to purchase them. So you can't just go to like, you know, Shoppers Drug Mart and get them. Part of, part of the reason for it is that, you know, you worry about people not actually doing it properly. So they're not just supposed to wear them all the time, they're supposed to, you know, be in a safe environment where nothing bad can happen if they're wearing them. Because when you're wearing them, your eye-hand coordination is thrown off. You could run into things, you could get into a car accident--

B

Brittany Ekelund 35:16

[crosstalk] Yeah.

C

Chris Striemer 35:16

If you're driving, you could injure yourself, all kinds of [inaudible], then you've got serious liability issues, right? [laughter] So part of it is making sure that it's supervised by someone who actually knows how to do it properly. And on top of that, there has been, you know, different clinical trials that have showed differing levels of evidence as to how effective they are long term for patients. So some studies say that they are effective, some say that they're not as effective as people believe there are to be. The problem with some of those studies is that there are some patients who seem to respond very well to them. And there are some patients who don't tend to show as strong effects over the long term. And that's the part that people are still trying to figure out is, you know, what is it that makes this particular patient maybe particularly responsive to the prisms and have a big benefit from them, whereas this other patient didn't have as strong of a benefit to them? Is it something to do with the type of brain lesion they had? Is it something to do with the type of deficits that they have? Maybe if it's really severely affecting their vision and, you know, because they have damage to visual areas of the brain and their attention system, maybe that's what's causing the poorer outcome for them.

B

Brittany Ekelund 36:19

Yeah.

C

Chris Striemer 36:20

And so if you just take a-- sometimes if you take a really big study with a whole bunch of patients that have a bunch of different neurological problems, in addition to neglect, it's not always clear why some are having a beneficial effect and others aren't. And that's what they're still sort of trying to tease apart. Um-- That all makes a lot of sense. Yeah.

B

Brittany Ekelund 36:35

Okay, well, [music starts playing] let's take a break. [music stops] Do you like beer or burgers or brunch or all three? Well check out Campio Brewing. It's one of Alberta's newest breweries, and it's the fourth brewery in the Bearhill brewing family. If you're a teetotaler, no worries!

Come for the deep dish or swing by for brunch. You don't have to drink to enjoy yourself and support local. Find them on Instagram, Facebook, or at campiobrewingco.com.

Dylan Cave 37:02

[music starts playing] Welcome back. So getting right back into it. We'd like to hear more about your research. With those lesions that we were talking about, right?

Brittany Ekelund 37:16

Cerebller lesions.

Dylan Cave 37:16

Cerebellar lesions [Dylan uses southern accent]. You got to say with an accent, I guess. Um, can you tell us about maybe whyyou chose to study this particular topic? [music fades out]

Chris Striemer 37:27

I first got interested in the cerebellum because it's an area of the brain that is known to be really critically involved in something like prism adaptation. So in-- the cerebellum is known to be involved - this has been known for, you know, 250 years - as a structure in the brain that's critical for for the timing and coordination of movement and also for motor learning. So, and, you know, based on research I was reading as a PhD student, I knew that damage to the cerebellum prevented people from being able to adapt to the prisms, they never learned to adjust in the direction opposite the prisms. And they never showed that aftereffect. So you could have a patient with a cerebellar lesion, who had, let's say, a rightward shifting prism and they were throwing prisms that-- oh sorry, throwing prisms - don't do that they'll break. [laughter]

Dylan Cave 38:10

Darts? [laughter]

Chris Striemer 38:11

They're throwing darts at the dartboard. And so you know, before the prisms, their darts are kind of all over the place because their cerebellum makes their coordination and movement kind of poorly coordinated. And then they put the prisms on, let's say a rightward shifting prison, they miss even further to the right. So the visual input of the prism still affects their accuracy, but they don't seem to be able to reduce their errors. So they don't really learn to adjust leftward to compensate for that, rightward visual shift. Some of the patients will adjust a bit, but not as much as a healthy adult.

B

Brittany Ekelund 38:43

Yeah.

C

Chris Striemer 38:43

And then when you, let's say after 50 or 100 throws you take those prisms off, and then the patient with a cerebellar lesion - in most cases - they won't show the after effects. So in a healthy adult, if they've adjusted leftward to compensate for the rightward shift in vision, then they'll miss the dartboard to the left after they take the prisms off. The cerebellar patients won't show, most of them won't show that effect. And so basically, it prevented people from being able to learn to adjust for those movement errors. So that's what got me interested in initially was how it played a role in in motor learning and prism adaptation. But then I started doing some more reading and there was some really, kind of, new work coming out of the time - this would have been the kind of late 90s, early to mid 2000s, where people started talking a lot more about how the cerebellum was involved in much more than just just motor control.

B

Brittany Ekelund 39:32

Yeah.

C

Chris Striemer 39:33

People thought it was involved in I actually a whole variety of different cognitive, um cognitive functions.

D

Dylan Cave 39:38

So--

B

Brittany Ekelund 39:38

Like what?

D

Dylan Cave 39:39

[crosstalk] Yeah, sure.

C

Chris Striemer 39:40

Go on.

D Dylan Cave 39:41

Like what? [laughter]

C Chris Striemer 39:42

Okay. I'll bite. So, so I mentioned-- remember I mentioned before how maybe-- I think I mentioned this before. I can't remember if we were talking about this amongst us or if it was online or not when we were recording. But I think I did mention how um - if I haven't I'll say it now - the brain structures involved in attention are also many of the same brain structures involved in movement.

B Brittany Ekelund 40:09

Yeah.

C Chris Striemer 40:10

And so people got started to get interested in you know, well, what what is it about the structure that might play a role in number one, you know, is there is there really a role for the cerebellum in cognitive function? Because that's a big question. Because, you know, you're you're going against 200-plus years of research that suggests it's strictly a motor structure. Right? The cerebellum is a movement structure that's part of that motor control network is actually one of the most ancient parts of the brain. There are species that have, that are much less sophisticated in terms of their nervous system that will have, you know, a brainstem and a cerebellum, but won't have really what resembles a cerebral cortex like we have. So evolutionarily speaking, it's one of the oldest areas of the brain. It has more neurons, or as many neurons in the cerebellum as the rest of the entire cerebral cortex combined even though it's quite small. There, it's densely densely packed with neurons, so tons of computational power, right? And as brains and cerebral cortex get larger in species, their cerebellum tends to gain, uh, kind of size up as well, tends to correlate with that. So they increase in size. And so, you know, getting back to the idea that they motor structures are also involved in cognitive functions like attention, I started doing some reading about, you know, studies showing that, at that time at least, that the cerebellum, [inaudible] cerebellar patients, in addition to the movement symptoms they're experiencing, some of these patients were showing difficulty with things like spatial processing, with language, with working memory - so being able to keep information in your memory, you know, for, let's say, 30 seconds at a time, you know, when it's not present anymore.

B Brittany Ekelund 41:32

Yeah.

C Chris Striemer 41:33

Chris Striemer 41:33

And no one's saying it's not a motor structure, it absolutely is. But it seems to do a bunch of other things as well. So I started getting interested in it. Wow, this is a whole new avenue of research that's opening up here for this structure that has thought to be really constrained to this one function for a long time. And so my own interest in attention, obviously, and the brain circuits that control attention, got me interested in the role of cerebellum and attention. And so towards the end of my PhD, I started working on, with with another colleague of mine, looking at patients with cerebellar injuries and how that might affect their attention. And then, as I did my postdoctoral fellowship at Western, one of my, one of my functional MRI studies looked at, in healthy adults, if you could take a look at different parts of the cerebellum, or whether parts of the cerebellum were involved in attention after you control for motor output. So one of the things that that people kind of got hung up on with the cerebellum - and for good reason - you know, you have naysayers who want to make sure that if you're saying something bold, like the structure that's involved in motor control is also involved in cognitive function, one of the things you have to ask is, well, how are you measuring cognitive function?

Brittany Ekelund 41:33

Yeah.

Chris Striemer 42:41

And if the measurements you're using are requiring motor movements to indicate the response, then the injury to the cerebellum could be affecting the movement they're making. That looks like cognition, but it's really just a motor problem, right? So if you're, for example, if you're, if you're, you know, measuring reaction time and having them press a button, well, maybe they're just slower at pressing the button because of the movement problem they have, and not because of something to do with attention. So diagnosis seems to be problematic in that case. It's, it's, it's just tricky, or you have to be aware of that limitation and know how to control for it so you can rule that out, right? So with fMRI, what you basically measuring is the magnetic properties of deoxygenated hemoglobin. So hemoglobin carries oxygen around in the blood system.

Brittany Ekelund 43:29

Yeah.

Chris Striemer 43:29

And so when the brain starts, the part of the brain starts to work really, really hard, uses up the local oxygen stores really quickly. And then it sends a signal to-- the brain sends a signal to say, you know, Send more blood over here with lots of oxygen, I'm running out of fuel. And so it sends lots of oxygen-rich blood to that area of the brain. And you can-- the magnetic properties of when those hemoglobin go from having oxygen attached to not having oxygen attached after the fuel is used, it changes the magnetic signal and you can detect that in different parts of the brain. So you can say, Where is that change in signal from oxy to deoxyhemoglobin the largest? Yeah.

B Brittany Ekelund 44:05

Yeah.

C Chris Striemer 44:05

Even just, you know, looking-- sitting here in the studio looking at you two right now, I'm getting auditory activation my brain from what I'm hearing, I'm getting visual activation from seeing light reflecting off of people and objects in the environment. I've got activity about what I'm about to say next thing but you know, the conversation I'm having-- In these conditions. And if you have that, then you can figure out what parts of the brain are more active. The most most important thing to keep in mind with fMRI is - and I try to teach my students this, to to ask themselves this question every time they read a study like that is - they say there's more activation this area or less activation in this area. The next question you have to ask yourself is compared to what? So there always has to be a control condition that is closely matched to the experimental condition you're interested in, so you can rule out all the-- because there's there's tons of brain activity going on all the time for things that have nothing to do with the task. It's almost a guessing game of what, what-- Without a control condition, it would be because all those parts of my brain are doing all kinds of things simultaneously, right? The classic fMRI approach is what's called a subtraction methodology where you say, show me the brain activity when they're when they're doing this task that I'm really interested in, and then subtract away the brain activity from the control condition where it's very similar but missing that one thing that I'm interested in.

B Brittany Ekelund 45:18

You've walked us through kind of what got you interested in this, but can you walk us through the research?

C Chris Striemer 45:24

So, you know, one of the first studies we did in patients with cerebellar lesions was we found that cerebellar lesions seem to affect their, what we call reflexive attention. So one of the more popular theories of attention in how it operates in the brain is these two attention networks, what are called the dorsal and ventral attention networks. But dorsal and ventral attention networks is really just to do with where they're located in the brain. Dorsal means higher up in the brain, ventral means a bit lower down. That's where the terms come from. Basically, one of these attention networks, the dorsal attention network is thought to be important for control - you're basically deciding where you want to shift your attention and what you want to attend to; for actively attending to things on an ongoing basis. So right now, according to this theory, my dorsal attention network, my voluntary attention, where I'm choosing to pay attention is to the conversation, to you know, what we're doing right now. Whereas this more, um, ventral attention that was thought to be more involved, in what would be called reflexive attention and more automatic type of attention. The theory is that it acts as what we call a circuit breaker, to interrupt your current focus of attention to get you to refocus on something else that might be important. So for example, if we have one of those terrible MacEwan fire alarms that goes off. And you know, that sound initially, get's you like, Oh, man, what's that? Right? And so it automatically jars you out of what you're currently thinking about to get you to focus on the sound of that alarm. And so the way we test that in the lab is by having people, you know, respond to targets that appear on the screen, but we have it preceded by a bright flash either on either on the same side of the screen the target appears, or on the other side of the screen. And then what you find is that people are faster when the flash is in the same location--

B

Brittany Ekelund 47:03

[inaudible]

C

Chris Striemer 47:03

The target appears because your attention already gets grabbed there. And you can even have it really quick. Like you can have a flash and then 50 milliseconds later the target appears and people are still faster to respond because their attention is drawn to that flash so quickly. Whereas a voluntary type of attention, you don't use flashes, you use other kinds of symbolic cues like an arrow in the center of the screen pointing left or right, and people have to look at the arrow and decide, Oh, I have to shift my attention to the left or shift my attention to the right. You have to kind of choose to attend there. Or you can have numbers, like a one means left--

B

Brittany Ekelund 47:32

Mmhm.

C

Chris Striemer 47:32

Or a you know, seven means right or something. But what we found in, in our cerebellar, initially, in our first group of cerebellar patients, was that reflexive attention seemed to be impaired in these patients following cerebellar injury, such that they were slower to shift their attention from from the cue location, sorry, from the uncued location to the to the-- To where the target was. What we also found in the fMRI study I was sort of alluding to - what I was doing as a postdoc - was that you know, in healthy adults without any brain injury, if you do an fMRI study where you have them do either that reflexive attention task with the flashes on the left or the right, versus a more voluntary type of attention, we have the arrow pointing to the left or the right, you compare activation in the cerebral cortex in the cerebellum, what you find is you get all the normal areas in the cerebral cortex activated that you would normally get - like, you know, areas in frontal lobes--

B

Brittany Ekelund 47:55

Brittany Ekelund 47:55

Yeah.

C Chris Striemer 48:25

Areas in parietal lobes, that we know are involved in attention that have been studied for 20 plus years. What we also found was that there was activation in the cerebellum, in the left side of the cerebellum, that was for those attention tasks - even when you subtracted out the motor response requirements. So remember that in the scanner, they're pressing a button to indicate that they detect the target?

B Brittany Ekelund 48:25

Yeah. Yeah.

C Chris Striemer 48:44

To get rid of the motor responses just get the attention part. And that's where we found that cerebellar activation in the left side of the cerebellum in healthy adults, and the the part of the brain in the left cerebellum that was active was more active for the reflexive attention tasks than it was for the more voluntary attention task - which kind of matched up with what we saw in patients where, again, it was the reflexive attention that was that was impaired in them.

B Brittany Ekelund 48:44

Yeah.

C Chris Striemer 48:44

That's a motor response, right? And so we had another condition, we had a few control conditions, but one of the control conditions we had was where they had to just, um-- there was a cross in the center of the screen with no targets, and every couple of seconds, that cross would kind of flash and you'd have to press the button to tell us that they saw the flash. So they'd be pressing the button the same number of times over the same time period, but they get the same motor response. So you can take that activity and subtract it out of the attention task--

B Brittany Ekelund 49:34

Yeah, and like this study - you guys found for the first time right-- [crosstalk] Oh this was-- [crosstalk] That the cerebeller regions may be involved?

C Chris Striemer 49:40

Chris Striemer

This, no. This though, there had been some some people-- so I didn't discover that the for the first that they might be involved. So so people had suspected that the cerebellum was involved in attention for a while but there was a lot of naysayers because of the reasons I pointed out earlier--

Brittany Ekelund 49:56

Yeah. Yeah.

Chris Striemer 49:56

That you know, maybe it's just motor responses, and anothermotor response that the cerebellum is involved in is eye movements. So, the-- when you have damage to the cerebellum, it can also affect a person's eye movement coordination. And we know that eye movements are strongly tied to attention. So a lot of the same parts of the brain that are involved in eye movements are also involved in attention. Yeah. And so, another thing that we did with with this cerebellar study was, we used the attention task but they didn't move their eyes around. They had to focus on that cross in the center of the screen and just pay attention to things happening in their peripheral vision. In the fMRI study, we had another control condition where patients had to, or in this case, sorry, healthy participants had to either just make a button press when they saw the target, or make an eye movement and the button press. So we wanted to look at, are the areas of the cerebellum the same for attention and when they're making eye movements? And we found that, in fact, even when you subtract, even when you control for eye movements and you control for the button presses, the same part of the cerebellum seem to be involved both for the eye movements with or without attention.

Brittany Ekelund 50:56

Yeah.

Chris Striemer 50:56

So--

Dylan Cave 50:56

There's a lot more going on there. [laughter]

Chris Striemer 50:58

Yeah. So basically, what it means is that, you know-- think about it like this - so it, what it suggests is that for reflexive attention, the role of the cerebellum in reflexive attention is one that might piggyback on its existing architecture to control eye movements, right? So if you that might piggyback on its existing architecture to control eye movements, right? So if you have a part of-- and just think about this from a neural engineering standpoint, right, from a conservative neural engineering standpoint - if you're going to design a brain area that's involved in attention, and you've already got brain areas that are involved in moving the eyes around - which are critical for shifting the focus of attention-- Yeah.

B Brittany Ekelund 51:29

Yeah.

C Chris Striemer 51:29

Why wouldn't you piggyback on those areas that are already involved in eye movements to help them become part of that attention system. They're serving many of the same functions, right? So it actually makes very good intuitive sense that the areas of the brain that are involved in shifting your eyes around to control the shift of attention in the real world, would also be involved in attending to those locations. So in this case, it's part of what I talked about earlier, that pre-motor theory of attention they call it-- The idea that, that you know, people who are kind of hardcore motor control people will tell you that attention is really just the intention to act. And so in this case, the cerebellum is involved in controlling shifts of the eyes, eye movements from one location to another in concert with other brain areas. And so the role of that area in attention might also involve the circuits that are using it to control eye movements, right? Because it doesn't make sense to have another area of the brain that does the same thing as this other part is already doing.

B Brittany Ekelund 52:23

Yeah.

C Chris Striemer 52:23

It's actually a waste of space, right? Wouldn't--

B Brittany Ekelund 52:25

We don't have a lot of space. [laughter]

D Dylan Cave 52:27

That's what I meant earlier, like, I had no idea what's going on in here. And it's so complex. And so like, once you learn about it and once you see actually all the really unique things that our bodies are built with, you're just like, Man.

B

Brittany Ekelund 52:40

You guys kind of did the first comprehensive examination of spatial, temporal and sustained attention following cerebellar damage. So I kind of want to know, why might there not be more studies looking at the cerebellum in this context?

C

Chris Striemer 52:58

Right. So I think what we wanted to do with these patients was - so there was some evidence that, you know, in isolated studies, that like-- you know, we had shown there was some effect of cerebellar injury on reflexive attention. Another study, back in the late 90s, had showed that as well. And other studies came out, showing there wasn't any effect of cerebellar injury on attention. And then other people came out and said, Well, it could be the motor responses that are being affected here. So there was-- there's still an ongoing debate as to number one, whether it's actually involved in attention or not. And number two, if it is, what types of attention and what parts of the cerebellum are involved, right? And so that's where we sort of want to kind of take it next.

B

Brittany Ekelund 53:35

Okay.

C

Chris Striemer 53:36

So we studied a series of 14 cerebellar patients, which doesn't sound like a big group. It's not a huge group. But cerebellar patients aren't incredibly common. So we want to study patients that have an isolated cerebellar injury, without injuries to other parts of the brain. Because then, if you're trying to convince people that this part of the brain plays a role that no one thought it played, and they have damage to other parts of their--

D

Dylan Cave 53:57

Yeah.

C

Chris Striemer 53:57

Yeah, you have other parts of the brain that are damaged, they're going to say, Well, how do you know it's not that other part in the cerebral cortex that's damaged. So you have to have isolated cerebellar stroke patients - doesn't have to be stroke, but typically, it is because it's, again, the leading cause of adult disability. But it's something like, I think I was looking up the stats at one point, something like less than 3 percent of all stroke patients are cerebellar-- isolated cerebellar stroke patients. So so from that perspective, you know, it's-- you have to study them over a few years even-- Yeah. To sometimes get this many patients, right? So we we wanted to test them in these patients, because we had reflexive attention that was impaired in one of our studies, but we didn't ever test voluntary attention in that group of patients. We have an fMRI study in healthy adults that showed that reflexive seemed to be more engaging the cerebellum than involuntary. So we, in our patient group said, let's test reflexive involuntary attention to kind of replicate that effect--

D

Dylan Cave 54:47

Amazing. I think we're running out of time today. So we're just gonna leave you with one more thing, just like, if there's, there's like one last really big point that we didn't get to cover today.

C

Chris Striemer 54:47

And show that that as a solid. And then we also tested-- because that's more what we call spatial attention, attending to the left side or the right side, where you're attending in the environment spatially. And so what we found was that in our group of cerebellar patients, we replicated our kind of earlier work showing that reflexive attention was impaired in these patients - voluntary attention, not so much. It was hard for us to say that it wasn't impaired at all, because we didn't really have a big enough patient group to conclusively demonstrate that. So, I would say that, you know, it has a variety of implications depending on on what what kind of take you want to you want to have with it. So, what we were able to show in our patient group was that we replicated earlier work on sustained, sustained attention from an earlier colleague of mine, sorry, on temporal attention from an earlier colleague of mine. So we replicated that work in a different patient group, we replicated our problems with reflexive attention this patients group of patients from an earlier study. So we further verify those results, suggesting that they're, you know, that they're common in these patients. What we were also able to show is that the same brain area in the cerebellum, that was involved in in temporal attention was also involved in spatial attention. So it seemed to be the same parts of the cerebellum, that when injured, were causing these problems. And it was more so in the left cerebellum than the right cerebellum, which is interesting. And the reason that's kind of interesting is because, if you think back to what I was talking about earlier with the spatial neglect and the parietal lobe and attention - the right hemisphere is thought to be dominant for attention in the cerebral cortex, right? And when you damage the right hemisphere, in the cerebral cortex, you cause these attention problems. So it kind of makes sense that the left cerebellum, which is connected to the right cerebral cortex, will be the one that's more involved in attention and spatial processing. And I'm not I'm not the only one that's found this with spatial processing. Other studies have found it too. I was-- this study, though, was one of the first to link it from a from a brain lesion standpoint, where we can actually correlate the area of the lesion in the left cerebellum to the problems with potential for experiencing. So that's so that's one part of it. The other part of it is, you know, this is part of a larger kind of area of research in mind, where I'm just again, trying to understand how the brain controls attention. How it controls movement. And how attention and movement are linked. And so this is a brain structure that is a movement structure, that also plays a role in attention - things like prism adaptation as well, right? And how we can learn about how these systems are organized? By studying damage to this one particular hub in the motor system that also seems to play a role in other cognitive functions. The way I sort of explain it, this is my own fascination with arrays - It's almost like the ultimate kind of reverse engineering project, right? So you think about, if we engineer a new car or an aircraft, we know how that works. Because we designed it to work for that purpose. We created it right? We didn't do that with the brain. We have the brain that we have, we've inherited over millions of years of evolution. And so the only way we can really try to understand it is through reverse engineering. If your car won't start, well, what could it be? Well, it could be this, could be, could be the ignition, could be the battery, it could be all kinds of things, right? And so you know-- but you have to troubleshoot to try to figure out what part of the car is broken so that you can then fix it. In our case, we don't for the brain. Now the brain being the analogy, we don't have that blueprint for the brain completely yet. And so we're still trying to figure out how the brain operates by studying the effects of what happens when something goes wrong. So if the brain is injured, and that causes a set of symptoms, then we can understand what parts of the brain are responsible for those behaviors. And that allows us to, number one, better understand how the brain operates when it's functioning normally, and also potentially how to rehabilitate the patients better. And by just understanding the deficits they're experiencing, more how to focus our rehabilitation efforts, more specifically. Yeah. If there's one thing I can tell people, I would say that, you know, don't, don't take your brain for granted. And don't underestimate how incredibly important it is. People get blown away when I say this sometimes, and they might think it's really really reductionist of me to say it, and I'll say it anyways. You know, everything you think, everything you do, everything you are, every part of your personality, every part of your, you know, memory from the past everything, even your ability to imagine the future, all comes down to firings of neurons in your brain. And you can see that by studying patients with brain injuries who don't have that ability anymore. Right? And so, you know, don't take it for granted. Take care of it. And and, you know, hopefully, we'll be as a society, better at funding research that that will help people understand it better totally understand all those different types of problems that people can have.

D

Dylan Cave 59:26

Well, Dr.Striemer, thank you so much for joining us here today. This has been another awesome episode of Research Recast(ed) and we couldn't do research or recast it if we didn't have awesome guests to interview. So thank you again. I don't know if you want to take us out.

C

Chris Striemer 59:42

Thank you for inviting me and it's been fun.

B

Brittany Ekelund 59:45

[Outro music starts] Yeah. Well, that's all we have for today's episode of Research Recast(ed). If today's episode blew your mind, please follow up with the links in the episode description to learn more.

D

Dylan Cave 59:58

If you want to keep picking our brain you can visit us at Research Recast(ed) on your favorite podcasting platform to catch new episodes every two weeks. Also, check us out on Instagram at Research Recast(ed) where you can leave a like, give us a follow or send us a message if you have any follow up questions from today's episode.

B

Brittany Ekelund 1:00:14

This has been Research Recast(ed), a knowledge mobilization podcast brought to you by the Office of Research Services and Faculty of Fine Arts and Communications at MacEwan University.

D

Dylan Cave 1:00:23

Research Recast(ed) is hosted and produced by me, Dylan Cave, and Brittany Ekelund. Music, sound design and editing are done by me, Dylan Cave, with research, copyediting, scripting by Brittany Ekelund. Our executive producer is Ray Baril. [music stops]