### Your Mind on Dance, with Dr. Emily Cross

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0:00:03.5 Beth Fisher: Welcome back to Minds Matter, a podcast sponsored by the Monash Centre for Consciousness and Contemplative Studies. I'm Beth.

0:00:11.0 Ava Ma De Sousa: And I'm Ava. On Minds Matter, we explore research from neuroscience and psychology while occasionally talking through our own personal experiences.

0:00:19.8 Beth Fisher: In this week on the podcast I interviewed Dr. Emily Cross, who's the primary investigator of the Social Brain in Action Laboratory, and she's also a Professor of Social Robotics at the University of Glasgow, and a Professor of Human Neuroscience at Macquarie University. So I spoke to Emily about her research on dance and the neuroscience of dance. We spoke about how dance can relate to how we express emotion. And she spoke about how they study dance and what are the methods she uses that we'll speak a bit about in the podcast. It's called a point light display where you put a light on the dancer's head and each of their joints and then put them in a dark room, so when they move around and dance, you can just see each of the lights light up. And that's how you can interpret the movement. This is a new method we haven't spoken about before on the podcast, so if you're curious about what that looks like, you can head over to our Instagram or our website. We'll have a link to a video.

[music]

0:01:25.4 Dr. Emily Cross: My name is Emily, and I classify myself as a cognitive and social neuroscientist. And my background before I was a neuroscientist and while I'm a neuroscientist is in dance as well. So I've always been really interested in the connections between perception and action and how the brain is able to negotiate that link between what we see others doing in the outside world and what we can actually put on our own bodies. And for the past many years, 15 years or so, I've been trying to explore that with human neuroscience methods, so things like brain scanners, brain stimulation and lots of clever training studies and behavioral paradigms.

0:02:01.9 Beth Fisher: You've mentioned that you do neuroscience of dance. So could you explain what exactly that is? And what can dance teach us about the brain?

0:02:12.8 Dr. Emily Cross: Great questions. So for years, I used to make the distinction that I'm not studying the neuroscience of dance. That's something totally different, and it doesn't really exist and at that time it didn't. What I'm doing is I'm using dance as a tool to understand the human brain, so as a tool for asking basic neuroscience questions. And indeed, that's very much how I started. So we'd use dance as a model system to help understand how we learn by observation, to help understand how expertise for physical actions is manifested in the brain. So dance was really valuable to me when I was first starting off in this area because we could classify it as movement for movement's sake. There was nothing about the art of it involved. There was nothing about the aesthetics. There was nothing about the reward value we get of watching dance or dancing ourselves.

0:02:58.0 Dr. Emily Cross: It was more just this really sophisticated, complex action stimulus that we are able to use to understand the human brain, not just when we're tapping our fingers or moving our mouths, which is how so much of research in the cognitive neuroscience of action got its start. But all of a sudden, we could look at full body movements and we could see people moving through space, and dance was a really useful tool in that capacity. However, fast forward a few years, and I would say for the past 10 years or so now, we are looking at the neuroscience of dance, dance as an art form and the pleasure we derive from it and the aesthetic value people assign to it and what that means in terms of the brain and in terms of how our reward buttons are pressed and these sorts of things.

0:03:38.9 Dr. Emily Cross: So it has evolved, and dance is fantastic in that way from a neuroscience perspective 'cause it offers us at least these two really useful things that can help us ask basic questions about basic function of the human brain. How do we link action with perception? But it can also help us to address really interesting and exciting questions about the value psychologically and neuroscientifically of the performing arts.

0:04:03.2 Beth Fisher: That's really cool. So another question I had when I was looking at your work. So we speak to all different sciences, and one of the things is, well, how do you operationalize a certain thing that you're studying? So how is dance then... So when you're studying dance, how is that different to other movements such as running or... We do obviously all these different movements throughout the day. What makes dance specific, yeah, and separates it from other things?

0:04:30.6 Dr. Emily Cross: Yeah, there's many, many beautiful definitions of dance and in many of our papers we'll try to throw one out there. I'm trying to get the words right for this one definition that I really like. It's movements that are far removed from the ordinary. There is a much more poetic way of saying that, but the spirit of that definition is one I really like. But dance is, it is bodily movement and just as when we're opening a door or going for a run or playing basketball or whatever it is, these are all full body movements as well. But dance has a slightly different start and end point. Lots of people will define dance in terms of music as well, so it's movement to music or to a rhythm. I always step away from that 'cause I think you don't have to have a sound track in order to have dance, and we often see that in society and throughout cultures. But it need not have the auditory component. It can just be the physical movement component.

0:05:21.4 Dr. Emily Cross: But really from like again neuroscience perspective, what we often define dance as is movement for movement's sake. So I'm not trying to get from A to B. I'm not trying to get a ball into a hoop. I'm not trying to open a door or to make myself a sandwich and drive a car. I am moving for either my own pleasure or for the observer's pleasure. So there is just this... It's movement for movement's sake, and that's really, really valuable, especially again, in the neuroscience perspective because there's lots of interest and lots of research looking at goal-directed actions. So my goal is to pick up this glass. My goal is to write with this pen. Dance doesn't have those object or outcome-specific goals. The goal of dance is to move your body, and you can just end the definition there. And I think it's really, really valuable in that regard because it allows us to look at movement with this really clear lens.

0:06:12.1 Dr. Emily Cross: Now, that being said, we do a lot of work... In places I've worked, I've been embedded in dance communities myself, and often will scan the brains of my fellow dancers or recruit them as my participants. And when I speak to the art communities, talking about the research we're doing, we do often get a bit of pushback saying like, "Oh, but what you're showing them on the screen is like these really distilled images of a black and white person doing these three-second snippets of dance or even point lights. So there is an array of 12 white spots in a black screen. And yes, that's a dancer, but how can you possibly say that that's relevant to these big performances we're putting on or what's going on in this French festival or whatever it may be." And these are really valid points.

0:06:55.8 Dr. Emily Cross: Dance can take all sorts of shapes, sizes, and scopes, but for a scientific perspective, it isn't often necessarily helpful for us to take the full fat version of dance, so with costumes and lighting and music and setting and audience members and all of that. So we do distill down. But with that being said, work by us and other teams are looking more at these live performance and rich performance contexts, and that's really interesting.

0:07:20.7 Beth Fisher: I really like the movement for movement's sake 'cause I feel when... I'm not a dancer or anything, I just love having a dance. [chuckle]

0:07:28.8 Dr. Emily Cross: Who doesn't?

[laughter]

0:07:30.5 Beth Fisher: But I feel that is a good one like, "Oh yeah, that's how it feels." Yeah. I like that. So cool. One of the theories, so this is more about the aesthetic side of things, looks at the embodied simulation account of aesthetics. Could you explain what that means and how we can test that theory?

0:07:51.2 Dr. Emily Cross: Sure, so the embodied simulation account of aesthetics, this is a fascinating theory. It's been around for about 15 years now, and essentially the researchers who proposed it, it was a neuroscientist and a philosopher, and their focus was on visual art. So it was on paintings, it was on sculpture. It was on things that you might find in your traditional art museum. And what they suggest is that one of the reasons or avenues through which we derive pleasure through art works is that the work itself evokes in us what it would take to create that work in a way. So if you see, they talk about these... They're not paintings, but these artworks that are hung that has a big gash through a canvas and you can viscerally appreciate what it would be to take a knife or something sharp and gash a canvas. Or when you see a sculpture that's kind of hewn from rock, you could appreciate the movements that were involved to make that. Or paintings like point to this... That had little dabs.

0:08:49.6 Dr. Emily Cross: Again, you could appreciate either long, smooth brush strokes or short brush strokes, and all of these can contribute to your pleasure and the embodiment, what it would take to make those. And I'm reading this paper by [0:09:02.2] \_\_\_\_ who came out with this embodied theory of aesthetics some years ago now, and I'm like, "But what about the performing arts? All this stuff is about painting. Great, but there is an art form that embodiment is central to it, to what's actually going on. It's not just the artefact of what someone's body did, but it's this ephemeral fleeting art form that is bodies in motion that we're watching in front of us right now. So what my colleagues and students and I have tried to do is to take this embodied simulation account of aesthetics and really move it to embodied neuroaesthetics of dance. And to say, "Okay, well, how much does our own vocabulary, our own physical limits or capabilities, how does this shape how we appreciate and perceive performing arts?"

0:09:49.1 Dr. Emily Cross: And perhaps not surprisingly, we're seeing it's hugely important, and it's a really slightly complex relationship in fact between what we can do and how we derive pleasure or what we derive pleasure from. But it's a very rich field of investigation for those of us interested at this intersection of aesthetics, dance and the brain.

0:10:07.9 Beth Fisher: Yeah, that's super cool. So one of your studies, your 2020 studies, so your more recent one, looked at what dance movements people find more beautiful, and you tested the differences between velocity and acceleration of the dance movements. So could you explain what people enjoyed more and why that may have been the case?

0:10:32.5 Dr. Emily Cross: This wonderful, wonderful post-doc who worked on it, Andrea Orlandi. He was a PhD student at the time. He's a post-doc now, and he's actually in Australia doing some really cool new work that's following this up, so it's all very cool. So with this paper, we wanted to test this embodied simulation account of aesthetics, and we wanted to understand how movements that were essentially smooth and really placid and they have one movement flow to another, how people perceive those and derive pleasure from those compared to movements that were far more dynamic, and there's really quick shifts in direction and trajectory and velocity, peaks and troughs. So we knew from some aesthetic accounts that people really like smooth motion and smoothness in general, smooth objects, smooth contours, etcetera. So we had one hypothesis or theory that said that people might like these really smooth predictable movements much more, and we also know that to a certain extent people like predictability.

0:11:29.4 Dr. Emily Cross: But then we have another hypothesis that says that people might actually like the more dynamic shifts based on how that might make them feel in their own bodies. And essentially what we found was that people did prefer the much more dynamic directions and tempo-changing movements compared to the really smooth ones. And we think this has to do with people finding the smooth ones maybe a bit boring 'cause they're too predictable. There's probably a sweet spot somewhere in between there. But yeah, we found that in general that people like, we call them uniform and varied movements, and that people like the varied movements overall much more than the uniform ones. And yeah, that was exciting to see.

0:12:05.2 Beth Fisher: So one of the reasons that we would like these more varied movements is because anything too predictable, so that's boring to... So if anything is too predictable, that's boring to us, but if it's not predictable enough, that's too much. Is that what's going on?

0:12:24.8 Dr. Emily Cross: Yeah. So there's certainly an element of that going on there. We did have this interesting finding with motion entropy, and that sounds a bit crazy. 'Cause... To what motion entropy is, essentially, it's another measure of predictability. And somewhat counter-intuitively, there was actually less motion entropy in the varied movements than the uniform ones, and again, how that was calculated was through a number of very complex algorithms. So again, we think this makes sense. This shows that varied dance sequences were actually more predictable. And you would think that the uniform ones were more predictable, but it was actually the other way around. So the varied ones were more predictable because you could see when you were building up to a crescendo in one movement where it moved to in the next one whereas with the uniform ones 'cause people were moving so smoothly in this particular study that that wasn't translating to knowing where they would go next. And yeah, so essentially what we see is that the varied dance sequences were more predictable, based on this motion entropy measure and the uniform ones were less predictable.

0:13:29.4 Beth Fisher: Yeah, I see. And I'm not sure if this is something that you [chuckle] have an answer to, and it's quite a complex question. So in terms of this varied movement and everything, so a lot of about dance, we feel is an expression of emotion. Is there anything that from your research, you've come to understand how that is playing into how we enjoy these movements and what the dancer intended to express and how we feel that? Because I feel when you watch dance, it is a very emotional thing. I've been to the ballet and I've cried, and I don't know anything about ballet, but there's something...

0:14:08.3 Dr. Emily Cross: There's something being conveyed through limbs, moving on stage that is so beautiful that it brings you to tears. I totally hear that. And this is a beautiful segue into my most recently graduated PhD student who finished less than two weeks ago, so now Dr. Rebecca Smith. She was doing her PhD at the University of Glasgow, and this was her exact question, her exact program of research. It was, "How do dancers convey emotion through these paired down bodily movements?" And in her study, there were... Paired her studies, they were paired down even more to these point light displays. So she had a professional dancer come in, and she had a piece of choreography that the dancer was going to do, but she asked her to perform these in a very happy and joyful way, in a very sad and morose way, in an angry way, in a neutral way and in a surprised or fearful way.

0:14:57.3 Dr. Emily Cross: And in this way, she was making many, many clips of this dancer's movements, and we are able to look at the extent to which people can read these emotions accurately, compared to... The dancer might have intended one thing, but people pick up on something really different. And we also are able to look at the aesthetic value of these. And essentially, [chuckle] there's the big pieces that I can't summarize in one sentence, but we see that there is a very close correspondence more so for expert viewers than for novice viewers in the emotion that the dancers are intending to convey and what people actually can read from it. And also we saw that the clearer the emotional conveyance was and people's ability to read it, the more pleasure they derived from it too. So that's really clear to me that it's an angry movement or a sad movement. People tended to like those more.

0:15:46.3 Dr. Emily Cross: It's a really big space though when we're looking at the emotion and communication in dance, and it touches on a lot of other really interesting fields from psychology to artificial intelligence and others besides. But how we might convey emotion through bodily movements, it certainly has a lot of really important implications for human communication and expression, but also for how we might design artificial agents in the future to be readable and likeable by humans.

0:16:11.1 Beth Fisher: So you're looking to see ways that we move our bodies to express emotion, and then we would, I guess, say program robots to do this let's say.

0:16:22.3 Dr. Emily Cross: Yeah, robots are avatars or avatars more realistically at the stage. We have lots of hopes for robots, but they're a far cry from the human actors we see playing robots in Hollywood right now. But indeed, if there are certain things... And dancers can really emphasize and exaggerate through all of the training they've had like the clarity of expression and the range of movement they have with their bodies. We can look at which sort of signals need to be exaggerated or are really important for conveying different types of movement. And again, when we use the point lights. The Point lights, if you can imagine, you take a person and you put little, let's say glow in the dark balls. You put one on the top of their head, one on each shoulder, one on every joint, every big joint of the body. So on the elbows, the wrists, the knees, the hips and maybe a few on your spine.

0:17:10.3 Dr. Emily Cross: Then you turn out the lights. You watch that person move around and walk around and they just have these glowing balls in all these joint positions, you will have no problem at all being able to decipher that's, well, that's your friend or your mother, or a man, or a woman, or a walrus, or a dog. So just from 12 points or even fewer, we can tell based on the motion profile that that's a human body and it's doing... And that it's moving in a certain way. And we can also tell identities and all sorts of other really fascinating things just from these super stripped down bits of light. So there is no face information. There's no body size or shape information. There's just these 12 points of light that are attached to someone's joints. And this is what we use to again, to study movement for movement's sake even more reduced down. So we just have a few little spots moving on a screen, but through those we can really... We're not looking at facial expressions. We're not looking at, again, the size, shape, costume whatever that a person has. We're simply looking at their movement profile, and that can tell us so much.

0:18:09.1 Beth Fisher: And so just from that, people can still say they're expressing this emotion or they are... That's so impressive.

0:18:14.1 Dr. Emily Cross: Yeah, yeah. Very, very... And when I say very easily, we have a range of accuracies, but for some of the movements in particular that are super crystal clear and that have a lot of agreement, we absolutely do see that people would have no problem saying, "That's a fearful movement or that's... And again, it's not just... It was dance movements. It was a dancer doing choreography that was fearful or excited or angry or whatever it was.

0:18:37.9 Beth Fisher: I guess that's also... When we feel emotions, a lot of that comes through our body and you can be really excited and you jump up. It is, yeah...

0:19:29.0 Dr. Emily Cross: You can't constrain... Hold these things back. You're absolutely right. So we do express so much through the body, and I think this work to me, a lot of it was going on during COVID and lockdowns and the time when so much of humanities work became screen-focused. And even as we speak right now, we're on screens. We're certainly not in the same studio, but we have evolved over millennia to express ourselves and to read the expressions of others in real life with bodies, not just in these 2D screen renderings. And I think, yeah, lots of times we'll often be on Zoom calls without the video on, so people can't even see your expression coming through your body even if they wanted to. And I think that we lose a lot there because as humans, we are socially designed to express and to read those cues, so when we lose them going into virtual worlds, going into screen-based worlds, it's really, it's exhausting and it makes communication more difficult.

0:19:46.4 Beth Fisher: Yeah, it's so interesting 'cause I've had other people on the podcast speaking about emotion, but we've done language and everything, and I just haven't made... And then you have the gosh like of course movement is so involved, but it's so funny. It's not something that we think about.

0:20:00.9 Dr. Emily Cross: No, it's often not thought of, and I feel like in a lot of the write-up that we are doing, that Rebecca was doing on her PhD thesis talking about body movements, we have to always have this big justification saying "There's so much that's focused on emotion in the face." there is motion in the voice, but really the face that's received the most empirical attention and the voice a lot as well and Language as well, but hang on, we don't always have access to people's facial expressions up close and personal, if we're in a big crowd or we see someone at a distance, you can pick out your mom walking across the street, even if you don't have a clear view of her, just from her outline or just from her motion profile. There is so much that we can get from this. And you also like Pixar and a lot of the animation studios. They get this so well about how much emotion is conveyed they'll design characters that are kind of more evil or more sad with these body postures and not just postures, but how they move, and that really amplifies those character qualities and it's really...

0:21:00.7 Dr. Emily Cross: Like we don't think about it as you say, but it's categorically something that we're really quick to pick up on and we use it a lot...

0:21:06.7 Beth Fisher: I guess I'm thinking of... What's the little Penguin is it Pingu or Pingu?

0:21:11.2 Dr. Emily Cross: Oh Pingu, yeah.

0:21:14.1 Beth Fisher: 'Cause he doesn't speak at all, [laughter] but he has so many emotions.

0:21:16.4 Dr. Emily Cross: But there is so much going. No, you're absolutely right.

0:21:19.2 Beth Fisher: And watching that as a kid, it was like you could definitely tell, but it was all the movements that they did [chuckle]

0:21:24.3 Dr. Emily Cross: Yeah, yeah, I remember reading this thing a while ago about Walt Disney talking about animation, and I think one of... I don't know if it was one of his... First things that he worked on or if it was just an example to show what you need to be thinking about as an animator, but he talked about a sack of flour and how this is a square slightly squishy, three-dimensional square, but you should be able to show the range of a human emotion and experience with this sack, if there's no face, there's no eyes, there's nothing but just... And there's all these sketches that show this flour that can move and show and more joyous, happy, sad, scared ways. And you just think like, yeah, you really can reduce it down into all of that, you don't need language, you don't need a face, there is so much that we can do with our bodies.

0:22:05.4 Beth Fisher: The body.

[music]

0:22:14.2 Ava Ma De Sousa: Well, one thing that I wanted to talk about, based on what Emily was saying, was this idea of this point-like display that you described and that Emily described, and the idea that we can base so much emotion and so much of our identity through our movements in a way that's just walking, and I just wanted to tell people about [chuckle] some stuff that I found while I went on a little black hole on the Internet about gait, which is the way that you walk. Because she mentioned that you can tell who people are based on their gait, and this is some research that I've heard of, but I wasn't sure how real this is, but it's very real, so much so that there is a lot of tech going into people's gaits and gait recognition it's called, and there is all these softwares being developed, especially for surveillance. It's so dark.

0:23:10.8 Beth Fisher: So it [chuckle] brings some darkness to this nice podcast.

0:23:13.7 Ava Ma De Sousa: One of the things that is being developed specifically is by the Chinese government, and so the Chinese government, as people probably know, do have a lot of surveillance, a lot of video cameras, and so the government is specifically trying to develop this gait recognition software, which I think is actually relatively advanced, but it's able based just on people's bodies and silhouettes and the way that they move to recognize very specific people, and apparently your gait is almost as unique as your fingerprint.

0:23:45.8 Ava Ma De Sousa: So when Emily was talking about the fact that you can tell your parents or your loved ones by their gait or maybe the professor or something, I was like "Okay." But I didn't think that it was that specific. And apparently, the FBI has also been using this technique, and it's something that FBI agents who are undercover need to know about because it's one of the hardest things to disguise, so even if you walk with a limp or something, you're not actually able to disguise your gait, so what some FBI agents do, or CI agents is they'll put a stone in their shoe because that's the only thing that can actually disguise their gait, otherwise they could be picked up by software or by other spies.

0:24:29.2 Beth Fisher: Is that because if they step on the stone they walk strangely.

0:24:32.9 Ava Ma De Sousa: Yeah, I think that actually will throw off what your walking style is, but it's something that's almost impossible to change willingly without some intervention that you're not 100% cognitively in control of.

0:24:45.3 Beth Fisher: And is this the same? Is this a human-specific fingerprint in terms of gait or do animals have a unique gait as well?

0:24:55.2 Ava Ma De Sousa: I don't know, that's a good question. Perhaps they do, but I would assume that we probably are not able to tell gaits apart just because I feel... Unless you have expertise in a certain area even faces, it's hard for us to tell even different dogs or monkeys apart from each other, and of course, famously, there is also the cross-race effect in psychology, which is that it's harder for people to tell faces even of different races apart when they're not used to seeing those faces, but I don't know, that's a Good question. I do feel little dogs all seem to walk the same, but I'm sure a dog might think that all humans walk the same, so I don't know.

0:25:32.0 Beth Fisher: And I feel if you have a dog when you're at the dog Park, you can tell your dog from the gait when it's running far away, I think dog owners would feel that. So maybe it is.

0:25:42.4 Ava Ma De Sousa: Maybe it is. Dog owners tell us that us that you recognize your dog just by some lights on their back, but so in my rabbit hole, is that what it's called, my rabbit hole. I also found other technologies which are even scarier, and I don't know, maybe the impact is not as scary as in for good, but there is a team at MIT that are creating this device that also looks at gait...

0:26:08.7 Ava Ma De Sousa: But the way that it works is that it uses the Wi-Fi signal and radio signal and radio waves. And it doesn't even have to be inside the home, it can tell the movement that someone is making from inside their homes, and they're using it to be able to tell when an elderly person is suffering, when their health deteriorates basically...

0:26:29.0 Beth Fisher: Wait I don't understand so the Wi-Fi from outside the house is going into the house, and picking up movements of where you are in your home?

0:26:38.9 Ava Ma De Sousa: It's actually... Okay, let me clarify. So it's actually, it's just a wave, so it's actually radio waves that are weaker than Wi-Fi, and it can basically through the bouncing of the signal off of the walls and off of your body, it can measure the velocity of your gait and doctors apparently refer to this as the sixth vital sign, so your gait is known in the medical community to be really important too, and so it just can set up... It's called Wi-gait or it's Wi-gait you can look it up if you're interested in it, but basically it just checks... Learns your regular gait and then it will compare that to how your current gait is to see if there is something wrong.

0:27:20.8 Ava Ma De Sousa: And it doesn't even have to be inside the home, so I don't know, I just thought this was really surprising because I have never thought really about gait... And there is also, obviously, as you probably could guess, there is a bunch of applications to running and to checking to make sure that runners gaits are proper and they're not injuring themselves, but I just thought it was an interesting application of this neuroscience research where obviously in a different context, of dance, but where a lot of this research is being used for technology, which I think we often forget, in the trenches of the psych, but I think in terms of identification and all these other outcomes, of health, I was really surprised about the importance of body movement, which goes beyond what we were even talking about with emotion and dance, and she was also talking about velocity and predictability, and I just think it's interesting how much we can plug in to technology to get these outcomes and predictions.

0:28:14.4 Beth Fisher: That's actually really cool.

[music]

0:28:22.3 Beth Fisher: Some of your research has also looked at how our enjoyment of a dance changes after we learn it, and if we physically learn it or if we watch it on videos, could you explain a bit about how you've studied that and... Yeah, what you've found with that area...

0:28:40.0 Dr. Emily Cross: Yeah, no problem. So this again, so much of my research, I feel like a lot of it is a happy accident how we made these discoveries and then how we followed them up, it's been a really fun and worthwhile exercise to chase up what some of these things might mean. So in one study, the first study we were working with some professional dancers in the Leipzig Ballet a guy and a girl, and they were just exquisite dancers, and then we had them perform all sorts of... I think 80 movements each. We asked them to just freestyle, you can do choreography or you can just walk in a circle, but really wanted them to do things that were really, really, really easy for them to do and really hard for them to do, so that we had this range of complexity and difficulty for them and their movements, and we cut all these beautiful bits of movement into three-second segments and we showed them to people in the brain scanner, and we ask people two questions about all these movements, we said, How well could you reproduce what you just saw there? And some things were as simple as the dancer putting their arms above their head and down by their side or walking in a circle, and people are like, "Yeah, no problem," or they would be really complex...

0:29:42.4 Dr. Emily Cross: Like we had our male dancer do a plié and then he leapt into the air and did three circles and landed with perfect aplomb, all in the space of a second and a half. And people were like, "Yeah, I can't do that." Or we had our female dancer doing split leaps and or bringing her leg right up next to her ear stuff that people were like... "No." So we also asked them, How much did you like watching these? So we also... They're rating all these movements at different times throughout the experiment on how well they could reproduce them and how much they like them. And what we saw perhaps unsurprisingly, as I describe this, people really liked watching the dancers doing three leaps in the air... Sorry, three spins in the air or split leg leaps or pulling their leg up behind their ear, but they weren't deriving so much, aesthetic pleasure from seeing the dancer walk in a circle or put their hands above their head. So we got this really strong negative relationship between reproducibility and liking, so people liked the stuff they could not do and the stuff that they could do with their own bodies, they are like "Yeah, not so impressed. Don't really like that as much."

0:30:38.4 Dr. Emily Cross: And I should mention here that our participants were all dance naive, so they didn't have any dance training, they didn't go to the dance or the opera and watched a ton of dance, so that was interesting. And we called that The Cirque du Soleil effect. So the idea, which has a lot of intuitive appeal, we pay a lot of money to go see professional athletes at the top of their ability, to see professional dancers, circus performers do stuff that is crazy, that's not stuff that we can do in our own living room or on our own backyard. Football, pitch, or basketball, court. So yeah, that's like we want to pay to see stuff that's really crazy that we can't do with our own bodies, and that's fine, that fits in with some other aesthetic accounts of wanting to see things that really challenge and push us in our own way and from an embodiment perspective, we try to tie that in. However, we also had this inkling, that that's not necessarily the case, once you do start to gain some of your own physical experience with something, I'm thinking about my own dance pleasure when I'm watching a dance, a piece of choreography or sequence that I can do myself, it's like I have in into it, I really enjoy seeing it 'cause I can say like, "Oh okay, now they're gonna go around and do this split or do this jump here," and I can feel it with my own body, and that really gives me an in into it.

0:31:49.0 Dr. Emily Cross: And what we wanted to do to... Does this actually happen or is there perhaps more complex, to this relationship is that we brought people into the laboratory and we had this fantastic, really fun hip hop dance game, you Just Dance 2, and people would dance with an avatar on screen and we teach them, they'd go from being complete novices to being quite expert at performing some of these dance sequences, and in the meantime, we scan their brains before and after they had this big training period, and we also asked them to rate throughout how well they could do these movements, they were learning and how much they liked them, and again, they're split into little movement pieces.

0:32:21.4 Dr. Emily Cross: And perhaps not surprisingly. Again, based on what I've just said, What we did see here is that as people transition from being novices to expert in these particular dance sequences, they actually liked watching them a lot more and they derived more aesthetic pleasure, so we saw that the better you could do it, the more you liked it, once you actually start to embody it, once you actually have a chance to learn, so this seems like at first blush that it really contrasts the Cirque du Soleil effect, but we think that again, with embodiment, there is something else going on and with the Cirque du Soleil effect. And we have brain data to back this up to both, when you're seeing something that you cannot do what you really like watching or you can do and you really like watching, we see engagement of part of the brain that we know is responsible for leaking up action and perception, so in particular, this is part of the inferior parietal lobe, so we think that when you can't do something that you really like it and it's really exciting, it's almost aspirational embodiment, so your brain is saying like, boy, I can't do it, but it's cool.

0:33:17.8 Dr. Emily Cross: And what would it take or... I'm trying, I'm trying to learn or pick up or do something with this, whereas when you're really expert at something and you're watching it, and those same areas are being activated, they're like, "Yeah, I know what's coming next," and like, "I can do this," and like... "Yeah, they put their hand above their head and then they do this and it's great, and it's cool, and I can feel it in my body because I have done it in my body." So hopefully that's not a totally confusing way of describing it, but we can see that embodiment can serve both directions here, so stuff that we cannot do, but we really like watching, we try to embody it, and stuff that we can embody because we've practised a lot, and we really enjoy watching it, sorry, that also results in really enjoying watching things.

0:33:58.3 Beth Fisher: I guess in that explanation, what is good about that because sometimes when I think about being experts in these things, I get worried, what does that mean? People who don't have access to our education and all these things don't enjoy it as much, and I feel really strongly against that because I think that should be for everyone. So that's so what's nice about this, it's like. Well, no, you get pleasure either way, it's just a different kind and you can still... Am I right in...

0:34:27.7 Dr. Emily Cross: You're absolutely right. Yup. It's different avenues with the same end, more or less, and can we say it's actually the same end... I mean, with neuroscience, we can't say a lot of things with great certainty, we can say with our study, with this manipulation, with this particular group of participants, this is what we found, but I think that that general idea does hold, and I also think like for arts outreach, the training study has a lot of really important value as well, because it suggests that if you do take time to go into schools, maybe a dance company or a circus company or whatever, and teach kids or teach young people or whoever, bits and pieces about what they're about to see then when they see this on stage, it's like, "Oh yeah, I actually tried that, or I can actually do that, I know how hard it is to do that, or that looks really easy, but it's really, really crazy." So I think it's a real promising finding in terms of Arts Outreach and getting more involvement, embodiment, sorry, physical involvement, embodied involvement in young people in particular, but in building arts audiences across the lifespan.

0:35:30.2 Beth Fisher: Yeah, I really like that it's a very inclusive way of how we can understand that. So yeah, that's really cool.

0:35:36.3 Dr. Emily Cross: Absolutely.

0:35:39.0 Beth Fisher: So another thing with dance obviously, and this is another really big question, but obviously it's different across cultures, so different cultures have different dances. And I guess that also comes back to what we've just been speaking about in how our movement is so wrapped up with how we communicate our emotions, 'cause we have spoken about how that's with different languages and people have different emotions and different cultures in all this... How does dance... How dance is different, across cultures play out in that and all... Are there things that are just the same across culture with certain aspects of dance?

0:36:21.2 Dr. Emily Cross: So these are really important questions, I think, and I feel very lucky to be working with a researcher starting to explore some of these questions over the past few years, unfortunately, again, COVID threw a bit of a spanner in the works, but we continue to do some great stuff, and she managed to do some brilliant work with getting stimuli with Indian classical dance well, back home in India during some of the lockdown. So the science continues. But I think maybe the biggest universal of dance across cultures is the fact that every culture dances, every people every... I don't wanna say modern, but like historical account of human societies we have, and of course, across the contemporary world, we know that all cultures have dance of some description so dance is certainly a human cultural universal aspect, however. There is of course a lot of variety in how different types of cultures manifest their dance and what dance is used for in different cultures, and what's aesthetically valued across cultures.

0:37:16.3 Dr. Emily Cross: We are starting to do some work on this now, again with this fantastic collaborator, Dr. Kohinoor Darda who is at... Well she was at Macquire university than she was at University of Pennsylvania, and now she's working for a start-up back in India. But she is really interested in looking at... We just picked two cultures and styles of dance to begin with, so we picked classical ballet and Indian classical dance, so Bharatanatyam and she's a beautiful expert in performing that dance style, and we tried to understand, are there some things that people find aesthetically valuable and beautiful across cultures, or are there more cultural specific things? And we find a little bit of evidence for both things to be honest, and expertise really comes into play here.

0:37:56.3 Dr. Emily Cross: We see that with expertise to some extent, that that broadens people's horizon, but it could also be that with dance expertise, you just have a more of an appetite for dance, so whether that's classical ballet, Bharatanatyam or some other sort of dance form, from another part of the world, people just are more interested in it. So it's hard to speak in absolutes about what these data mean, but the space is really exciting and it's really interesting, and there is some other nice work by some groups in London such as Guido Orgs and his team that are looking at similar questions. I think they have done some nice work in Japan and Britain doing some cross-cultural comparisons, but as this work continues to gather interest and efforts to reproduce it and to carry it on, I think we'll be able to answer your questions a lot better in the hopefully near future.

0:38:41.3 Beth Fisher: Yeah. Cool. Well, this has all been amazing and also... I wasn't expecting the direction of the emotion and dance, so that's also given me a lot to think about.

[laughter]

0:38:51.1 Dr. Emily Cross: Cool. Very cool.

0:38:52.2 Beth Fisher: But is there any... I guess you've already covered this, but is there any other new stuff you're working on or anything else you're excited to share?

0:39:00.0 Dr. Emily Cross: Oh, great question as always.

[laughter]

0:39:01.0 Dr. Emily Cross: There is lots of stuff going on. So I think some of the most exciting stuff that we're doing right now, we have a nice team in Sydney that are trying to ask a few different questions, having to do with aesthetics and learning and taking that a little bit further. And one of these fantastic researchers, this is the post-doc, Andrea Orlandi, his project is looking at interoception and the extent to which you're in touch with your own heart rate and breathing and how that impacts how you see others movements. And again, your aesthetic appreciation and how expertise influences that. So if you're an expert dancer, the expectation is that you're more aware of your heart rate and your breath because this is a big thing that you train. But also people who do mindfulness and meditation are really aware of this too.

0:39:46.5 Dr. Emily Cross: But we're trying to understand how that acts with aesthetic value that you derive. And we also have some fantastic expertise with another team member, Reesa Moffitt, Dr. Reisa Moffitt, using mobile brain scanning. So we're talking about Functional Near-infrared Spectroscopy or fNIRS. And we want to start to do some hyper scanning, in fact, which is where like two people are wearing the brain scanning set-ups at once. And understanding how when you synchronise your movements with another person, what pleasure and what sort of processes are going on there. Hopefully moving up towards more sophisticated dance questions with that as well. So we have a lot of exciting things that are just now starting to take off. So I think 2023 is gonna be an exciting year for these things.

0:40:26.1 Beth Fisher: Yeah, 'cause that's true I guess dancing with your friends or...

0:40:29.0 Dr. Emily Cross: That's fun. [laughter] Yeah.

0:40:30.7 Beth Fisher: It's a lot more fun doing that than dancing on your own. So there is obviously that's...

0:40:37.5 Dr. Emily Cross: There's a social aspect that's big and it's... It adds a whole other layer to the reward. And just on that note, I'll say I was involved at the ABC, they had a program that came out in October called Keep on Dancing. And it was looking at kinda the benefits of dance for the older adults in terms of cognitive, physical and social aspects of aging. And I think that that social aspect cannot be underestimated. And it's hard oftentimes when we come from a cognitive neuroscience perspective to really do justice to the social aspect or we want to control for it. So we want to remove it entirely so we blur out faces or just show bodies. But the lived experience of us humans in the world and when and how we use dance, it is a social thing through and through. So I think that's gonna be a really interesting challenge that we can hopefully work towards, which is understanding more about the social... The pleasure of the social-ness of dance and how we can maximize that for people.

0:41:28.2 Beth Fisher: So do you think one of the main... Well, so the benefits for older adults dancing, do you think one of the main benefits is being together socially?

0:41:37.6 Dr. Emily Cross: Yeah, I think that is one of the main benefits. And I think that benefit has a knock-on consequence for the cognitive and the physical aging because the social is the glue, it's the fun part. That's why you want to continue going to a dance class or dancing with your partner or whatever it may be. The cognitive and the social... Sorry. And the physical benefits for heart rate, for flexibility, for endurance, all these things that there is really good evidence that those exist too. There are individual differences. So it's not gonna be panacea for everyone. It's gonna work perfectly and everyone goes home happy. But we can see in this program, I highlighted this as well, that for some individuals these... There's really quite impressive improvements and cognitive and physical function. But I think you need the social aspect and people talked about that in that program at length, it's like, "Well, we kept doing this and we are committed to it because it was fun and we know of course that social... Well of course, but sadly that that lots of social connections break down as we age and it's harder to maintain those.

0:42:33.1 Dr. Emily Cross: So I think something that can hit all three of these things are our social well-being, our cognitive well-being and our physical well-being that's not to be sniffed at. That's really quite remarkable. And figuring out how to maximize that even more will be really, really good.

0:42:48.6 Beth Fisher: Yeah. And I suppose even in all ages, the thing about dancing together is nice is because you... Yeah, you don't feel lonely, you feel connected.

[music]

0:43:04.9 Ava Ma De Sousa: This is a rare episode and probably the only time in my life that I was listening to the episode and Beth said something and I was like, "I actually think I disagree with that statement." And I love... But I just wanted to talk about it because I thought it was interesting. And it was specifically near the end of the episode, you were having a conversation about expertise and enjoyment of art and aesthetics, and dance in particular, about art in general. And expertise and how novices can also enjoy art in just the same way. And this was based on the findings from Emily's studies that show that novices can really enjoy art and dance as well, but that when you have expertise you also enjoy it in a different way.

0:43:46.2 Beth Fisher: Yup.

0:43:46.4 Ava Ma De Sousa: And I think the way that you interpreted this was you don't have to be an expert to love dance or to love art. Anyone can enjoy it. Which I think is 100% valid. But I do think that there is a pretty big distinction in the type of enjoyment that people can get out of art and maybe dance is perhaps a little bit different. But, so there was one study that supported what Emily was saying about the different types of appreciation of art and there was a study that was specifically about painting, which is obviously a different context. But I think specifically with painting as you were saying, people can go to the museum and still love a painting. I sometimes don't feel that way. [laughter] If I don't know much about a painter's background or if I don't know much about a style of painting, I feel it's very hard for me to connect sometimes.

0:44:35.0 Beth Fisher: Really?

0:44:36.9 Ava Ma De Sousa: Yeah. And I think that's why people find it really boring to go to museums.

0:44:42.5 Beth Fisher: So, okay, you don't have to connect with every painting. I understand you'll go to a museum and you're not gonna be moved by every painting regardless if you know about it or not. But don't you feel that there is moments where you connect with paintings or art of some form without that knowledge just because it's so beautiful or it stirred something up inside of you?

0:45:01.5 Ava Ma De Sousa: Yes, I do. I definitely agree with that. But I think that you might get more out of some types of aesthetic experiences when you know more about the aesthetic experience. But there is... So, there is a study in painting that basically holds up exactly what you're saying, which is that they trained people to basically know more about the history of art, know more about certain techniques that are used in painting and then assessed people who had this so-called expertise versus people who didn't have this training. And they found that the people who had the expertise, they ended up judging the paintings differently, cognitively for certain qualities, but emotionally there was no difference between the two.

0:45:36.5 Ava Ma De Sousa: So it was impactful just as much on the emotional side. But I do think that there's something to, let's say when you're in high school and you have to read some great classic, I feel, I get... I hate to say it if there's any high schoolers listening, but I get... I got so much more outta those books when I was forced to analyse them. And if you, for example, have read a play in class or on your own and then you see the play in person because you know the play, I feel there's something more that happens that it becomes more pleasurable. Also not because you're, as Emily was saying, I don't think it's just this embodiment idea, but I think it's also just this cognitive comparison that you're able to make and that you're just doing more when you're in that situation where you know something more intimately.

0:46:23.3 Beth Fisher: I think this is so interesting because, look, I definitely know from studying or whatever, that my enjoyment can change, but I sometimes think that the first time I read the classic without someone telling me how to interpret is the best and the most beautiful and the most moving. When I was 13 we had to read Macbeth and I read it on my own in the summer I was a really, really cool kid. [laughter] My mom came down to my room and I was in tears because I was so moved by the whole Macbeth thing. And I didn't feel after that studying, it gave me anything more. I felt that experience I had just from reading it on my own was enough. And I feel that with art as well. I like to, when I go to a museum or a gallery, look at something and experience that.

0:47:07.1 Beth Fisher: And then if I want to decide to then learn about it. And this is actually even more interesting because recently I was at the VCA, which is an arts college in Victoria and it was their end of year gallery thing. So all the students put on art and there were no little plaques on the wall, just the name. So there was no descriptions of any of the art. And I was speaking to one of my friends who has worked in curation before and I was asking, is that something that they've decided to do or did they just run out of time? What's going on? And they said, in the art world at the moment, there is a big discussion in curation if we should have these plaques that tell us what the work's about or if we should just go and have that experience. And they had decided that people should just go and have whatever experience they felt. And in this, 'cause it was young artists, there was a lot of abstract stuff. And sometimes it was difficult to sit in the art without being told what you're meant to think. But then, I don't know, I found it extremely enjoyable. So maybe this is also one of our personal differences.

0:48:08.7 Ava Ma De Sousa: That's so interesting 'cause I definitely feel the complete opposite. If I go to a museum and I don't have the audio guide, I have a much worse time than if I have the audio guide.

0:48:21.0 Beth Fisher: Really?

0:48:20.9 Ava Ma De Sousa: Yeah.

0:48:21.0 Beth Fisher: This is... I'm trying to think if we went to museums together in Amsterdam.

0:48:26.5 Ava Ma De Sousa: I think we must have.

0:48:27.6 Beth Fisher: Maybe...

0:48:28.4 Ava Ma De Sousa: But I don't think we had audio guides. But I feel if I go without an audio guide, I'm just, okay, I'm here to see something but I'm not gonna really understand it. And I don't think I'm a structured person, so I'm kinda surprised that we are having this difference...

0:48:40.0 Beth Fisher: No, that's why I'm confused. By your response because I would think that you would be someone who would move through art spaces like I do, but...

0:48:50.1 Ava Ma De Sousa: No, I hate it. I can't do it. [laughter] And I also had a really similar experience with a play in high school where we had to read, I think it was an Ibsen play called Hedda Gabler, which we read at school...

0:49:00.1 Beth Fisher: Yeah, we had to read that too.

0:49:03.6 Ava Ma De Sousa: But I read it also before we had started it at school. I think it was just because I wanted to impress my English teacher because I loved her. Not because I was actually cool and interested, perhaps.

[laughter]

0:49:13.0 Ava Ma De Sousa: But I remember reading it and I really loved it and I felt I connected to the stories in some ways. But then after we'd studied it, I just felt like the world opened up to me. And then when we saw it in person, I felt the play was so much more interesting, even though I didn't necessarily agree with all the choices, it just felt I was able to be so much more engaged with it because I understood it. And I feel that's the same with certain pieces of music. Sometimes I'll listen to music and I feel I don't really like it and it's too jarring.

0:49:43.5 Ava Ma De Sousa: But I think it's that idea that Emily was talking about with the predictability is that if you don't know a certain piece of music then, and it's a weird piece of music, then it's hard to predict and maybe less enjoyable. But then you're able to predict it once you have listened to it a whole bunch of times and you're able to get that enjoyment out of knowing what's coming next. But still being somewhat surprised. I feel all of it just lies in this sweet spot of knowing enough to be engaged but also not knowing so much that you are not engaged anymore. I don't know if you've read this book by this Chilean writer, Benjamin, Benjamín maybe, Labatut, but he came to give a talk at our university and he said this quote, he has these great one-liners and he said this quote where he said that comprehension is the death of thought, which he's obviously, he's still in literature, he's not a psychologist.

0:50:38.7 Ava Ma De Sousa: But I thought that was really interesting. And the other side of this where if you understand something too much, which is maybe the issue that you have, if you're learning too much about something, you don't wanna think about it anymore 'cause it's not as interesting. And maybe the first time that you read something you... Maybe you just come with a lot more structure and understanding than I do and I need more scaffolding. So to me, getting that extra training gets me to that sweet spot. But to you it pushes you over the edge into too much comprehension to the point where this is not interesting at all.

0:51:07.8 Beth Fisher: Yeah. This is really interesting 'cause I feel... Yeah complete. I agree with that author that comprehension is the death of thought.

0:51:15.8 Ava Ma De Sousa: No, I don't really.

0:51:17.1 Beth Fisher: Yeah. That's really interesting that we have totally different experiences with this. Yeah.

0:51:21.2 Ava Ma De Sousa: But do you feel that way? Is that the source of you not being interested in learning further, is it because you feel it loses its mystery and...

0:51:30.5 Beth Fisher: Yeah.

0:51:30.5 Ava Ma De Sousa: Developing your thoughts about it too much make it less interesting?

0:51:34.1 Beth Fisher: Yeah, because I love having mystery in life and all of these kinds of things and I like that I don't want everything to be understood and I don't want everyone to tell me what I should think or feel about characters. Or sometimes even when I see movies with my friends and they wanna talk and talk and talk about the characters in the movies, I don't enjoy that either. I just... Yeah, I don't know. But this is funny 'cause we have a totally different...

0:51:58.8 Ava Ma De Sousa: Okay, so after you watch a movie that is a little bit hard to interpret or even not hard to interpret, you will not go online and watch a 20 minute YouTube video about the themes of the film?

[chuckle]

0:52:09.3 Beth Fisher: Never.

0:52:13.2 Ava Ma De Sousa: Okay. That's the peak of my experience of watching a movie is after I've seen it and I go online and read articles or watch commentary videos about it, that's when I'm like, "Oh, everything's clicking together."

0:52:23.8 Beth Fisher: Yeah, I...

0:52:24.4 Ava Ma De Sousa: And then I wanna see it again.

0:52:26.7 Beth Fisher: Really?

0:52:27.7 Ava Ma De Sousa: Yeah.

0:52:29.6 Beth Fisher: I would hate that. I would truly hate that.

[laughter]

0:52:31.1 Ava Ma De Sousa: This is so interesting. I feel like there is a steady idea here.

0:52:33.9 Beth Fisher: Yeah, I know.

0:52:34.9 Ava Ma De Sousa: I feel like there is something about maybe ambiguity and the amount that we feel we understand versus the amount that we want to understand something.

0:52:42.2 Beth Fisher: And connection to uncertainty and then maybe how much prediction error we like. [laughter] So maybe I like to live a bit, but I just have that little bit more, I don't know.

0:52:52.4 Ava Ma De Sousa: That's very interesting. I wonder if this applies to dance. Maybe we should go to a dance show and see...

0:52:57.6 Beth Fisher: And see...

0:52:57.7 Ava Ma De Sousa: How we feel about it.

0:52:58.7 Beth Fisher: Yeah. And you guys should let us know what side of the spectrum you sit on. Are you a Beth or are you are an Ava? [laughter]

0:53:04.1 Ava Ma De Sousa: Yeah, I'm good. Yeah are you a Beth?

[laughter]

[music]

0:53:19.4 Ava Ma De Sousa: Our intro and outro music is Nobody Stayed For The DJ by Glassio. Our transition music is Back for More also by Glassio. Minds Matter is mixed, edited and created by Beth Fisher. She's the Australian one and me Ava Ma de Sousa. We'll be back in two weeks with a brand new episode of Minds Matter. In the meantime, find all our episodes and show notes on mindsmatterpodcast.com.