**Pandemic and Beyond Podcast 6: Motion Capture and Virtual Dance Performance with Dr Dan Strutt and Clemence Debaig**

*Pascale Aebischer:* Hello I’m Pascale Aebischer. Welcome to the sixth in a series of new podcasts from The Pandemic and Beyond, a project at the University of Exeter funded by the Arts and Humanities Research Council to show how research in the arts and humanities is helping us live through, make sense of and recover from the Covid-19 pandemic. We've all got used to having to adapt to not only not being able to be in the same space, but also to having to find digital substitutes for being together. But one of the most elusive things - and it's the thing that my dad tells me he misses most of everything - is the ability to touch each other. It’s also something that has really bedevilled many of the attempts at creating digital performances in which actors in separate locations interact with one another. Because even when they appear on the same screen together it's fiendishly difficult to create the illusion of co-presence, not least because the actors don't touch.

My guests today are Dr Daniel Strutt who's a lecturer in the department of Media Communications and Cultural Studies at Goldsmiths University of London and Clemence Debaig who is a London-based interaction designer, dance artist and creative technologist who also lectures on Creative Computing at Goldsmiths. And they've spent much of the past year, working on an AHRC funded project to develop a motion capture technology, one that does not depend on a camera and that enables dancers in separate locations to create virtual dance pieces together in which their digital avatars interact and are able, not just to touch, but actually to take on humanoid shapes and morph into one another. And it's been one of the great pleasures of my job in the past few weeks to actually watch those performances, which are quite extraordinary. Can I go over to you Dan and could you possibly tell me something about how your project started and why you were in the right place at the start of the pandemic to re-imagine how dancers could continue to dance together virtually.

*Dan Strutt:* Hi there, so well and in answer to that, I would stress initially that I’m not practitioner, I’m not a dancer in any meaningful sense. I was a pure ivory tower theorist coming from a film studies or film philosophy background. And through that thinking in terms of concepts of embodiment and stuff and I wrote a little bit about dance in my PhD thesis which later became a book: The Digital Image and Reality. But this led to a couple of digital dance collaborations and the most significant one was at the end of 2019 or beginning of 2020 where - it was a small partnership innovation fund - with a partner institution in Singapore called Lasalle. I reached out to an academic there who's a creative technologist who I could see had previously done something with dance and we put together a short proposal for a completely remote collaboration.

Lot of academics have been flying to and from Singapore within the remit of this fund and we saw an opportunity here to evidence a totally remote totally virtual collaboration using servers and repositories to share materials. It was largely successful in doing that in the first few months of 2020. Then, of course, the pandemic hit, and we were all working from our homes which made no difference to our research project because that's what we were doing anyway. But it made us realize how adaptive our project was to working under the conditions of social physical distancing and social isolation.

So when the AHRC funding call came around for ideas that address Covid I spoke to the dance partners that I’d previously worked with. Specifically, Mavin Khoo of Akram Khan Company. I spoke to him about the problems he was experiencing working through video conferencing software and you know the sense of distance there, so we put together a proposal for the AHRC and it was gladly accepted. This was offering a model for the streaming of motion capture data for a kind of more fully embodied engagement at a distance and providing evidence, essentially, for the ability for people to work together using choreography, using dance in a sustainable way. We've discovered ourselves offering also a vision of the future of that beyond simply the pandemic and ability to work at a distance. Of course it has certain affordances, certain limitations you could say. As well it's never going to be quite the same as being in the same room with someone, but it certainly provides a vision of what could be within a sustainable future for remote collaboration in performance.

*Pascale Aebischer:* That's really, really exciting. I’m just wondering whether you could paint a visual picture for our listeners of how this technology works and what a performance in a virtual space actually looks like because I have had heard a description of your project, and I had read one before actually seeing the work and then, when I saw the work I went: Oh well, that's what it means! So could you sort of fill in that sense of what it's like.

*Dan Strutt:* Yeah, I mean at its core, you know, there was a technical challenge which was simply to stream motion capture data. Now, what is motion capture data? It is simply like, several different sensors placed on the body that is put into binary code and transmitted across the world. Fortunately it's quite lightweight data, so it can be done. But that does not speak to the experience of dancing with another person in a virtual space or virtual landscape. Obviously, what we see is not - you know - the physical dancer themselves on the projected image. We see an avatar right? so it, you know it would be more familiar to people as if it was like a game space, perhaps. You’re aware of where the player is within that game space. But here we have a purely dance interaction. We're not battling monsters, although we could do this. We're not battling monsters, we’re interacting with another human being, or another humanoid avatar within that virtual space. They can even move through each other, of course, because there is no physical body and then you can also change the appearance of the avatar. So we can see, you know, a recognizably humanoid figure, but we could also add some kind of extension to the body. We can change the shape or scale of the body. Or we can take the body away completely and just have the movement, creating changes in the environment around - you know the hypothetical avatar. So while we lose a sense of the real, or the physical body, you know, in terms of gravity and sweat and stress and effort, perhaps we also gain a lot of other kind of effects - or expressions - of human movement. And somewhere in between all these elements we can have quite an evocative sense of space, of immersion and maybe also something that is quite novel in terms of dance performance.

*Pascale Aebischer:* It sounds to me like you know this is really trailblazing a new way of looking at dance as something that can be augmented by technology and that allows the human body to do things that the human body on its own is simply not capable of. And that we're actually moving towards a new aesthetic form that is virtual and where the human and the technology are interacting in very organic and intricate ways. I was, I was really struck when I was watching the videos. Sometimes you had on the side of the screen, while the main screen was showing the virtual performance… on the side of the screen you're actually showing the performers themselves wearing the motion capture suits in separate studios, performing their roles individually. And so on the main screen, you could see the composite image and the virtual image generated by their movements. My eye kept being drawn to the side of the screen to the real bodies of the actors - sorry to the dancers – and the interest for me lay in the relationship between the real body and the virtual body. That's something that I’ve noticed in theatrical avatar performances as well, that whenever there was a human body and an avatar at the same time, the eye is constantly drawn towards the human body. I’m just wondering whether the pandemic has changed that, in your view? whether we are now so used to virtual people rather than the real people, that we might actually be in a transitional phase where the virtual avatar becomes an acceptable substitute for the human body? I’m just wondering what your view is about this, this fixation on the real body and how the pandemic might be changing that - is it or is it not?

*Dan Strutt:* I would say that the reason we put in the real live video feed is purely for the audience really, you know it's to demonstrates the functionality of the system. Otherwise I don't think people would fully engage with the idea that there's a real person interacting in real time live with another dancer. So we put those insets in to spell it out, really. But from the point of view of the dancer in the suit, then this is redundant information. All they're seeing is the avatar of the other dancer and experiencing their live interaction with that. So from the dancer’s point of view I’d say their engagement with the digital avatar is totally immediate and natural and immersive. You know, we could talk about experiences of flow. And for the audience, I think we, you know, as I said before - a lot of people are used to kind of video game interactions with avatars more and more. I read a paper recently saying that something like 70% of UK residents have played some form of video games during lockdown during the pandemic, so increasingly you know people are getting used to these very natural, very intuitive interactions with digital avatars. But there is a need, I think, for us during the stages of research and when we're not really performing so much for showcasing what we think is possible, to really clearly spell it out for the audience what is actually happening here.

*Pascale Aebische*r: That's really helpful. I feel a little bit on the spot, as the audience member who is very transitional still not quite there yet, with it, with a purely virtual existence. Clemence you've actually danced in some of these virtual dance pieces and have experimented with the technology and with being in that virtual space with other people. Could you just tell us about what that feels like and what it's like to touch or not touch? What does it feel like when your body takes on a shape that isn't yours? and when it's able to do things that your own body can't do? and especially you know what happens inside your feelings and your brain when you are suddenly morphing into somebody else on the screen? because I can just imagine that must be one of the, the wildest and most exhilarating, but also bewildering and awful feelings?

*Clemence Debaig:* I think there's a lot in there to unpack because it's a very new experience for a dancer to step in those environments and step into the suit. I’m actually going to start with the second part of the question because this is what we've experienced as dancers, but it's also what I have observed with all the dancers we put in the system. They start by considering their own image and looking at the virtual representation as some sort of digital mirror and the fact of kind of puppeteering an avatar instead of having - this is my body that is interacting, I am manipulating an image that is not me that is then going to interact with the image of someone else that is behind the scene in a suit. So there's a little bit of abstraction there that is happening.

There's a bit of a learning curve, the first moments you’re completely absorbed by looking at your own image and the fun things you can do with your own body to animate this avatar. And then you start realizing that you can do more things, that there's like superpowers that emerge. So we've experimented with other shapes that are bit less humanoid. We had a fox, so how do you embody the fox to then animate this avatar? We had a flower where different parts of the body would animate the flower. For the people who haven't seen the performance, for example, we had the body whose length was representing the stem of the flower, but you have the petals around the head that were actually activated by the movement of the fingers. You can start giving life to a kind of inanimate object by your body movement and by using different parts of your body. So there's a lot of play around this in involving my own body and in moving those virtual elements.

On top of that, then there's the interaction with the other person. And I would kind of unpack this under more kind of improvisation games. You don't have the feeling of touching someone, but all the interactions we've created in those virtual worlds are actually amazing games on their own. A lot of dance with a partner is really playing with that other person and reproducing this in a virtual environment becomes really interesting. But those games are like completely different and then the digital technology enables us to create new forms of interactions. So, for example, we have experimented with this idea of virtual touch where, when the other avatar is changing colour, of course that will not happen in real life - but it becomes really interesting to see what we can do then when those new representations are happening in the virtual space. At first it's a little bit challenging to position yourself and understanding where the other person is. But then once you've done this work on kind of understanding that actually this is a person I’m touching, even if it's a virtual representation. You turn the lights off a little bit and can immerse yourself in the world… and it becomes really strong. And then I remember having a really kind of embodied feeling at first of having been isolated, for a long time, and I can now interact with another person in a very intimate manner. And it's not necessarily the physical sensation on my skin, but more this intimacy that has been created because it's two persons interacting, just in this bubble together, and living this moment together.

*Pascale Aebischer:* That sounds really powerful, and I love the way, in the absence of actual touch of haptic contact and feedback on your hands, that you've activated through the technology, a different sense - the sense of sight through the colour changes. So that when one sensory tool isn't available to us, we can replace it imaginatively, almost metaphorically, with another sensory tool. You've talked about how the technology allows you to do things that you can't normally do with the limitations of your human body. Are there other ways in which the technology is also constraining you and limiting you in what you can do as a dancer?

*Clemence Debaig:* So there's the practicality of wearing a suit that is already to be considered a little bit. The suit is a beauty of technology, it is very minimal and it's actually very light on the body, but they still you know, you have sensors on different parts of your body, you need to be a little bit careful when going to the floor, for example. This you know gets in the way a little bit. But I would say the biggest challenge has been to navigate the space, and what is my physical space versus the virtual space? and how do I find the other person in this space? We are currently in our first version as well a bit constrained by our setup where the dancer has to look at the screen. So we are in - at least the people who are with us in Goldsmiths are in – a really big production space. The other dancers who are remote are looking at it on the small computer screen, which means they have to pay attention to what's happening to be able to interact with the other dancer. So we're not yet in a fully immersive environment where you can turn around and if the person is behind you, you can still interact. We are looking at potentially putting this into virtual reality, where we will have a bit more flexibility in the space. We still don't know what that means to dance in virtual reality with a headset on your head so there's a lot of interesting research questions there.

But almost to flip your question, one thing that was also really interesting in working with those limitations, is how the body is able to adapt. You were talking earlier about this parallel between the dancer that we see on the video and the avatar. We've seen a lot of really interesting embodiment of the avatar and working with the limitations. So to give you an example, obviously the fox is an obvious one when you have to kind of embody the animal. But we also had one that was a – we call it bubble gum - where the avatar is kind of quite flexible and they can merge with each other. One thing we've noticed is, for example, if you wanted to express being sad you might want to put your hand on your head. In real life, you could put your fingers against your forehead. But with an avatar your virtual head might be bigger or your virtual hands might be bigger so you need to understand that, for it to be visible, you need to put your hands a little bit further away. And then very naturally you have this relationship between the image, you see, and the way you adapt your body to really embody those characters and then what's happening in real life gets also really, really interesting.

*Pascale Aebischer*: That's utterly fascinating. It sounds like the limitations are actually something that makes you grow in new directions that are not entirely foreseen but that are worth exploring further in in all sorts of different ways. And what you're saying there about dancing with a virtual headset on - I can imagine that that actually has some sort of commercial opportunities in it as well. I’m just wondering how expensive, is it to do this sort of work? And does it have a commercial future? how portable is that technology we're talking about? An immersive room in which you might be able to see yourself on a screen, whichever way you turn that that sounds like a pretty high-tech environment to me. So what do you see as the sort of the practical commercial at financial limitations and opportunities of this?

*Clemence Debaig:* I can start on this and I’m sure Dan will have more kind of future versions of this. I think there's a difference between what we can do in the research context to push the boundaries of the technology and how we can bring it back to something a little bit more accessible. At the moment, and Dan will be able to give you proper numbers, but the suit is fairly expensive. If you take just a dance practitioner, it will probably be a little bit beyond their budget. We then, we are talking about the space where if we wanted to have a proper immersive space, we need to have several projectors, you need to hire a venue, so this is quite heavy investment. But if we look at the way we've set it up just for our showcase, we have the opportunity to have two dancers dancing, one from their living room, one in their daughter's bedroom. That has tremendous opportunities, then in terms of reducing costs for a production. I’ve personally, with my own dance company that's called Unwired Dance Theatre, I have worked a lot with dance and technology. And I have performed in virtual reality from my living room during the pandemic and now, when I’m looking at budgets to produce new shows, there’s do I hire a rehearsal studio? or are we able to do this remotely? maybe invest in the tech upfront but then the ongoing costs is much lower. And then we can think you know beyond having massive rooms with immersive technologies, a headset now costs about £300, so it's becoming more and more accessible for dance companies

*Pascale Aebischer*: Dan over to you. What sorts of opportunities do you see for commercial exploitation and how portable and flexible is this technology? I am really taken with Clemence’s idea of people dancing in their children's bedrooms and, that being a real cost cutting opportunity for people who are in far removed sort of geographical locations to get together and do work together without having to travel. So what are the opportunities?

*Dan Strutt:* Um yeah Well, first I’m saying, as always for the AHRC funding proposal, it was an absolute priority of ours, that this was in some way accessible to small and medium sized dance companies, maybe not individuals, but small and medium sized dance companies. Because the technology that we're using, which is an inertial motion sensor – they’re called IMUs - these have only been around for about six years on the consumer market. And previous to that the only other motion capture systems were very expensive studio systems where markers are placed on the body and there's multiple cameras.

These were simply not accessible, except to the most you know highbrow highly financed dance companies.

So it was always an emphasis, for us, that this was in some way accessible, affordable to a range of different people. And what we discovered, as I think, from what Clem said, you would get the idea that there's multiple different points of entry here, you know from the very very cheap to the more expensive.

One thing that we're certainly focused on in the future and for follow up funding bids is the interoperability of different systems. So you can have someone with a very expensive system, working with someone who's doing motion capture with simply a camera that's embedded into their existing computer and have some way that people can be working within their own spaces coming together in virtual spaces for some kind of interaction. The prices are coming down rapidly, you know, like I say six years ago, these IMU motion capture systems came on the market and already they’ve come down dramatically in price, because of competition. So I don't think we could say that this is inaccessible technology. I think it's almost inevitable that people will be engaging in this kind of fully embodied interactions in virtual spaces in the very, very near future. And it's simply a matter of making that more user friendly and more affordable for a range of different people - not just don't dancers but also gamers, performers and just bedroom enthusiasts.

*Pascale Aebischer*: Well, I think I'm a convert and the bedroom enthusiast to come! But who do you think the audiences for these sorts of dance performances are? and what is the role of the work that you're doing within the wider creative economy of the UK? is there a sense that this is something that is being done elsewhere or is this something unique to the work that you're doing and is actually opening the doors to the UK = re-emerging from the pandemic with more tools and a greater ability to hold its own in the global market?

*Dan Strutt:* I would say, you know as evidenced by recent government industrial strategy funding through schemes such as Audience of the Future, which was specifically about immersive technology, there was a huge drive and a huge interest to position the UK at the head all this kind of industry. I mean a lot of gaming happens in the UK and what we're doing naturally fits in with a lot of the tools that are developed for the gaming industry, which is obviously very well financed already. A huge amount of revenue come through gaming into the UK. So we're hoping to piggyback on that and say look, these are affordable consumer technologies that can be used within an arts and performance context.

A lot of the stuff that is being developed at the moment, and specifically The Royal Shakespeare company project that is almost doing something very similar to what we're doing, but in a theatre context, and also with a very expensive setup. You know I kind of think of our project as counterpoint to that – I love what they're doing, but we're doing it a lot cheaper and even though their system may be more efficient and more robust like I say there's different levels of entry here. So whatever we can do to make a use case or a clear case for the efficiency of a relatively low cost system, I think it'd be very productive for the future of the immersive technology economy let's say in the UK.

*Pascale Aebischer*: That is a perfect point to stop,with a view of a future in which we are all able to do this sort of work and access it at the level that is appropriate for our own needs. So, thank you very much, Dan and Clemence, for being my guests today. The Pandemic and Beyond team are Sarah Hartley, Victoria Tischler, Des Fitzgerald, Rachael Nicholas, Benedict Morrison, Garth Davies and me Pascale Aebischer.

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