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Technology and Dance

A still frame from the movie *Nightsss*

Sandra Frydrysiak from the Institute of Humanities at the SWPS University in Warsaw talks about what dance teaches us about the human brain and the ways in which we experience the world around us.

Where did you get the idea to conduct research combining technology and dance?

SANDRA FRYDRYSIAK: I have been studying dance and its history for a long time. In the 1960s, this field of art started to be strongly influenced by technology. What I mean here are new technologies, such as the Sony camera, which started to be used to record rehearsals, movement, and performances. Before that, there were notation systems for recording and analyzing human movement, but it was the arrival of new technologies that revolutionized the world of dance. Back then, systems were created that made it possible to design sequences of movements, so technology was given creative power through the use of appropriate software. Examples include systems that generate new choreographies.

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At the same time, dance also entered the world of science. Scholars began to take a broader interest in the body and movements, abandoning the traditional binarism of the body and the mind. The Cartesian myth, which had persisted for centuries, faded away, and a human being started to be perceived as an entity whose body and mind were inextricably entwined. This was reflected in postmodern dance and the New York avant-garde, which reinvented dance and movement. It moved away from the understanding of dance solely as a transmitter of emotions and stories by focusing on the body and its ways to get to know the surrounding world, possible movements, and characteristics of everyday movements. All of a sudden, everything started to be perceived as dance. Even walking the streets was interpreted as practicing choreography.

In other words, an absolute revolution took place in thinking about the body, dance, and movement, both in art and in science. The 1990s and 2000s witnessed groundbreaking studies on the issue of dance in cognitive neuroscience and other neurosciences. Before that, the 1990s saw the discovery of mirror neurons, which adjust their activity in response to specific stimuli. Mirror neurons were first discovered in macaques, but the presence of such systems was later noted also in humans. The discovery was made at the University of Parma, where a team of researchers led by Giacomo Rizzolatti noticed that certain areas of neurons activated in animals both when they reached for food on their own and when they saw a researcher do so. In other words, it turned out that we internalize the movements we watch. Neurons reflect the movement we see like a mirror, which means that the processes that occur in the brain when we see someone dance are similar to those occurring when we ourselves are dancing. This discovery shed new light on the perception and understanding of dance. After all, watching dance is about "feeling" it, about its internalization. People who see others dance are also "dancing" in their brains. Research shows that this attunement pertains both to the body and to emotions.

Even before cognitive neuroscience started to study dance, movement, and dancers in laboratories, other disciplines and philosophies, such as phenomenology, claimed that there is an ever-present connection between body and mind. These two entities started to be understood as inextricably linked. This was coupled with the development of philosophy of mind and cognitive science, which is a sub-discipline of philosophy that deals with the ways in which we get to know the world. It was argued that cognition happens not only through the mind – rather, the body, too, has its impact on the process of perception and is actively used to explore the world. There are many theories in cognitive science that attempt to explain the exact mechanism of this exploration. Dancers, on the other hand, are experts on movement and exploration of the space surrounding them. They constantly interact and enter into relationships with other subjects and with their environment.

Such topics are also addressed by early childhood psychology. For example, Daniel Stern studied the infant–mother relationship and discussed what is referred to as affective attunement. It refers to the communication between the primary carer and the newborn child that takes place on an emotional level. The infant cannot tell the mother what it needs, but the mother still knows, because they communicate at the level of the body, movements, gestures, and emotions by using what we might call shared choreography. Attunement means that the mother shares the child's emotions and therefore knows what the child needs. Stern's research has been further developed by

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Prof. Joanna Rączaszek-Leonardi, a Polish researcher who spent years studying non-verbal bonding between mothers and infants.

Other disciplines that study movement include ecological psychology. It studies our relationship with the environment and the ways in which we explore it. Likewise, this discipline doesn't restrict itself to studying the mind. It takes into account the fact that we also experience the world around us using our bodies: through movements and – what is crucial in this approach – our interactions with other elements of reality such as nature, architecture, and so on. This phenomenon is also described by philosophy and kinesthetics. These disciplines search for answers to the question of how the information we obtain using senses, such as the sense of touch and smell, becomes attuned within the body in a way that allows us to get to know the world we live in. Kinesthetics, as a discipline understood in this way, has been developing since the early 20th century, but dancers have been using this knowledge for a long time. The meaning behind affective attunement has long been clear to dancers, who know how to learn movements from others.

All these concepts have informed one another, and they now function within the broad paradigm of art & science, one in which the fields of art and science meet through technology. Prof. Ryszard Kluszczyński, a Polish researcher of culture from the University of Lodz, has partially introduced this paradigm in Poland. He proposes using the term art@science, instead of art & science, to stress the role of technology in mediating between art and science.

What is the relationship between science and art?

This relationship can take on different forms. Prof. Kluszczyński writes about three ideal ones that may nonetheless be mixed in practice. The first of these is called "art for science." There, science is inspired by art and takes something from it just for itself. The second is called "science for art." In this relationship, art takes advantage of scientific achievements and discoveries. The third is called "art for reality." In this relationship, these two fields not only inspire each other, but also have an impact on society.

In my opinion, the projects that fall under the scope of this third form are the most interesting ones. I am greatly impressed by the work of BeAnotherLab, an interdisciplinary group of researchers, artists, and IT experts. For example, BeAnotherLab has conducted research on dancers with mobility impairments, who use wheelchairs, and dancers without such limitations to see how they learn choreography from one another. In addition, software developed for the rehabilitation of people with nervous system injuries has been made available under a free license. It involves training neuronal pathways in virtual reality settings to restore physical fitness.

In the cognitive neuroscience of dance, which I have studied, this interdisciplinary approach allows us to better understand the phenomena of the cognition of movements, perception, and attention processes. This offers insights not only into how people learn to dance. Other things that science takes from the world of dance are ways of thinking and perceiving things, and these findings can be transferred to other disciplines, to general human knowledge. This is what art & science is all about – about how various disciplines intermingle and draw inspiration from one another.

Does technology act as an intermediary in this process?

Yes, but we should also look at its role critically. Sometimes technologies act as distorting lenses. We need to remember that they do not reveal the whole truth and the whole of human nature, but only their fragments, such as neuronal activity in a particular area, which

we can then interpret. We must be careful to keep in perspective the results that we obtain by using research technologies. We must be aware that this picture is far from complete. But it is thanks to technology that discoveries are often made.

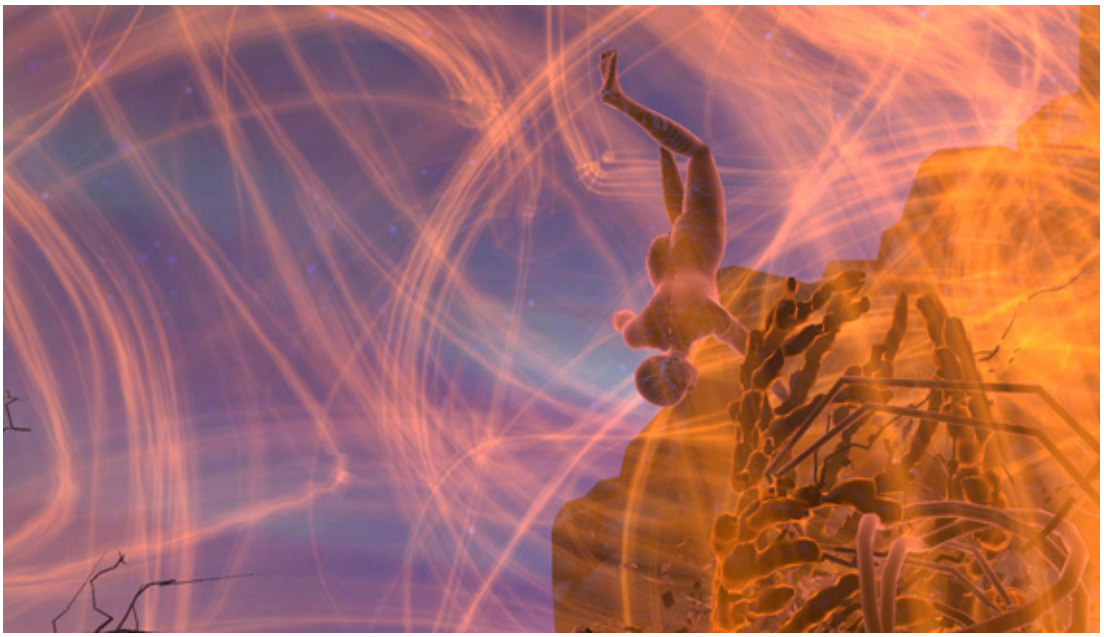
In this approach, are you a scientist or an artist?

I have a doctorate in cultural studies, and also degrees in international relations, sociology, and gender studies. I study feminist theory and conduct training in equality, diversity, and inclusivity. I encountered cognitive neuroscience science and technology along the way. I have now returned to collaboration with the VR Lab in the PAS Institute of Psychology on research into movement in virtual reality. I have no background in clinical psychology or neuropsychology, but these are important fields that must not be ignored in my – interdisciplinary – research area. In the phrase "art & science," science is typically associated with natural sciences, but even Prof. Kluszczyński argues that the term should also include the humanities and social sciences. For that matter, divisions into disciplines are often artificial, and art & science projects that also encompass humanities and social sciences prove it. Everything boils down to scientific thinking, which is not restricted to neurology or biology, although they use different tools.

For more than a decade, I was professionally involved in dance. Today, I am mainly a theoretician and a researcher involved in artistic activity. Together with the researcher and artist Weronika Lewandowska, we directed a VR movie entitled *Nightsss*. I use the word "movie," but this is not exactly a movie. It's a computer-generated virtual reality animation whose viewers are also participants in this reality. The movie was shown for example during the Przemiany Festival in the Copernicus Science Centre in October 2021.

In the context of virtual reality, two words are important: immersion and experience. This means that we immerse ourselves in a specific world, which is basically what happens when we are watching a movie or reading a book. Immersion can have different depths. In the most common VR settings, referred to as Three Degrees of Freedom, or 3DoF, we can only move our heads, but we can't move throughout the virtual space. In Six Degrees of Freedom, or 6DoF, we can move our whole bodies and interact with the virtual reality environment. In addition to experiencing this world through the senses of hearing and sight, we can activate our whole bodies. We can move around the virtual world in real time and interact with objects. In such situations, we can talk about deeper immersion. This also holds true for *Nightsss*. We have created what can be described as a both esthetic and cognitive experience, namely one in which you can move and use the sense of touch. You are invited to participate. It was shown at the Sundance Film Festival and caused quite a sensation. I think the movie was noticed precisely because it was created in the spirit of art & science. We designed an art experience, but we did so using science, and the goal was to test our hypotheses in real life. We will continue this research in the VR Lab, looking for answers to various questions. For example, is there room for empathy in such worlds? We will use various qualitative methods to study how people perceive such experiences, but we will also use cognitive neuroscience methods to study brain activity in the area of mirror neurons.

Interview by **Justyna Orłowska, PhD**



A still frame from the movie *Nightsss*