Improvisation in dance with technological mediation: An investigation through studies of situation cognition

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Abstract: Situated cognition seems to be one of the relevant pillars in the literature on embodied cognition: a matter of understanding the subject and its cognition in involved and mutual manner. This is a continuous process in which the flow of information affects the body, the world, and the very process of engagement. Dance should be deemed as situated cognition. Thus, assuming that contextual interdependence, one can confirm that improvisation in dance constructs specific conceptual system processes in which movement emerges from actions and reactions from stimuli promoted, systematically, in real time. Unlike pre-determined situations (such as dances created through choreography), training for dance improvisation gives priority to sharpening the dancers' perception for action in terms of preparing them with good sensorimotor knowledge. The analytical focus of this article engages in the area of improvisational dances performed in sensitive environments mediated by digital technologies. In those contexts, new semantic layers, other levels of spatiotemporal relations, and different possibilities of interaction between the group of dancers and between them and their own computational devices emerge. Through concepts such as embodiment, enaction, actionism, and empathy, we are

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PUBLIC INTEREST STATEMENT

This article discusses new understandings on the presence of a dancer who is performing as an image or as some graphic representation in a dance piece created with new technologies. We discuss how one can dance with someone who is not there in flesh-and-blood, but with a projection of the remote partner who is in another place in the meantime. In our digital culture, we communicate with friends through WhatsApp, Skype, and other digital tools, and believe that they are there with us when we contact them. This article brings an analysis of some dance pieces to reflect about the perception and the action of the dancers in those contexts.
interested in addressing the notion of presence in systems of improvisation in dance in that context. In order to do that, we consider dance with technological mediation as a cognitive artifact and empathy as one of the conditions for interaction between dancers and their relationship between physical and virtual bodies.

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Keywords: improvisation in dance; dance mediated by digital technology; perception; situated cognition; embodiment; empathy

Knowledge doesn’t fix reference; knowledge enables access.

Noë (2012)

1. Introduction
This article focuses on dance performed with technological mediation, centering only on works that use improvisation as a creative strategy for artistic achievement, demonstrated in performances created for sensitive and interactive systems, in distributed and telematics spaces, installation, and screendance.¹ Those artistic configurations present other possibilities for the bodies and hence carry specific procedures for relationships and actuation, since they are in a steadily constructed dynamic system. In those contexts, new semantic layers arise: other levels of spatiotemporal relationships and different possibilities of interaction among the group of dancers and between those and their own computing devices. Thus, we wish to investigate: how are the various presences of physical and virtual bodies perceived in dances create in real time? In other words, is there a perceptual experience of those different presences that provide paths for a dance improvisation to occur? And we could also ask ourselves: how is this notion of presence experienced when many of those “states of being” are often abstract and even appear to be anthropomorphic representations?—how, then, can we understand them as subjects, partners with whom we can improvise in dance?

It is our belief that investigation can be better supported by cognitive studies. In this article, we assume the perspective of embodied mind (Varela, Thompson, & Rosch, 1991) in conjunction with the understanding of a situated cognition. We start from the premise that the subject and his/her cognition are mutually implicated, and that there is an engagement with the world that he/she inhabits (cultural, social, physical), a world that the cognitive subject is constantly exploring. That is a continuous process in which the flow of information affects the body (in the body and mind sense), the world and the very process of engagement. Situated cognition inherently involves perception and action: the condition for humans to know and apprehend the environment which they belong, its elements, and themselves. This is the meaning of the term: “enactive to emphasize the growing conviction that cognition is not the representation of a pre-given world by the pre-given mind but is rather the enactment of the world and the mind on the basis of the history of the variety of actions that a being in the world performs” (Varela et al., 1991, p. 9).

Through concepts such as embodiment (Lakoff & Jonhson, 1999), enaction (Varela et al., 1991), actionism (Noë, 2004, 2012), and empathy (Curtis, 2012), we can draw some arguments about, for example, the importance of the attention given to the improvement in decision-making for the development of dance improvisation; aspects that help the dancer’s readiness in the act of improvising and of understanding the presence of digital bodies captured through dance environments with technological mediation. Thus, the goal is to achieve the understanding of presence that goes beyond the obvious unique condition of being here-and-now and in flesh-and-blood. This repositioning may contribute to the understanding, learning, development, and execution of artistic works in
which biological and non-biological bodies must interact. For the philosopher Andy Clark (2003), one of the greatest capacities of our biological being is the ability to engage with non-biological beings.

Dance, as any other knowledge, is a reflection of situated cognition. That is, we are beings in the world; beings and the world that are not separate, but related, co-dependent, and co-evolutionary. Seen in this light, dance’s interest in integrating digital devices and environments into its creative processes cannot be seen as a mere utilitarian necessity. In other words, it is not just an update and a sophistication of the scenic infrastructure, set design, lighting, sound, or anything else. Rather, mediation with digital technologies promotes other perceptual systems, stimulating other sensorimotor relationships and different possibilities to act and interact with the environment, thereby offering new esthetic possibilities.

This article analyzes some artistic projects—Disturbance (2012); Le Moi, Le Cristal et L’Eau (2007); Embodied in Varios Darmstad 58 (2013); “e fez o homem a sua diferença” (2005)—following those concepts and arguments to think about the varieties of presence into the dance field and how they are implicated with the perceptual experience.

2. Understanding digital dance from the perspective of cognitive sciences

Studies on cognitive sciences, especially those on situated cognition and embodied perspective, are widely used in the field of dance, probably because they restore the importance of sensorimotor apparatus. For me, it has been a very fertile and coherent field of study from which to address the body’s relationship with digital media. Since the 1990’s, I have created performative actions, performances, images, and installations that seek to incite further experiences in doing and enjoying contemporary dance. I am interested in the study of perception in order to create new “sensitiveness”. Possibilities conquered with digital technology, continuously expanding, have allowed us to address issues of body and movement through unique experiences only available now through the advent of digital innovations, a transmutation process of the world of things into “0s” and “1s”. In following those codes, decoding is performed in a wide spectrum of conditions, i.e. a moving body can be encoded (become binary data) and then be turned (decoded) into sound, picture, and other solids forms, the latter by means of 3D printer. In these decades of artistic and academic research—the two modalities that have always been intertwined in my life—some questions have always accompanied me. They are involved with how the body “exists” in dance (or perhaps more generally in Art, that interests me): how we understand the body; how we perceive it; what the possibilities of moving it are, or perhaps, better, of feeling it, in which body dance can happen, and so on.

Those may be common inferences to all who are immersed in the universe of dance for a long time, a fact that explains principally, but not exclusively, those who approached technologies as a way of providing other possibilities to see dance. Age-old examples can be offered to illustrate how those questions influenced dance, even before the digital world. For example, dance underwent huge changes with the arrival of electricity, when it was not just the body that danced. It is seen in the example of the American dancer Loïs Fuller’s 1890 spectacle of dancing lights, the Serpentine Dance, “fée électricité” [fairy electricity] in Paris, The City of Light, where she spent much of her life up to her death.

Even before the popularization of digital media or its application in the field of dance, Merce Cunningham already imagined the possibility of the dance being visible in a virtual body:

A situation that strikes me as being immediately accessible to the dancer would be ... like this: on the ... screen, images in stick-figures ... This screen is the notation. The shapes move in depth giving accurate details as to the movement, the time is indicated on the side by conventional musical score or by second, minutes-hours, the space is defined by outlines indicating edge of stage, wings if needed, downstage etc. If the space is unconventional this also can be indicated. (Cunningham (1968), apud Schiphorst, 1986, p. 25)
Approximately 20 years after that, dance was able to be created in animation softwares,\(^2\) such as Life Forms.\(^1\) Since then, many graphical representations have been used in the dance field. An important and more contemporary example can be given with the project Synchronous Object,\(^4\) directed by William Forsythe, Mary Palozzi, and Norah Zuniga Shaw, and created from the production One Flat Thing, Reproduced (2000) by Forsythe. The website starts with the question: “What else might physical thinking look like?” Thinking about the purpose of this article, I could add to that question: how are moving images of physical thinking embodied when they are used during the actual execution of the work, as in the examples we are using here for the analysis?

Just to finalize those examples of “which body can dance exist in?”, it is important to mention the screendance *Birds* (1999), by David Hinton. The film was edited with archival footage on the social behavior of birds, their feeding and breeding. Hinton uses only birds in a narrative that employs repetition devices to create dialogues between characters (the birds), favoring anthropomorphism: “[Hinton also uses] an element of choreographic composition in the film. In the longer sequences’ repetitions, a certain amount of contraction occurs; i.e. frames are removed from each clip as the sequence progresses” (Mcpherson & Fields, 2009, p. 53). To date, festivals of screendance debate whether *Birds* is or is not a work of dance, since there are no dancers or any human individuals in the video.

Thinking of those forms as dance events, whether they be “the luminance of electricity” of Fuller; avatars of animation softwares, like in Life Forms and in the other software that came after it; translated images of the parameters of dance, as in Synchronous Object; or moments when only parameters are indicated, as in *Birds*, all are considered here as varieties of presence of the moving body, of dance. In my view, what we see dancing in *Birds* is David Hinton’s physical thinking, his situated cognition. Namely, his concepts and bodily understandings of dance, which he applied in the assembling and editing of those images in which we see his thoughts about dance.

However, in the focus of this article, the question arises as to how the dancer, himself/herself, deals with a dance in which his/her partner is perceived in one of the presence conditions, the physical thinking, with which he/she will be continuously interacting during improvisation. I consider the conditions as varieties of presence, following the reflections of the philosopher Noë (2012). He affirms that our perceptual experience takes truly distinct forms of presence, even if they are fragile, since there are various gradations, qualities, and modalities of presence. Noë considers that thinking and perceiving those varieties of presence is a matter of “style”, in the sense of referring to different possibilities of access to the world. In the philosopher’s words:

> My proposal is that the distinction between thought and perception, like the distinction within the category of perception among the different sensory modalities, is a distinction among different styles of access to what there is. Thought and perception differ as styles differ. A style is a way of doing something—dressing, writing, singing, painting, dancing. Thought and experience are different styles of exploring and achieving, or trying to achieve, access to the world. (Noë, 2012, p. 33)

Noë discusses perception (and the varieties of presence) with the understanding of actionism (Noë, 2012), which incorporates and expands the concept of enaction (Varela et al., 1991), as well as emphasizing, forcefully, sensorimotor understanding.

Perceptual experience acquires content thanks to our possession of bodily skills. What we perceive is determined by what we do (or what we know how to do); it is determined by what we are ready to do. In ways I try to make precise, we enact our perceptual experience; we act it out. (Noë, 2004, p. 1)

The sensorimotor approach is the cornerstone for many scholars of cognition studies, and also here in this article. During the last decade (or more), concepts such as embodiment, enaction, and extended mind (also distributed cognition) have been found in studies of dance. The most important
reason for that is the idea that the brain and the body are both involved in the cognition process, and that is the embodiment thesis. Thus, considering dance, we can say: what we learn, practice, and create with the body as dancers is not a matter of motricity only.

After all, our sensory and motor capacities depend on more than just the workings of the brain and spinal cord; they also depend on the workings of other parts of the body, such as the sensory organs, the musculoskeletal system, and relevant parts of the peripheral nervous system (e.g. sensory and motor nerves). Without the cooperation of the body, there can be no sensory inputs from the environment and no motor outputs from the agent—hence, no sensing or acting. And without sensing and acting to ground it, thought is empty. (Robbins & Aydede, 2009, p. 4)

In some ways, our dance movements are also implicated in our cognition process (in the construction of our concepts about the world, the things that exist in it, and about ourselves), because this “cognitive activity routinely exploits structure in the natural and social environment (the embedding thesis). The boundaries of cognition extend beyond the boundaries of individual organism (the extension thesis)” (Robbins & Aydede, 2009, p. 3).

In the case of the artistic projects discussed in this article, the dancer avatar, the technological interfaces, the dancer’s image that achieves the remote partner, all of them are understood here as cognitive artifacts which matter for the situated cognition. This is a brief overview of those important concepts which are explored here to argue about the presence in telematics systems of dance. This section is just a bird’s-eye view of situated cognition to introduce the terms and how they are related with my understanding of dance mediated by new technologies. Situated cognition studies “is a loose-knit family or approaches to understanding the mind and cognition” (Wilson & Clark, 2009, p. 55).

This article is an effort to reflect about the relationship of dancers that interact with each other through synthetic information (i.e. digital image, sound, data) based on the concepts indicated in the first section: embodiment (Lakoff & Johnson, 1999)—the dancer is implicated with technologies and devices that he/she uses to dance and to create dance—and enaction (Varela et al., 1991)/actionism (Noë, 2004, 2012)—those cognitive artifacts used in dance are very important to the dancer’s perceptual process. This analysis is also based on the concept of empathy (Curtis, 2012), which will be discussed in the Section 5. For now, it’s important to realize that empathy is a condition for dancers to understand one another during telematics dance. They can feel each other because there is empathy contributing in the process of perceiving (and acting with) the partner and the environment during the art piece. However, it is very important to observe that this article’s goal is not to discuss the audience reception, as several studies about empathy and arts have done. The interest here is the internal relationship between the dancers, in order to think about presence in those distributed project where subjects are located in geographically distant places.

3. Disturbance—a discussion from the perspective of embodiment, enaction and actionism

In 2012, I conducted a scenic study called Disturbance in partnership with the musician Pedro Rebelo. Two wireless lapel microphones were attached to my hands and to my back (at the waist height) and I carried a small wireless speaker. Behind the curtain, on the back of the stage, there were four highly potent speakers. The intention was to create sounds through audio feedback according to the movements performed in improvisation. Despite having studied the potential of the speakers and microphones over the work’s development, and have had explored several times the types of sound that audio feedback could realize during the performance, I did not rely on any of the calculated conditions. Rather, I let myself be led by the sensorimotor perception of my body in contact with the sound I was producing. The sound became “solid but flexible” in my hands. My partner and I off-loaded our cognition into that space resulting in an engagement between my body and the environment. I did not think about the outcome, but literally felt the sound in my hands—the sensation was of modeling the sound in space with my own body. There was not an internal thinking about
what and how to do the movement. There were no movements pre-organized to be done. There were no scores, symbols, or previous representation to conduct the movement. Our experience and studies of audio feedback were organized in the space configuration (the speakers behind the curtain and the small speaker in my back), in the filters created with the software MAX MSP, and in my body that had the memory of those sensations to create, perceive, and re-construct the audio feedback. That is situated cognition.

The experience, in my view, is related to studies conducted on the game Tetris, in which the player has to fit the pieces falling into the bottom of the screen. Some Tetris researches argue that experienced players did not think about how and whether they should rotate the pieces, they simply rotated it to fit into place. That is a matter of sensorimotor knowledge that does not go through an instance of judgment and decision. The body simply knows!

We use the cognitive strategy all the time in our daily lives in various manners to off-load cognitive work. When we adjust our direction on the map when referring to an address, indicating directions and roads with our arms; when we mark off dance steps with small hands gestures and our body’s direction; and, in a non-spatial sense, when we organize our thoughts in conceptual diagrams, as shown in Figure 1, which I schematically set out to illustrate the discussion of this article. Even the gestures used as we speak should not be considered just an epiphenomenon, since they are cognitive strategies that help our bodies to save energy, as well as speech—gestures are also part of a cognitive strategy.

My explanation above was to demonstrate how the piece Disturbance is very interesting for understanding the idea of embodiment and enaction/actionism. It was a strong experience for me to realize how my body had to perceive and act to create sound in real time.

That was a very different experience from those created into interactive systems. The later have the possibilities of interaction, since they have parameters and data already fixed in the computer. The acoustic systems react in a very distinct and unpredictable way. However, in both systems...
(interactive and acoustic) an embodiment process occurs, but the acoustic system seems to demand more attention from the dancer, because real time brings new perceptions (unpredictable) at every instant, demanding new actions. The aim in describing Disturbance was to emphasize the sensorimotor aspect in a highly demanding situation as the acoustic effect is not controllable. My knowledge of that system could increase just as my action in that space did.

4. Telematics body, a variety of presence
In the piece Le Moi, Le Cristal et L’Eau (Me, the Crystal and the Water, 2007) that I created during my residency at the Center National Chorégraphique—Pavillon Noir, a traditional stage was re-dimensioned to establish spaces for both the public and the dancers. According to my esthetic approach, dance is considered as a system, and the environment (including what is contained in it) goes far beyond the constraints of a black and neutral box. The architecture itself, the furniture and machinery that the Pavillon Noir houses were part of the dance. The theater itself is already the scenario. The spectators entered on the exit door that was closest to the stage access. Both the audience and the dancers were distributed throughout the theater space, and each zone of the area was conceived as sub-sections, called niches. The image of each of those niches was screened in various projections around the space, such as TV sets that were moved continuously from location to location. Through this multiplication and displacement of the dancers’ image, several connections were established between them.

In Figures 2a, 2b, and 2c, we can see the junction of three niches. In one, the dancer remained almost fixed throughout the performance, her face was wrapped up in a wire that descended from the theater scaffolding (Figure 3). The wire, which gave the impression of being endless, served as a metaphor to address the destruction of our identity, often imposed by contemporary societies. The aim of the work was to discuss concepts and identity positioning in today’s world.

In a second niche, the image of the dancer Maria Fernanda was projected in a passageway where small scenes were developed. In Figures 2a and 2b, we can see two small scenes: in Figure 2a there is another image—from niche 3—superimposed on Maria Fernanda’s niche, in which the dancer Juliana Rocha appears, although she was located in another point of the scenic area. She was positioned in a frontal plane to the camera, forming what we call a “window” since, by being in close-up,
it formed a frame for the other elements (in this case, Maria Fernanda’ image). Thus, it become a “portal” through which one could see the other events, as well as a connected space for images, creating an ambience between Maria Fernanda’s niche and the dancer in the passageway space. At that moment (Figure 2a), Hugo Leonardo and Flávia Castagno were interacting with Maria Fernanda and Juliana Rocha through their images. And in Figure 2b, the image in close-up (niche 3) disappears and the second niche was only Flávia dancing with her virtual partner (Maria Fernanda).
From the descriptions, we can extract several arguments about the meaning of presence for each of the dancers and how they interacted with the images of the others and of the self. The relationship between them was established by this imagistic portal constructed in real time. For them, the way to get in touch with each other was very kinesthetic and demanded the same readiness as if they were face-to-face in a physical relationship.

By having his image multiplied (Figure 2a), Hugo Leonardo danced at the same time with Juliana and Maria Fernanda, thus, igniting other sensorimotor stimulations that could only be experienced through technological mediation. When the dancer left the passageway niche, Fidavia remained in it and intensified her relationship with the virtual space, since she had to keep her own image in the right spot of the remote space (i.e. the other niche) and her movements, created by improvisation, had to ensure the complicity and interaction with her partner who was still blindfolded. Even Maria Fernanda, devoid of her vision, remained in perceptive awareness of her colleagues. This is a point that must be emphasized: the relationship of those presence variations are not only in the dialog with the audiovisual.

Thus, it is an error to assume that the presence of the other should be considered only when it is here-and-now, in flesh-and-blood, as currently noted in the parlance and understanding of contemporary everyday life. That is a misconception about the real possibility of perception. As Noë has stated, “real presence,” if we think of this as the presence that would be afforded by the existence of detailed internalizations of everything, is a myth. Presence as access is as real as presence gets, and that’s real enough” (Noë, 2012, p. 33). “Presence is a matter of degree” (Noë, 2012, p. 34).

In that sense, I can assume that the degree of presence in each of those layers was enough for a dancer to access the other or the remote environment. This aspect of presence, that can even be considered fragile (Noë, 2012), therefore, demonstrates that it possesses the means to create conditions of engagement with the other. The sensorimotor apparatus finds other ways of reaching that image (and that subject): they are reached by the retina, by the perceptual intermodality that allows an effective experience of the perception of presence. Thus, the dancer is not dancing with an image, but he/she is dancing with another subject, with the presence of the other dancer in some degree.
Perceptual experience (even the vision) does not happen like the sight of a picture on the wall, represented in a finished and inert form. We do not access the world in a ready-made and set form, and yet we are entirely certain that we feel a complete perceptual experience. That traditional understanding must be replaced by another one: we perceive the world from our sensorimotor skills; perception is linked to our ability to move and explore the world, for it is through our actions in the environment and our relationships with objects that perceptual experience happens. What changes is how we interact with what is available in the world, once there are different forms, conditions, and possibilities to access it, and the different accesses modes provide different experiences of presence. “Skills, know-how, knowledge, and understanding—these are the ground of our access to what there is; these mark out the extent of consciousness” (Noë, 2012, p. 32).

Dancers of Le Moi, Le Cristal et L’Eau (2007) have worked with me since 2004, in dance projects with technological mediation, and have participated in several creations of telematics dance since 2005. Those experiences have provided us with new skills and other understandings of time, space, interaction, and body. Image was not simply understood as a projection on a screen, the camera was no longer a cold device to capture corporate images, nor the computer was something distant, exclusively operated by a programmer. Quite to the contrary. The relationship with all those devices—cognitive artifacts—was one of complicity, the dancer understood the camera as if it were the dancers’ own eyes and, at the same time, also in terms of the perceptual awareness of her/his partner and/or of the audience. The image became a double, an extension of the self on its own, which was moved to activate its own body (as Flávia in Figures 2b and 2c, when she saw her own image moving and interacting with the remote partner; such perceptual experience is the stimulating element that had her moving again throughout an informational cycle in which there was no starting point).

The experience of presence is explored in another form in the telematics dance performance called Embodied in Varios Darmstadt 58, realized between Brazil, Mexico, and Spain in 2013. This telematics piece was the unfolding of my postdoctoral project developed in the Sonic Arts Research Center (SARC), at Queen’s University Belfast (United Kingdom) in 2012. In the last scene of the piece, three remote graphic points were created from the data of dancers’ movements which were captured by Kinect, and processed in the Pure Data program. Those graphics were not intended to represent an anthropomorphic avatar. To the contrary, the aim was to fill the space occupied by movement, but not just its trajectory. In the case of Brazil, I danced behind a transparent curtain that allowed the graphics of my movements, as well as those of my partners, to be projected on the screen in front of me, so the graphics could be superimposed on my own body.

Such example is important to enhance the understanding of those varieties of presence. Even though “copies” of the other dancers’ bodies did not exist (as could be the case of a transmitted video image), those graphs could yet provide a perceptual experience of the presence of the other. It might be more fragile, but still, I felt the other’s presence and that served as a stimulus for my action. Keeping in mind that the perception of presence is not a matter of being close, but a matter of availability (Noë, 2012), which is established because there is an understanding (Noë, 2012) regarding the system by all the involved, including the audience throughout the work. An understanding that allows one to be captured by the idea and absorbed by the proposed distributed space. That understanding, as explained by Noë, signifies “conceptual knowledge, but also more practical forms of knowledge including what I will call sensorimotor knowledge. To see an object, it must be there for us, and to be there for us, we must, in some sense, know it” (Noë, 2012, p. 15).

Then, according to the philosopher, the perceptual experience of the presence oscillates in its apprehension according to two conditions: (1) movement-dependence (the relationship with the object is manifestly controlled by the body’s movement); (2) object-dependence (the object’s movement manifestly controls the character of the relationship object/perceiver) (Noë, 2012, p. 22). That means that the higher the degree of existence of those two conditions, the greater the strength of the presence. Perceptual presence will be more effective in the degree the two conditions are more effective: the form in which the object manifests and the perceiver’s potential of action.
The digital age has allowed another way of knowing the body with non-invasive devices, and it has established a particular way of investigating the human condition by attempts to simulate that condition. And what we intend to discuss is the relationship of perception and the dancers’ action in a system mediated by new technologies. “Perception and action, sensorium and motorium, are linked together as the emergent successively and mutually Selecting patterns” (Varela et al., 1991, p. 163). This relationship is responsible for the construction of our conceptual systems that largely are formed by our cognitive unconscious. “An embodied concept is a neutral structure that is actually part of, or makes use of, the sensorimotor system of our brains. Much of the conceptual inference is, therefore, sensorimotor inference” (Lakoff & Jonhson, 1999, p. 20).

Our experience of the world is not separate from our conceptualization of the world. Indeed, in many cases (by no means all!), the same hidden mechanisms that characterize our unconscious system of concepts also play a central role in creating our experience. This does not mean that all experience is conceptual (far from it!); nor does it mean that all concepts are created by hidden mechanisms that shape experience. However, there is an extensive and important overlap between those mechanisms that shape our concepts and those that shape our experience. (Lakoff & Jonhson, 1999, p. 509)

I believe that conceptual systems will be established in dancers or groups that develop ongoing experiences in dance with technological mediation, as long as they are focused on learning, as well as on corporal perceptions that form their cognitive unconscious. Those experiences promote new notions of space-time, ignite other sensorimotor simulations, and sharpen the perceptual apparatus in those sensitive environments. In the process of embodiment with the environment, the dancer encounters other perceptual experiences that are reflected in the formation of conceptual systems. An example is the use of a sensor coupled to the body that stimulates the dancer in specific movements that depend on the kind, sensitivity, and capturing ability of device data, actions that would probably not have been thought of if they were not demanded by the mediation. Another example is found in the complicity between the camcorder, the dancer, and the videomaker in well-developed processes in which the device is no longer a barrier and becomes an integrated and interconnected part of the dancer’s eyes and of the one assisting, being the public or the other fellow dancer.

Studies I developed in the field of telematics dance—in contrast to screendance, which is fixed and involves post-production—demonstrated that in shows taking place in real time between different geographic locations connected via the network of telecommunication, the dancer is aware that the camera is one of the interconnection points between him/her, his/her partner, and the remote audience. The spatial and temporal notion is completely altered in that type of system, igniting other sensorimotor stimulations for the implementation of performance.

In the case of telematics works, improvisation is demarcated by keyframes, which establish points of convergence between dancers and existing devices. For example, corporal locations, in conjunction with the plan and camera movement at a determined moment of the work, constitutes a keyframe moment that helps the connection between all the participants and the narrative’s development. During the creative process of those distributed works, a complex storyboard that encompasses both the plan markings and camera movement, as well as where the images should be projected, and the proposal for the dancer’s action is created (Figure 4). Those storyboard’s components are considered cognitive artifacts: in other words, mechanisms that serve to expand our bodies and minds in the world (Clark, 2003).

Both the keyframes we used in scenes, and the storyboard created during the process of organizing the narrative—such as monitors used by the dancers as well as images already superimposed on remote scenic environments—are considered strategies to create cognitive niches. We off-load our cognition into the world as a survival strategy, which is spread by different cognitive artifacts. Those in turn, amplify, extend, and transform our skills responsible for dealing with our environment and everything in it, including ourselves. We off-load our cognitive work in the world “because of
limits on our information-processing abilities (e.g. limits on attention and working memory), we exploit the environment to reduce the cognitive workload. We make the environment even hold or manipulate information for us, and we harvest that information only on a need-to-know basis” (Wilson, 2002, p. 626).

5. Empathy in the telematics dance

Finally, I would like to offer one last argument on our manner of apprehending the world through artistic processes. Some studies claim that human beings have the capacity of mimicking what happens to another human being. Robin Curtis (2012) makes a comparative analysis of the term Einfühlung, emerged in nineteenth-century Germany, translated into English as “Empathy” and introduced in the United States by Edward Titchener. In the analysis, she clarifies distinctions in terms of affiliations and meaning of the concepts. For the discussion raised here, it is mainly important to understand that

Whether studies of empathy make mention of Einfühlung as empathy’s precursor, or not, with only few exceptions, contemporary accounts focus on the forms of empathy that are instilled by our alignment with animate—and mainly human—figures and thereby overlook the broader, often more abstract sense of engagement with the world and with the esthetic object that was central to Einfühlung as it was historically understood. (Curtis, 2012, p. 426)

Referring to studies by the German psychologist and philosopher Theodor Lipss, Curtis explains:

[ ... ] the basic inclination to this kind of broad engagement with the world (i.e. this kind of Einfühlung) is based on an involuntary, instinctive mimicry of others. He describes its effect on the viewers of dancers who themselves begin to sway or rock, or else in what he terms the sympathetic tension, or internal mimicry felt by the observer of a tightrope walker. (Curtis, 2012, p. 429)

In 1999, Lakoff and Johnson wrote in his important book Philosophy in the Flesh,

Empathy is the capacity to take up the perspective of another person, that is, to see things as that person sees them and to feel what that person feels. It is conceptualized metaphorically as the capacity to project your consciousness into other people, so that you can experience what they experience, the way they experience it. (Lakoff & Jonhson, 1999, p. 309)
Discussions on *Einfühlung* and Empathy can find resonance in studies of the mirror neuron discovered by Rizzolatti and colleagues (1996), which showed that some neurons (frontal lobe, area F5) are activated at the same time that an animal performs an action with a specific purpose, but also when it is observing another one (usually of the same species) performing the same task.

The recent discovery of “mirror neurons” in the premotor cortex, neurons that are activated either by the subject’s own motor behavior or by the subject’s visual observation of someone else’s motor behavior, shows a direct and active link between the motor and sensory systems and has important implications for explaining how we understand other people ([Di Pellegrino et al., 1992; Galeses et al., 1996; Rizzolatti et al., 1996] Shaun, 2005, p. 9) [...] Mirror neurons link up motor processes with visual ones in ways that are directly relevant to the possibility of imitation. (Shaun, 2005, p. 77)

Many articles are being written to address the reception of a work of art and the public’s enjoyment, using those terms as a theoretical basis, which are also relevant to discuss issues of learning. Another application of the concept of empathy is in the field of cinema in the research on the potential of images in the body of those who watch, as it is the case of Curtis’s article, which is based on arguments regarding the concept of *Einfühlung*. Curtis mentions the emphasis given by Erwin Panofsky on the ability of the filmic experience to literally move the observer. The dance, or even screendance, is also being analyzed by those studies dealing with reception.

However, I would argue from another point of view, not thinking in terms of the relationship public-work, but using those concepts within the work itself. My goal is to argue that those skills are important for improvisational dancers (the telematics environments, in this case) to understand one another. Additionally, I argue that dancers are also in the system as “the subject’s visual observation of someone else’s motor behavior” (Shaun, 2005, p. 9) since they must have moments, even the briefest, of contextual contemplation. Those moments are not to pre-judge, but to act; to sense, as well, the power to “feel” that the other can function as important data for decision-making during improvisation.

“All perceptual experience is matter of bringing the world into focus”, Noë (2012, p. 128) explains to us. The perceptual experience of dancers in a telematics environment brings to their focus a variety of presence by of partners located in another space at any part of the world. For example, in Versus (2005) there was empathy with a big hand shaking (dancer located in Salvador) in the screen because the dancer (located in Brasília), who perceived it, had embodied the idea of space off from cinema, so she could comprehend that there was a body to complete that hand out of sight.

We are beings who need to build our world all the time, because we do not have a ready and pictured world that arrives completely in our minds. The action and perceiving process work together to bring that world into focus “by achieving the right kind of skillful access to it, the right kind of understanding” (Noë, 2012). The dancer gets that skillful access during his/her practice in the rehearsal of telematics dance production. Indeed, we are already familiar with telecommunications systems, such as Skype, Hangout, WhatsApp, Web conference, and so on. It is usual for all of us to have (and believe in) conversations with a distant person. That variety of presence is constructed during the rehearsal when the dancers get their sensorimotor understanding about their partners as an avatar, sometimes as video image, but it could also be the graphics of the dancer’s movement trajectories as in *Embodied in Varios Darmstadt 58*. Noë explained that “if you don’t understand what you see—in the sensorimotor sense […]—then sensory stimulation caused by an object [in this case, the remote dancer’s graphic] won’t rise to the level of contact” (2012, p. 72). The dancers have empathy with the lines and the shapes, because they can feel them as the presence of someone else, and they can feel them because this perceptual experience was embodied during the process of perceiving and acting at rehearsals experiences.
The problem is to understand in what our perceptual sense of the thing's hidden presence could consist if it does not consist in the fact that we see it. [...] As a phenomenological matter, there is a difference between thinking that someone out of view is present (e.g. that there is money in the purse), and looking as if something out of view is present (e.g. that the tomato is not a mere tomato-façade). What we want is an account of the perceptual presence of that which is not perceived (Noë, 2012, p. 74). [...] Perception is an activity of sensorimotor coupling with the environment. It is not a type of engagement with mere appearances or qualia (Noë, 2012, p. 80) [...] When you perceive an event unfolding, it is not as if you occupy a dimensionless point of observation. You live through an event by coupling with it. What you experience is the event, as it plays out in time. (Noë, 2012, p. 81)

If we agree with the arguments already raised in this article, so there is a sensorimotor understanding, and therefore, the dancer does not make judgment about the context in order to act, rather the body acts from stimuli offered in the environment—then those stimuli are related to empathy felt by whoever is dancing. We can also establish a relationship with perceptual intermodality because, according to Shaun, the mirrors neurons “constitute[s] an intermodal link between the visual perception of action or dynamic expression, and the intrasubjective, proprioceptive sense of one’s own capabilities. Their functioning clearly helps to account for the communication between proprioception and vision, and between specific movements and the visual perception of those movements in others” (Shaun, 2005, p. 77). When we take that understanding into improvisation performed in sensitive environments and accept those presences, in their weaknesses and varieties, we can say that, to some degree, the capacity of mirrors neurons also helps the dancer to establish empathy with his or her partner, whether presented in images sent by telematics streaming or decoded in avatars or graphics; managing to simulate the environment in order to help the decision-making about which movements to execute.

6. An analysis of “e fez o homem a sua diferença”
In another piece, “e fez o homem a sua diferença” (2005) (and the man made his difference) (Figure 5) the different forms of access to variations of presences were part of the public enjoyment of the process.

I sought to break, once again, the Renaissance perspective of the vanishing point that structures conventional theaters, taking advantage of the warehouse architecture with suspended galleries of the Theater Vila Velha (Salvador, Brazil) and tried as much as possible to distribute the public to engage with different forms of enjoyment; in other words, to propitiated a rich environment in forms of access to the perceptual experience. Each of those layers offered forms of differentiated access, completely destroying any point of central and exclusive domination. No point in the space could be

Figure 5. e fez o homem a sua diferença (2005) Ivani Santana.
Set design by Igor Souza. Photo is Andrea Viana.
considered as the one with the whole picture, since no location allowed possible completeness. Bodies and images happened at all levels, each allowing an experience with the work, the dancers, and the images. Not only the spatial arrangement propitiated the individuality of perspective, but the nature of the proposals from which dancers improvised, also created such situations.
For example, dancers who worked with the aerial fabric established more direct relationship only with who was in the upper galleries. In a particular scene, the dancers obstructed part of the view the public sitting on the first floor around the scene had; the dancers covered one of the public’s eyes, or they created grids with their fingers with their hands superimposed on the public’s face, while they told stories, in the public’s ears, that gave some ways to understand the scene. Thus, there was a questioning whether the “body in dance” could tell a story like in literature (believe it, or not). In another example, we saw the actions what arose between dancers and the people in the audience who were sitting on the swings in the middle of space.

I believe that the description of that work is a good example of the enormous possibilities for creating diverse perceptual access to offer the public, as well as to our own dancer, esthetic experiences only feasible through the potential of the Arts.

This analysis could indicate some possibilities to think about empathy in the process of audience reception. But, as assumed in this article, this is not the objective for our discussion here. “e fez o homem a sua diferença” is a piece in which I definitely worked with dance as a system. Thus, audience could be understood as a performer because they had different demands in each place where they choose to be to attend the piece (Figures 6a and 6b). Since the theater’s entrance, where two dancers were performing, the audience had the perceptual experience of taking part of the piece. The audience’s sensorimotor understanding was being built since the very beginning.

7. Conclusion
The aim of this paper was to outline some arguments about the engagement of dancers with digital media; how they deal with perception in a sensitive system that provides different forms of presence.

It can be an effective task to investigate and to keep in mind concepts of embodiment, enaction, actionism, and empathy, in order to develop theoretical and artistic projects in the field of improvisation in dance performed in spaces mediated by digital technologies. That could improve the relationship between biological and non-biological bodies, as well as being effective to expand possibilities of access and availability in terms of esthetic experience.

Dance with technological mediation is a fertile environment for the exploration of the perceptual system, whether from the perspective of who performs or from those who participate as spectators. Those experiences promote new perceptual stimulations, putting into contact distinct forms of presence by finding available synergistic points in the individuals. That is the condition of the located cognition.

The arts have the great potential of offering other experiences to humans by creating multiple access spaces so that they might have the opportunity to re-experience their own variations of presence! A chance to act and know the world always in the process of being discovered.

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Notes
1. Screendance serves as a reference for all and each dance creation made for audiovisual media, whether they are films of dance, screen dance, dance screen or any other denomination or connotation currently given to this field.
2. To learn more about the first softwares created for the environment of dance, see Thecla dissertation “A case study of Merce Cunningham’s use of the lifeforms
computer choreographic system in the making of trackers“, Simon Fraser University, 1986. Available at: https://www.sfu.ca/~tschipho/publications/Schiphorst_M.A.Thesis.pdf. Accessed on May 12 2016.

3. The first register of a computational program was published in Calvert et al. (1991). After being established on the market, a software version for dance, called Dance-Forms, came into being, while LifeForms is focused on another area the human animation. The software is commercialized by Credo Interactive https://www.credo-interactive.com.

4. https://synchronousobjects.osu.edu/

5. It is possible to work with genetic algorithm in interactiv systems, but the perception and action are still different of the acoustic system.

6. This work was created and supported by the Artists in Residence Award from the Center Choréographique National, given to me in the 2006 Monaco Dance Forum. https://poeticastecnologicas.com.br/site/midias/videos#!/le-moi-le-cristal-et-leau-2007

7. The Center is directed by the choreographer Angelina Prelijocaj. It houses her dance company founded in 1984, and moved to the Pavillon Noir, in Aix-en-Provence, France in 1996.

8. This conception of dance as a system considers all members as scenic part of the work. In this sense, there is no separate space for lighting and sound technicians; all of them and their work consoles are visible to the public. Dance is imbued with the elements, conditions and context of the living space, rejecting the understanding of theater, specifically stage, as a neutral and passive receptacle.

9. Two main articles constitute a review of my projects in telematics dance articulated with cognitive studies: Santana (2015), for more complete reference in telematics dance articulated with cognitive studies: https://journals.cambridge.org/abstract_journal/S0269889712000178

10. Embodied in Varios Dornstadt 58. https://www.youtube.com/watch?v=FDMyR48c1Zk

11. Versus was the first telematics piece created in Brazil, by Ivani Santana, with the academic network. The piece was produced to launch the new backbone network, named Ipé Network in 2005. The piece had three cities connected: Salvador, Brasilia and João Pessoa. https://poeticastecnologicas.com.br/site/midias/videos#!/e-fez-o-homem-a-sua-diferenca-2005

12. e fez o homem a sua diferença (2005) http://poeticastecnologicas.com.br/site/midias/videos#!/e-fez-o-homem-a-sua-diferenca-2005

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