Can I Consider the Pong Racket as a Part of My Body?
Toward a Digital Body Literacy

Stefano Di Tore, University of Salerno, Italy

Paola Aiello, University of Salerno, Italy

Pio Alfredo Di Tore, University of Salerno, Italy

Maurizio Sibilio, University of Salerno, Italy

ABSTRACT

Up to which point can people consider as part of their body the Pong racket, or an avatar on the screen, on which do people exert direct motor control as well? When individuals move in a virtual environment, do the proprioceptors convey information about the location of which body? In which environment? How will the information contaminate each other? How does the temperature felt on the real environment influence the interaction in the virtual environment? This paper is not intended to answer these questions, it is rather intended to raise fundamental questions of perception and phenomenology in a digital context in which bodies "are not born; they are made" (Haraway, 1991). The work should act as a positio quaestionis, with the aim of affirming the urgent need for a necessarily interdisciplinary reflection on the overall design of the body - perception - cognition - technology perimeter; it also identifies in the Berthoz simplexity and Ginzburg evidential paradigms, and in the Hansen concept of mixed reality, the building blocks of a theoretical framework aimed to the solution of these questions.

Keywords: *Augmented Body, Augmented Reality, Cognition, Corporeity, Digital Body Literacy, Natural User Interfaces (NUIs), Simplexity*

INTRODUCTION

The purpose of this paper is to investigate how some lines of evidence from the hard sciences and some changes in technology affect the overall design of the body - perception - cognition - technology perimeter.

Topics covered include:

- The evolution of the idea of body.
- The role of body in nuis (natural user interfaces).
- Perceptual and cognitive implications of the nuis.
- The implications of nuis on the idea of body.
- The emerging need of a digital body literacy.

DOI: 10.4018/jdldc.2012040104

The subject requires a theoretical framework which includes a definition of body, an historical excursus on the idea of body and on the relationship between body and cognition, a definition of interface in the context of an historical evolution of the interfaces, and a virtual and augmented reality environments definition.

In this scenario, this work has the preliminary nature of a *positio quaestionis*, which aims to put into context the questions which we will try to answer later in subsequent works, once the issues listed above have been addressed in a systematic and exhaustive way.

RES EXTENSA VS. THE EXTENSION OF MAN

The central role played by corporeity and body in the current cultural context is the result of two different lines, which have, throughout their history, large overlapping and contamination areas.

One line of thinking starts from the Mind-Body problem, from the husserlian perspective and Merleau Ponty's phenomenological perspective, going through the concept of embodiment and the studies of Varela, Maturana, Lakoff, gradually finding confirmation in experimental evidence of the "hard sciences," which have on several occasions identified possible neurobiological basis of cognitive processes - we mention, above all, the research line on mirror neurons (Rizzolatti & Sinigaglia, 2006), progressively reducing the wasteland area determined by the distinction between res cogitans and res extensa.

The other guideline is purely technological, determined by modifications in bodily function, including both body extensions in the sense introduced by McLuhan (2001), both as tout-court modifications, such as the "intelligent" prosthesis systems that are interfaced directly with the synaptic circuits (on use of mind-controlled robots and on how people with tetraplegia use their thoughts to control robotic aids, see Hochberg et al., 2012).

The ability to the automodification of the body, a unique feature that the human species has by virtue of its peculiar cultural evolution, is certainly, on the theoretical level, a revolutionary element.

The machine, as vicar or amplifier of subject potentialities, would affect subject integrity and, as such, redefines subject identity.

This mutation of identity does not stop at the starting field, be it biomedical or mediatic one, but it involves, and occasionally overwhelms, ethics and politics, law and cognition, and arises as a matter pertaining, with full epistemic legitimacy, to philosophy.

In the intentions of this preliminary work does not appear certainly the ambition to establish whether or not the cyborg is our ontology, but, from the introduction reported, it is evident that, before proceeding in reflection, it is appropriate to try a functional definition of "body," in the meaning that the body assumes in the common sense, in an attempt to distinguish what is "body" by what it is not.

In common sense, if I look and I move my hand; it is evident that it is part of my body. If my hand is amputated, it is no longer "body." Therefore, the body, in its ordinary organic meaning, implies a continuity of biological tissues, cells, nerve endings.

This meaning, certainly reductive, is not functional for the purposes of this work.

Another instrumental meaning sees the body as that on which I exert motor control. A prosthesis definitely falls into this vision. It is not equally obvious, in this sense, to consider avatars used in sophisticated virtual or augmented environments.

For example, some latest generation neuroheadset allow control of objects or avatars in virtual environments directly via electrodes capable of intercepting the brain activity (Jackson & Moore Mappus, 2010).

In practice, I can play Pong without using a joystick, but by directly controlling the paddle on the screen thinking "up" or "down," or I can, smiling or thinking to smile, bring an avatar to smile.

AUGMENTED BODY: TOWARD A DIGITAL BODY LITERACY

Up to which point we can consider as body, or as a body part, the Pong racket, on which I exert direct motor control as well, or an avatar on the screen?

Without going into sci-fi scenarios, and fleeing from neuro-mythologies destitute of any scientific basis and successfully stigmatized by Pier Cesare Rivoltella in his "neurodidattica" - such as that relating to the so-called "digital natives" (Rivoltella, 2012), let's consider a fairly common condition in living rooms or bedrooms of teenagers.

The latest generation of video games console are using devices that involve the whole body. In particular, Microsoft Kinect, as an accessory of the Xbox, is able to detect the body segments of a user placed in front of the camera and to use this information to move an avatar in a video game.

We assist, not in the MIT laboratories but in the bedrooms of middle school students, to forms of HCI (Human Computer Interaction) that go, in video games and virtual environments in general, beyond the flattening on the Cartesian plane, which, limiting interaction to eye-hand combination, forces the reality in a non natural dimension. HCI is going to expand in three dimensional space, founding the interaction on the whole body, with cognitive implications whose impact is still unexplored.

In other words, HCI is "appropriating the human body as an input device" (Harrison, 2010)

Natural User Interfaces and Gesture Recognition technology foreshadow the impending scenario of convergence between body centrality, learning and technological dimension: the Augmented Body as an interface in Augmented Reality and in Augmented Learning.

The relationship between body, perception and technology is nothing new: the swift-footed Achilles owed its ability in the race to a transplantation surgery (the heel of a very quick Centaurus).

The novelty are the augmented bodies which "read" and "write" in mixed reality (Hansen, 2006), with the awareness that "knowledge is mapped in our sensory-motor system" (Gallese, 2001).

Corporeity becomes the pivot of Human Computer Interaction, surpassing the principle of oversimplification which has historically marginalized the body. It is stated a principle of simplexity, meaning with simplexity the body's ability to organize with originality, creativity, and elegance the complexity of the world and of natural processes that regulate it (Berthoz, 2011).

The acronym used to describe the technologies that go beyond the iconic and symbolic dimension of the existing GUIs (Graphical User Interface) is NUI (Natural User Interface) (Wigdor & Wixon, 2011).

"Natural User Interface (NUI) is the next metaphysical paradigm shift in man machine interaction (MMI) also known as human computer interaction (HCI). Beginning with the Command Line Interface (CLI) and followed by the Graphical User Interface (GUI), we are now in the midst of discovering the next phase of a more organic interfaces which are based on more traditional human interaction paradigms such as touch, vision, speech and most importantly creativity" (NUIGroup, 2009).

The Natural User Interfaces include input and output based on touch, voice, movements and move towards an efficient use of the senses in the interaction with machines.

The use of the senses, of all the senses, in Human Computer Interaction reverses the symbolic perspective, opens the way for the "swift recapitulation of rational processes" (Ginzburg, 1979) that is rooted in the senses, the ability to go in an instant by known to the unknown, based on clues, returning to the brain processes the proactive dimension sacrificed on the symbolic level (Berthoz, 2011; Ginzburg, 1979).

Adhering to an active approach to perception, one way of thinking about literacy is that the body senses or "reads" the environment and as it interacts with it, it "writes."

Noë describes the enactive approach as one that draws simultaneously on direct perception and sensorimotor knowledge (Noe, 2004).

In this scenario, embodied actions within a digital media interface are "fluid and functional crossings between virtual and physical realms" (Hansen, 2006).

Hansen advances the paradigm of "mixed reality" which posits that virtual reality is not an exclusively technical/digital ecosystem due to the analog functioning of the body that enacts upon it. At the same time natural reality is not exclusively analog because of the contemporary human dependence on digital constructs within it.

These reflections open the way to the affirmation of the need for a digital body literacy, to lead the acquisition of skills in a context in which the bodies are not born, they are made (Haraway, 1991), and "read" and "write" in a mixed reality where we can no longer artificially distinguish between natural and digital elements

OPEN QUESTIONS

We leave in abeyance the previous question (to what extent can I consider "body" the Pong racket?), to introduce two additional considerations functional to the discussion.

The first consideration is derived directly from the abused Marshall McLuhan's statement that "the medium is the message." McLuhan himself felt the need to better clarify and specify his own thought:

"In a culture like ours, long accustomed to splitting and dividing all things as a means of control, it is sometimes a bit of a shock to be reminded that, in operational and practical fact, the medium is the message. This is merely to say that the personal and social consequences of any medium -that is, of any extension of ourselves - result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology" (McLuhan, 2001).

Technology is never neutral, since "activities shape the requirements of Particular tools and the application of the tools begins to reshape the activity ..." (Gay & Hembrooke, 2004).

The second consideration regards, however, the asymmetrical feedback given by the interaction in virtual or augmented environments. We intend to emphasize how purely technological constraints determine the prevalence of some channels of sensorial afferences in the interaction.

Even McLuhan warned that "in experiments in which all outer sensation is withdrawn, the subject begins a furious fill-in or completion of senses that is sheer hallucination. So the hotting-up of one sense tends to effect hypnosis, and the cooling of all senses tends to result in hallucination."

With the switch from GUI to NUI, by abandoning the iconic-symbolic dimension in favor of an immersive dimension, the risk pointed out by McLuhan grows in geometric progression.

In virtual or augmented environments, channels afferent to sight or hearing play a predominant role to the detriment of other analyzers, such as proprioceptors, vestibular system, touch, estimation of weights, temperatures and other environmental factors.

This predominance of vision and hearing also appears in the GUIs, with the significant difference that the GUIs are based on an iconic-symbolic system while the augmented reality or virtual systems are able to offer an experience that may be independent from the symbolic level.

When I move in a virtual immersive environment or in an augmented reality environment, do the proprioceptors convey information about the location of which body? In what environment? How will the information contaminate each other? How does the temperature felt on the real environment influences the interaction in the virtual environment?

This asymmetry, related to technological contingencies, is probably transitional. As an example we report the spread, for now still limited, of haptic interfaces. This would indicate that, in future, interface devices allow an interaction really immersive. However, here and now, the interaction in virtual environments is

characterized by a kind of sensorial asymmetry. At present, we are not able to assess the temporal extension of this asymmetric condition.

"Remember that it took 30 years between when the mouse was invented by Engelbart and English in 1965 to when it became ubiquitous, on the release of Windows 95. Yes, it was released commercially on the Xerox Star and PERQ workstations in 1982, and I used my first one in 1972 at the National Research Council of Canada. But statistically, that doesn't matter. It took 30 years to hit the tipping point" (Buxton, 2007).

If any technology results in a change of patterns, rhythms, proportions, as stated previously, which effects does the extension in virtual environments, balanced by the loss or alteration of sensory information, produce on the perception of self?

In other words, has the systematic training of specific neural patterns to react only to stimuli of a certain kind cognitive implications?

And more, if every technology determines a change in user behavior, this change itself determines and directs the research and dissemination of new technologies. Can the asymmetry of feedback trigger a spiral technology that involves a progressive marginalization of the analyzers for which we do not have interfaces?

CONCLUSION

As mentioned in the introduction, articulating an answer to these questions without giving reason of an explicit and documented theoretical framework would be unrealistic.

The purpose of this preliminary work is not to provide answers, but to ask questions, affirming, with this, the need and the urgency to initiate a systematic analysis and a trans-disciplinary confrontation which will enable documented answers to these questions, in full awareness that the only act of the *positio quaestionis* leads to a definition, even if short, of the perspective from which we intend to address the research field and of reference paradigms within which we will try to find the answers.

Body and corporeity become, in this perspective, theoretical "places" of intersection of several disciplines, belonging to both "hard sciences" and "soft sciences" (Frith, 2007), whose object of investigation are human beings and their activities.

Characters and lines of research of the emerging simplexity paradigm, which often seems to cross the "roots of a evidential paradigm" expounded by Ginzburg, and the Hansen mixed reality paradigm may constitute the building blocks of a theoretical framework of reference. It is on this basis that the issues outlined here will be investigated systematically.

REFERENCES

Berthoz, A., & Niola, F. (2011). *La semplessità*. Codice.

Buxton, B. (2007). *Multi-touch systems that I have known and loved*. Redmond, WA: Microsoft Research.

Frirth, C. (2007). *Inventare la mente. Come il cervello crea la nostra vita mentale*. Milano, Italy: Tr. It. Raffaello Cortina.

Gallese, V. (2001). Neurophysiological mechanisms underlying the understanding and imitation of action. *Nature Reviews. Neuroscience*, *2*(9), 661–670. doi:10.1038/35090060

Gay, G., & Hembrooke, H. (2004). *Activity-centered design: An ecological approach to designing smart tools and usable systems*. Cambridge, MA: MIT Press.

Ginzburg, C. (1979). *Spie. Radici di un paradigma indiziario in Miti. Emblemi. Spie. Morfologia e storia*. Milano, Italy: Einaudi.

Hansen, M. B. N. (2006). *Bodies in code: Interfaces with digital media*. New York, NY: Routledge.

Haraway, D. (1991). *A cyborg manifesto*. New York, NY: Routledge.

Harrison, C., & Tan, D. (2010). Skinput: Appropriating the body as an input surface. In *Proceedings of the 28th International Conference on Human Factors in Computing Systems* (pp. 453-462).

Hochberg, L. R., Bacher, D., Jarosiewicz, B., Masse, N. Y., Simeral, J. D., & Vogel, J. (2012). Reach and grasp by people with tetraplegia using a neurally controlled robotic arm. *Nature*, *485*, 372–375. doi:10.1038/nature11076

McLuhan, M. (2001). *Understanding media: The extensions of man*. New York, NY: Routledge.

Moore Jackson, M., & Mappus, R. (2010). Applications for brain-computer interfaces. *Brain-Computer Interfaces*, 89-103.

Noë, A. (2004). *Action in perception*. Cambridge, MA: MIT Press.

NUIGroup. (2009, May). *Multi-touch technologies*. Press release.

Rivoltella, P. C. (2012). *Neurodidattica: Insegnare al cervello che apprende*. Milano, Italy: Cortina Raffaello.

Rizzolatti, G., & Sinigaglia, C. (2006). *So quel che fai: il cervello che agisce ei neuroni specchio*. Milano, Italy: Cortina Raffaello.

Wigdor, D., & Wixon, D. (2011). *Brave NUI world: Designing natural user interfaces for touch and gesture*. San Francisco, CA: Morgan Kaufmann.

Stefano Di Tore is PhD student in Pedagogical and Didactic Processes and Political-Social Analysis at the Department of Human, Philosophical and Educational Sciences of the University of Salerno, Italy.

Maurizio Sibilio is full professor of "Didactics and Special Pedagogy" at the Faculty of Sciences of Education of the University of Salerno-Italy. - Director of Interdepartmental Centre for Sciences of Health, Sport and Integration Processes. - Responsible of Handicap Laboratory at the Faculty of Educational Sciences at the University of Salerno. - Responsible for the "Laboratory of Didactics and Special Pedagogy" at the Department of Human, Philosophical and Educational Sciences of the University of Salerno. -Responsible of the "Laboratory of Movement Analysis" at the Faculty of Medicine and Surgery of the University of Salerno. - President of the degree course in "Science of Childhood and Preadolescence Formation" at the Faculty of Sciences of Formation of the University of Salerno. - President of the Didactic Area "Inclusion ad Health" at the Faculty of Educational of the University of Salerno. His scientific theoretical and empirical research is aimed at the study of the educational potential of the bodily experiences and at the analysis of teaching - learning processes and didactic practices aimed at enhancing body and movement in educational processes. His research activity has been conducted mainly as Supervisor and Didactic and Scientific Coordinator at University, at the Genetic and Biophysics Institute of C.N.R. in Naples, C.O.N.I. and Ministry of Education, University and Research.