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PRESENTER ABSTRACTS

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How Do You Feel Architecture? Heartbeats Induce Affinities with Virtual Interiors

DR. ISABELLA PASQUALINI
Ecole Polytechnique Fédérale de Lausanne[1]; Haute-école d'Art et Design[2]; isabella.pasqualini@epfl.ch
Lausanne, Switzerland[1]; Geneva, Switzerland[2]

PROF. DR. OLAF BLANKE
Ecole Polytechnique Fédérale de Lausanne[1]; Department of Neurology, Hopitaux Universitaires de Genève[3]
Lausanne, Switzerland[1]; Geneva, Switzerland[3]

Several notions of embodiment are known in architecture. While embodiment is a well-studied phenomenon in cognitive neuroscience, little is known about the impact of architecture on human behavior and bodily self-consciousness. Here, we present a series of studies based on empirical scientific methods suggesting that the environment modulates the subjective experience of the body. We argue that our findings can be implemented into the architectural design process to improve and enhance the user's experience of space.

1. EXTENDED ABSTRACT

The Vitruvian ideal inscribes the architectonic module into embodied perception, and by associating the architectonic experience of material space to the human bodily senses, it became a lasting frame of reference. Particularly architects of the Quattrocento and the 19th century highlighted the embodied experience of space as a relevant criterion for the scientific conception of architectonic form (Pasqualini & Blanke, 2014). Embodiment unveils great potentials for immersive Virtual Reality (VR), where – like in Merleau-Ponty's phenomenological space – the body is introduced as the 'third figure' in the artistic figure-ground scenario. What are the effects of virtual architectonic shapes on the user, and, reversely, of the user on the virtual architecture? Is there a mutual interaction between architectonic space and the observer's experience of herself in space? In the past decade cognitive neuroscientists have studied embodiment by focusing on the concepts of body ownership (or self-identification with one's own body or body parts) and self-location. That is, bodily self-consciousness has been defined as the unity between the highly subjective feeling to own a body and to exist at a unique position in space (Blanke & Metzinger, 2009). Scientists have found ways to manipulate bodily self-consciousness in the laboratory and to interfere with the unified conscious experience of one's own body or body parts through multisensory illusions, such as the Rubber-Hand-Illusion or the Full-Body-Illusion: visuo-tactile synchronous stimulation of one's own body and of an artificial body induces body ownership for the artificial body and a shift in self-location towards the artificial body (Lenggenhager, Tadi, Metzinger, & Blanke, 2007; Serino & Haggard, 2010). More recently, similar paradigms and illusions have been extended to the field of interoceptive sensations, by applying visual stimulation to an artificial body synchronized with the participant's heart-beat (cardio-visual stimulation) or respiration (pneumo-visual stimulation) (Aspell et al., 2013; Rainville, Bechara, Naqvi, & Damasio, 2006). Could it be that, if architectonic elements are subjected to similar multisensory manipulations, architectonic space itself is perceived as if it were part of one's own body and integrated as a whole in the perception of one's body, in a similar manner as shown for external objects (Armel & Ramachandran, 2003; Hohwy & Paton, 2010)? In our previous research we have applied the Full-Body-Illusion in virtual rooms of large and narrow size (Pasqualini, Llobera, & Blanke, 2013; Pasqualini et al., in preparation). We have shown that the size of the room significantly affects the way participants self-identify with their virtual bodies, and, reversely, that altered self-identification and self-location modulate the way in which the interiors are perceived based on the position of the surfaces near or far from the body. In addition to the responses of self-identification with the avatar, we have also found architecture specific effects, such as touch illusion with the walls; sensations of drift in space and the feeling of walls retracting towards ones own body. In the present study we placed 18 participants into an immersive virtual interior of which surfaces randomly displayed three-dimensional human bodies or blob shape objects in a VR mini-Cave (Figure 1). We recorded the participants' heart rate (ECG), and we used the signal to project the bodies or the blobs shapes within the virtual interior, either in real-time (synchronous) or with a delay (asynchronous). After each condition (Bodies or Blobs, synchronous or asynchronous) participants answered to a questionnaire adapted from previous experiments to assess the subjective bodily experience in the virtual interiors (Aspell et al., 2013; Pasqualini et al., 2013) and rated their emotional states. We also tracked the participants' head position to measure the participant's movements. When participants saw the Blobs, they felt "as if they were touched by the flashing volumes".

Such effect was even stronger when the Blobs appeared synchronously with the participant's heartbeat. Viewing the Blobs also induced the sensation that "the interior was drifting towards them". On the other hand, when Bodies or Blobs appeared synchronously with the heartbeat, participants reported, "as if they were drifting towards the interior". When the Bodies were presented synchronously with the heartbeat, participants showed the tendency to oscillate back and forth (shape*synchrony, p=0.08222). Viewing the Bodies also induced stronger changes in the participants' actual heart rate, and such effects were more frequent in case of asynchronous cardio-visual stimulation. Participants reported higher degrees of fear and less comfort when viewing the Bodies. Overall, our new results show that both, shape and architectonic interior affect the subjective experience of one's own body in space. The integration of body-related stimuli (interoception) and visual stimuli related to external objects strongly contributes to such effects. We discuss the links between embodied, self-conscious experience of architectonic space and novel experimental designs. We argue bodily feelings and sensations are fundamental in the design process and the user's experience of space.

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3. AUTHOR BIOS

Isabella Pasqualini graduated as an architect at the Swiss Federal Institute of Technology in Zürich (ETHZ). After professional practice in Switzerland and abroad she founded a design firm in 2004. Since 2012 she holds a PhD degree in architecture and cognitive neuroscience from the Swiss Federal Institute of Technology in Lausanne (EPFL). She has been visiting Professor at the Art & Design Academy of Tsinghua University in Beijing and is currently a lecturer at the EPFL. In 2013 she received the Cogito Fellowship grant to pursue scientific practice in architecture. Her works were presented at the Swiss Art Awards in 2008 and 2010, the Espace d'Art Contemporaine 'Les Halles' in 2011, the Beijing Design Week and Beijing Triennale 2011, as well as the Shanghai International Science & Art Exhibition where she received the SAST award in 2012. Isabella Pasqualini has won several international competition prizes and worked as an expert for the City of Helsinki and the City of Rome in Italy.

Olaf Blanke is founding director of the Center for Neuroprosthetics, Bertarelli Foundation Chair in Cognitive Neuroprosthetics at the Swiss Federal Institute of Technology (EPFL). He also directs the Laboratory of Cognitive Neuroscience at EPFL and is Professor of Neurology at the Department of Neurology at the University Hospital of Geneva. Blanke's research is dedicated to the neuroscientific study of multisensory body perception and its relevance for self-consciousness by using a broad range of methods such as neuropsychology, invasive and non-invasive electrophysiology, and brain imaging in healthy subjects, neurological and psychiatric patients. Most recently he has pioneered the joint use of engineering techniques such as robotics and virtual reality with techniques from cognitive neuroscience and their application to systems and cognitive neuroprosthetics and neuro-rehabilitation.