

archi|DOCT

*The e-journal for the
dissemination of doctoral
research in architecture.*

July **2020**

www.archidoct.net

ISSN 2309-0103

VARIABILITY

15

Listed in
Scopus®

The notion of Mixed Embodied Presence as a variable for generating mixed environments

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Abstract

During the last years, the insertion/ invasion of technology has led to the redefinition and re-approach of architecture and its immanent aesthetics (Fox and Kemp 2009). The emerging new realities and spatialities, and especial those of mixed reality and mixed environments, are considered as the origin of the transition of architectural culture towards new technologies. In this sense, an alternative framework for approaching and analyzing the variability of such spaces and realities is introduced through the lens of Mixed Embodied Presence, a proposed notion that reflects aspects of both the senses of presence and embodiment. The ultimate goal is to highlight the various embodied and spatial aspects that are emerged and can affect the production and the design process of mixed environments, and therefore the generation of different spatial conditions.

Keywords

presence; embodiment; mixed environments; design framework

I. Introduction

To etymologically define space means to primarily define its nature (Tschumi 1996, p. 29). During the last years, it is more than obvious that space – and especially architectural space – is not perceived as a solid and immobile frame, but rather as a fluid state that is constantly changing due to various accommodated or/and afforded activities (Iacucci and Wagner 2003, p.150). Traditionally, architecture is considered as the effort of enhancing the user's spatial awareness, through the construction of a tangible reality that articulates individual and collective experiences (Tuan 1977, p.100). However, a number of issues regarding mobility/movement and stasis are raised due to new potentials that emerge from the fluidity of modern nomad culture (Fox and Kemp 2009, p.29) which leads to a transition of traditional design methods, towards more interdisciplinary practices (Somol and Whiting 2002, pp.75-76). This phenomenon is, on the one hand, driven by the way that technology affects and reforms the sustained interactivity between an embodied entity and the structured environment, and on the other hand, by the reinterpretation of, until recently common grounded, notions of space and time (Tuan 1977, p.53; McLuhan 1964). The introduction of technology has led to the reconsideration of architecture and its immanent aesthetics (Fox and Kemp 2009) and to attempts of creating alternative environments and realities (Bock, 2008 p. 275). Thus, the emerging new realities and spatialities, and especial those of mixed reality (and consequently mixed environments), are considered as the starting point of shifting architectural culture towards new technologies.

In this context, it is argued that the role of the architect is to re-examine and redefine architectural design, in the light of the activities that take place in these new generated (mixed) variabilities/typologies. Therefore, an alternative design framework, that will be able to correlate the emerged spatial variations to the active embodied presence, as well as to calibrate aspects of reality with representations of virtuality, is examined. In this direction, the present research proposes the notion of Mixed Embodied Presence, and the underlying parameters, as an alternative design approach and tool, that can adequately capture and record the coherent experience of a user, in a combined environment of physical and digital entities. This concept was primarily based on two fundamental questions that are raised in the context of the PhD research: a) whether or not the experience of presence in a mixed environment can be considered as a new sense, different from the one shaped in a real or a virtual space, and if so, b) is this phenomenon inextricably related to the embodied and kinesthetic senses that are triggered and activated in such an environment?

Through the previous questions, more than one variables are denoted; namely the notion of presence, the notion of embodiment, as well as the spatial conditions that determine the nature of interactivity. Therefore, to further analyze these variables, literature review was performed on the two aforementioned notions (i.e. presence and embodiment) (Papasrantou and Bourdakos 2012) as well as on the various conditions and aspects that are related to spatiality (i.e. physicality and virtuality). Apart from shaping the definition of the notion of Mixed Embodied Presence (Papasrantou 2013), the following hypothesis was formed: if the sense of presence – namely the conscious embodied experience of space – is related to kinesthesia and the formation of perception (which is based on someone's memories and performed actions in a place), then the recording and the combination of their interrelated parameters, can probably lead to some kind of "mapping" of the shaped experience in this intermediate space (i.e. the space that is consisted by physical and digital aspects). Thus, and in the light of this hypothesis, all the above parameters will be presented in the following sections, in order to highlight the numerous embodied and spatial aspects that emerged. The ultimate goal is the creation of a taxonomy that can be applied to the production and the de-

sign process of mixed environments, generating various spatial conditions through the lens of mixed embodied presence.

2. Mixed reality: variation of spaces and emerged needs

The initial step toward the scope of this research is a brief presentation on what is perceived as mixed environment.

In the context of the PhD research, an extended and thorough literature review was performed on the fields of real/physical and virtual space, and specifically on the variant ways that these spatial conditions have been defined, over time. Both of these spatial conditions are rather complex and therefore, a simple or common definition cannot be conveyed. In short, as real/physical space can be conceived an area of specific dimensions and geometry, and at the same time, a subjective place that is shaped according to user's sensory, kinesthetic and perceptual skills. As virtual can be characterized a technologically-based abstract space where familiar elements are embedded in imaginary and uncanny places/landscapes, as well as one that manages to immerse user by capturing her/his senses and by making her/him feel present in this imaginary field.

As a result, a number of keywords, detected to better describe reality and virtuality, were highlighted and gathered in the following table (Table 1). The main purpose is an initial approach towards the definition of mixed space, based on the expected outcomes from the aforementioned literature review.

| Space | |
|--------------------------|----------------------|
| Real/Physical | Virtual |
| geometrical/ dimensional | abstract/imaginative |
| neutral and ideal | technological |
| subjective | feasible |
| existing | immersive |
| perceived | |
| experiential | |
| kinesthetic | |
| embodied | |

Table 1.

Keywords describing reality and virtuality

It is noted that even though there are rather discreet and, in the core, different characteristics for both spatial situations, there is however a common ground where these two conditions converge. The keywords included in these fields (i.e. perceived, experiential etc.) are highly correlated to the presence of a human body, which is perceived as a vehicle of embodied and kinesthetic skills as well as a carrier of lived experiences. Therefore, an initial hypothesis is that an analysis on spatial

variations oscillate between reality and virtuality should be primarily based on the variable of embodiment. This assumption was investigated through literature review that is performed on theories related to mixed environments. Some of them are briefly presented in the following section.

Mixed reality is a rather complex spatial condition. According to Milgram's "Reality-Virtuality continuum" (Milgram et al 1994, p.283), presented in Figure 1, as mixed environments can be considered all the realities and spatialities included between the extremes of real and virtual environments, that combine proportional views of physicality and digitality (Drascic and Milgram 1996, p.123; Harrison and Dourish 1996, p.72). In these environments, physical and digital objects and entities co-exist and interact in real time (Benford and Giannachi 2013, p.3). Therefore, the nature of a mixed environment is determined by the hosted objects and entities, as well as by the nature of the accommodated and afforded activities.

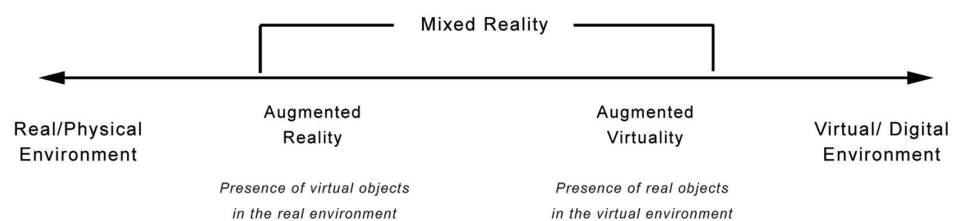


Figure 1.

Representation (by the author) of Milgram's "Reality-Virtuality continuum" diagram

In an effort to describe mixed reality, some researchers borrow terms and parameters that usually applied to physical space, such as boundaries and tangibility. For Rogers (Rogers et al 2002, p.679) the term "boundaries" is implemented to delineate the transition from the real world to the virtual one, and vice versa. In this sense, boundaries are characterized by the parameters of permeability, situation (which is described as "the boundaries spatial properties") and dynamics, and are utilized to denote the occurring transformations as far as perception, action and cognition are concerned. For McGarrigle (2012, pp.36-37) it is the boundaries that should be demolished so as the new generated spatialities and realities to be discovered, and the underlying conditions that differentiate their meaning and their experiential dimensions to emerge. After all, as Weijdom (2017, p.7) argues, the experience of mixed reality is strongly related to the user's cognition and her/his lived experience. Therefore, in this context, it can be perceived as a rather flexible and adaptable spatial condition/variation, which can be determined by the user's embodied engagement, sense of presence and interaction.

In comparison to traditional or virtual spaces, there are some significant advantages on using mixed environments. The enhancement of learning processes and user's experience, as well as the improvement of cooperative work are considered to be among them (Rogers et al 2002, p.677). The reason is not totally obvious, but it is argued that it is the outcome of the proliferation of the sense of embodiment due to the combined qualities that are embedded in a mixed environment (i.e. combination of familiar objects with technologically enhanced spatial conditions). Therefore, it is sustained that the nature of interaction hosted and provoked in mixed environments is in accordance with peoples' performed actions and interactions, on a daily basis (Rogers et al 2002). This is also one of the reasons that mixed reality is closely related to the development of the field of interactive

architecture. The aim of interactive architecture is the creation of a responding space capable of behaving, interacting and being adaptive; qualities that are compatible to a (human) embodied entity (Fox and Hu 2005, p.92). Moreover, it is argued that architecture is constantly oriented toward the creation of spaces that can balance the possible emerged needs of the inhabitants to their preferences, as far as design is concerned (Diniz 2008). In addition, a successful smart environment is considered the one that stops putting emphasis on the implementation of plain technology, and is rather oriented towards the emerged, from the presence of human factor, needs, namely her/his activities and her/his carried experiences (Fox and Hu 2005).

Therefore, it is argued that the exploration and study of mixed environments through the lens of the variables of presence and embodiment, is rather essential. For this purpose, the present research introduces the notion of Mixed Embodied Presence.

3. Introducing Mixed Embodied Presence as the declared variable for mixed environments

The notion of Mixed Embodied Presence is the outcome of questioning whether or not a mixed interactive space, in which the human body is introduced as the link between real and virtual environment, can lead to a mixed experience of presence that is related to bodily senses, memory and kinesthesia. After the extraction of parameters – derived from relevant literature review – that are related to presence, like bodily awareness, memory, information, attention and interaction; and to embodiment such as perception, kinesthesia, and sensory system; a taxonomy was created shaping the basic guidelines for the investigation of primary hypothesis, in materialized paradigms of mixed reality (Papasrantou 2013; Papasrantou and Bourdakos 2012). Through this taxonomy the following definition for Mixed Embodied Presence was shaped.

Mixed Embodied Presence is defined the coherent sense of presence that derives from the progressively embodied engagement and interaction in an environment consisting of physical and digital aspects. It is considered as a measure and a design framework that is related to the parameters of embodied interaction, and specifically to the nature of interaction and the nature of interface as well as to the parameter of co-presence, in the light of socialization and the sense of shared awareness deriving from the mediated or immediate presence of other users in the interactive environment.

Towards justification/verification of the variable

After the extraction of these two main parameters (i.e. embodied interaction and co-presence), and their underlying characteristics, an experiment was designed (Papasrantou and Rizopoulos 2015; Papasrantou et al 2014) to test whether or not the notion of Mixed Embodied Presence can actually suggest an alternative and meaningful framework for analyzing and/or generating mixed spatial complexes. Therefore, a virtual environment illustrating an imaginary exhibition place, was produced. The participants (32 in total) were informed that the curator mistakenly placed some paintings that were planned to be included in another exhibition. Their task was to move around the exhibition space and spot these paintings.

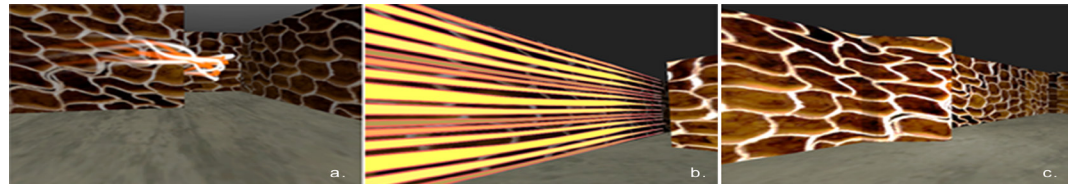


Figure 2.

Indicative screenshots from each condition of co-presence, a. somatic echo, b. video-trail, c. deformation

The environment was displayed through Oculus rift. Embodied interaction was implemented through the use of a Kinect camera which turned users' locomotion on physical space, to a steady-paced walking inside the virtual environment, as well as through the use of a USB mouse which enabled users to select the divergent paintings. Moreover, three different conditions for denoting the parameter of co-presence were designed, namely a. the condition of somatic echo, b. the condition of video-trails and c. the condition of deformation (Figure 2). In detail, in the condition of somatic echo, another moving entity was present to the environment in the form of 3d colorful trails. In the condition of video-trails the co-presented entity was represented as a 2d colorful waveform, displayed as a moving texture on specific walls of the digital environment, while in the condition of deformation, specific (digital) walls were deformed creating a moving 3d folding pattern. In all cases, the initial intention was the creation of abstract dynamic representations that might be perceived as embodied metaphors of an anthropomorphic embodied entity, or as social (abstract) entities that try to establish some kind of communication with the user. For this reason, all the conditions were enriched with an audio pattern. Also, the activation of each condition was based on the proximity of the user.

A between-groups design was implemented. Therefore, each participant was engaged in only one of the aforementioned conditions of co-presence. After completing their interaction with the environment (and the embedded entities), each participant filled – among others – a Mixed Embodied Presence questionnaire, which was compiled in the context of PhD research. Also, after the end of the entire procedure, a short conversation with each participant was made.

4. Towards the determination of an alternative framework for generating various mixed spatial conditions

Through this experimental process, a number of interesting hypotheses and outcomes, concerning the spatial and embodied qualities that could characterize a mixed environment, emerged. Several aspects, regarding lived and spatial experience, communication, as well as learning processes (in an informal way), are also highlighted.

The main hypothesis that is formed, as far as the criterion of lived experience is concerned, is that a virtual environment can, to some extent, be perceived as real when entities that perceived as somatic echoes are co-presented. In this case, the comprised spatial experience tends to be characterized as hybrid and not as virtual. A significant parameter toward this direction is the active participation of user's body, which – in the context of the experiment – was implemented as a navigation medium (i.e. simulation of body locomotion to walking process).

As far as the communicative aspect is concerned, it is highlighted that the enhancement of an environment with dynamic entities (waveforms, deformations) is perceived as an attempt of the envi-

ronment to establish a form of communication (with the user). It is also noted that the parameter of co-presence can be crucial for the proper communication and comprehension of the general concept that is attempted to be conveyed through an interactive environment. The learning process is approached in the light of getting familiar with the interactive methods. It is noted that when the co-presented entity was perceived as an embodied metaphor (i.e. echo condition), users were able to feel faster professional, as far as the navigation methods are concerned, and therefore felt the entire interaction process as more natural.

A key question that is set after the extraction of the aforementioned outcomes and hypothesis is, how these data can be interpreted to spatial conditions or/and to designing methods for generating a variety of mixed spaces.

The following table (Table 2) is a revised version of a diagram that was created after the performance of literature review on the notions of presence and embodiment (Papasrantou and Bourdakis 2012). The corresponding highlighted parameters were utilized as a common ground upon which the definition of Mixed Embodied Presences was formed. The additional column, entitled as Space, includes elements that are related to the spatial interpretation of the aforementioned common ground, as well as to the results of the experiment.

| Presence | Space | Embodiment |
|-----------------------------------|--|---|
| Awareness | Co-presence/co-habitation (C) | Perception/ Movement/ Position |
| Memory | Representation of familiar activities and events (C) | Bodily + mental existence/ Kinetic memories |
| Information | Integration of spatial (SE) or narrative (C) triggering points/ Co-presence (HF) | Orientation/ shared communication |
| Sensory centers | Tangible objects Wearables Co-presence (SE) | Kinesthesia/ visual perception/ Proprioception/ Empathy |
| Mechanisms of obtaining knowledge | Content/ Embodied engagement (SE) / Orchestration of movements/ Co-presence (HF) | Technology/ Imagination/ Behavior /Perception/ Sensory cooperation |
| Realism | Representation of familiar actions and events (C) | Experience of being/ Sensory aspects |
| Interaction | Co-presence (as part of – informal– learning processes) (HF) | Spatial and bodily correlations/ Body toward other bodies/ Body toward itself |

Table 2.

Spatial interpretation of Mixed Embodied Presence (SE: Spatial Elements, C: Concept, HF: Human factor)

These parameters stand as propositions for the design process towards the generation of various mixed environments, and are organized in three categories:

- a. elements and/or qualities that can compose a spatial condition
- b. embodied entities that are present in a space
- c. issues related to the general concept that stands behind a design approach

It is highlighted that the selection of (design) methods for representing the incorporated (to the environment) information is significant. Specifically, it is argued that representation should be related to memory, and especially to the user's embodied and kinetic memory. The implementation of familiar (physical or virtual) activities and events, is also noteworthy in order to produce spaces that are able to reflect upon user's previous experience, facilitating their easier adaptation to the new/ designed environment. In this context, the parameter of realism is also critical. Regarding the parameter of orientation, and the way that the incorporated elements (physical or abstract) act as stimuli and triggering points, another important aspect is the way that information is spatialized. In this line, co-presented embodied entities and the developed cooperation with them, in an implicit or explicit way, have significant contribution, while promoting a sense of shared awareness and communication.

Another notable condition is the nature/content of the represented information (i.e. whether is physical or digital), since it is argued that it affects user's behavior, and the extent of engagement toward medium, as well as the developed mechanisms for obtaining knowledge. In this direction, it is also important the nature of interface (i.e. tangible objects, wearables etc.) that is implemented since it determines the sensory centers that are stimulated (i.e. vision, proprioception etc.), and the embodied skills that are applied (i.e. kinesthesia, gestures etc.).

The human factor, in the light of the embodied engagement and the orchestration of bodily movement, is also crucial, as far as interaction and mechanisms of obtaining knowledge are concerned. However, in this case, it is not only the user's body that is taken into consideration. The manner that co-presented (embodied) entities are included in the designed environment is also essential. Therefore, it is sustained that apart from perceptual cues, a mixed environment should also contain trigger points that boost the embodied engagement and sensory cooperation, promoting the formation of a shared communicated experience. This experience stems from the proper spatial and bodily correlation, as far as interaction is concerned, turning the entire experience to a sense of shared awareness; a rather meaningful aspect for informal learning environments. Again, the parameter of co-presence is significant, since it affects the learning process as far as the interaction methods are concerned. In this direction, co-presence is related to the so called "actor-observer effect", leading to the development of alternative kinesthetic behaviors (i.e. mimicking or avoiding performing the same actions). This observation is considered crucial, especially for designing an environment that will be used by a wide range of people, with differences familiarity to the use of technology (such as a museum or an exhibition space).

5. Discussion

The present paper is part of on-going PhD research, seeking an alternative design framework for analyzing and generating mixed environments through the lens of presence and embodiment. In the context of this research, Mixed Embodied Presence (namely the coherent sense of presence that derives from the progressively embodied engagement and interaction in an environment consisting

of physical and digital aspects) is proposed as a notion and a variable that can reflect a variety of embodied and spatial aspects that can contribute to architectural design towards the realization of such environments. Apart from literature review, an experiment was run, so as to verify the hypothesis formed on the ground of this proposition.

Through the experiment, a number of parameters and hypothesis referring to the spatial and embodied qualities that could characterize a mixed environment, were highlighted. These outcomes were interpreted to spatial conditions and designed methods through an analysis in the light of the notion of presence and embodiment; parameters that were utilized as a common ground upon which the definition of Mixed Embodied Presences was formed.

To summarize, and in the light of the notion of mixed embodied presence, the parameter of co-presence is considered as a crucial variable, concerning the generation of mixed environments. It has been argued that, this parameter can enhance the coherent lived experience of a mixed environment, due to user's active embodied engagement, provoked from her/his interaction with other participant embodied entities. In this direction, the orchestration of movements in the designed space, is also significant. Moreover, the mediate or immediate embodied interaction can lead to the comprehension of the materialized spatial concept, in a meaningful way. Furthermore, co-presence can affect the learning process, as far as the familiarization of user with the incorporated interactive methods is concerned, which also leads to the creation of a seamless (i.e. not disrupted from the different spatial aspects) and more natural interaction.

Another notable variable that is highlighted is the determination of the way that the included elements and artefacts (physical and digital) are spatialized. This decision is considered as vital since it can provoke a variety of behaviors, while triggering and activating sensory skills that promote the formation of a coherent lived experience. Enriching spatial elements with dynamic qualities (i.e. displaying interactive videos on a wall) can enhance the proper communication of the spatial content; something that can be also perceived as an intention of the environment to establish some kind of communication. The aforementioned design gesture is not only related to the way that information is spatialized, but also to the selection of the proper medium that will produce an essential interaction between user and environment.

The suggested taxonomy does not only aim to function as an alternative design framework for mixed environments (in the light of mixed embodied presence), but also to enrich the design process of the emerged new technological-driven realities and spatialities, with the unpredictability of embodiment and embodied presence.

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