Embodied Emotions

A phenomenological aproach to computation to explore empathy through architecture

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Abstract. *In this paper we present a PhD research that aims to develop a design methodology that, using computational tools can generate livable spaces that allow the design of user centered architecture. We propose that a "corporeal architecture" might be able to work in a prophylactic or therapeutic way that can face some adversities generated by the contemporary impact of technology in the human body. We are using motion as the basis the tool to simulate the body's motion as a spatial generator. We hope to understand how an embodied space, generated by motions that reflect emotions, can create a sense of attunement with its dwellers. We also wish to achieve the holistic stimuli of the human body in a naturally immersive environment, with the induction of the body's motions in space by the physical properties of the architecture.*
Keywords. *Corporeal Architecture; phenomenology; computation (shape grammars); user-centred design; empathy.*

INTRODUCTION

This research started with the intention of developing a PhD thesis on the relationship between the human body and architecture, in the context of the digital era. It aims to establish a common ground between different practices in order to achieve a holistic understanding on the human body as embodied mind and architecture as an extension of the Self and to integrate new knowledge on instinctive actions of the human body and on intuition that has grown considerably in the last years, due to the studies of the human brain in cognitive sciences (Varela, 1991) and neurosciences (Damásio, 1995). These have brought a new light on the sensorial experience of the body and also on the role of emotions and subconscious thinking in reasoning and action, breaking the chains of Cartesian Dualism. Descartes' "cogito ergo sum" motto (I think therefore I am) was replaced by the holistic thought of the whole human body as a thinking thing. This view on the human body and mind as a single entity and the psychophysiological implications that it arises are having implications in many research areas such as Biology, Artificial Intelligence and Robotics. It has also been applied to the configuration of space in extreme conditions such as space travel or military training, in order to ensure the comfort of the crew (Durão, 2009). In Computer Sciences and in the design of Human-Machines interfaces this knowledge has been applied in the development of intuitive means of interaction between users and software or hardware. In the Arts, some contemporary artists such as Olafur Eliasson and Bob Wilson have found

a Neuroaesthetics based on the knowledge developed by neurosciences and apply it to projects and installations that explore intentionally the potential of the senses as media. In the field of philosophy, Somaesthetics (Shusterman, 2008) has appeared as a new branch of research that combines theoretical reflection on the body in the phenomenological tradition, with embodied practices such as yoga or martial arts, encouraging it's participants to think through the body in order to improve body consciousness and so enhance one's knowledge, performance and pleasure.

Regarding architecture, these attitudes towards the body and its emergent knowledge offer many and new possibilities for exploration and most likely a paradigm shift. New technological equipment used by the referred areas of research allow a better understanding on how the human brain works and this can allow architects to better understand desirable human requirements, how to provide spaces that will accommodate human activities in the best manner and correlate them with responses on the human brain and mind (Eberhard, 2009). Architects and scientists will collaborate more to determine what we build and why and how it will enhance the human experience (Chong, 2009). By designing the structures we live in, architects are sculpting user's brains and so affecting the user's behaviour, so there are promising advantages to integrate this new knowledge to the purpose of building a more sound and quality of life oriented human establishment.

Context and framework

Social interaction in cyberspace is a very important aspect of communication today, as a growing number of individuals and groups are using the same tools to leisure or work, such as email or social networks. These modes of interaction are subjecting the body to very specific and limited kind of tasks that are mostly mechanical and passive which make us reflect on the kind of consequences it can have on the human body, in a short or medium period of time. As digital space blurs with physical space, it's urgent to understand its impact on contemporary living, in what concerns the body as a holistic system, and its health as an organism depending on sensory stimulation, both physically and mentally. Medical studies are already relating the growth of pathologies such as lack of visual acuity, muscular skeletal disorders, obesity, insomnia and depression with this type of human-computer interaction. This triggers even more alarm as younger generations seem to grown in hyper stimulation and even children are starting to show signals of this kind of stress such as trouble concentrating while studying. Many software and hardware designers, supported by the new studies on the human brain, express the thought that the majority of the information systems used today not only disregard the whole potential of the human mind, but it also conditions and limits it (Lanier, 2010). The excess of images and the primacy of vision over the other senses also express the superficiality of media culture and of some architecture. Most designs are made with this kind of approach, also due to the use of digital tools that are still mostly oriented to the production of images on a flat screen.

Pallasmaa (2005) stresses the issue further by saying that beyond architecture, contemporary culture is heading to what he believes is a terrifying de-sensualisation and de-erothisation of human relationships towards reality. But good architecture provides complex and simultaneous sensual stimulation that arouses subjective and phenomenological experience and this can't be achieved in designs that regard only sight. Some contemporary architects such as Peter Zumthor, Steven Holl and Juhani Pallasmaa are defending a phenomenological standpoint on architectural design, trying to express in their work the sensorial experience of the body in architectural space, "*a unique way of being that speaks to all my senses at the same time*" (Merleau-Ponty, 1945). To Pallasmaa, "*the dehumanization of contemporary architecture and cities can be understood as a consequence of a neglect of the body and the senses* […] *an imbalance in our sensory system, [being] today's growing experiences of alienation and loneliness related to a certain kind of pathology of*

the senses". He states that this is the heritage of the modernist paradigm of ocularcentrism, started at the Renaissance and continued by Le Corbusier who considered the eye as the king of architectural experience.

Anyhow, one must note that twenty five years before designing the Modulor, Le Corbusier expresses in L'Esprit Nouveau the need for rules in architecture based both in scientific knowledge and also art and experiment, a Scientific Aesthetics that joined reason and intuition. This would be based on his studies in cubist painting and sculpture and the musical concepts of harmonics, applied to architecture, in the pursuit of the fourth dimension, the moment of boundless freedom brought about by an exceptionally happy consonance of the plastic means applied in a work of art, being the key to aesthetic emotion a function of the architectural space.

The referred recent developments in the realm of brain studies are bringing back the interest in the phenomenological philosophy as proposed by Husserl (1931) and Merleau-Ponty (1945). Some architects such as Peter Zumthor, Steven Holl and Pallasmaa are defending this approach to architecture and they try to explore the sensorial experience of space through their work, what Merleau-Ponty defined as a unique way of being that speaks to all senses at the same time. In "De Architectura", Vitruvius had stated that the origins of architecture were most likely related to these instinctive human gestures of protection of the body, facing nature. Also Bachelard (1957) presents us an idea of archetypical house, a body tailored shelter where one can explore infinity in intimacy and find in this state of well-being a place for the Self. This house is shaped by the movements of the body, like the bird that shapes its nest.

However, there still isn't an approach in architectural practice that joins in an organized system or methodology the knowledge the scientific community already has on the perceptive mechanisms of the human body, ancient systems of developing somatic and corporeal awareness, and the means of architectural conception, in order to design with more assurance or with specific intents. If architects assume the responsibility to design tools that surpass the limitations of the flat screen to explore the whole potential of sensual experience, and risk to integrate embodied practiced in the conception of new tools, these can generate an architecture that is more intelligent, stimulating and corporeal. So, these new tools could support a desirable paradigm shift in architecture and allow its reconnection with the human being and its emotions while producing designs that generate a body-conscious interaction between the dwellers and the physical environment. This would arouse user's mind and body holistically and by providing a naturally immersive environment that could offer balance, a sense of well being, increased quality of life and a place for the Self.

This was Le Corbusier's intent with the Modulor and although, as a system of rules, it wasn't complex enough to deal with the challenges of its time, reducing them exclusively to a problem of proportion, its use was intended to open the path for the architect to work with more assurance, letting intuition flow and make art easier. So, we can say with some assurance that if Le Corbusier had at his disposal the means and the knowledge available today, most likely the Modulor would have produced different results, opening the path to a more individualized, subjective and corporeal architecture. Even so, on some cases, it did prove useful and accomplished its mission, such as in the plastic, corporeal and arousing architecture of the Ronchamp's cathedral.

Model: description, goals and evaluation

We propose a theoretical model that is embodied in a design tool that tries to bridge the gap between phenomenology and computation. To achieve this, we are designing a computational tool, based on shape grammars (Stiny, 2006) that simulates the movement of the human body as a spatial generator, having in mind that the body generates space with its movement (Gil, 2001) and that, as many studies in the realm of the sciences referred before claim, the movement of the human body, being voluntary or involuntary, reflects emotions and inten-

tions and these can be conscious or unconscious. So, assuming that the human being's brain architecture, namely the mirror neurons, are programmed to establish empathy and affective links with the environment, which includes animated or inanimate objects, material or immaterial, this thesis aim is to demonstrate the hypothesis that if the movement of the human body reflects emotions and if movement generates space, then movement can be used as a tool to generate an architecture that has a desired emotional effect in the dweller, through a process of empathy. This will be expressed by the reactions of his body and his behaviour. If this hypothesis verifies, it will be possible to design architectural space in order to conduct the emotion and the experience of the dweller and so influence his behaviour in a subliminal level.

Walter Benjamin, in his essay "The Work of Art in the Age of Mechanical Reproduction" states, referring in terms of existential space to the affinity between cinematic and architectural experience, that "*although the situation of watching a movie transforms the viewer in an incorporeal observer, the cinematic space of illusion returns the body to the viewer, as the haptic experience and the movement [of the image] provide him powerful kinaesthesia [and so] a movie is not only seen with the eyes but also with the muscles and the skin* […]*, the images stored in our memory are visual but also incorporated as haptic*". Likewise, the thesis proposes a view of architectural space as fully immersive experience, in which the movement of the human body is explored in its design as a means to establish an empathic connection with the dweller. This idea on empathy tries to follow aesthetic subjectivism as it is related in Lipps' (Lipps, 1903) theory, as "*a means to objectify our sensations, to project ourselves into the insides of objects*". To Lipps an apperceptive motion, which creates a line is "empathic" into it; the act of creation of something spacial is in fact a motion and this is not only in our mind, but it is directly experienced".

At last, the thesis aims to demonstrate that it will be possible to design architectural space regarding the emotions that it can generate in dwellers and that this strategy can be useful in order to maximise user's psychophysical well being and health improvement by increasing his corporeal awareness. We hope that this way, such architecture can operate in a prophylactic or therapeutic way, for example, making the user exercise without being rationally aware of it and so improve/maintain his overall health condition, as synaesthesia and kinetics are acknowledged to function as very powerful sensory stimulators and main factors in the holistic maintenance of the human body. The system, once digitally implemented and set to a virtual setting can also be used to demonstrate with empirical evidence that some architectural spaces can be inducing subliminally in the dwellers, through their morphological characteristics, emotions that have a negative impact in their bodies and that this is revealed in behaviour such as aggressiveness or depression.

A grammar of movement: the body in movement as a design tool

Regarding the construction of the tool, this research tries to make an incorporation of knowledge and practices such as the experiments done by the Futurists, in search for the dynamic sensation made eternal through mechanization; Russian Constructivist dynamic style of theatre in order to create a psychological synchronism with the viewer; Oskar Schlemmer's idea of "sensation of space" and the origin of his dance productions; Jackson Pollock's action painting and his expression of emotion in motion; and finally Merce Cunnigham's pioneer work in dance theory and practice that proposed indeterminacy as a means of composition and that the full range of natural movement possibilities, such as walking, standing, leaping, could be considered dance and each movement as something in itself.

We have started to write a shape grammar based (Stiny, 2006) synthesis of the human body, hoping to transfer the biomechanical process of movement into information in a way similar to the method used in kinesiology. The lexicon of movements of the body encoded by a shape grammar allows developing "choreographies" of movements

and later such choreographies can be constrained by the architecture to maximize the well-being of the subject. This influence may be done using the simulation and optimization program whose fitness function reflects the level of well-being, and so qualifying the performance of the architectural solution which determines the movement.

The tool may be used to manipulate spatial modeling with the composition of the various elements of the grammar in rhythmic variations in order to provide specific experiences in the dweller and it may grow in complexity. To the elemental parameters of movement others such as color, light, sound, texture, scent, temperature, taste and so on, might be added until it is possible to achieve a global synthesis of sensory experience in the simulation. In order to make a rigorous evaluation of the psychological effects of the generated spaces in the dwellers, virtual simulations will be made in a fully immersive 4d interactive environment and users will be wearing sensors that measure the heart beat, muscular tension, electrodermal activity and brain wave frequency (Biocca and Levy, 1995). In the final step, one of the spaces generated by the algorithm will be chosen to fabricate a material model trough rapid prototyping and this will be installed in an exhibition context. User's behavior will be recorded and this data will be analyzed to detect behavior patterns and to confront them with the data collected in the virtual simulations.

This research presents two problems that can compromise the successes of its outcome. One regards anthropomorphism, as suggested by the simulation of human motions, as a strategy to generate empathy. If the movements generated by the algorithm are not adequately reproduced, for instance in terms of rhythm, the space generated can make the dweller feel uncanny and his affective response may be opposite of expected and the hypothesis would not verify. This problem is regarded as main risk factor in research areas that use anthropomorphism with the same intents, such as robotics and computer animations (Mori, 1970). The other problem this research implies regards the use of architectural space as a strategy to condition human psychophysiological response, for intended harmful purposes, which presupposes further and extensive ethical discussion. As Le Corbusier pointed out in the Modulor, having a tuned instrument isn't enough to generate harmony, it is necessary to use with, "standards, the product of analysis and painstaking study; they are evolved on the basis of a problem well stated. In the final analysis, a rule is established by experimentation." Likewise, we wish to reach for design solutions that are focused on user well-being, providing a more subjective and corporeal experience of architectural space, bridging the gap between digitality and physicality and hopefully, as Bachelard proposed, heading towards the construction of a place for the Self.

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