

How to make rehabilitation intersubjective: the “Gesture” tool

P. Abreu & P. Esteves

Faculdade de Arquitectura da Universidade de Lisboa/ Centro de investigação de Arquitectura, Urbanismo e design (CIAUD)

ABSTRACT: It is widely acknowledged that architecture differs from current building, as a higher level, because it conveys a deeper meaning, something beyond plain function. The meaning of a work of architecture – something of existential value – is what makes it unique and irreplaceable. Understanding it is necessary so that we can better benefit from its content, but also so that architects can uphold it when working on pre-existing architecture. But how can we acquire this meaning, and acquire it in an intersubjective manner, so that we can hope to agree on it? We suggest the concept of *gesture* as an interpretative basis. “Gesture” is the chain of movements (walking, looking around) and also emotional shifts of someone experiencing an architectural space. “Gesture”, inasmuch as it is determined by the environment, would be essentially similar for every person. These movements we make – an unconscious dance – are induced by space itself and convey its meaning to us. Our hypothesis is that we can use *gesture* to reach meaning. Its value as an analytical tool lies on the fact that it a) derives directly from the work itself rather than, for instance, the architect’s intentions; b) focuses on the more tangible, observable parts of the subjective experience; c) is typically shared by everyone: a common ground for discussion of meaning. We performed an experiment based on this theory in which we recorded the motion of a group of architecture students freely exploring the church of the Monastery of Alcobaça, registering their walking trajectory as well as their gaze trajectory (using an eye tracking device). Our preliminary observations seem to indicate the existence of a shared response to that architectural form. If the statistical analysis of the data (not yet completed) does identify an exploratory pattern, we will have a basis to further pursue our theory, refine it and attempt it in other buildings.

1 MEANING

Reflecting on architecture, Paul Valéry (1926) recognizes that some buildings are *silent*, others *speak*, and yet others *sing*. We believe that “singing” is not a mere superlative degree of a hierarchical scale of *architecturality*; we consider that it is an identity attribute. *Architecture* can indeed be associated with *music*, as the only two forms of art capable of producing an ambience, an atmosphere (Abreu 2007a).

We believe that it is in this capacity for creating an environment that lies the fundamental principle of the architecture’s specificity.

This *singing* that works of architecture are capable of doing offer a *meaning* – some kind of poetical, existential, not merely functional content. Something significant to us, to the way we should live our lives, some truth about human condition.

That meaning is the essence we should preserve, as architects, when working on pre-existing pieces of architecture – and, whenever possible, not only preserve but emphasize it. Meaning should work as a guide in every project decision: to discern whether we can demolish a wall,

use artificial lighting in a certain way or add a window to a certain room – without distorting the identity of the pre-existing work beyond recognition. When we act upon a piece of architecture not knowing its meaning, even our knowledge of its history, our comprehension of materials and building techniques become useless, because we do not know how to apply them. It is important to notice that, in a way, all architecture work is done on something pre-existing, since it usually happens in the context of some kind of humanized landscape, with its own character and values.

Meaning is the message conveyed by a piece of architecture. It allows the dweller – anyone who experiences the building – to understand it, to fully relate to it, to grab and assimilate its identity and its cultural value.

2 TONE, RHYTHM, MELODY

How can we, then, understand the meaning of a piece of architecture? We will use as a starting point the vision of Valery mentioned above to allegorically describe the endogenous process of communication of architecture with the Self and in this way describe its identity.

It is quite straightforward, within a first glance, to grasp the tone of a building. *Tone* corresponds to the general affective hue of an environment, which steadily and significantly affects our perception. *Tone* is the first element of the feeling conveyed to us by architecture. This is why we sometimes refer to an atmosphere as being ‘warm’ or ‘cool’, ‘formal’ or ‘casual’.

Rhythm derives from the intensity and frequency of stimuli and is materialized in the type of walking and visual movement that it causes in the subject who perceives the piece of architecture. *Rhythm* may exist inside a room – in its shades and contrasts with the background color – but its most remarkable function is the separation of various atmospheres, organizing and directing the subject’s trajectory.

The way in which *tone* and *rhythm* are arranged (or tones and rhythms, if the work has several different spaces), that is, how stimuli are distributed spatially and also, through the sequence perceived, temporally, induces variations in the behavior and feelings of the reader and creates the “melody” (to take our musical metaphor further); it is the musical “theme” of that work of architecture.

This organized sequence of stimuli (with different shades) that we designate as “melody” guides the reader’s feelings. Through its “melody”, the piece of work no longer simply makes a direct impression on the subject, as it does through *tone* and *rhythm*: the repercussion of the “melody” is more personal. It starts by inducing a particular mood, modelling and guiding it afterwards – as in a waltz – subsequently offering a path of life, the shades of a state of mind, a trail of existential understanding of the Self, of culture, of mankind. “Melody” tells a story, which conveys an existential meaning.

(It should be noted that this terminology is allegorical: the words we use are imperfect, but they are meant to translate what typically happens when we experience a work of architecture. The actual experience is of course more complex than these notions are able to say.)

3 GESTURE

The idea of “melody” helps us to explain our concept of *gesture*.

What we designate as *gesture* is the inner and outer motion (in space and time) of the subject – both movement and feeling – induced by architecture, through the layout of *tone* and *rhythm* set in a kind of “musical phrase”. “Gesture” is the organized chain of movements – walking and looking – and feelings – caused directly by architectural form. It is through *gesture* that a piece of architecture communicates itself to the subject who perceives it. Edmund Husserl had already understood the value of kinesthesia, the sensation of movement. The way our body feels like in a certain place and how it moves through space truly determines our experience of that place and our understanding of its identity. Husserl writes: “*The place is realized through kinesthesia, in which the character (das Was) of the place is optimally experienced.*” (Casey 1998). Maurice Merleau-Ponty (2006) also claims that it is the way our body reacts to the environment that makes us realize that environment. He rejects a traditional linear causality of cause

(environment)/effect (reflex reaction) and remarks that although our body motion was caused by the stimuli around us, those stimuli were first received because of our previous movements.

If we consider that a work of architecture is capable of producing a “melody” and has the ability to cause a “gesture” – an arranged sequence of movements and feelings of the subject perceiving the environment – then it is easy to admit that this sequence conveys a message, a meaning (order is always meaningful). Hence, the understanding of the meaning of the piece of architecture comes directly from the work itself and what strictly belongs to it, i. e., its form: not from the artist’s intention or any other external matters. “Gesture” corresponds thus to the immediate repercussion of the piece of architecture on the subject – because nothing stands between the piece of work and the subject (other than himself). Therefore, the awareness of *gesture* is the crucial tool to realize the meaning of a work of architecture; once aware of the gesture, the work towards the understanding of meaning begins.

As we said earlier, only works of architecture are capable of producing a “melody” and causing a “gesture”: every building produces a kind of noise – inasmuch as they offer the subject a collection of stimuli – but some “orchestration” is needed in order to generate this *dance*. The artistic quality of the environment, the existence of *architecture*, is fundamental for the concept of “gesture”.

Discovering the meaning of a piece of architecture would be useful to architects, but also to architecture critics and historians. We should note that it is not a personal, private meaning we speak of (in the sense of “what does this building mean *to me*?”), but an intersubjective one – one that is shared by everyone. That is why “gesture” is such an invaluable tool. As we have seen, it comes directly from the work itself, from its physical existence; it is an observable, measurable phenomenon; finally, it is fundamentally shared by most people¹, which allows it to be the common ground for a discussion about meaning – and, ultimately, the basis for a responsible intervention on valuable pre-existing architecture.

4 TWO EXAMPLES

In order to illustrate how gesture leads to meaning, and how meaning advises rehabilitation, we will provide the example of two buildings in Lisbon: Basílica da Estrela, and Torre de Belém². We will shortly exemplify how to discover meaning through gesture and how knowing the meaning affects project decisions.

Basílica da Estrela is a church built in the late eighteenth century in Lisbon.

Because its dome can be seen from any high point of Lisbon, its presence is felt throughout the town; even when there are other domes in the landscape, this one stands out due to its size and its details; it has a distinctive long, vertical lantern that differentiates it from the rest. Due to its decoration, it has a kind of black and white intense texture which casts a vibrant brilliance, like a sun. The sight of it is somehow magnetic – it arouses our curiosity, it attracts us.

If we accept that tacit invitation, we will find that reaching the dome is not easy: we need to cross some of Lisbon’s labyrinthine neighborhoods, sometimes losing sight of the dome and discovering it again, from a new angle, further ahead in the way. When we finally reach it, however, we find out that its façade works like a barrier: it is flat, with somewhat small doors, always shaded (because, awkwardly, faces north) and not very inviting overall – but the sunlit dome, above it, still attracts us; so we dive swiftly through this façade to get to the inside dome.

¹ About the intersubjectiveness of the environment’s experience, Mark Johnson (2007) proposes the sensory-motor system as the basis for our dialogue with the world. This system, composed by all peripheral receptors (which capture external features such as temperature, light, color, ground inclination, smell) and their connections with the sensory cortex in the brain, also encompasses the motor response which is part of the stimuli processing. It generates an understanding of the environment that is, on a primary level, very much alike for every human being. There is a specifically human way of being embodied: a “tactile-kinesthetic” way; it shapes our perception of the world and creates a *human* type of meaning.

² Both examples are more extensively analyzed in Abreu (2007b).

We find a quiet, warm, welcoming space – we have to stop, the architecture makes us stop. We sit down in one of the benches and rest. The interior of the church is full of recesses with altars in which we rest our eyes for a moment, but which visually block us the way, preventing us from walking.

All around, there is a yellow-orange ambient hue caused by the light from the superior windows reflecting multiple times on the yellow and red stone panels. Somehow, this experience is vaguely evocative of being inside a living body, like a fetus inside its mother's womb.

But then, against the warm atmosphere, we notice the fresh, brilliant light coming from the dome that we now see from the inside. We are now immersed in a soothing environment, free of the gravitational forces previously compelling us to move; our body is resting, but our head looks up, our eyes are attracted to the lit up windows in the dome. They fixate the light coming from *outside*, from *above*, from the *sky*, from where absolute meaning comes from. We feel protected, embraced, but also keen on the drive to act, resolute.

There are therefore two types of “gesture” in the way we relate to this building – the first one, centered around the dome, is centripetal; it happens outside the Basilica and encourages us to pursue it and enter it. We could say the dome works as a star that guides us on our way (in fact, “Estrela” means “Star”). The second type of gesture happens once we are inside; while the warm atmosphere and overall layout of the church is inviting us to rest, our attention is still captured by the dome, which throws it outside, upwards, now in a centrifugal motion.

The nature of the Basílica da Estrela is both the one of a Star and of a Heart. Like a star, it is a reference, a guide, both spiritually and geographically. And also, like a heart, it draws us in and sends us back again to the exterior, but in a very extraordinary, meaningful way. The heart metaphor is especially significant, since the Basilica is devoted to the Sacred Heart of Jesus.

Having found – through the “gesture” – the meaning of the Basílica, we are better equipped to think over its revitalization.

In the interior, the atmosphere depends mostly on the color-charged light that comes from the reflection of sunlight on the wall stones. These surfaces have deteriorated, lost their luster, and it would be advisable to restore them in order to achieve the original intensity of reflection. Other contributors to the experience of the interior are the painted retables by Battoni – also important for the thematic understanding of the building, and which need cleaning as well.

As for the exterior, the most important thing for the existential reading of the building is the Star analogy, which is conveyed primarily through the white glow of the stone; in that sense, periodic cleaning should help to keep its surface free from chemical and biological black spots. But, as we mentioned, this cleaning has to be mindful. The most recent one may have been too rough: it removed the oxidation of the stone surface; that natural reaction, which happens over time, generates a pulverized layer which polarizes light and contributes to the building's splendor.

Torre de Belém is a fortified tower built in the Manueline style in the beginning of the sixteenth century, also in Lisbon.

When approaching it, two features strike us most about this monument: the fact that it is built over the water; and its dense and variegated decoration.

The vertical element of the tower denotes ownership and humanization of the place in which it stands: as if someone was taking possession of a new territory, marking it, grabbing it out of Chaos and into Cosmos – like the Portuguese discoverers did when they left a “padrão” on newly found land. The boat-shape of the building indicates that is the *surface* that is being appropriated: i. e., the seas. This, in fact, more or less summarizes the enterprise of Portuguese Discoveries period (we may say that the Portuguese most important cultural task was precisely showing that the seas were a vehicle, not a barrier).

This meaning is corroborated by decoration, that, if we look carefully, we will see that it tells a story: the story of a sea voyage: with the elements that talk about the vessel (ropes, shields on the side of the ship, the rail section, the seemingly galleon profile, with a tower on its stern, when seen from along the river, etc.), elements that talk about exotic landscapes (ribbed domes, strange animals like the rhino, the mythical sea beasts) and elements that talk about home (the

saints and angels, the tower itself, the seemingly Romanic church profile, when seen from north). (Several other aspects of the interior space experience, which we do not have the time to address right now, also support this interpretation.)

To any architect who has to work in or around the Torre de Belém, this reading should be a guide as to what could potentially help the building express its meaning and what could destroy its ability to do so.

About the site, for instance, an important understanding arises from the fact that the Torre's identity is that of a *tower built in the waters*: that the coastal line increasing closeness to the monument, as well as its loss of altimetric dominance by the construction of higher buildings nearby compromise its very nature; it reads less and less as being in the water and as being a tower.

Further considerations can be made, as for instance about the decision made in the 1998 cleaning, not to reproduce the rhino image – the ornaments are a fundamental part of the identity of the building; also about the erasing of several projectile marks in the east and north façades. This speaks to the fact that every intervention on a work of architecture, even a cleaning operation, supposedly neutral, has to take into account the identity of the building – so as not to wipe it away unknowingly.

These analyses exemplify the potentiality of our approach, but they could also render the unprepared reader somewhat uncomfortable and unsatisfied with its subjectivity. We can assert the experience of architecture as being subjective, as it always depends on the experience of a human subject (we will never be able to program a computer to tell the difference between building and architecture). Validity, in this case, comes from *intersubjectivity*. That is why we designed an experiment meant to investigate the existence of a common way of reading and reacting to a piece of architecture.

5 EXPERIMENT

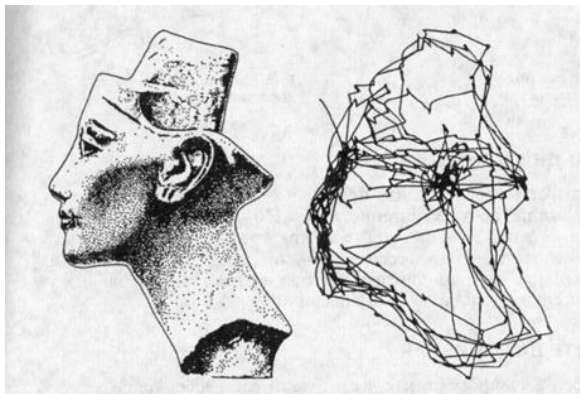


Figure 1 – Scanpath of the bust of Nefertiti, as acquired by Yarbus eyetracking experiments.

Our empirical study is the first to attempt to test the “gesture” theory. The technical difficulties in doing so are great and only recently did the means to reliably register eye movement in free movement conditions become available.

In other fields, however, such as Painting, there is already a large number of empirical studies regarding perception, which help anticipate what is to be expected in Architecture. Alfred L. Yarbus found out that, when looking at pictures, our eye movements form a consistent pattern (Yarbus 1967). Instead of exploring the whole image, the eye repeatedly returns to the same few elements: each picture spontaneously generates its own visual

pattern. He observed that this pattern is repeated, with small deviation, by different subjects. Later investigators³ named this pattern “scanpath”.

We believe there is a possible analogy between the exploratory pattern of architectural space – *gesture* – and the exploratory pattern of pictorial space – the *scanpath*. The former would be a

³ Noton and Stark (1971) analyzed the sequential nature of eye motion and, like Yarbus, saw those perceptual cycles, which they named “scanpaths”. Each image suggests its own sequence, which is recognizable from subject to subject, with variations. Brant and Stark (1997), and later Kapoula, Yang, Vernet and Bucci (2008), observed that these eye movements are also reproduced by our eyes when we imagine the image previously seen. This findings support the supposition according to which scanpaths reveal inner mechanisms of object comprehension and memorization.

three-dimensional version of the later. Consequently, if we recorded the motion of different subjects freely exploring an architectural space, it would be possible to make out a common pattern, revealing in which way our body reads the whole group of stimuli presented by the building and responds to it. Surely the sequence would not be equal for every subject, but nonetheless there should be a certain consistency of results.

For a complete validation of the *gesture* theory, a vast series of empirical studies would be in order. We would have to find a common exploratory pattern in different sites – buildings, gardens, squares and every living space with enough architectural quality to generate an intersubjective response.



Figure 2 - Calibration of the Tobii Glasses Eyetracker Smart IR.

We performed a preliminary empirical study in which the walking trajectory as well as the visual exploration of 50 subjects (39 first-year architecture students plus 11 older architecture students and just-graduated architects) were recorded while they freely explored the church of the Monastery of Alcobaça.

We used an eye tracker– Tobii Glasses Eye Tracker Smart IR (figure 2), perfectly portable, similar to a pair of glasses wired to a light pocket-sized device – which recorded a movie of the subject's point of view through the visit, while also registering the motion of their right eye pupil. The output was a video recording of each visit with a moving cursor indicating where the subject was focusing their vision throughout the visit (figure 3).

Unfortunately, the existing data treatment software is not yet adapted to real life eye tracking the way it is to 2D image viewing and thus there are few automated analysis tools. The ideal output would be a heat map juxtaposed to a 3D model of the church, showing the most fixated sites. Because that technology does not exist yet, we manually coded every recording (figure 4) and are, at this stage, still processing our statistical results.



Figure 3 – Video frame of one of the eye tracking recordings. The red dots represent a series of fixation locations.

Additionally, we asked participants, immediately after the visit was made, to draw their perceived trajectory (fig. 5) and also to make a drawing that represented the most meaningful experience of the church itself (fig. 6). We also interviewed each subject about their experience, using their drawings as a starting point.

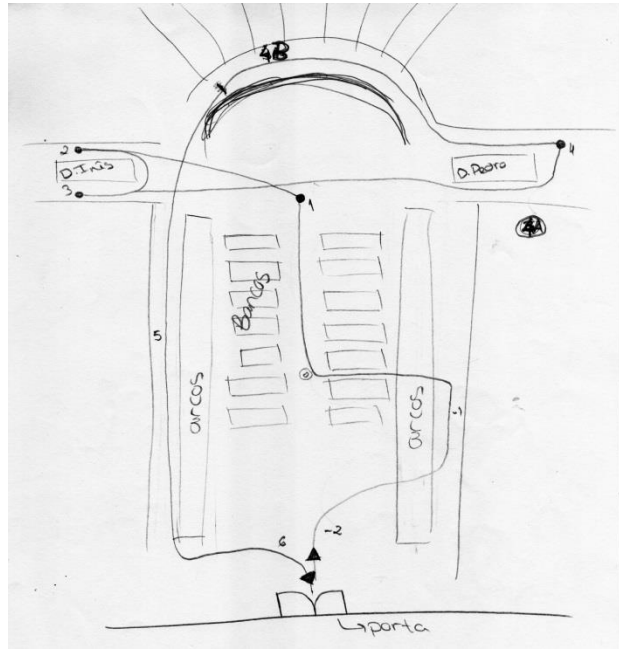
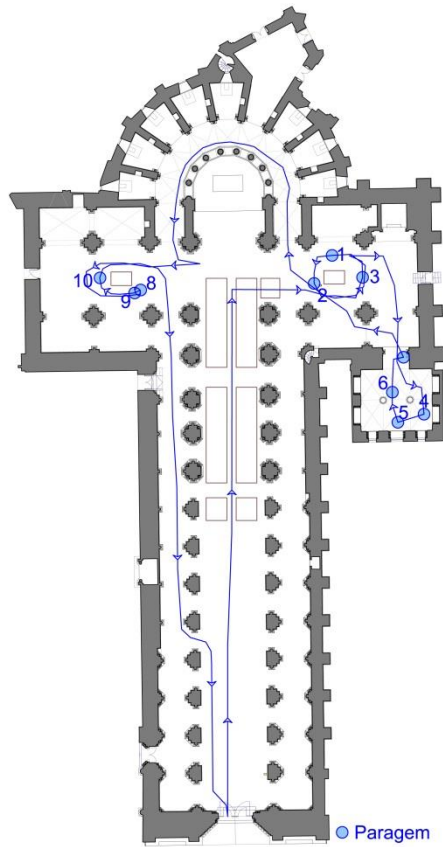


Figure 4 (left) – Walking path of one of the first-year participants, manually extrapolated by watching their eye tracking recording.

Figure 5 (above) – Drawing of perceived path by one of the first-year participants.



Figure 6 – Drawing of the architectonical experience by one of the first-year participants.

While statistical results are still being processed, a few observations can be made, relying only on our attentive viewing of the recordings. When exploring a place like the church of the Monastery of Alcobaça, participants seem to make use of three kinds of looking strategy. They are: navigation, reading and contemplation. The first seems to allow them to navigate the space; it is composed of quick, long saccades (eye movements) and short fixations; the eye jumps from element to element, from nearby objects to people entering the visual field, in a reactive, involuntary manner. *Reading* is also an informative form of looking, but a voluntary one; it happens when, for instance, the participant notices and seems to study the small figures and signs on the tombs; this pattern of looking usually consists of short saccades and longer fixations that progress according to a linear and constant trajectory, not going back and with no accelerations or disaccelerations. The last and to us most interesting looking pattern, which we designated *contemplative*, differs from reading in the fact that the eye repetitively returns to the same feature (a window, for example) while in reading it usually fixates each region only once. A contemplative gaze is not extracting information anymore, but seems to be an

end in itself – as if it was enjoyable.

Let us note that the existence of two distinct ways of visual processing has already been established for image (static scene) and also video (dynamic scene) viewing. This duality has been referred to as *focal-ambient* (Trevarthen 1968) or *foveal-ambient* (Stone, Dreher & Leventhal 1979). Although parameters can vary, fixations with a duration of 90 to about 260 milliseconds, along with saccades that go beyond the parafoveal part of the retina, thus aiming at blurred targets, are associated with ambient mode. Fixations longer than 260 milliseconds and smaller saccades tend to indicate focal processing (Velichkovsky, Joos, Helmert & Pannasch 2005). Although our equipment did not measure fixation duration, and thus we cannot compare our data with that from 2D eye tracking, it seems very likely that the distinction in visual processing found in those conditions also exists in real-world navigation. What we call *reading* and *contemplative* ways of looking are both part of the foveal processing, while ambient processing would be the more navigation-oriented type of looking described above.

Even though it is not easy to make an integrated analysis of walking and looking behavior, we observed that contemplative gaze is often paired with two walking patterns: the first is simply being still, for instance stopping just as the eye engages a certain feature; some of the subjects sit down on the benches to examine the apse more extensively. The second is slowly walking towards, or around, the element one is looking at. This behavior is possibly site-specific: the church in which the experience took place has a nave more than 100 meters long which ends in a well-lit apse; walking along the length of the nave while fixating the apse seemed to be a common response to that architectural form, i. e., the typical “gesture” induced by this piece of architecture. Another observation about this contemplative gaze mode is that it seemed to fall on the same regions (for example, the apse in one end of the nave or the rose window in the other) over and again; the subjects looked at them from different angles at various points of their visit.

Although they are also not yet formally processed, something can be said about the interviews: the same words were repeated by different subjects. “Silence”, “solemnity” and “height” seemed often to be first impressions, which shows how the *tone* of the building is promptly and easily picked up. Older participants described the “magnetism” of the apse and how its light was inviting. Many acknowledged that appeal, but said they were too shy of the grandiosity of the central nave to pursue it immediately or directly.

As for the “experience drawings”, the most recurring theme was perhaps the height and repetition of the naves (something like the example on figure 6) – which again reveals a commonness in how stimuli were processed. It should be noted that each visit and subsequent drawings and interview were made individually and separately, so that each participant was not influenced by the experience of the next.

6 CONCLUSION

More substantial conclusions will arise when statistical processing is completed. This is of course still an incomplete account of the results of our experiment. This article aims mostly at its theoretical justification, still lacking the statistical evidence it pursues.

However, the preliminary observations seem to indicate that the building’s form generates a pattern of exploration; for example, the long, repetitive nave with sunlit extremities creates an axial walking movement where the eyes are constantly being drawn to the light ahead.

That observation could already tell us something about how to improve the church of the Monastery of Alcobaça; it already could help us make decisions about simple interventions, by helping us ask the right questions: “which illumination best suits the solemn, repetitive rhythm of the nave?”, “How dim does the artificial lighting need to be so as not to take the focus away from the apse?”, “Where should signage be located so that it doesn’t disturb axial movement?”, “Is it adequate that the tombs of D. Pedro and D. Inês should be where they are?”, etc.

This empirical way of finding meaning could guide the architect’s knowledge and creativity in order to enhance the architectural experience of the building. If the statistical analysis of the collected data should verify the pertinence of the gesture theory, other experiments, in other

locations, would still have to be made. As for now, it seems to be a valuable research path that could lead to a better understanding of buildings and, in the future, provide useful guidance for decision-making in architectural projects.

7 BIBLIOGRAPHY

Abreu, P. (2007a) *Palácios da Memória II. Secção Teórica*. Tese de Doutoramento. Lisboa: Faculdade de Arquitectura da Universidade Técnica de Lisboa (polycopied document). Online em: http://home.fa.ulisboa.pt/~pabreu/memory_palaces_Theoretical_section.pdf

Abreu, P. (2007b) *Palácios da Memória II. Secção prática*. Tese de Doutoramento. Lisboa: Faculdade de Arquitectura da Universidade Técnica de Lisboa (polycopied document).

Brandt, S. A. and Stark, W. L. (1997) "Spontaneous eye movements during visual imagery reflect the content of the visual scene" in *Journal of Cognitive Neuroscience*, vol. 9, nº 1, pp. 27-38.

Buswell, G. T. (1935) *How People Look at Pictures: A Study of The Psychology of Perception in Art*. Chicago: The University of Chicago Press.

Casey, E. S. (1998) *The Fate of Place: a Philosophical History*. Berkeley: University of California Press.

Esteves, P. (2010) *Gesto: Trabalho Preparatório para uma Demonstração Empírica*. Lisboa: Faculdade de Arquitectura da Universidade Técnica de Lisboa (polycopied document). Online em: <http://home.fa.ulisboa.pt/~almendra/Gesto-Patricia-Esteves.pdf>

Findlay, J. M. (1985) "Saccadic eye movements and visual cognition" in *L'Année Psychologique*, 85, pp. 101-136.

Johnson, M. (2007) *The Meaning of the Body*. Chicago: The University of Chicago Press.

Kapoula, Z., Yang, Q., Vernet, M. and Bucci, M.-P. (2008) "2D-3D space perception in Francis Bacon's and Piero della Francesca's Paintings: Eye movement studies" in *Proceedings of the 20th Biennial Congress of the International Association of Empirical Aesthetics*, pp. 75-78.

Kowler, E. and Zingale, C. (1985) "Smooth eye movements as indicators of selective attention" in *Attention and Performance XI*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Locher, P. and Nodine, C. (2008) "What does visual exploration of an artwork contribute to a viewer's immediate aesthetic reaction to it?" in *Proceedings of the 20th Biennial Congress of the International Association of Empirical Aesthetics*, pp. 69-71.

Merleau-Ponty, M. (1997) *O Olho e o Espírito*. [1961] Lisboa: Vega.

Merleau-Ponty, M. (1999) *Fenomenologia da Percepção*. [1945] São Paulo: Martins Fontes.

Merleau-Ponty, M. (2006) *La Structure du Comportement*. [1942] Paris: PUF.

Noton, D. and Stark, L. (1971) "Scanpaths in saccadic eye movements while viewing and recognizing patterns" in *Vision Research*, vol. 11, pp. 929-942.

Stone, J., Dreher, B. and Leventhal, A. (1979) "Hierarchical and parallel mechanisms in the organization of visual cortex" in *Brain Research Review*, 1, pp. 345-394.

Trevarthen, C.-B. (1968) "Two mechanisms of vision in primates" in *Psychologische Forschung*, 31, pp. 299-337.

Valéry, P. (1926) *Eupalinos au l'architecte ; Précédé de l'âme et la danse*. [1921] Paris : Gallimard.

Velichkovsky, B. M., Joos, M., Helmert, J. R. and Pannasch, S. (2005) "Two visual Systems and their Eye Movements: Evidence from static and dynamic scene perception" in *Proceedings of the XXVII Annual Conference of the cognitive Science Society*, pp. 2283-2288.

Yarbus, A. L. (1967) *Eye Movements and Vision*. New York: Plenum Press.