Università degli Studi di Parma
Dipartimento di Ingegneria Civile, dell'Ambiente, del Territorio e Architettura

Dottorato di Ricerca in Forme e Strutture dell'Architettura

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XXVII Ciclo

Alessandro Gattara

Empathic response in office space
The notion of embodied simulation in corporate interiors

ICAR 14

La reazione empatica negli spazi per uffici
La nozione di simulazione incarnata negli interni aziendali

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Titolo della tesi:
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The notion of embodied simulation in corporate interiors

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Abstract

The main subject of this dissertation is the reciprocal relationship between buildings and their users. It describes the empathic response to architectural settings and frames the notion of embodied simulation and its implications for office design. The field of research is limited to office environments for two fundamental reasons: first, the number of physical variables is limited especially with regard to the interior scenery; second, its performative nature entails description and measurement. The research is theoretical and incorporates evidence-based research from the varied disciplines of architecture and cognitive neuroscience.

The first part of the dissertation defines the notion of empathic response to architectural space through the illustration and interpretation of some of the major theories and theoretical positions proposed since the end of the 19th century. These were collected in three different categories, each representative of the contemporary architectural and philosophical debates. This part concludes with an original interpretation of the subject. The second part of the dissertation describes the typological evolution of corporate office buildings in modern history with regard to their most representative models and examples in Europe and North America. These were collected within three different categories that characterized and defined the configuration of such spaces.

The third part of the dissertation frames the notion of embodied simulation within office interiors, and concludes that they are inseparably tied to their users by means of embodied simulation, which in fact defines their relationship with space itself. The research introduces neuroscientific evidence according to which the experience of architecture is based on a complex relationship between the body, its motor system, and architectural space.

Keywords

Office building, office space, office interior design, space planning, embodiment, embodied simulation, empathy

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CHAPTER 1
INTRODUCTION
Aims, objectives, and methodology

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Aims, objectives, and methodology

A theory is the more impressive
the greater the simplicity of its premises,
the more different kinds of things it relates,
and the more extended its area of applicability.[1]

Albert Einstein

1. Intentions

This dissertation is about the reciprocal relationship between buildings and their users.

The first aim of this dissertation is to describe the empathic response to architectural settings.

In every design usually a number of solutions are possible and the relationship between buildings and users can be studied in as many ways there are social and biological sciences. While architecture has always been considered as much a science as an art — at least from Vitruvius until the 18th century, when it started to evolve as an autonomous artistic discipline — it is only in the 20th century that, with a few notable exceptions, architecture tried to preserve its autonomy and theoretical purity.

It has been only in recent years that architectural theory considered some new or updated scientific and humanistic models in architectural terms, and indeed the academic involvement and the literature about this topic are still meagre and uneven.

The second aim of this dissertation is to frame the notion of embodied simulation and its implications for design.

It has to be emphasized here that it is not the intention of this dissertation to announce the next great revolution in design, but rather it is intended as an exercise to describe some basic "laws" of its very ancient knowledge.

2. Description and explanation

While some architects look at cognitive neuroscience to improve the quality of our built environments — either a building or a city — this dissertation is intended to be descriptive. It is not a manual for design nor a prescription of facility design guidelines.

Rather it is an attempt to describe the reciprocal relationship between buildings and their users drawing from and referring to a recently formulated evidence-based body of knowledge.

The intention of this dissertation is to help architects to find scientific evidence for some architectural theories and positions traditionally formulated as philosophical discourses that are primarily critical, or speculative, and with significant historical elements. If needs be it will also help neuroscientists in framing such relevant questions such as what it means to be human with philosophical perspectives, conjectures, and presuppositions, without limiting theirselves to scanning brains in a lab.

Hence, also, this dissertation aims to foster a conducive dialogue and a fruitful confrontation between these apparently different domains that may eventually lead to a common ground and language. A complementary level of description could frame new questions in the hopes of providing new answers.

3. Why office interior design?

A case study of the reciprocal relationship between buildings and their users had to be found where architectural design is less concerned with "authorship" but rather shaped by a larger political, societal, and economic context. Either

office and domestic environments would fit the purpose of this dissertation. It was decided to concentrate on office environments for two fundamental reasons.

The first reason is that the number of physical variables is limited especially with regard to the interior scenery rather than the building shell. In plain English the word 'office' stands for "a room, set of rooms, or building used as a place of business for commercial, professional, or bureaucratic work."[2] Moreover, the continuous development of office interiors throughout the course of the 20th century made the workplace today the most ubiquitous, detailed, and lavishly designed human environment. Even though emerging information technology is challenging the classic notion of workplace it is largely recognized that the average employee spends much part of their daily life in the office.

The second reason is that its performative nature entails description and measurement. The word 'office' in Modern English originated from Middle English via Old French from Latin *officium* 'performance of a task,' based on *opus* 'work' plus *facere* 'do.'[3] Office interiors have been systematically studied and analysed since the beginning of the 20th century, and a wealth of reserach has been collected in management and social sciences as well.

According to this account it is ideal for measuring the empathic response to architectural settings.

4. Research methodology

The research is theoretical and incorporates evidence-based research from the varied disciplines of architecture, spatial cognition, and cognitive neuroscience.

It is based on the implications of the biological sciences and the humanities for design, in the belief that a multidisciplinary approach to artistic and architectural expressivity is integral and vital to the comprehension of the human condition.

The first part of the research is intended to thoroughly define the notion of

empathic response to architectural settings; theories and positions are described, compared and interpreted.

The second part of the research is intended to describe the typological evolution of space planning in office interiors in Europe and North America; models and examples are described, compared and interpreted.

The third part of the research collects the implications for office design and provides a general discussion of the results.

5. Research limitations

This dissertation would have gained evidence to some of its conclusions if some laboratory experiments were performed. A few different grant proposals were written but none won and no funding for the experiments was provided. The laboratory experiments were intended to study how daily actions or social interactions virtually presented within differently designed architectonic spaces are experienced differently by beholders. They were also intended to study if and how such different experiences correlate with different profiles of bodily and brain responses.

While this of course limits the results and conclusions of the research, it has to be considered here that some of the main arguments of this dissertation have already been presented and published by the author.[4]

Notes and references

1. Einstein, A. (1979). *Autobiographical Notes. A Centennial Edition*. (Chicago: Open Court Publishing Company), 31.

2. Oxford Dictionaries, US English, s.v. "office," accessed July 30, 2015, http://www.oxforddictionaries.com/definition/american_english/office.

3. See note 2.

4. See Gallese, V., and Gattara, A. (2015). "Embodied Simulation, Aesthetics and Architecture: An Experimental Aesthetic Approach," in *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design*, eds S. Robinson and J. Pallasmaa. (Cambridge, MA: Mit Press), 161-179. See also Gallese, V., and Gattara, A. (2015). Architectural space "from within". The body, the space and the brain. Manuscript sumbitted for publication.

CHAPTER 2
THE NOTION OF EMBODIMENT IN ARCHITECTURAL THEORY

The physiological response to architectural settings

CHAPTER 2

THE NOTION OF EMBODIMENT IN ARCHITECTURAL THEORY
The physiological response to architectural settings

We make our buildings, and afterwards our buildings make us.[1]

Winston Churchill

1. Raumgefühl
Space, form, and architectural experience

Einfühlungstheorie. Questions of aesthetics

The idea that the body might play an important role in the aesthetic experience is quite old. The notion of empathy, as we know it today, was originally introduced in 1873 by the German philosopher Robert Vischer with the term *Einfühlung*. Vischer described *Einfühlung* — literally "feeling-into" or "in-feeling" — as the physical response generated by the observation of forms within paintings. Particular visual forms arouse particular physiological and psychological responses, to be distinguished in immediate and responsive sensations, and attentive and responsive feelings. He also clearly distinguished a passive notion of vision — seeing — from the active one of looking. According to Vischer, looking best characterizes our aesthetic experience when perceiving images, in general, and works of art, in particular. In his doctoral thesis *On the Optical Sense of Form*, Vischer wrote: "We can often observe in ourselves the curious fact that a visual stimulus is experienced not so much with our eyes as with a different sense in another part of our body […]. The whole body is involved; the entire physical being is moved. […] Thus each emphatic sensation ultimately leads to a strengthening or a weakening of the general vital sensation."[2]

Developing Vischer's ideas further, Heinrich Wölfflin[3] speculated on the ways in which the observation of specific architectural forms engage the beholder's

bodily responses — which will be discussed in the next paragraph. Shortly afterwards, Theodor Lipps discussed the relationship between space and geometry on the one hand, and aesthetic enjoyment as "inner imitation" within the body on the other.[4] He discussed several types of empathy and in regard to architecture — examining a Doric column or the influence of proportion and mass — he defined empathy as a somatic and visceral experience.

The work of Vischer around the notion of feeling exerted an important and wide influence at the time; it will be summarized here the contribution of two other German scholars — Adolf Hildebrand and Aby Warburg — on this topic. In 1893, Hildebrand published *The Problem of Form in the Fine Arts* and proposed that the aesthetic value of works of art resides in their potential to establish a link between the intentional creative acts of the artist and the animation of those acts by the beholder.[5] Drawing also from the work of the German physician, physiologist, and philosopher Wilhelm Wundt and the German physician and physicist Hermann Helmholtz, he developed his theory describing the artistic and scientific aspects of visual and kinesthetic perception in sculpture, painting, and architecture as the relationship between a series of antinomies, i.e. two-dimensional representaions, plane, depth, volume, and architectural space. A further interesting aspect of Hildebrand's proposal concerns the relevance he assigned to the motor nature of experience. Through movement, the available elements in space can be connected, objects can be carved out of their background and perceived as such. Through movement, representations and meaning can be formed and articulated. Ultimately, according to Hildebrand, sensible experience is possible and images acquire their meaning because of the acting body.

Hildebrand strongly influenced another famous German scholar, Aby Warburg. In 1888 and 1889 Warburg studied in Florence at the Kunsthistorisches Institut, founded by the art historian August Schmarsow. As Georges Didi-Huberman emphasizes, Schmarsow was determined to open art history to the contributions of anthropology, physiology and psychology and studied the role of body gestures in visual art, arguing that bodily empathy greatly contributes to the appreciation of visual arts.[6] As noted by Andrea Pinotti, Schmarsow "art historian and theoretician, centered his reflections, which exploited both

the results of the theories of empathy and the analyses of the formal character of art works, on the idea of the trascendental function of corporeality as a constellation of material a-priori, that is, on the idea of bodily organization as the condition of the possibility of sensory experience."[7] Warburg clearly learned this lesson as he conceived art history as a tool that would enable a deeper understanding of the psychology of human expressive power. His famous notion of "pathemic form" (*Pathosformel*) of expression implies that a variety of bodily postures, gestures and actions can be constantly detected in art history, from Classical art to the Renaissance period, just because they embody in an exemplary fashion, the aesthetic act of empathy as one of the main creative sources of any artistic style. According to Warburg, a theory of artistic style must be conceived as fragments of a pragmatic science of expression.

The theories and positions that defined the *Einfühlungstheorie* will be described and compared in the next paragraphs in regard to the notions of architectural form and space.

Architectural form

The notion of architectural form within the so-called *Einfühlungstheorie* found a remarkable contribution in the aforementioned Wölfflin's doctoral thesis, *Prolegomena to a Psychology of Architecture*, discussed in 1886, but published even later than his *Renaissance and Baroque*. In the first lines of his thesis Wölfflin raised the issue of "how is it possible that architectural form are able to express an emotion or a mood?"[8] to which he found an explanation due to the fact that "physical forms possess a character only because we ourselves possess a body" and "our own bodily organization is the form through which we apprehend everything physical."[9] He also went on to propose that the principal theme of architecture is "the opposition between matter and force of form, which sets the entire organic world in motion."[10]

Only one year later, in 1887, in an essay titled *What is the Cause of the Perpetual Style Change in Architecture?* the German architect Adolf Göller

defined architecture as the "art of visible pure form"[11] and intended to investigate architectural form psychologically. Göller proposed a notion of architectural form as a meaningless but pleasurable play of light and shade and most remarkably introduced for the first time an explanation of architectural development without regard to historical context or function.

It has already been noted that the notion of empathy introduced by Vischer widely influenced the sculptor Adolf Hildebrand; it will be presented here only his contribution to the architectural discourse. Hildebrand was concerned with "the relation of form to appearance and its implications for artistic representation" and with how "are these different appearances of equal value, and how do we measure their value?"[12] In developing his arguments Hildebrand noted that the idea of form is the result of multiple apperances or "the assimilation of many perceptions from one specific viewpoint."[13] and that thence the notion of form results from a complex kinesthetic experience related to a spatial effect. He later came to define inherent form as space that becomes "effective to the eye"[14] in a similar fashion to what Johannes Volkelt[15] had already called "spatial forms" in 1876 and to August Schmarsow's concept of space.

On the same year of Hildebrand's publication, Schmarsow presented a more elaborated contribution on this topic. In *The Essence of Architectural Creation*, Schmarsow argued that, in regard to architecture, the empathic perception of the beholer — in a direct opposition to Wölfflin's psychology of form — is not directed to the mass, but rather to the space. He focused his attention on architecture's interior space rather than its exterior form, and proposed that the essence of architectural creation is not its form but its spatial construct and its peculiar feature of enclosure of a subject. According to Schmarsow this idea of spatial construct entails that architecture's most important dimension is depth and is measured through the organization of the beholder's enclosed body. It is particularly interesting to emphasize his words on the notion of intuited form of space, "which surrounds us wherever we may be and which we then always erect around ourselves and consider more necessary than the form of our own body, [and] consists of the residues of sensory experience to which the muscular sensations of our body, the sensitivity of our skin, and the structure of our body all contribute."[16] While his notion of spatial construct based on

the projection of actual and potential movements of the body within the spatial form and its consequent bodily responses was consistent with the theory of empathy, his notion of architecture as "creatress of space" proved completely different from the other contemporary theories of form.

Architectural space

The notion of architectural space within the so-called *Einfühlungstheorie* found a comprehensive explanation in 1893 in three essays from different German authors, namely Adolf Hildebrand, August Schmarsow, and Theodor Lipps.

In *The Problem of Form in the Fine Arts*, Adolf Hildebrand — who was also influenced by Conrad Fiedler — developed the idea that the enclosed space was the preeminent consideration dealing with architecture. It has already been mentioned his "idea of form" and the role of the movements of the eye and the body in the perception of space; it is here interesting to emphasize his notion of space, in his own words: "by a spatial continuum we mean space as three-dimensional extension and as a three-dimensional mobility or kinesthetic activity of our imagination. Its most essential attribute is continuity."[17] Hildebrand suggested that space is animated from within and "our relation to space finds its direct expression in architecture, which evokes a definite spatial feeling instead of the mere idea of the possibility of movement in space."[18] Whether in painting and sculpture the artist had to represent space, in architecture space is apprehended directly and is thus the result of multiple apperances, with no need for further imaginative perception.

In August Schmarsow's *The Essence of Architectural Creation* these arguments on architectural space found different explanations, though Schmarsow, like Hildebrand, basically assimilated architectural space and form. In his original "aesthetics from within" Schmarsow transposed the theory of empathy from the perception of solid objects to architectural space, asserting that an intuited sense of space is acquired through optical and muscular sensations. He went on to conlude that "our sense of space [*Raumgefühl*] press toward spatial creation [*Raumgestaltung*]."[19] According to Schmarsow, space exists because

we have a body — "The spatial construct is, so to speak, an emanation of the human being present, a projection from within the subject, irrespective of whether we physically place ourselves inside the space or mentally project ourselves into it."[20]

A third contribution to the notion of architectural space within the theory of empathy was provided between 1983 and '87 by the aesthetic philosopher Theodor Lipps in the essay *Raumästhetik und Geometrisch-Optische Tauschungen* (Aesthetics of Space and Geometric-Optical Illusions), where he distinguished two kinds of seeing — optical and aesthetic — that, together, are involved with the perception of geometric and natural forms. For Lipps, geometrical forms are independent from actually existing natural forms, and are experienced optically, or purely. In his words: "since forceful or vital space is the single object of the arts of abstract space creation, nothing can prevent us from eliminating the material carrier. So it is possible that in the art of abstract representation of space, the spatial form can exist purely, unmaterialized!"[21] He later asserted in his *Aesthetik*: "the beauty of spatial forms is my ability to live out an ideal sense of free movement in it. Opposed to this is the ugly form, where I am not able to do this, where my underlying compulsion to freely move within and observe the form is hindered and not possible."[22] Lipps's theory was thus mainly concerned with a notion of architectural space defined by the inner life of matter and not by the enclosure of the subject, although he was not against Schmarsow's idea.

2. Lived space
Phenomenological experience and sensory perception

Theories of perception in architecture

Several arguments proposed by Schmarsow were effectively developed a few decades later by the philosophers Edmund Husserl and Maurice Merleau-Ponty in their classic phenomenological perspective on the built environment.

The emphasis Schmarsow placed on movement comes to mind in Husserl's notion of spatial constitution, where movement plays a crucial role in its spatial and temporal unfolding. In *Thing and Space* (a lecture he gave in 1907) Husserl stated that "all spatiality is constituted through movement, the movement of the object itself, and movement of the "I"."[23] His theory of kinesthesis is indeed based on the relationship between the actual and potential movements and the body, which he also described as a thing "placed" between the environment and the perceptual subject. According to this account, the body is considered a lived body (*Leibkörper*) but the act of perception excludes the body itself from the objects perceived. Moreover, in his idea of "lived world," movement and rest can only be experienced with reference to the ground, in a similar fashion to what Schmarsow described the precondition for our naturally developing sense of space.[24]

In *Phenomenology of Perception* (1945), Maurice Merleau-Ponty emphasized the role of the body in perception and human experience. Unlike Husserl, Merleau-Ponty compared the perceptual body to the lived body, as he noted: "as for my body, I do not observe it itself: to be able to do so, I would need the use of a second body, which would not itself be observable."[25] He also argued that: "far from my body's being for me no more than a fragment of space, there would be no space at all for me if I had no body."[26] However the French philosopher drew consistently from Husserl's arguments on the role of bodily movements in perceptual awareness, arguing that the bodily movements are "motives" which frame and instruct the perceptual appearances.[27] According to Merleau-Ponty the body is a structure for perception that relies on the five

traditionally differentiated senses, as he insists that "all the senses are spatial, if they are to give us access to some form or other of being, if, that is, they are senses at all."[28] Consequently, external perception is synonymous with some level of perception of the body, while the perception of the body is an outcome of external perception. In summary, in his own words: "the theory of the body schema is implicitly a theory of perception."[29]

The relevance and the applications of Husserl and Merleau-Ponty's insights will be briefly discussed in regard to the architectural discourse in the next paragraphs. Since their work, it has started to become clear that the world we live in frames every sensory perception and that the body's perceptual awareness is defined by the responses to the surrounding built environment.

Overcoming of the primacy of vision

Traditional phenomenology provided only the initial prompt in regard to overcoming the primacy of vision in the architectural discourse. An important effort was introduced in 1979 with American psychologist James Gibson's *The Ecological Approach to Visual Perception*.[30] In his work visual perception was defined as an ecological interaction between the physical body and its movements within the environmental field, disputing the idea that the perceptual system could separate the beholder's bodily states from the perception of external objects. Indeed, Gibson argued that all the senses — which he described in the form of basic-orienting system, auditory system, haptic system, visual system, and taste-smell system — play a role in the physical interaction, from proprioception to exteroception. In his own words: "proprioception or selfsensitivity is seen to be an overall function, common to all systems, not a special sense."[31] From this point of view, the body and the environment define a reciprocal and mutual relationship within which perception entails co-perception, or bodily's self-perception. He also noted that "in all bilaterally symmetrical animals, the eyes are in the head, the head is attached to a body, and (for terrestrial animals) the body is supported by the ground."[32] Gibson's perceptual systems are thus different from the commonly acknowledged five senses, as the former explore and absorb information from the environment,

while the latter provide experience with its conscious qualities. In other words, the perceptual systems are active, while the senses are passive. It should also be empashized that Gibson's basic orienting system is the basic framework for the other four perceptual systems: it defines our spatial cognition, the awarness of the environment and its sense of place. As he conluded: "when vision is thought of as a perceptual system instead of as a channel for inputs to the brain, a new theory of perception considered as information pick up becomes possible."[33] He continued: "it is information about both the persisting and the changing features of the environment together. Moreover, information about the observer and his movements is available, so that self-awareness accompanies peceptual awareness."[34]

For decades Finnish architect Juhani Pallasmaa has criticized Western culture's excessive "oculocentrism," the overriding tendency that assigns a cognitive privilege to vision. With the invention of perspective, the eye became at once the center of the perceptual world and the center of the subject perceiving that world. According to Pallasmaa, the scopic regime instantiated by visual perspective exemplifies the disembodied nature of the Cartesian subject, whose solipsism segregates the mind from the body, the subject from the object and the I from the Thou. As he stated, the perspectival visual understanding of space "gave rise to an architecture of vision, whereas the quest to liberate the eye from its perspectival fixation enables the conception of multi-perspectival, simultaneous, and atmospheric space. Perspectival space leaves us as outside observers, whereas multi-perspectival and atmospheric space and peripheral vision enclose and enfold us in their embrace."[35] Instead, a purovisibilist attitude deeply influenced contemporary architecture by predominantly adhering, according to Pallasmaa, to a purely formalist perspective, and as a consequence, has lost contact with the very people for whom the architectural project was originally intended.

Applications to the architectural discourse

Amongst others, Husserl's idea of "lived world" strongly influenced a debate between architects Christian Norberg-Schulz, Kenneth Frampton, and Juhani Pallasmaa in 1970s and '80s.

The Norwegian architectural theorist Christian Norberg-Schulz embraced and developed a phenomenology of architecture based primarily on the interpretation of Martin Heidegger's essay *Building, Dwelling, Thinking*.[36] In this work, Heidegger — who studied under Edmund Husserl — described the relationship between building and dwelling, tracing back the etimology of the German word *bauen* (building) and rediscovering its ancient and existential meanings. In *The Phenomenon of Place* (1976) Norberg-Schulz refers to phenomenology as a methodological investigation of the visible world of things, opposed to the diagrammatic and functionalist modern architecture.[37] Norberg-Schulz interpreted Heidegger's notion of dwelling as living in a sheltered place and defined the purpose of architecture as that of providing orientation in space and identification with place. The definition of place within space is considered the archetypal act of building and the origin of architecture. It is also worth to notice that, in *Existence, Space and Architecture* (1971), Norberg-Schulz distinguished perceptual and existential space through the antinomic couples center/place (proximity), direction/path (continuity), and area/domain (enclosure), and defined architectural space as the concretization of existential space.[38]

The British architectural critic and historian Kenneth Frampton contributed to the development of architectural phenomenology throughout his broad and extensive theoretical production. In 1974 he touched explicitly on Heidegger in developing his response to the concerns of the contemporary built environment.[39] Following Heidegger's interest in the etimology of words he suggested to make a clear distinction between architecture and building and between space and place. As he noted, the persistent use of the English term 'space,' which originated from the abstract Latin term '*spatium*,' opposed to the social nature of 'place,' or to the more vivid Germanic word for 'space' (*Raum*), which is related to the English term 'room,' seems to provide evidence

to Heidegger's thesis that language shapes thought. In his essay Frampton, hence, proposed a renewed attention to the quality of the act of enclosure by which architecture defines a place, emphasizing also its symbolic, social, and political meanings.

The Finnish architect and critic Juhani Pallasmaa took a first and early look into the phenomenology of architecture in a remarkable essay titled *The Geometry of Feeling* (1985).[40] Based on the work of Husserl, Heidegger, and Gaston Bachelard, he formulated a theoretical position about the role of memory and imagination in the experience of architecture, which he defines as a synthetic operation at the antinomic mental/physical, cultural/biological, and collective/individual levels. According to Pallasmaa architectural forms per se are meaningless; their meaning relies on their ability to express human experience or presence, and on their capacity to constitute spatial experiences.

It is worth mentioning here that architectural theory at the time wrongly included phenomenology amongst the primary paradigms that shaped postmodernism theories, indicating such positions and arguments as nostalgic or stylistic and ignoring or dismissing that the experience of architectural space is basically sensorial and existential.

3. Embodied space
Human experience and its material and spatial manifestations

Body schema, peripersonal and extrapersonal space

Merleau-Ponty's discussion of the primacy of bodily perception in the experience of the environment originated a phenomenological turn around the notion of space. From his philosophical perspective, the body became the framework of the perceptual processes and spatial analysis. The notion of embodied space presented here basically draws together the ideas of American anthropologist Edward T. Hall on proxemics, the Gestalt principles of German-American perceptual psychologist Rudolf Arnheim, and the phenomenological understandings of American architect Sarah Robinson.

In *The Hidden Dimension* (1966), Hall established the field of proxemics — a term he conied — analysing the infuential role of culture on spatial perception and use of space.[41] His notion of personal space theorized that spatial perception involves a distancing mechanism, shaped by cultural factors, that surrounds the beholder's body like a bubble and varies in size in response to how intimate or how public the situation might be. The beholder then becomes aware of the cultural space surrounding their body only when the boundary of its bubble is crossed.

In a comprehensive review of the relationship of body and space, Sarah Robinson recently explained the differences of body schema, peripersonal and extrapersonal space within the architectural context.[42] In her discussion over Gibson's theory of perception she also presented a number of studies in cognitive neuroscience that seem to validate some of her precursor's assumptions. The notion of body schema, which was introduced over a century ago by the neurologist Henry Head and originally defined the bodily organizations of "the impressions produced by incoming sensory impulses in such a way that

the final sensation of [body] position, or of locality, rises into consciousness charged with a relation to something that has happened before,"[43] includes the brain and the sensory processes that collect the bodily responses to the environment. According to Robinson "the body schema is plastic, amenable to constant revision, extends beyond the envelope of the skin and has important implications for tool-use."[44] The notion of body schema is completed by two terms that neuroscientists today use to describe the space beyond the body schema, i.e. "peripersonal" and "extrapersonal" space. The peripersonal space, which is similar to Hall's personal space, defines the space immediately surrounding the body in a bubble-like shape; the extrapersonal space then defines the space immediately beyond the peripersonal. Peripersonal space can also be differentiated into grasping space and instrumental grasping space, while extrapersonal space into near-distant and far-distant space. Further subdivisions have been proposed and studied, however it is here worth to emphasize that the boundaries between them are flexible — to a certain point — and influenced by a number of variables through motor, tactile, visual, and auditory stimuli. Indeed the basic subdivision of body schema, peripersonal space, and extrapersonal space, does not imply that these are distinct entities, but rather provides a schematic explanation of the bodily perception of surrounding space as a complex and integrated multi-sensory process "irreducible to a gross measure of inside and outside."[45]

Multisensory integration and multimodal interaction

In *Art and Visual Perception* (1974), Rudolf Arnheim, a perceptual psychologist trained in the Gestalt tradition of the Berlin School of Experimental Psychology, made a clear distinction between the notions of shape and form.[46] According to Arnheim, while shape is the mere physical object, form is the visible manifestation of shape. One of his main contributions to the architectural discourse is certainly the idea that the act of perception is not passive recording, but rather it is an active construction made of basic elements.

In his review on the topic, Mallgrave noted that "in an organic world in which there are no straight lines or self-accentuating features, for instance, we impose

upon it [the world] a visual organization, figure-and-ground, geometric order, and constancies of shape and color that are, quite literally, the labor of our neurological structures."[47] According to Gestalt psychology, indeed, the environment is experienced not only by means of sensory perceptions but also by means of such physiological responses as heart rate and blood pressure, as it was described by German psychologist and phenomenologist Wolfgang Köhler.

Although Arnheim could not support his arguments with neuroscientific evidence, in the *The Dynamics of Architectural Form* (1977), he noted that "genuine metaphors derive from expressive shapes and actions in the physical world."[48] Arnheim also conluded that "the most powerful symbols derive from the most elementary perceptual sensations because they refer to the basic human experiences on which all others depend."[49]

Nevertheless, Arnheim's explanation of perception of architectural space was mostly based on visual perception. In recalling the notion of *Einfühlung*, indeed, he rejects the idea that architectural experience is informed by bodily sensations. As he concluded, visual impression is "more convincingly derived from, and controlled by formal properties of the visual shapes themselves," while muscular responses could be understood "as secondary reactions to the primary visual dynamics."[50] This conclusion certainly weakens his relevant and remarkable arguments on the embodied nature and multisensory integration of perceptual experience, but it has to be emphasized that his writings are still of invaluable interest for those who seek to investigate these issues.

Applications to the architectural discourse

Although the notions of embodiment and embodied space are relatively new and the literature within the architectural debate is meager, they will be discussed here some contributions of the architectural scholars Alberto Perez-Gomez and Harry Francis Mallgrave.

According to Perez-Gomez, the meaning of architecture has to be found in

the notion of attunement, the English translation of the German term *Stimmung* of Romantic philosophy. Drawing also from studies on embodied cognition — particularly from Francisco Varela, Evan Thompson, and Eleanor Rauch — he considered the built environment complementary to self-awareness and enacted by a mode of "coupling."[51] In his own words: "the mind and the world are simply not separate and independent of each other; the mind is an embodied dynamic system in the world, rather than merely a neural network in the head."[52] He also criticized Descartes' dualistic model, which placed emotions between the material body and the immaterial soul, with arguments like Merleau-Ponty's intercorporeality and Bachelard's resonance with another's experience, as well as the neuroscientific description of mirror-neurons. He concluded that an "embodied, non-dualistic understanding of reality includes our emotions and feelings; its primary seat of awareness is *Gemüt* [mind], and its most significant experience is *Stimmung*."[53]

In his *Architecture and Embodiment* (2013), Mallgrave discussed the implications for architectural design of some recent discoveries in the fields of psychology, biology, neuroscience, and anthropology in regard to architectural embodiment. It is interesting to notice that Mallgrave — and Eleftherios Ikonomou — also introduced the *Einfühlungstheorie* to the English-speaking scholars with their translations collected in *Empathy, Form, and Space* (1994), which began his interest in this topic.[54] In his own words: "we are continually evolving and self-organizing organisms-within-environments, and that this dynamic mind/body/social field of relationships, rather than some static abstraction of our presumed human natures, shapes our precognitive and cognitive understanding of the world." He continued to note that the new scientific and humanistic models he proposed strongly oppose "any reductionist way of thinking, which is a specter inevitably, and seemingly gratuitously, raised whenever the words "science" and "art" are mentioned in the same sentence."[55] Mallgrave indeed rejected the postmodernist ideas that sought the meaning of architecture in an over-intellectualized semiotic approach and considered buildings as extravagant objects. In his uncommonly wide review of scientific research he highlighted two major discoveries that inform new models of embodiment of the built environment — a better understanding of emotions and the functionality of mirror neurons — and called for new models of phenomenological perception

that appreciate the role of the sensorimotor system.

4. Embodied simulation theory and architecture

The role of the sensorimotor system in architectural experience

It is proposed here to consider the sensorimotor and affective aspects of the architectural experience mainly in their bodily connotations.[56] Of course, this approach covers only one aspect of aesthetics, as it refers to an early component of the perceptual experience, i.e. to what is happening before any explicit judgment is formulated. The neurophysiological and behavioral evidence of this early phase of aesthetic experience is strikingly similar to that which underlies the mundane perceptual experience of non-artistic objects. Thus, this approach can also clarify how different the neurophysiological and bodily correlates of "real world" experiences are from those that characterize experiencing the symbolic representations of that world. Some recently discovered multimodal properties of the motor system will be addressed — introducing mirror neurons and embodied simulation and discussing their relevance for an embodied account of aesthetic experience — summarizing recent empirical research that targets the relationship between gestures and meaning-making.

It can be stated that observing the world is more complex than the mere activation of the visual brain. Vision is indeed multimodal: it encompasses the activation of motor, somatosensory and emotion-related brain networks. Any intentional relation we might entertain with the external world has an intrinsic pragmatic nature, hence it always bears a motor content. More than five decades of research has shown that motor neurons also respond to visual, tactile and auditory stimuli. The same motor circuits that control the motor behavior of individuals also map the space around them, the objects at hand in that very same space, thus defining and shaping in motor terms their representational content.[57] The space around us is thus defined by the motor potentialities of the body. Premotor neurons controlling the movements of the upper arm also respond to tactile stimuli applied to it, to visual stimuli moved

within the arm's peripersonal space, or to auditory stimuli also coming from that same peripersonal space, proving that the manipulable objects we look at are classified by the motor brain as potential targets of the interactions we might entertain with them.[58] Premotor and parietal "canonical neurons" control the grasping and manipulation of objects and respond to their mere observation, as well.[59] Finally, mirror neurons, motor neurons activated during the execution of an action and its observation performed by someone else, map the action of others on the observers' motor representation of the same action.[60]

More than twenty years of research on mirror neurons have demonstrated the existence of a mechanism directly mapping action perception and execution in the human brain, here defined as the mirror mechanism.[61] Also in humans, the motor brain is multimodal. Different — visual and auditory — sensory accounts of the same motor behavior, activate the very motor neurons that normally enable the original action. The brain circuits showing evidence of the mirror mechanism, connecting frontal and posterior parietal multimodal motor neurons, most likely analogous to macaques' mirror neurons, map a given motor content like 'reach out' or 'grasp' not only when controlling its performance, but also when perceiving the same motor behavior performed by someone else, when imitating it, or when imagining performing it while being perfectly still.

These results completely change the understanding of the role of the cortical motor system and of bodily actions. The cortical motor system is not just a movement-machine, but an integral part of the cognitive system, because its neurofunctional architecture structures not only action execution but also action perception, imitation, and imagination, with neural connections to motor effectors and/or other sensory cortical areas.[62] When the action is executed or imitated, the cortico-spinal pathway is activated, leading to the excitation of muscles and the ensuing movements. When the action is observed or imagined, its actual execution is inhibited. The cortical motor network is activated, though, not in all of its components and not with the same intensity, hence action is not produced, it is only simulated.

The prolonged activation of the neural representation of motor content in the

absence of movement, likely defines the experiential backbone of what we perceive or imagine perceiving. This allows a direct apprehension of the relational quality linking space, objects and others' actions to our body. The primordial quality turning space, objects and behavior into intentional objects is their constitution as objects of the motor intentionality that our body's motor potentialities express.[63]

The role of "mirror" neural mechanism in embodied simulation

The discovery of mirror neurons provides a new empirically founded notion of intersubjectivity connoted first and foremost as intercorporeality — the mutual resonance of intentionally meaningful sensorimotor behaviours. The comprehension of others as intentional agents does not exclusively depend on propositional competence, but also on the relational nature of action. In many situations we can directly understand the meaning of other people's basic actions thanks to the motor equivalence between what others do and what we can do. Intercorporeality, thus, becomes the main source of knowledge we have of others. Motor simulation instantiated by neurons endowed with 'mirror properties' is probably the neural correlate of this human faculty, describable in functional terms as "embodied simulation."[64]

The multiple mirror mechanisms existing in the brain, thanks to the "intentional attunement" they generate, allow us to recognize others as other selves, allowing basic forms of intersubjective communication and mutual implicit understanding.[65] Embodied simulation provides a unified theoretical framework for all of these phenomena. It proposes that the social interactions become meaningful by means of reusing our own mental states or processes in functionally attributing them to others. In this context, simulation is conceived as a non-conscious, pre-reflective functional mechanism of the brain-body system, whose function is to model objects, agents and events. This mechanism can be triggered during our interactions with others, being plastically modulated by contextual, cognitive and personal identity-related factors.

Embodied simulation is also triggered during the experience of spatiality around

our body and during the contemplation of objects. The functional architecture of embodied simulation seems to constitute a basic characteristic of our brain, making possible our rich and diversified experiences of space, objects and other individuals, and is the basis of our capacity to empathize with them.

Altogether the results summarized thus far suggest that empathy, or at the very least, many of its bodily qualities, might be underpinned by embodied simulation mechanisms. According to this account, empathy is the outcome of the natural tendency to experience our interpersonal relations fundamentally at the implicit level of intercorporeality; that is, at the level of the mutual resonance of intentionally meaningful sensory-motor behaviors.

It is perhaps worth emphasizing that embodied simulation not only connects us to others — it connects us to the world — a world populated by natural and man-made objects, with or without a symbolic nature, and with other individuals. The sense we attribute to the lived experience of the world is grounded in the affective-laden relational quality of our body's action potentialities, enabled by the way they are mapped in our brains.

It is worth to be emphasized that embodied simulation can be relevant to aesthetic experience in at least two ways. First, because bodily feelings are triggered by works of art by means of the mirror mechanisms they evoke. In this way, embodied simulation generates the peculiar "seeing-as", that characterizes the aesthetic experience of the images perceived. Second, because the potentially intimate relationship between the symbol-making gesture and its eventual reception by beholders is enabled through the motor representation that produced the image by means of simulation; when we look at a graphic sign, we unconsciously simulate the gesture that has produced it.[66]

Three distinct experiments applied to visual arts have recently investigated, by means of high density electroencephalography, the link between the expressive gesture of the hand and the images produced by those gestures. The beholders' brain responses were recorded during the perception of graphic signs like letters, ideograms and scribbles, or abstract art works by Lucio Fontana and Franz Kline.

The results of the first study showed that observing a letter of the Roman alphabet, a Chinese ideogram or a meaningless scribble, all written by hand, activated the hand motor representation of beholders. In the two other studies it has been demonstrated that a similar motor simulation of hand gestures is evoked when beholding a cut on canvas by Lucio Fontana, or the dynamic brushstrokes on canvas by Franz Kline.[67]

The visible traces of the creative gesture activated the specific motor areas that control the execution of that same gesture in the observer. Beholders' eyes capture not only information about the shape, direction and texture of the cuts or strokes; by means of embodied simulation, they breach into the actual motor expression the artist used when creating the artwork. The sensory-motor component of our image perception, together with the jointly-evoked emotional reaction, allow beholders to feel the artwork in an embodied manner.

Feeling Follows Form

Heinrich Wölfflin has already been quoted as one of the earliest proponents of a bodily grounded experience of architecture. According to Wölfflin, if we were merely visual creatures, the aesthetic appreciation of works of art and architecture would be precluded.[68] The very nature of the body allows us to experience gravity, force and pressure, and thus makes the enjoyment of contemplating a Doric temple or the feeling of being elevated when entering a Gothic cathedral, possible in the first place.

It has been shown so far in this dissertation that theorists have commented on the bodily engagement within the built environment, but the very mechanism by means of which this relationship is explained remained empirically unclear. Mirror mechanisms and embodied simulation today found evidence of the empathic relationship established in aesthetic experience.

Forthermore, as the experience of the built environment and its affordances is shaped through the precognitive activation of motor simulations, the role of

embodied simulation in architectural experience becomes even more interesting if one considers emotions and sensations. A typical and recurring experience in everyday life is reacting with positive or negative feelings upon entering a door and being, for the first time, in a new architectural environment. The same applies to the haptic qualities of materials employed to design exterior and interior parts of architectonic spaces whose multimodal impact could be easily measured.

Indeed, today these assumptions can be empirically tested by recording the brain and bodily responses of volunteers perceptually experiencing and exploring virtual architectonic environments by means of immersive virtual reality. Virtual caves can reproduce with high accuracy three-dimensional and detailed digital versions of every type of building in which individuals can not only enjoy a vivid and realistic experience, they may also virtually explore them as if they are moving around, directing their gaze at different details and spatial locations. The ecological plausibility of such virtual experience can be obtained in the absence of any active movement of the beholder. These are ideal conditions in which to record brain signals and autonomic bodily respones, thereby minimizing movement-driven artifacts and signal noise.

This experimental approach has been briefly proposed here as a means to empirically address important aspects of the relationship between architectural spaces and the way they are experienced by the people living and working in those spaces.

5. Chapter summary

The second chapter has defined the notion of empathic response to architectural space through the description, comparison and interpretation of some of the major theories and theoretical positions proposed since the term *Einfühlung* was coined in 1893. These were collected in three different categories, each representative of the contemporary architectural and philosophical debates. Since the modern definition of architectural space developed by some German scholars in the late 19th century, they were subsequently considered the notion of "lived space" developed by Edmund Husserl and Maurice Merleau-Ponty and the influence that this has had on the architectural debate, and the later notion of "embodied space" developed also in cognitive neuroscience. The chapter concluded with some interpretations of these definitions, and with the introduction of embodied simulation theory to the architectural discourse.

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CHAPTER 3
THE NOTION OF SPACE PLANNING IN OFFICE INTERIORS

A typological evolution in Europe and North America

CHAPTER 3

THE NOTION OF SPACE PLANNING IN OFFICE INTERIORS
A typological evolution in Europe and North America

Interviewer: Mr. Public, have you any experience working in an office before?
Mr. Public: Yes, I have.
Interviewer: What kind of office was it?
Mr. Public: Rectangular.[1]

Woody Allen

1. Form Follows Function. The open plan office

Taylorism and the American organizational model

The prevailing organizational model that influenced office culture in the 20th century has been unequivocally attributed to the work of the American mechanical engineer Frederick Winslow Taylor at the end of the 19th century. Taylor's methods inspired also Henry Ford's development of the assembly line and mass production.[2] Indeed, Taylor introduced to the factory floor a revolutionary managerial model — called "scientific management" — that later spread to office culture in North America and Europe. He proposed to organize work applying engineering principles based on a scientific study of the tasks, enforcing employees' supervision, and methods standardization. In 1911, he published his famous *The Principles of Scientific Management*, a textbook that influenced a number of others on how to run the office in the Taylorist way.[3]

Taylorism meant that the employees were treated as units of production, supervised — as if they were in a panopticon — by foremen whose job was to constantly improve the processes and duties in the most efficient way; the organization of the work of the employees paralleled the one of the workers

in the assembly lines; a machine-like behaviour was expected; order and regularity were considered bureaucratic virtues.

Hierarchy was essential to the Taylorist model. Every clerk was assigned their workplace. The same job for life was the reward for the clerks who proved their commitment to their tasks, indeed no external turnover was expected. Rather, career progress was marked "by the gradual unfolding of rewards, often in what became the universal currency of space standards: a larger desk, more space around the desk and, best of all, your very own office."[4]

Although the Taylorist office was never completely accepted because of its dehumanization of work, it has certainly proved to be the most common and popular in the first half of the 20th century and still today influences management ideas. Indeed, the office environment today is a direct consequence of Taylor's influence on the industrialization of ever larger office tasks.

When the office building typology was introduced at the end of the 19th century, Taylorism's principles of hierarchy and supervision "became an integral part of the architecture of those initial, pioneering, turn-of-the-century North American buildings."[5] According to the British architect Frank Duffy, "this mélange of innovations was so successful that, once established, the pattern of the office building immediately cristallized, and in that process of crystallization the transient values of the pioneers of office organization found their way into short-term interiors and long-term architectural forms."[6]

The introduction of a new paradigm

The famous axiom "form follows function" stated for the first time by American architect Louis Sullivan in 1896, characterized office building types — and modern architecture — as much as the principles of Taylorism. Amongst the major figures of the so-called Chicago School, Sullivan actually asserted that "form ever follows function, [...] this is the law" and concluded also that "where function does not change, form does not change."[7]

In his essay *The Tall Office Building Artistically Considered*, Sullivan proposed a sort of manifesto for the modern office building, which he considered the result of the evolution, integration, and special combination of particular conditions that architects had to face.[8] He indicated that these conditions were: the necessary office space to accomodate business transactions, the invention of the elevator, the development of steel-frame constructions, and the rising ground values. According to Sullivan this was the "joint product of the speculator, the engineer, the builder."[9]

Therefore, he framed the problem that the architects of his time were asked to solve: "how shall we impart to this sterile pile, this crude, harsh, brutal agglomeration, this stark, staring exclamation of eternal strife, the graciousness of those higher forms of sensibility and culture that rest on the lower and fiercer passions? How shall we proclaim from the dizzy height of this strange, weird, modern housetop the peaceful evangel of sentiment, of beauty, the cult of a higher life?"[10] Sullivan seeked not an individual or special solution, but rather a normal type, characteristic of every tall office building in the United States.

He described its pratical requirements as: a story below-ground for mechanical equipment rooms; a ground floor for stores or other businesses requiring light and easy access; a second story accessible by stairways; above the second, an indefinite number of stories of offices similar to a cell in a honey-comb; at the last story, the attic filled with other mechanical equipments.

Sullivan then proposed two solutions: one emotional, the other philosophical. He indicated loftiness as the most important characteristic of office buildings

and called for making them even taller.

In his second and final consideration, he concluded that the tall office building must be divided in three parts according to its functions. In his own words: "does not this readily, clearly, and conclusively show that the lower one or two stories will take on a special character suited to the special needs, that the tiers of typical offices, having the same unchanging function, shall continue in the same unchanging form, and that as to the attic, specific and conclusive as it is in its very nature, its function shall equally be so in force, in significance, in continuity, in conclusiveness of outward expression? From this results, naturally, spontaneously, unwittingly, a three-part division, — not from any theory, symbol, or fancied logic."[11]

In this way, he assured the tall office building would find its place "with all other architectural types made when architecture, as has happened once in many years, was a living art."[12]

The development of the open plan office

As it has been shown above, the office building type was introduced at a time of tremendous economic activity in North America — particularly in Chicago and New York — by the end of the 19th century.[13] The introduction of steel-frame structures and high-speed elevators, electric lighting and air conditioning made possible and comfortable to work in such buildings. This caused enormous advances also in real estate practices and in city planning, which have been thoroughly addressed by Carol Willis in his *Form Follows Finance* (1995).[14]

It is the aim of this dissertation to illustrate here an exemplifying number of case studies and describe how the office interiors evolved in their spatial arrangements and cultural practices.

Amongst the first skyscrapers in the United States and in the world, the Wainwright Building was built by Louis Sullivan and partner Dankmar Adler in St. Louis in 1891. The building was regarded as the prototype of modern office buildings and the architect was dubbed as the "father of skyscrapers." Although it was built a few years before Sullivan's essay on tall office buildings, it perfectly exemplifies his theory, with the tripartite composition of base, shaft, and attic, which is usually referred to the structure of the classical Greek column. The ground floor houses street-level shops with wide glazed openings and the second easily accessible public offices; the higher floors house the office space Wainwright needed to manage the St. Louis Brewers Association; the top floor houses water tanks and building machinery.

The construction system is based on steel-frame clad in masonry and is credited for being the first successful utilization of steel-frame construction in the United States. (See figure 3.1). Sullivan described the building as simple, geometric, and structural forms, a juxtaposition of objective tectonic and subjective organic influences.[15]

Architect Frank Lloyd Wright — who worked for Sullivan at the time — in his essay *The Tiranny of the Skyscraper* of 1930 called the Wainwright Building "the very first human expression of a tall steel office-building as Architecture."[16]

He continued, "[it] has characterized all skyscrapers since, as St. Peter's characterized all domes, with this difference: there was synthetic Architectural stuff in the Wainwright Building, it was in the line of organic Architecture — St. Peter's was only grandiose Sculpture."[17]

As in other projects of this type, Sullivan and Adler's steel-frame structure — with its tall narrow columns — ensured regular internal partitions; the double-loaded corridor with central elevator and stairway block distributed the office space with an enfilade of rooms. (See figure 3.1).

Another example of office building within the American tradition of corporate office design was the Johnson's Wax Buildings, built in 1936-39 by Frank Lloyd-Wright. It is often compared to the Larkin Building — an earlier project

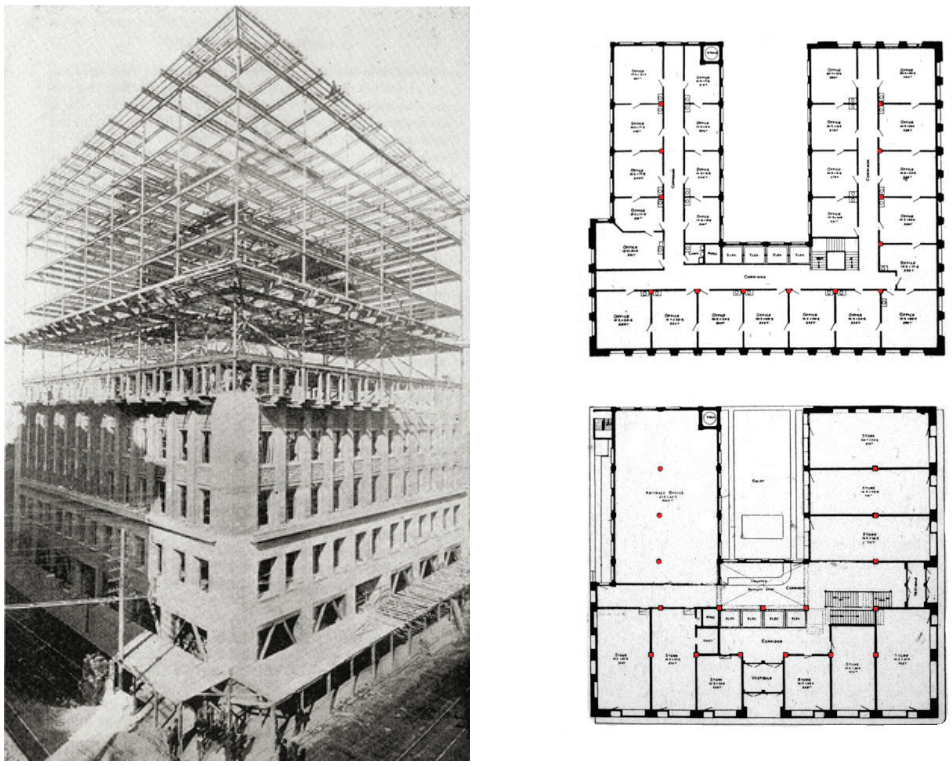

Figure 3.1. The Wainwright Building, St. Louis, Missouri, USA, 1890-91.
Architects: Dankmar Adler, Louis Sullivan. Red dots: the internal steel-frame structure.

by Wright — because of its hierarchically ordered open plan layout.

Since Wright designed the Larkin Building, Taylorism had shifted to a model based on more humane values. Indeed, the old photographs of the interiors of the Johnson's Wax Buildings show a more informal atmosphere but still an equally self-conscious clerical workforce. (See figure 3.2). Corporate imagery was still extremely important, but what also became probably more important was the personal vision of the architect. Wright himself asserted that he conceived the hypostyle hall as "an interpretation of modern business.. as inspiring to live and work in as any cathedral ever was to worship in."[18]

As Frank Duffy commented on this project: "what conceivable managerial argument could Wright have used to justify his use of mushrooms columns

Figure 3.2. Johnson's Wax Buildings, Racine, Wisconsin, 1936-39.
Architect: Frank Lloyd Wright.

and clerestories of curved tubular glass? On what business basis could he justify so many open-plan workplaces without any external view? There is more architectural impetus here than organizional invention or social sensitivity. Even the workplace furniture, elegant as it is, seems more concerned with style than with the overtly Taylorist principles reflected in the Larkin furniture."[19]

The idea of the office as the world of tayloristic "scientific management" was here supplanted by the imagery of the office as the "place of the patron." As office organizations in the late 1930s showed the first tendencies towards becoming slightly more responsive to end-users, and as management issues were becoming more complex, Frank Lloyd-Wright addressed the design consequences of organizational change with stylistic and technical manners.

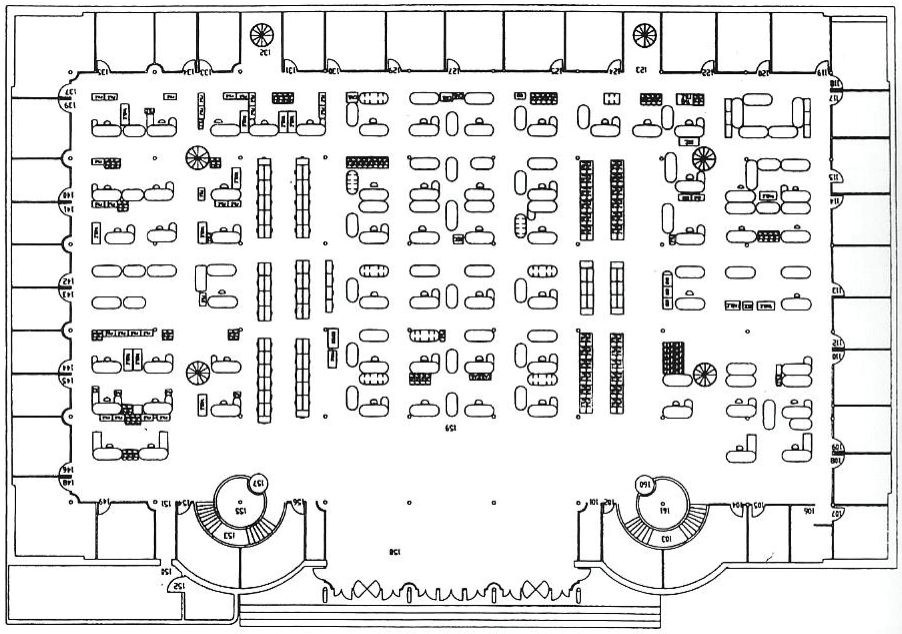

Figure 3.3. Johnson's Wax Buildings, Racine, Wisconsin, 1936-39.
Architect: Frank Lloyd Wright.

The Seagram Building, was built in New York in 1954-58 by German architect Ludwig Mies van der Rohe. It is considered "the most perfect realization of the North-American high-rise, city-centre, developer's office building."[20] Its form was inspired by Sullivan's Guaranty Building, built in the same year and in the same city as the Larkin Building. The Guaranty was an office building that solved the design problem created by the multiplication of endless office cells. While Sullivan's solution stretched the relationship between external architectural form and internal occupation, on the bland and elegant exterior of the Seagram building there is no sign of this relationship.

Within the North American office design tradition, once the standardization of steel-frame structure, floor-plates, and architectural services was completed, the main architectural initiative had to be found in the external cladding.

Figure 3.4. Seagram Building, New York, 1954-58.
Architect: Ludwig Mies van der Rohe.

An orthogonal grid emphasized — first — simplicity and cheapness of construction and — second — easy divisibility into separate and flexible rentable units; in the Seagram Building, this process — though still particularly evident — found its most refined and understated expression. Due to its richness of materials — bronze, travertine, and granite — it was dubbed "the most luxurious skyscraper ever built."[21]

At that time in the United States a particular relationship between building owners and tenants was delineated. The owners and their architects became responsible for the long-term office building shell, usually for at least a few decades; the tenants and their interior designers, or space planners, became responsible for the short-term interior, designed to last only the lenght of the office space leasing, usually less than a deacde. In this way, the architects

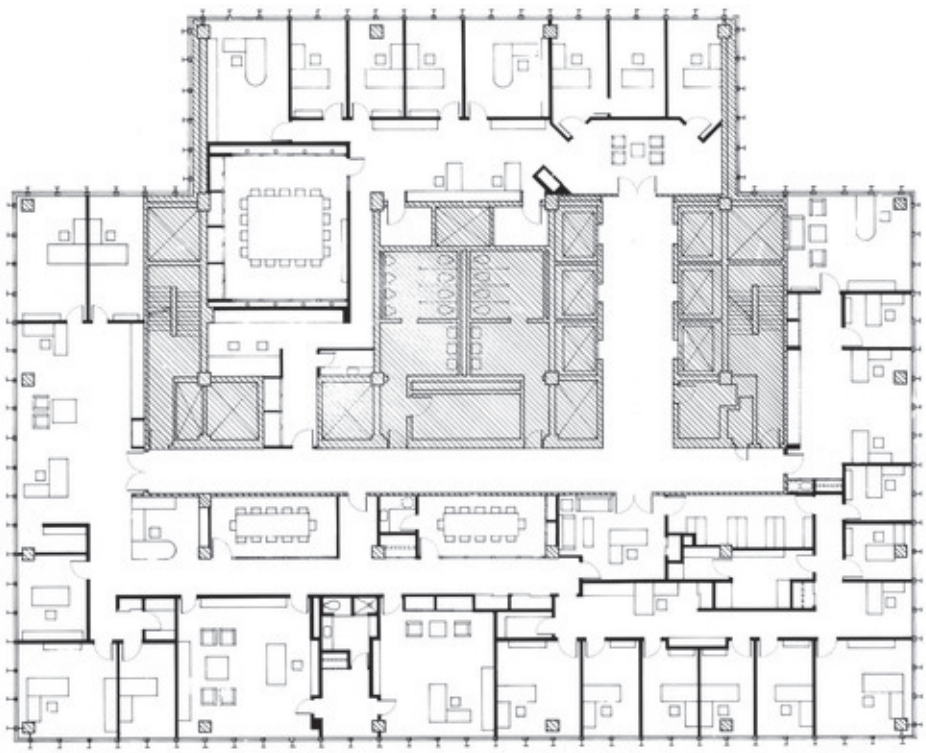

Figure 3.5. Seagram Building, New York, 1954-58.
Architect: Ludwig Mies van der Rohe. Grey hatch pattern: the building shell.

of the external shell and the designers of the interior scenery began to work independently. Indeed, in office buildings, interior scenery is likely to be related to the organizational structure of the tenants, while exterior shell is more within the concerns of the developer.

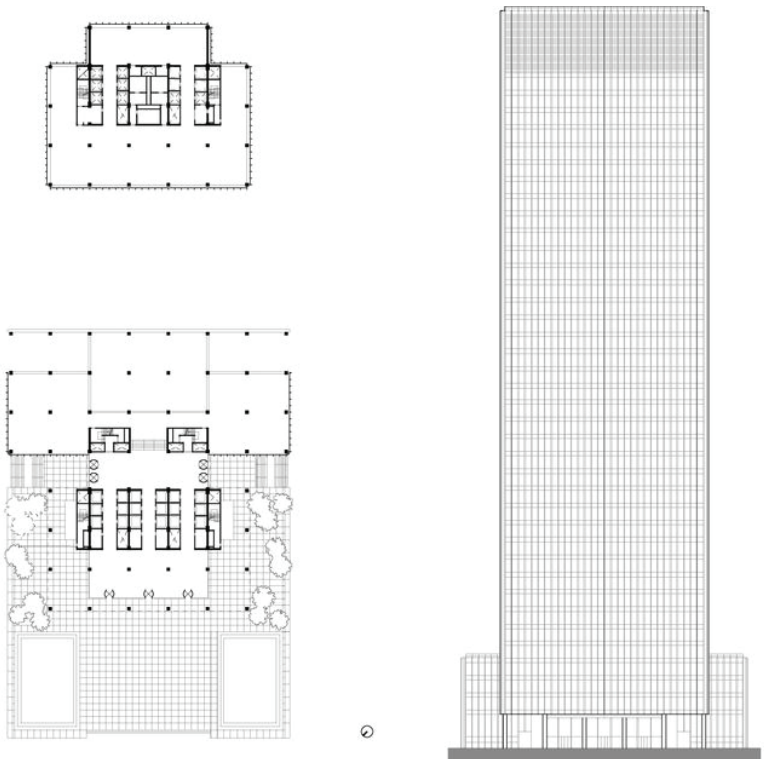

Figure 3.6. Seagram Building, New York, 1954-58.
Architect: Ludwig Mies van der Rohe.

2. Burolandschaft. The office landscape

The facility management and the German organizational model

Taylorist office environments have been seriously questioned and rethought starting from the 1950s in a few European countries — notably Germany and Scandinavia — with more complex and evoluted organizational models. It has to be noticed that this happened for a variety of reasons. First of all the European cities are much older than their North American counterparts. The tall office buildings in Europe have never been given the importance Sullivan called for at the end of the 19th century — with some rare recent exceptions — and the European organizations were more inclined than their American competitors, until the 1960s, to be accommodated in small office buildings.

The new free open plan offices of the 1960s added to a basically Tayloristic concern with work flow, a number of ideas drawn from later theories about organizational structure. Indeed, it was the explicit attempt to rethink the design of the office environment from its fundamental principles, through a new understanding of office communications and processes. For the first time in office space planning, it was made a clear distinction between informal and formal organization. The Taylorist hierarchical organizational structure was held accountable of a lack of cooperation between management and workers. A new organizational model translated fashionable managerial ideas into what was considered the equivalent physical form, i.e. no physical barriers and a complete reorganization of desks according to needs rather than status.[22]

In Hamburg in 1956, Eberhard and Wolfgang Schnelle with Hermann Dunst founded the Velox-Organisation Hermann Dunst — a consulting firm later called Quickborner Team Für Planung Und Organisation — whose team of specialists introduced all these ideas and challenges into an attractive design and management consultancy package that aimed to eliminate status and improve communications. It was called *Bürolandschaft* — usually translated in English as 'office landscape' — and it was a more complex, dynamic, and

organic model alternative to the conventional American orthogonal office grid.

The office landscape developed not from spatial considerations — the Schnelle brothers were not architects, but facility management consultants — but rather from the analysis of information within the office environment. The layouts were open and deep, frequently based on a simple rectangular floor plan with stairways, elevators, and restrooms placed on the sides. The final result gathered, in an apparently messy way, small or medium-size groups of desks. Groups were subdivided with wall-to-wall carpets, decorative plants, and break areas. Contributions from studies in proxemics were applied in the attribution of space per workplace and groups. The landscaped office was flexible, more informal, and less hierarchical in the relationship between management and employees, who shared the same open space and had the very same workstations.

The introduction of the social sciences

Architectural theory within 1970s American circles sought to integrate architecture with other disciplines, particularly the social sciences and technology. British architect Frank Duffy's doctoral dissertation can be viewed as amongst the most influential attempts in this regard.[23] He advocated the introduction of the social sciences in architecture from the particular perspective of an architect; indeed, he considered architecture as a synthetic act crossing different disciplines and influences. Duffy's work was formulated in the language of the social sciences, but still he held that "the research had to be relevant to a topical issue which was of practical importance to architects and designers."[24] Rather than seeking cause and effect type relationships, he sought to demonstrate through the analysis of sixteen organizations "the relationship between people and buildings" by means of a "comparative format for both social science and architecture data."[25]

While Duffy gathered data informed by the social sciences on the effects of office environments factors, he also questioned the architectural determinism according to which buildings determine users' behavior. He considered this attitude as "cheerfully paternalistic at best, or grimly exploitative for the sake

of productivity at worst."[26]

This idea was introduced in the social sciences by the so-called Hawthorne studies, a series of experiments on the effect of light conditions on worker productivity held at Western Electric's Hawthorne Plant in Chicago in the 1920s and 30s. The most widely publicized conclusion of these studies, often referred to as the "Hawthorne effect," was that worker productivity increased accordingly with the workers' knowledge that their work was being observed and that their opinions were being taken into account.[27] For Duffy, the effect of the "Hawthorne effect" was that social scientists would no longer "conduct environmental research which dealt only with overt stimuli and response," which in turn resulted for organizational research in "a swing away from human engineering to human relations; among social scientists there was a rapid decline of interest in environmental variables; architects became even more cut off from the stimulus of good empirical work in their own field."[28]

In his effort to rebalance the inclusion of the social sciences in architectural theory, Duffy's dissertation concluded that "the relationship between buildings and people is a wide ill-defined field which can be studied in as many ways as there are branches of social science — from cultural anthropology to the boundaries of clinical psychology — but with little chance of clear-cut or guaranteed success."[29] It is also interesting to notice that the results of his research "also confirm that the symbolic capacity of office layouts (and perhaps of other architectural variables) to express values [...] is greater than their capacity to achieve operational results such as more or less internal interaction."[30]

The development of the office landscape

One of the first commentators on *Bürolandschaft* was British architectural critic Reyner Banham, who — in 1963, on the Architectural Review — described it to be "one of the most unexpected and intriguing thoughts to be let loose in Europe recently."[31] Frank Duffy followed-up a year later and opposed the office landscape to the American open plan office, emphasizing its arguments for a participative organizational model in antithesis to the Tayloristic hierarchical one.[32]

The first example of office landscape was realized in Germany (1961) for the two-hundred and fifty workers of a company in Gütersloh, which was followed by the office landscaping for the one thousand workers of the steel company

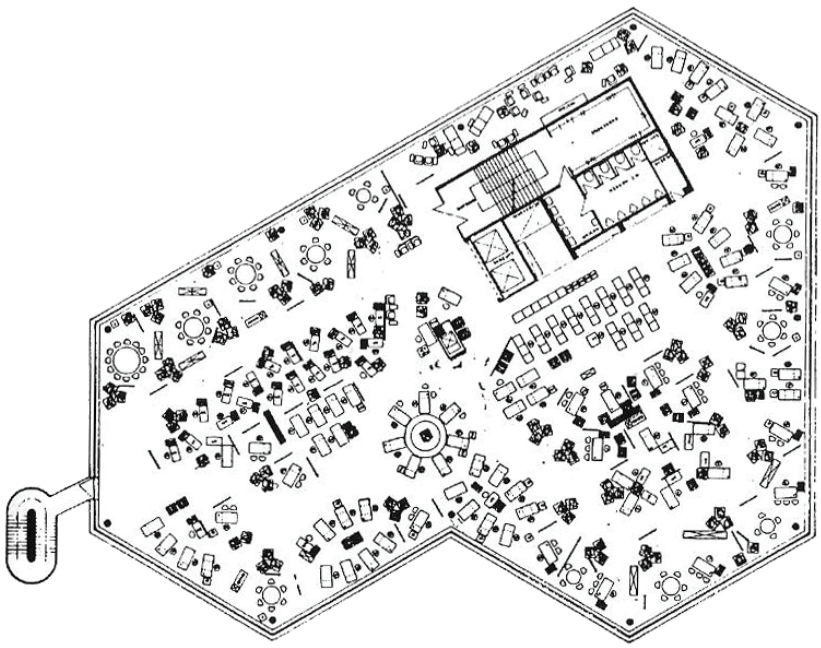

Figure 3.6. Ninoflax building, Nordhorn, Germany, 1962.
Architect: Quickborner Team nad Werner Zobel.

Krupp in the nearby Essen a year later.[33] In Nordhorn, on the Dutch border, the Quickborner Team with architect Werner Zobel designed for the textile company Ninoflax one of the most successful office landscape of the time. (See figure 3.6). Furthermore, they provided almost 10 square meters for every workplace rather than the average 6 square meters of the American open plan office.

The office landscape was quickly and widely exported to the United Kingdom and Scandinavia, where amongst its most remarkable examples was the Volvo Car headquarters in Torslanda, Sweden (1965-67). In the United States in was experimentally introduced in 1967 at DuPont in Delaware and the following year at Eastman Kodak in New York. Indeed, the office landscape was adopted in American organizations with some caution. It is interesting to notice that at

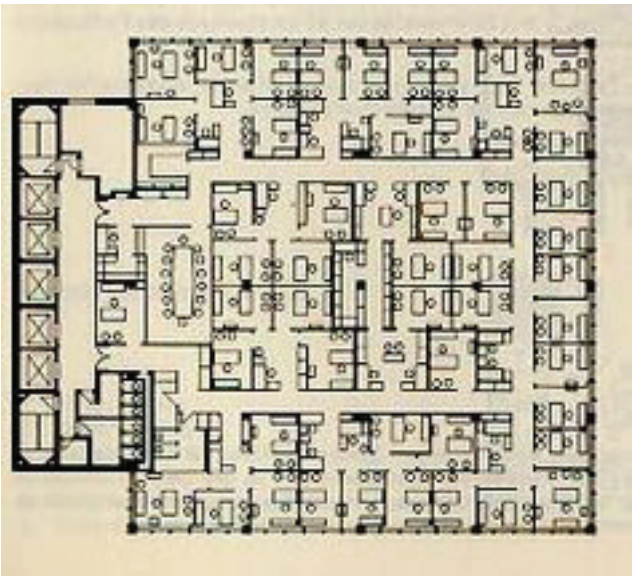

Figure 3.7. Freon Division - DuPont, Wilmington, Delaware, USA, 1967.
Architect: Hans J. Lorenzen (Quickborner Team Inc.).

DuPont, for example, only one floor was converted according to the office landscape model, in order to test its presumed benefits. (See figures 3.7 and 3.8).

The office landscape appeared to be set at random — with desks separated by acoustic screens and plants — within a deep and wide floor. Secretaries were pooled together. Executives had no private office but still conspicuously more space than other staff members. Meetings were held on large tables enclosed by curved partitions. Every piece was mobile and flexibility was achieved everywhere.

Nevertheless, its advancement within American organizations was preeminently due to the substantial reduction in construction and in fitting out fixed costs,

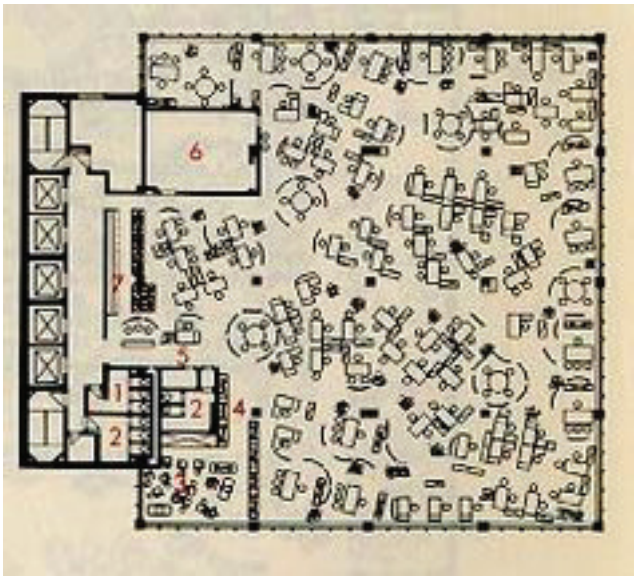

Figure 3.8. Freon Division - DuPont, Wilmington, Delaware, USA, 1967.
Architect: Hans J. Lorenzen (Quickborner Team Inc.).

along with the shrinkage of the average space per workstation. The flexible office, thus, was also a cheap office. It had no walls, nor any other amenities that could not be easily rearranged.

The most innovative American contribution to Bürolandschaft was the Action Office designed by Robert Propst for the furniture manufacturer Herman Miller. Indeed, it was simply the disposition of the furniture — and no longer the walls — that articulated the space within the office landscape. In the intentions of his designer, the Action Office was more a process than a product. As Propst noted: "the real office consumer is the mind. [...] Its function is to be a mind-oriented living space."[34] He proposed a system to keep the worker's mind awake throughout visual perception of information and workers interaction.

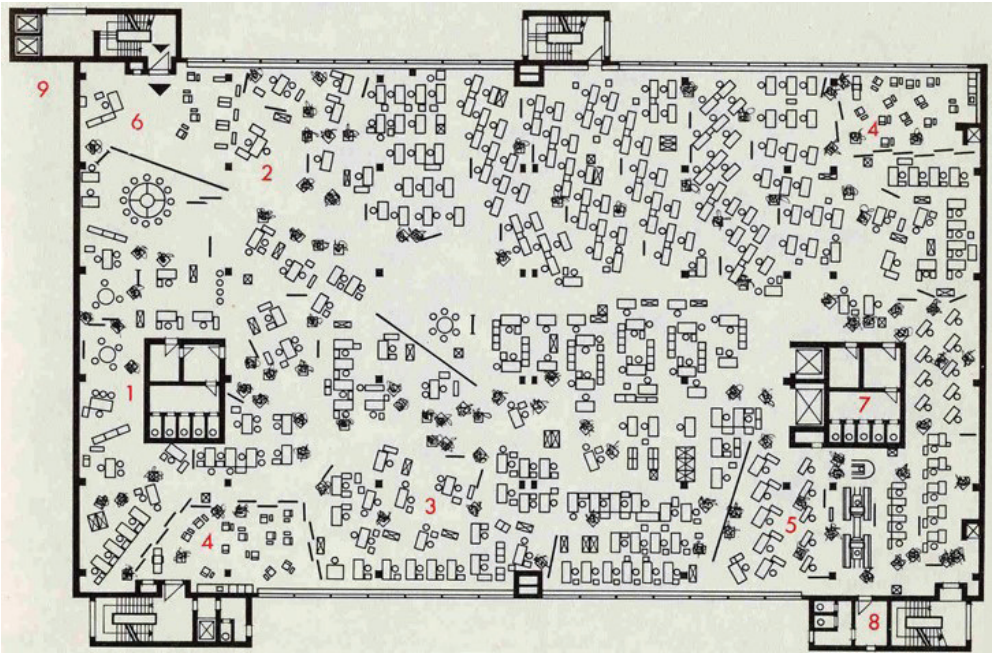

Figure 3.9. Bertelsmann Verlag, Gütersloh, Germany, 1961.
Architect: Quickborner Team.

The original feature of the Action Office was its vertical arrangement. The Quickborner team suggested only screens to articulate the office interiors, while Propst replaced the classic desk with a more complex assembly of vertical panels, hanging shelves, file cabinets that organized the paper-based work before one's very eyes, or within hand's distance. The basic configuration was a 'U' shape, which allowed a two hundred and forty degrees visual field in a sort of arena effect that framed the worker's social relations as well. The panels then could be clad in different materials, according to the needs, and set at different heights as stand-up desks.

The Action Office I (1964) was a market failure — also because the office landscape had yet to catch on in the United States — while the following Action Office II (1967) was the market biggest success ever. But the overwhelming

Figure 3.10. Stadtwerke, Karlsruhe, Germany, 1975-77.
Architect: Quickborner Team.

success of the Action Office had unpredictable effects on office space. Rather than making it more flexible, it soon became more regimented, and eventually the office landscape became what today is better known as the cubicle office.

Although *Bürolandschaft* would be dismissed in Germany by the labor unions, its legacy continued in office space planning ideas and in furniture systems. As Branden Hookway noted, office landscape's legacy continued also "metaphorically: as a new kind of spatial order, rule-based and heuristic, a synthesis of ideas drawn from communications, information, and management theory, and an expression of a contemporary fascination with the biological and the cybernetic."[35]

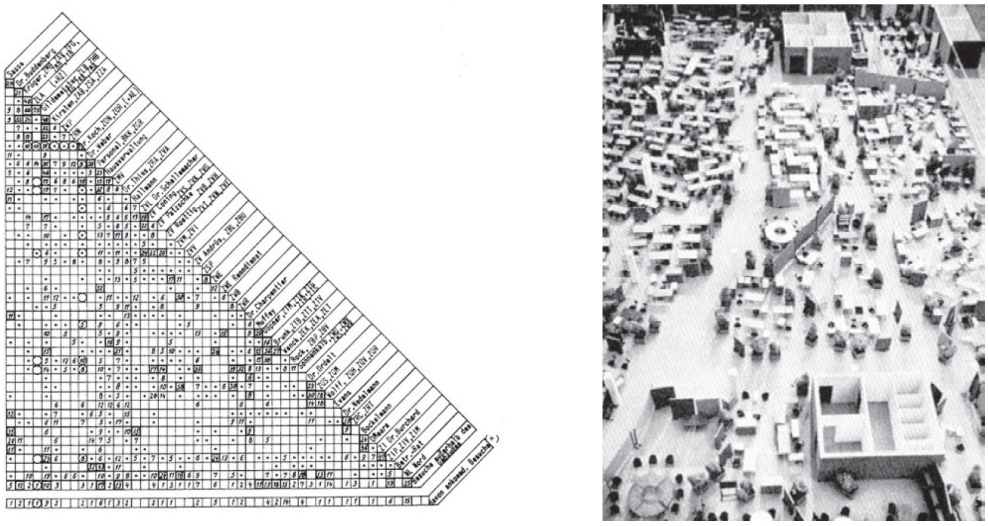

Figure 3.11.
Left: The matrix chart of the work flow between groups.
Right: Buch und Tom, Gütersloh, Germany, 1961. Architect: Quickborner Team.

3. Silicon valley. The office playground

The prevailing model for creative organizations

Today, Tayloristic assumptions about efficiency are being questioned and abandoned and new ideas about the workplace are being actively explored within creative organizations.[36] More than a century ago, Taylor introduced the principles of scientific management to the office, instilling efficiency in what was essentially a paper-based process. In the last few decades, emerging information technology has challenged the classic notion of workplace up to the point that some tasks can be completed outside the office itself. As a result, the gap between office layouts and novel forms of organization became more evident; until very recently, innovations in office design tended to fall short on organizational initiatives, rather then express their full potentials.

At a time when corporate office space is frequently unfit for the purpose of knowledge work, examples from different contexts are being taken into account and new kinds of office environments are still being built. According to Duffy, the prevailing model for creative and innovative organizations is the club. As he noted, "the traditional (usually gentlemen's) club allows an élite gruop, often of ambitious, successful, intellectual people with many common interests, to share what is, in effect, a kind of palace, a rich and diverse environment that provides a level of comfort and service that each member could not afford separately. Moreover by frequenting the same club, members are able to take calculated advantage of the possibilities of more or less accidental, more or less intended, personal encounters."[37]

In this way, creative organizations are trying to promote internal interaction among staff, provide access to richer and wider resources, and accommodate different types of knowledge-based activities. It is important to emphasize here the difference with more conventional offices. The club office is not the place where everyone should be at in order to get their tasks done, but rather is characterized as a place for meetings, exchanging ideas, and sharing resources. The most significant effort is dedicated to accidental or deliberate

informal meetings, although it also provides the diversity needed with a wide range of settings for workers who need to stay focused and isolated.

A few examples will be illustrated here with the primary purpose of showing recent innovations in office design in different industries and in different cultures. They include some of the most noteworthy and singular cases, although it has to be cleraly explained that in terms of overall numbers this type of office space is far from being statistically relevant.

The introduction of play-time

Since the 1990s the new cultural background of the American creative class has introduced a novel aesthetic approach to the office environment, deliberately distancing itself from the top-down surveillance and pervasive control culture of previous organizational models. Real estate investments started to take into account also former factories and industrial buildings, i.e. where the new creative offices could find what they once looked for in lofts.[38]

The office space of advertising agencies, information technology and communication companies introduced for the first time a number of fun amenities like bar, gym, library, all colored and friendly rendered in playful aesthetics. In *Funky Business* (1999), Nordström and Ridderstråle asserted that people work always more for earnings, fun, meeting other people, developing their skills, and less for a sense of duty.[39] The creative office — sometimes accommodated within unfinished walls and exposed pipes — provides a collection of different solutions: sharp pieces of furniture that unfold into tables or meeting rooms, sculpture-like boxes for one-to-one meetings or focused solo work, workstations and ping-pong tables next to each other.

In Silicon Valley — where many world's most innovative companies have their offices — the extreme organizational attention paid to interactions, performance, and innovation introduced also play-time within the workplace.

Indeed, Google's new campus accommodates virtually every amenity the

workers would need during their recreational time. Furthermore, it is well-known that the company allows its employees to spend up to one day a week (20 percent of the time) on special solo or team projects. Another Silicon Valley company — Yahoo — recently revoked its work-from-home policy because, as it was explained, "some of the best decisions and insights come from hallway and cafeteria discussions." Samsung's new U.S. headquarters will provide ample outdoor areas where executives hope that engineers and salespeople will mingle with each other.

While the creative office is characterized by an original and juvenile atmosphere that aims mainly to express the company innovative ambitions, its amenities and meeting and relax areas seem to increase the worker's stimuli for creativity and their presence within the office — although this could not be more distant to Taylor's notion of efficiency.

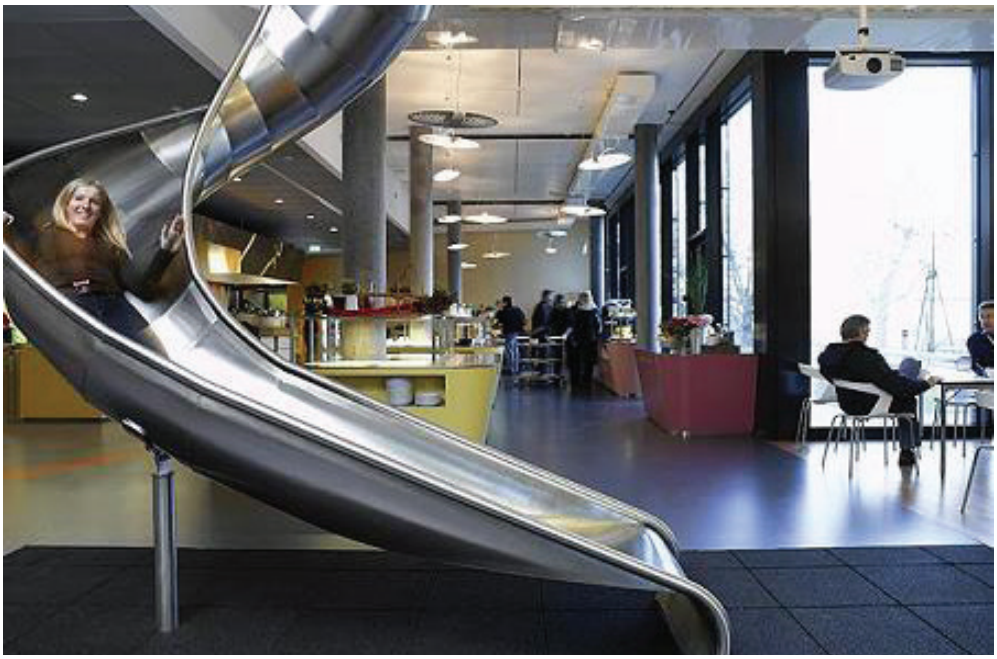

Figure 3.12. Google Headquarters, Mountain View, California, USA, 2005.
Architect: Clive Wilkinson.

The development of the office play-ground

Amongst the first examples of humanization of the workplace is the Think Tank designed by William Nichols and Richard Stonis (Associated Space Design Inc.) within the headquarters of McDonald's Corp. in Oak Brook, Illinois (1973).[40] It was a sort of "thinkery" room where workers could generate ideas or simply rest. It was circular, with suede-clad walls, a waterbed with heating system, an adjustable table for scribbles and notes, meditative lights and music.

More recently, Robert Baum and Douglas Thornley designed the offices of Ideo Product Development in a former workshop in San Francisco in 1996. The overall informal atmosphere of mixed colours and materials became typical of the creative factories that housed design or advertising agencies.

In 1990s oft-quoted examples were the offices designed by different architects around the peculiar organizational model of advertiser Jay Chiat. No single person dedicated workstations and a wide open plan that gathered together every staff member were the main features. The office was equipped with mobile workstations set up with laptop computer, wireless telephone, and daily work assignments. Meetings were held on easy chairs and sofas or around big tables hither and yon in the office. At the end of the day every table was cleaned and tided up for the next day.

Chiat commissioned American architect Frank Gehry to design its Los Angeles branch as a college campus. To encourage information exchange, private offices and cubicles were replaced with clusters of sofas, tabletops and stools grouped into common areas, along with a central gathering place and several conference rooms. Some domed cars from a "Tilt-A-Whirl" amusement park ride where also installed for one-to-one meetings. The only remainders of a conventional office were the enclosed project rooms, which were designed for clients' meetings or work groups.

A few years later, The New York branch was designed by Italian architect Gaetano Pesce on a single floor of about 3.000 square meters in an office building downtown Manhattan. The bright, cheerful office interior – Pesce's

statement against the austerity of contemporary workplaces – was covered in multicolored resin and fit with custom designed furniture. A staff of a hundred and fifty people worked without personal office, desk, nor equipment. The design magazines loved it and such was the interest that the agency started to host paid tours, but the workers never adjusted to the new environment and productivity plummeted. When the agency merged with Tbwa a few years later, the new offices – now on two floors – were fit-out anew and many pieces of the custom-made furniture later went on auction.

However, for a while it seemed that advertising agencies had caught on Chiat's ideas: Fallon McElligott experimented "portable offices;" MadDogs & Englishmen used desks that moved on tracks attached to the ceiling. Notwithstanding, Chiat's bold experiment on the office of the future did not last long.

Figure 3.13 Tbwa Chiat Day, Los Angeles, USA, 1997.
Architect: Clive Wilkinson.

When Chiat's agency merged into Tbwa Chiat Day in 1998, Los Angeles-based firm Clive Wilkinson Architects was commissioned to design their new 11.000 square meters headquarters in a former warehouse in Playa Del Rey. The building was dubbed "Advetising City" because of some features typical of urban environments; it included a "main street", a "central park" with ficus trees and benches, a gleaming basketball court, billboards, client-based neighborhoods and several different structures accommodating meeting spaces. (See figures 3.13 and 3.14). In this new office every staff member had a personal desk and a hardwire phone – some had screened workstations called "nests," others had cave-like offices called "cliff dwellings." Advetising City set a new benchmark in office design for the way it merged lifestyle and recreation space with an effective office environment.

Figure 3.14. Tbwa Chiat Day, Los Angeles, USA, 1997.
Architect: Clive Wilkinson.

Clive Wilkinson Architects also designed Google's 50.000 square meters Silicon Valley campus (2005). Together with workplace strategists Degw, the architects developed a masterplan for the existing building complex that resembles a university campus. The design provided a variety of experiences throughout the workplace combining thirteen different possible workplace settings. (See figure 3.15). These settings, which re-created typical college environments, were distributed according to the level of social interaction they provide, from more public to private.

The architects integrated the workplace with learning, meeting, recreational and food facilities, dealing with the interior space as if it was at the urban scale; in order to provide a large number of rooms, they developed the so-called "Glass Tent" office system, which houses 3/4 people and satisfies their

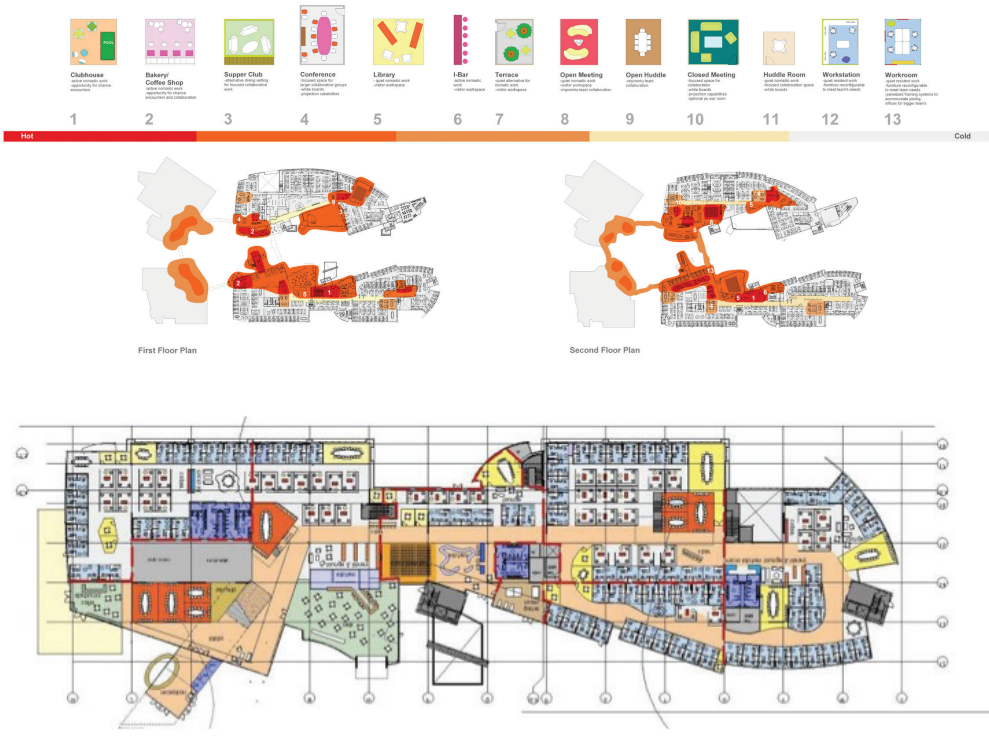

Figure 3.15. Google Headquarters, Mountain View, California, USA, 2005. Architect: Clive Wilkinson. From "hot" to "cold:" workplaces were designed and distributed according to the level of social interaction they provide.

needs for individual and group work.

The most famous characteristic of the Google offices in Silicon Valley and around the world is the overall sense of playfulness. Indeed, workers share cubes, yurts, and huddle rooms, games like foosball, pool tables, volleyball, ping pong, gyms, and break rooms, which together provide occasions for spontaneous interactions.

Another example of this type of office in Silicon Valley was recently built by Frank Gehry for Facebook Inc. and accommodates the largest open-plan *Bürolandschaft* in the world to date. The single floor 40.000 square meters office space is elevated above the ground-level car park and topped with a rooftop park.

Figure 3.17. Facebook West Campus, Menlo Park, California, USA, 2012-15. Architect: Frank Gehry.

The building is conceived as a series of boxes, ranging from 14 to 22 metres in height, to be flexibly arranged and modifed over time. The open layout aims to foster collaboration and group work. The unfinished look, with exposed services and dangling wires, is balanced with artistic decorations in bright colours and floor to ceiling size.

In summary, it can be stated as service companies are being organized more as creative companies, the office space dedicated to interaction – both formal and informal – is growing in absolute terms and in percentage to the workstations, although it has to be cleraly stated that in terms of overall numbers this so-called office play-time is hardly relevant yet.

Figure 3.18. Facebook West Campus, Menlo Park, California, USA, 2012-15. Architect: Frank Gehry.

4. Chapter summary

The third chapter of this dissertation described the typological evolution of corporate office buildings by means of the description, comparison, and interpretation of the most representative models and examples in Europe and North America. These were collected according to three different categories that characterized the configuration of these spaces in modern history.

From the Tayloristic office proposed at the end of the 20th century in Chicago and in New York by architects like Louis Sullivan and Frank Lloyd Wright, two main variations were considered and illustrated: the so-called *Bürolandschaft* introduced by the Quickborner Team in Germany and by Frank Duffy in the United Kingdom and the United States since the 1960s, and the so-called Office Playground, which was described with some American examples starting from the early 1970s.

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CHAPTER 4
RESULTS OF A MULTIDISCIPLINARY APPROACH

The paradigm shifts

CHAPTER 4
RESULTS OF A MULTIDISCIPLINARY APPROACH
The paradigm shifts

The human being knows himself only insofar as he knows the world;
he perceives the world only in himself, and himself only in the world.
Every new object, clearly seen, opens up a new organ within us.[1]

Johann Wolfgang von Goethe

1. The space around the workplace

In the introduction to this dissertation it is stated that the aim of this research is twofold: the first is to describe the empathic response to architectural settings; the second is to frame the notion of embodied simulation and its implications for design. This chapter presents descriptivve, non prescriptive, implications from the theories and models described in chapters 2 and 3 within the case study of office environments.

It has been shown that office environments today present a series of spatial typologies and interior configurations based on a limited number of physical variations — especially with regard to the interior scenery — and for this reason it is the ideal set to pursue the first aim of this research. Indeed, the architectural theories developed to describe the complex architectural phenomena of embodiment can still be applied to office interiors. Norberg-Schulz's insights on perceptual and existential space and his correlations of center/place (proximity), direction/path (continuity), and area/domain (enclosure) can be found on any office floor. In office landscaping literature "place" is synonym to "subjective space," "path"is the rectilinear circulation route of the cellular office or the curved one in the open plan office, domain is the departmental area, which is sometimes defined by simple filing cabinets in the open plan office.[1] As noted by Duffy, in office space planning "the major features which vary [have] to do with short life scenery — the items in each workplace and the

screens which divide one workplace from another."[2] In every office workplace, by definition, chair and desk together are the physical setting which makes clerical work possible. Workplaces then are cut off from one another in the physical layout through the use of enclosures and screens.

According to a survey of the International Facility Management Association, in 2010 about 70 percent of American employees worked in open plan offices.[3] As it is shown in chapter 3, from the "Era of Industry" to the "Era of Information" and to the "Era of Ideas" corporate interiors have always been characterised by open plan floors suited to perform some clerical tasks.

It has to be emphasized here that it is not within the purview of this research to measure whether worker reactions to their workplace is generally negative or positive, cost-effective, or productive. Instead, the experience of office interiors,

Figure 4.1. A few different workplace ideal settings according to Herman Miller. From left to right, top to bottom: Haven, Hive, Jump Space, Clubhouse.

with their simple spatial arrangements and constantly evolving cultural practices, is ideal for studying some physiological responses to architectural settings. Furthermore, the notion of embodiment and its sensory-motor properties find meaningful relationships when situated in a typical and everyday environment like the workplace, since they refer to an early component of the perceptual experience, before any explicit aesthetic judgment is formulated.[4]

Different aspects of perception have been linked to distinct concepts of embodiment in architecture, based on spatial cognition on one side, or, the embodied perception of meaning or symbolic content on the other. The experience of the workplace is addressed here critically discussing properties of the visual vs. the somatosensory mechanism involved during embodied simulation. It has already been shown at the end of chapter 2 that for the last two decades evidence in the field of cognitive neuroscience has shaped our

Figure 4.2. A few different workplace ideal settings according to Herman Miller. From left to right, top to bottom: Landing, Workshop, Forum, Plaza.

views about the multimodal properties of the motor system in regard to an embodied account of the architectural space around us.[5]

In an early neuroscientific study by Giacomo Rizzolatti et al. — completed in Parma in 1997 — it is described the role "of motor areas and motor-to-sensory pathways for the construction of object and space perception, and the artificiality of constructing a rigid wall between sensory and motor representations."[6] Indeed it is shown that the visual receptive fields of neurons in F4 area — a premotor area wired to the primary motor cortex — "are circumscribed to the space around the tactile receptive fields, as if the cutaneous space extended into the visual space adjacent to it."[7] (See figure 4.3).

Some properties of F4 neurons provide empirical evidence of the (simulation-based) motor nature of peripersonal space. It has been noticed indeed that

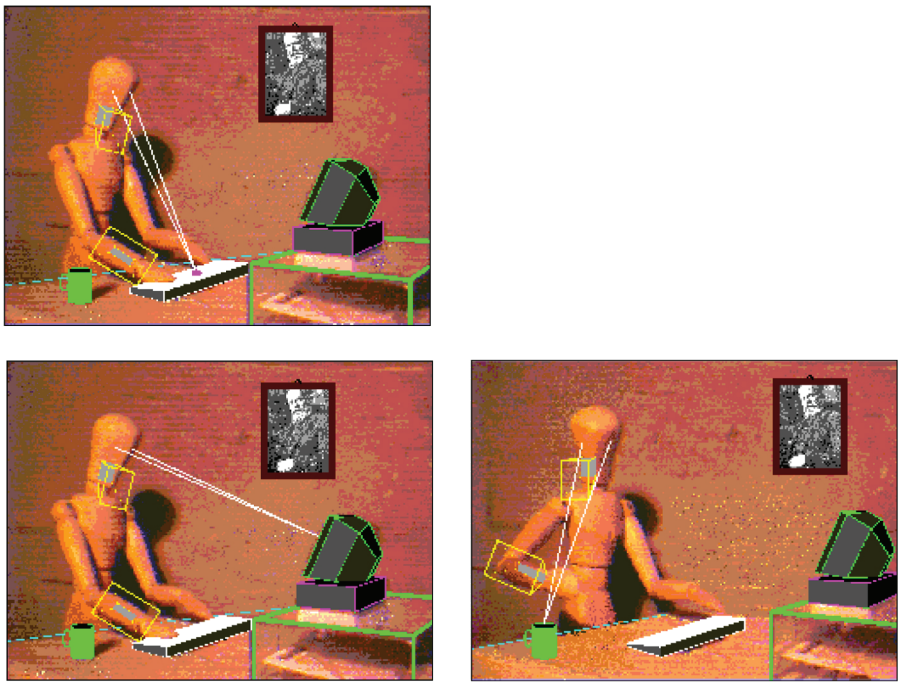

Figure 4.1. A visual receptive field coded in body-part coordinates moves only when the body moves.

the discharge of neurons reflects a potential, simulated motor action towards a particular spatial location.[8] This simulated potential action defines a so-called motor space, since it is measured in terms of action potentiality. It can thus be stated that F4 neurons "perceptually" work by means of embodied motor simulation.

This shows that cortical premotor areas are endowed with sensory properties which respond to visual and somatosensory stimuli. Posterior parietal areas, traditionally considered to process purely sensory information, are now believed to play also a fundamental role in motor control. The premotor and parietal areas, rather than having distinct and independent functions, are neurally integrated not only to control action, but also to serve the function of building an integrated representation of (a) actions together with (b) objects acted on and (c) locations toward which actions are directed.

This perspective in cognitive neuroscience describes a new model — opposite to the computational analogy of perception, cognition, action — according to which the same motor circuits that control the motor behavior of someone sitting at their desk also map the space around them, and the objects at hand in that very same space with their shape, size, orientation and distance from the perceiver, thus defining and shaping in motor terms their representational content.

It can thus be stated that F4 nerons map the worker's peripersonal space around their workplace — the space immediately surrounding their body — which has also been involved in proxemics and in office interior design since the 1960s, when anthropologist Edward T. Hall initiated this new field of study in his book entitled *The Hidden Dimension*.[9]

It can be conluded that the space around our workplace is thus defined by the motor potentialities and confinements of our body — meaning also that perception requires action simulation — and that it is perceptually measured not only visually but through a more complex model which involves the potential actions of the worker occurring within it.

2. The living office

The discharge of F4 neurons reflects a potential, simulated motor action directed within a specific space; this simulated potential action represents thus a motor space.

As noted, again, by Rizzolatti et al. the existence of peripersonal space is supported exactly by the notion that spatial awareness itself is derived from motor activity.[10] Indeed, they discovered that action is fundamental to spatial awareness because it is precisely action simulation that integrates multiple sensory modalities within the F4-VIP neural circuit in the brain.[11] The same neural structures involved in the unconscious modeling of our acting body in space also contribute to the awareness of the lived body and of the objects that the world contains. Vision and action are thus parts of an integrated system and the sight of an object at a given location automatically triggers a simulated potential action directed towards that object. The constant weighting of architectural and peripersonal space is thus mainly processed by premotor neurons mapping visual space on potential action and the sensory-motor system is thus responsible for the phenomenal awareness of the body, the capacity of action understanding, and space and action conscious awareness in the substantiation of experience.

It is interesting to notice that some observations in regard to extrapersonal space can be added measuring the size and proportion of a room. Architect Isabella Pasqualini, neuroscientist Olaf Blanke, and colleagues explained how "investigating bodily feelings, self-identification and self-location with respect to the architectonic unity or form and space, the observer may be confronted with architecture as an extension of the bodily volume."[12] According to this study the experience of a narrow room increases the somatosensory sensation of verticality "thus enhancing bodily stability" while, on the other side, a large room elicits "a destabilizing effect for the missing cue in peripersonal space provoking an illusory backwards movement."[13]

Recently, Duffy — who has studied since the '60s the relationship between spatial differentiation and worker interaction within office space — articulated a schema comprising four differing organizational types supporting different types of workers and working patterns, based upon dimensions of interaction and autonomy (hive, cell, den, and club).[14]

To the aim of this research it is interesting to imagine how these office types present different motor spaces and what this means in regard to the worker's spatial perception and spatial awareness. Duffy describes the contemporary office as made of variable configurations of these four organizational types. (See figure 4.4).

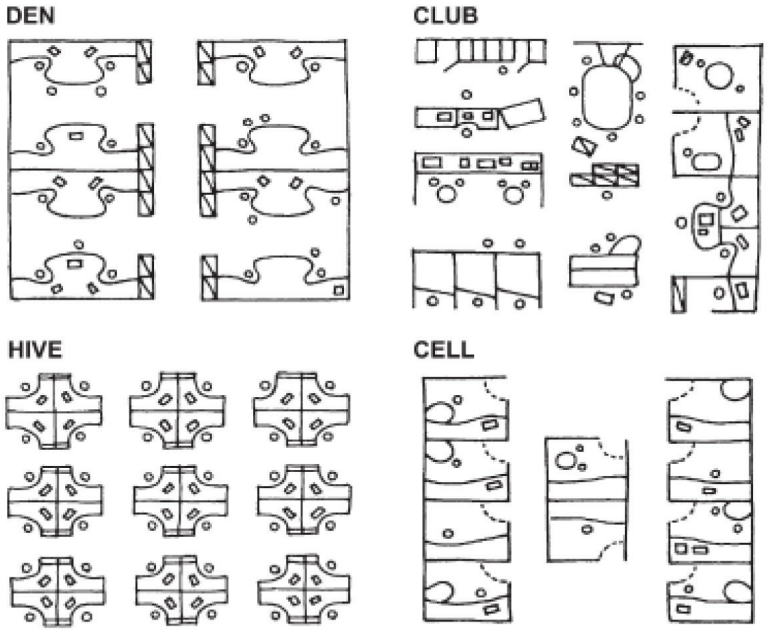

Figure 4.4. A diagram of the four different organizational types described by Duffy.

1) Hives are characterized by individual, routine-process work with low level of interaction and low autonomy. Workplace settings are typically uniform, open plan, screened and impersonal.
2) The Cell offices accomodate individual work with little interaction. Each person occupies either an enclosed cell or a higly screened workstation in a more open plan office.
3) Den offices are associated with group work, typically highly interactive. Den spaces are designed for group working and often provide a range of several simple settings, usually arranged in an open plan office or in group rooms.
4) Club organizations are for knowledge work. Individuals and teams occupy space on an "as needed" basis, moving around it to take advantage of a wide range of facilities.

It is important to describe here a proposal for an experiment by neuroscientists Vittorio Gallese and Francesca Ferri, and the author of this dissertation, which was intended to be performed during the time of this dissertation's research.

Behavioral, neurophysiological, and fMRI approaches would have been employed to assess the level of empathic responses to the same daily office action routines taking place within specifically designed different working environments. It was hypothesized that working environments maximizing employees' potentialities for action and interaction would lead to their highest conscious liking, to stronger modulation of pro-social autonomic responses (RSA - respiratory sinus arrythmia), and to stronger activation of empathy-related and reward-related brain circuits. Thus, behavioral and autonomic responses, and brain cortical activation profiles would have been measured in employees during the mere observation and explicit evaluation of working environments in which working space would have been varied in terms of individual space (presence/absence of physical barriers), room interior design, and potentialities for social interactions.

A work space and a meeting room would have been used as stimuli and presented in two versions, varying the potentialities for action and interaction. The work space would have been presented as (A) individually used open workstations with high screening or partitions and as (B) complex and

continuous spaces incorporating individual and team spaces. The meeting room would have been presented as a room visually (A) closed or (B) open from the outside. In such working environments, implemented by means of virtual reality, avatars will be displaying congruent work-related actions (typing, answering the phone, talking to someone else). Three different research methodologies would have been employed using such stimuli: 1) Behavioral assessment by means of questionnaires on the level of aesthetic liking, and propensity to work in the different environments; 2) Assessment of pro-social attitudes towards the same environments by means of electrophysiological recording of RSA; 3) Assessment of differential activation of empathy and reward-related brain circuits by means of two different factorial design (3 x 2) fMRI experiments. Participants would have consisted of a group of young employees (millenial knowledge workers) with working experience ranging between 2-5 years.

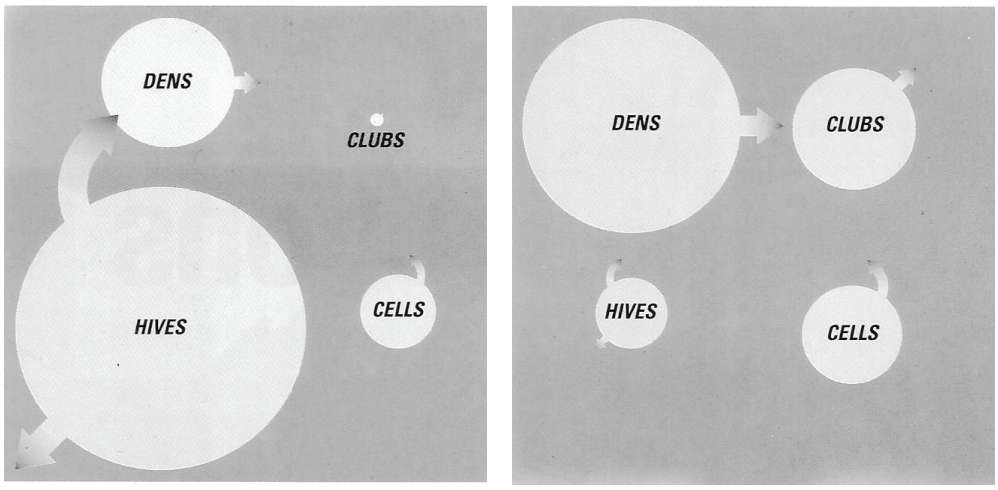

Figure 4.5. Left: the proportion of the four types of office at the end of the 1990s. Right: A prediction of how the proportion might change.

3. The affective workplace

The notion of effective workplace — a workplace where both the organization and the employees thrive successfully — is commonly debated as the ultimate goal for every office environment. It is proposed here that the notion of affective workplace is the one, unitary representation of the relationship between office space and its users.

It has already been noted in this dissertation that it was Heinrich Wölfflin at the end of the 19th century who, for the first time, questioned the fact that architectural forms are able to express emotions and moods.[15] This might be particularly explicit, for example, experiencing the nave of a Gothic cathedral or the Guggenheim museum in Bilbao, but in regard to corporate interiors it might seem to be less the case, or even irrelevant, also due to the fact they are generally not designed with such intentions.

Since Wölfflin, the role of sensations and feelings has been debated intermittently within the fields of philosophy and architecture. For the last two decades, since Jaak Panksepp's *Affective Neuroscience* and significant advances in neurobiology and neuroscience, researches are providing evidence for the biological and psychological underpinnings of emotions.[16]

It is not the aim of this dissertation to discuss the idea that a particular building might evoke a certain emotional response. The role of emotions is intended here in its biological sense as the innate system of values through which the environment is precognitively evaluated. It is important to clearly distinguish two different kinds of emotions: those arising by aesthetic pleasure and those resulting from easthetic judgment. Both are related to aesthetic experience, but are not interchangeable. Indeed, aesthetic pleasure is the result of automatic hedonic responses, while aesthetic judgment requires explitic cognitive appraisal.[17] In this approach only the first one will be considered.

The notion of "affective" here doesn't entail that a workplace has the capacity to make an employee feel happy or sad — although that might well be the case — but rather it considers the role of emotions in the experience of office interiors

and gains evidence from the already mentioned sensory-motor mechanisms and multimodal properties of the cortical motor system that contribute to perception and spatial awareness.

The notion of affective workplace largely draws from as well as refers to, again, embodied simulation theory. Embodied simulation entails a subjective experience of the architectural space which is precognitive and does not necessarily carry to an explicit judgment.[18] This perspective entails the notion that the relationship between buildings and their users is based on the user's bodily motor potentialities and always carries an affective experience or emotional response, measured, for example, in terms of cardiorespiratory frequency, blood pressure, hormonal response, etc..

These affective and emotional aspects characterize every relationship between the built environment and the human beings, which due to its sensorimotor nature is characterized by embodied simulation. As it has been shown above the architecural space around us is perceived through the expression of our own body's motor potentialities, which means also that we simulate the actions and movements it suggests. In this context, simulation is conceived as a non-conscious, pre-reflective functional mechanism of the brain-body system. The sense we attribute to our lived experience of the world is grounded in the affective-laden relational quality of our body's action potentialities, enabled by the way they are mapped in our brains. This is particularly meaningful to the notion of affective workplace, as embodied simulation is involved in every experience of architectural settings and not only during the perception of exceptionally dramatic and theatrical architectural expressions — though in these cases it is certainly more evident and more intense.

According to the proposed notion of affective workplace, the influential modernist principle of "Form Follows Function" — first coined by American architect Louis Sullivan at the end of the 19th century in the belief that the shape of a building should be primarily based upon its intended function or purpose — might now be updated with the phrase as "Form Follows Feeling and Feeling Follows Form."[19]

It is also interesting to notice that the notion of affective workplace involves the reiteration of the experience that the worker endures in their daily routines; this peculiar aspect is fundamental to the description of the reciprocal relationship between buildings and their users.

4. The novelty/familiarity loop within the experience of office space

Since it has been shown above that the reciprocal relationship between buildings and their users always involves affective and emotional aspects that are neurobiologically based, it has now to be explored how the reiteration of the same experience loses strength over time, shifting between the new and the familiar. The emotional grounding and the reiteration of the spatial experience that the worker endures in their daily routines has thus further implications to the notion of embodied simulation in corporate interiors.

Indeed, office space is generally experienced as a background reality while the worker's attention is focused on the performance of their task. In this case many aesthetic qualities of office environments are basically experienced as mundane and non-artistic, which means that they are experienced without any explicit aesthetic judgment being formulated. It has been shown above that this particular experience is based on the sensorimotor and affective aspects of embodied simulation, which can now be considered the fundamental cognitive mechanism underlying perception of office interiors.

At this stage in the argument the notion of familiarity needs to be introduced, an invisible temporal dimension within the experience of office space. It has also to be distinguished here the notion of familiarity within the collective and the individual experience of office space.

The collective experience is related primarily to the type of office space. It has been previously described in this dissertation the typological evolution of office interiors in Europe and North America through models and examples and it has been shown how indeed office types evolved as frames of reference

transformed by unforeseen and rapid changes. As it is noted by architect Paul Tesar "they allow the simultaneous perception of familiarity and novelty; of the familiar in the repetition of the underlying essence of the type, and of the new in each particular and specific instantiation and transformation, filling it with new meaning and keeping it alive."[20] It can thus be stated that the notion of familiarity sets the stage, reference, and context within which we experience office space over time.

The individual experience involves the reiteration of the typical daily experience. In this case the reiteration over time involves a different notion of familiarity where the user establishes a form of attunement with the space. It is supposed here that the reiteration of the same neural mechanisms over time entails a less intense activation of the sensorimotor and affective aspects of embodied simulation which means also that a familiar experience of space is framed by a less spatial awareness.

To the aim of this research it is not interesting to establish a preference for one or the other; rather, it is proposed here a notion of novelty and familiarity in architecture as a matter calling into play cultural and biological changes.

In discussing this assumption, it can be speculated that when the perceptual experience of an architectural space becomes gradually familiar, it means it has made a biological impression on our brain-body system. While it has been demonstrated that embodied simulation works in nonconscious and precognitive ways, it should also be emphasized here its role in enculturation. Indeed, the reiteration of an experience is especially what shapes who we are — and in doing so it becomes less emotional but more familiar and substantial. Brain plasticity today explains the process by which the brain changes as a result of our experiences and the environments in which we live and work.[21] Within this context it might be argued that — as it is primarily by means of mirror mechanisms and embodied simulation that we experience the space around us — it is by the same means that the space around us literally makes an impression on us. The shift from novelty to familiarity would thus be the resultant of reiterated and rooted impressions, which also sets the stage for further experiences and ultimately makes us who we are.

5. Chapter summary

In the paragraphs above some major implications of the notion of embodied simulation in corporate interiors has been presented according to the aims of this dissertation.

It has been presented how the experience of office interiors is ideal for measuring some basic physiological properties of embodied simulation and it has been shown that the space around the workplace is processed not only through the visual areas of the brain but rather through an integrated network of motor area and motor-to-sensory pathways. This argument also provides new scientific grounding to the study of proxemics in office interior design, a study initiated by Edward T. Hall about 50 years ago, when for the first time some considerations about the skin and muscles as receptive fields were taken into account in his work on space perception in office interiors.*

The action simulation represented by means of embodied simulation also informs spatial awareness integrating different sensory modalities within the F4-VIP neural circuit in the brain. This means that the same neural circuits involved in the bodily mapping of space also contribute to the phenomenal awareness of the body within the environment and the space conscious awareness in the substantiation of experience. It has also been described an experiment intended to measure the level of empathic responses to some daily office action routines taking place within different office environments based upon different levels of interaction and autonomy.

A new way regarding the notion of affective workplace is presented as the ultimate representation of the relationship between office space and its users and involves, again, embodied simulation theory. It considers the cognitive role of emotions in the experience of office interiors and gains evidence from the already mentioned sensory-motor mechanisms and multimodal properties of the cortical motor system involved during perception. This perspective entails the notion that the relationship between buildings and their users is based on the user's bodily motor potentialities and always carries an affective experience or emotional response.

After it has been shown that the reciprocal relationship between buildings and their users always involves affective and emotional aspects that are neurobiologically based, it has been questioned how the reiteration of the same experience loses strength over time, shifting between the new and the familiar. It has been argued how the reiteration over time involves a notion of familiarity according to which the user establishes a form of attunement with the space. It has also been supposed that the reiteration of the same neural mechanisms over time entails a less intense activation of the sensorimotor and affective aspects of embodied simulation which means also that a less spatial awareness frames a familiar experience of space.

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CHAPTER 5
GENERAL DISCUSSION AND CONCLUSIONS

Limitations and future research

CHAPTER 5
GENERAL DISCUSSION AND CONCLUSIONS
Limitations and future research

Measure what is measurable, and make measurable what is not so.[1]

Galileo Galilei

1. Some reservations

In the development of science, specialisation into disciplines has led to a demarcation of subjects to give shape to the body of knowledge and avoid its dilution. Each discipline has built its own field and defined its own methods of investigation and its systems of approach and validity.[2] This dissertation was based on a cognitive neuroscience model rather than on traditional architectural theory. Although during the time this dissertation had been carried out a few other examples of such a research were published in books and articles, unless someone has been specifically trained it might be difficult to understand the different approaches architects and neuroscientists apply in their field of studies. Nevertheless, this dissertation is written by an architect and is intended primarily to have relevance for architects and designers.

One possible criticism to the approach proposed in this dissertation might be the apparent passive and deterministic relationship that embodied simulation seems to entail — in which beholders are relegated in their empathic receptivity, hence loosing sight of the peculiar individual quality of aesthetic experience that is largely determined by one's individual taste, background, memories, education and expertise.

It is possible to counter this criticism by arguing that there is ample evidence that mirror mechanisms and embodied simulation are dynamically modulated and affected by contingent and idiosyncratic factors. Several studies showed

that one's previous experiences, memories and expertise strongly determine the intensity of activation of mirror mechanisms and the ensuing perceptual contents.[3]

Indeed, it is postulated here that embodied simulation, by virtue of its diachronic plasticity and modulation, might be also the vehicle of the projective qualities of our aesthetic experience — where our personal and social identity literally shape the way we relate to a given perceptual object. Embodied simulation, if conceived of as the dynamic instantiation of our implicit memories, can relate the perceptual object and beholder with a specific, unique and historically determined quality.

Another noteworthy limitation, which was also stated in the introduction to this dissertation, can be found in the nature of the qualitative results of this dissertation. Although the research is supported by a wealth of scientific knowledge, it would have gained evidence and details to some of its results if some laboratory experiments were performed.

2. Some explanations

Within the field of architectural theory a dichotomy between complexity and simplification, or an opposition between the lived experience of the real phenomenological world and the essence of architectural design has characterized the debate of the 20th century.[4]

The application of embodied simulation theory within the field of office interior design provided a preliminary validation of a method that entails the whole richness of reality and at the same time does not limit itself to the observation of its phenomenal manifestations. Such an approach would allow the architects to understand the particular manifestations of the lived experience of architecture and link them to the broader knowledge of their essential qualities.

What became evident in this research is also a new approach to architecture as a bridge between art and science. Looking beyond the field of office design,

the results of this study supported a multidisciplinary approach to the study of architecture and its cultural norms and social values. In providing scientific evidence to theories and positions traditionally formulated as philosophical discourses this research also validated some basic "laws" of its very ancient knowledge. It became clear that a new approach to architectural design theory grounded on scientific evidence — together with a more traditional one based more on empirical facts and practices — offers an open field of study for architecture scholars.

It has to be emphasized that this approach does not intend to diminish the artistic component of architectural design in favor of a scientific one; on the contrary, it is intended as a means to show and display that the more the scientific contribution is taken into account, the more the artistic contribution becomes not only indispensable, but also particularly evident. Harry Mallgrave recently noted that today the missing art in the art of building has to be found in a better understanding of the human beings for whom the architects build.[5] In summary this research offers a theoretical framework to re-establish the primacy of the artistic component of architecture, firmly opposing any reductionist and simplistic approach, which is a criticism sometimes gratuitously raised whenever the words "science" and "art" are juxtaposed in the same sentence."[6]

Finally, the results of this study seems to support the underlying premises by concluding that architecture is inseparably tied to its users by means of embodied simulation, which in turn defines their relationship with architecture itself. In fact it has been shown that any experience of any built environment is intrinsic to the mechanisms of embodied simulation; the "as-if" mechanism of embodied simulation seems to qualify not only the appreciation of the fictional worlds of verbal representations, art, or cinema, but also every form of perception, including the most mundane daily reality. For many years studies in aesthetics and cognitive neuroscience neglected the multimodal nature of vision in aesthetic experience and in representations of perception.

This research introduced neuroscientific evidence — namely the discovery of mirror mechanisms and the development of embodied simulation theory — according to which vision and the experience of architecture are based on

a more complex relationship of the body, its motor system, and architectural space. Within this context this dissertation also provided some explanation of how the experience of architecture can be deconstructed into its most basic bodily elements. This approach also contributed a new perspective on the evolution of architectural typology and its cultural diversity, speculating on the bodily roots of architectural experience as a reason for change or repetition.

3. Future research

The interesting relationship shown in this study between architecture and embodied simulation warrants further inquiry.

Further work is needed to understand the role of embodied simulation within the frame of culture in architecture or, in other words, the relationship between biology and culture. At the end of this dissertation it was speculated that when the perceptual experience of an architectural space becomes gradually familiar, a biological impression on the brain-body system has taken place. If this is the case, this would then open a question — to be further investigated — about another relationship between architecture and its users, or the means by which the first shapes the second.

Further work should also assess and relate the empathic responses to other building types besides offices, such as for example public buildings like schools and hospitals. While this would certainly offer new insights and details to some of the assumptions presented in this dissertation, it might also impart greater breadth to the discussion and provide greater opportunity to explore the potential of reciprocal contributions possible between such apparently divergent disciplines as architecture and cognitive neuroscience.

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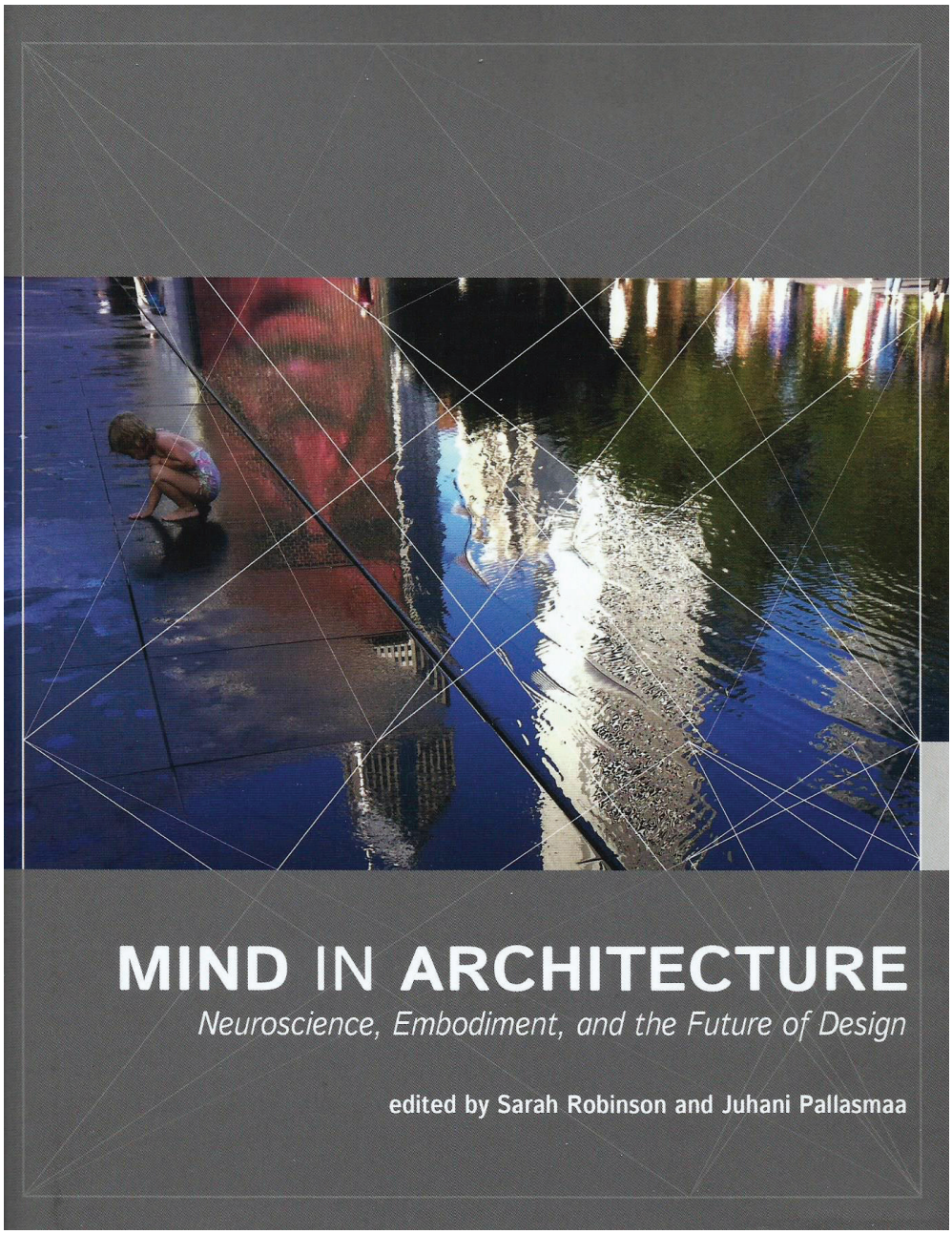
CHAPTER 7
APPENDIX
Co-authored research papers


MIND IN ARCHITECTURE
Neuroscience, Embodiment, and the Future of Design
edited by Sarah Robinson and Juhani Pallasmaa

CHAPTER 7
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1. Embodied simulation, aesthetics and architecture An experimental aesthetic approach

Gallese, V., and Gattara, A. (2015). "Embodied Simulation, Aesthetics and Architecture: An Experimental Aesthetic Approach," in *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design*, eds S. Robinson and J. Pallasmaa. (Cambridge, MA: Mit Press), 161-179.

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AND THE FUTURE OF DESIGN

edited by Sarah Robinson
and Juhani Pallasmaa

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EMBODIED SIMULATION, AESTHETICS, AND ARCHITECTURE: AN EXPERIMENTAL AESTHETIC APPROACH

Vittorio Gallese and Alessandro Gattara

Every human contact with the things of the world contains both a meaning- and a presence-component. ... The situation of aesthetic experience is specific inasmuch as it allows us to live both these components in their tension.

Hans Gumbrecht[1]

Cognitive neuroscience today offers a novel approach to the study of human social cognition and culture. Such an approach can be viewed as a sort of "cognitive archaeology," as it enables the empirical investigation of the neurophysiological brain mechanisms that make our interactions with the world possible, thereby allowing us to detect the possible functional antecedents of our cognitive skills and to measure the sociocultural influence exerted through human cultural evolution on that very same cognitive repertoire. Thanks to cognitive neuroscience we can deconstruct some of the concepts we normally use when referring to intersubjectivity or to aesthetics, art, and architecture, as well as when considering our experience of them.

This chapter, written by a cognitive neuroscientist and an architect, endeavors to suggest why and how cognitive neuroscience should investigate our relationship with aesthetics and architecture—framing this empirical approach as experimental aesthetics. The term

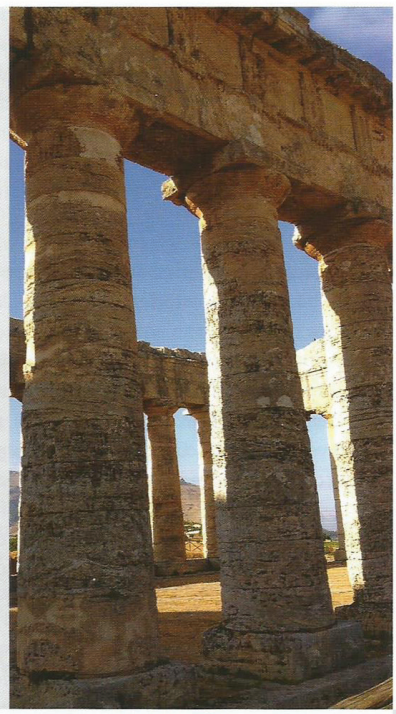
experimental aesthetics specifically refers to the scientific investigation of the brain-body physiological correlates of the aesthetic experience of particular human symbolic expressions, such as works of art and architecture. The notion "aesthetics" is used here mainly in its bodily connotation, as it refers to the sensorimotor and affective aspects of our experience of these particular perceptual objects.

Of course, this approach covers only one aspect of aesthetics, since it refers to an early component of our perceptual experience of the object: to what is happening before any explicit judgment is formulated. The neurophysiological and behavioral evidence of this early phase of aesthetic experience is strikingly similar to that which underlies the mundane perceptual experience of nonartistic objects. Thus, experimental aesthetics can also clarify how different the neurophysiological and bodily correlates of "real-world" experience are from those that characterize experiencing the symbolic representations of that world. We address some recently discovered multimodal properties of the motor system, introducing mirror neurons and embodied simulation, and discuss their relevance for an embodied account of aesthetic experience, summarizing recent empirical research that targets the relationship between gestures and meaning-making. We conclude by proposing several suggestions on how experimental aesthetics might help us to understand the experience of architecture. We believe that only a multidisciplinary approach can increase our understanding of these important and distinctive aspects of human culture.

FOUR REASONS WHY COGNITIVE NEUROSCIENCE MATTERS TO ARCHITECTURE

Cognitive neuroscience is not an alternative to the humanities but a different methodological approach that explains the same phenomena with a different epistemological attitude, a different level of description, and a different language. Cognitive neuroscience can contribute to addressing the following questions: What does it mean "to look at" a painting, a Greek temple or a film, in terms of the brain-body system? To what extent does the way we experience "reality" and fiction depend upon different epistemic approaches and different underpinning neurofunctional mechanisms?

The reasons why cognitive neuroscience is entitled to formulate such questions, and supposedly also to help in answering them, are the following, listed according to their decreasingly broad implications: The first reason deals with the relationship between perception and empathy. For many years aesthetics and cognitive science have shared a particular attitude toward the sense of vision when accounting for aesthetic experience and



8.1 Greek temple at Segesta, Sicily.

the perceptual representation of the world, respectively. Both approaches endorsed a sort of "visual imperialism," neglecting the multimodal nature of vision. In the following section we demonstrate that such a notion of vision no longer holds, and introduce neuroscientific evidence of the relationship between the motor system, the body, and the perception of space, objects, and the actions of others.

The notion of empathy, recently explored by cognitive neuroscience, can reframe the problem of how art functions and how architectural spaces are experienced—revitalizing and empirically validating old intuitions about the relationship between body, empathy, and aesthetic experience.

The second reason addresses how the real and fictional worlds relate to one another and to the brain-body system. Empirical research has shown that we experience fictional realities through neurobiological mechanisms fairly similar to those through which we experience real life. We show how, from a certain point of view, any experience of any possible world basically depends upon similar embodied simulation routines. The "as-if" mode of embodied simulation appears to qualify not just our appreciation of fictional worlds, but all forms of intentional relations, including those characterizing our prosaic daily reality.

The third reason deals with architecture and its aesthetic quality. Embodied simulation can illuminate the aesthetic aspects of architecture—both from the perspective of its making, as well as the potential experience it affords the beholder—by revealing the intimate intersubjective nature of any creative act: where the physical object, the product of symbolic expression, becomes the mediator of an intersubjective relationship between creator and beholder. The experience of architecture, from the contemplation of the decorative element of a Greek temple to the physical experience of living and working within a specific architectonic space, can be deconstructed into its grounding bodily elements. Cognitive neuroscience can investigate of what the sense of presence that some buildings possess is made. This approach can also contribute a fresher empirical take on the evolution of architectonic style and its cultural diversity, by treating it as a particular case of symbolic expression, and through identifying its bodily roots.

THE MULTIMODAL NATURE OF VISION

Observing the world is more complex than the mere activation of the visual brain. Vision is multimodal; it encompasses the activation of motor, somatosensory, and emotion-related brain networks. Any intentional relation we might entertain with the external world has an intrinsic pragmatic nature; hence it always bears a motor content. More than five decades of research have shown that motor neurons also respond to visual, tactile, and auditory stimuli. The same motor circuits that control the motor behavior of individuals also map the space around them, the objects at hand in that very same space, thus defining and shaping in motor terms their representational content.[2] The space around us is defined by the motor potentialities of our body. Premotor neurons controlling the movements of the upper arm also respond to tactile stimuli applied to it, to visual stimuli moved within the arm's peripersonal space, or to auditory stimuli also coming from that same peripersonal space.[3] The manipulable objects we look at are classified by the motor brain as potential targets of the interactions we might entertain with

them. Premotor and parietal "canonical neurons" control the grasping and manipulation of objects and respond to their mere observation, as well.[4] Finally, mirror neurons—motor neurons activated during the execution of an action and its observation performed by someone else—map the action of others on the observer's motor representation of the same action.[5]

More than twenty years of research on mirror neurons have demonstrated the existence of a mechanism directly mapping action perception and execution in the human brain, here defined as the mirror mechanism (MM).[6] Also, in humans, the motor brain is multimodal. Thus, it does not matter whether we see or hear the noise made by someone cracking peanuts, or locking a door. Different—visual and auditory—sensory accounts of the same motor behavior activate the very motor neurons that normally enable the original action. The brain circuits showing evidence of the MM, connecting frontal and posterior parietal multimodal motor neurons, most likely analogous to macaques' mirror neurons, map a given motor content like "reach out" or "grasp" not only when controlling its performance, but also when perceiving the same motor behavior performed by someone else, when imitating it, or when imagining performing it while being perfectly still.

These results completely change our understanding of the role of the cortical motor system and of bodily actions. The cortical motor system is not just a movement machine, but an integral part of our cognitive system,[7] because its neurofunctional architecture structures not only action execution but also action perception, imitation, and imagination, with neural connections to motor effectors and/or other sensory cortical areas. When the action is executed or imitated, the corticospinal pathway is activated, leading to the excitation of muscles and the ensuing movements. When the action is observed or imagined, its actual execution is inhibited. The cortical motor network, though, is not activated in all of its components and not with the same intensity, hence action is not produced—it is only simulated.

The prolonged activation of the neural representation of motor content in the absence of movement probably defines the experiential backbone of what we perceive or imagine perceiving. This allows a direct apprehension of the relational quality linking space, objects, and others' actions to our body. The primordial quality turning space, objects, and behavior into intentional objects is their constitution as objects of the motor intentionality that our body's motor potentialities express.[8]

Other MMs seem to be involved with our capacity to directly apprehend the emotions and sensations of others due to a shared representational bodily format. When perceiving others expressing disgust, or experiencing touch or pain, the same brain areas are activated as when we subjectively experience the same emotion or sensation. We do not fully experience their qualitative content, which remains opaque to us, but its simulation instantiated by the MM enables us to experience the other as experiencing emotions or sensations we know from the inside, as it were.

EMBODIED SIMULATION AND THE EMPATHIC BODY

The discovery of mirror neurons provides a new, empirically founded notion of intersubjectivity connoted first and foremost as intercorporeality—the mutual resonance of intentionally meaningful sensorimotor behaviors. Our understanding of others as intentional agents does not *exclusively* depend on propositional competence, but also on the relational nature of action. In many situations we can directly understand the meaning of other people's basic actions thanks to the motor equivalence between what others do and what we *can* do. Intercorporeality thus becomes the main source of knowledge we have of others. Motor simulation instantiated by neurons endowed with "mirror properties" is probably the neural correlate of this human faculty, describable in functional terms as "embodied simulation."[9]

The multiple MMs present in our brain, thanks to the "intentional attunement" they generate, allow us to recognize others as other selves, allowing basic forms of intersubjective communication and mutual implicit understanding.[10] Embodied simulation provides a unified theoretical framework for all of these phenomena. It proposes that our social interactions become meaningful by means of reusing our own mental states or processes in functionally attributing them to others. In this context, simulation is conceived as a nonconscious, prereflective functional mechanism of the brain-body system, whose function is to model objects, agents, and events. This mechanism can be triggered during our interactions with others, since it is being plastically modulated by contextual, cognitive, and personal identity-related factors.

Embodied simulation is also triggered during the experience of spatiality around our body and during the contemplation of objects. The functional architecture of embodied simulation seems to constitute a basic characteristic of our brain, making possible our rich and diversified experiences of space, objects, and other individuals, and is the basis of our capacity to empathize with them.

Taken together, the results summarized thus far suggest that empathy—or, at the very least, many of its bodily qualities—might be underpinned by embodied simulation mechanisms. According to our proposal, empathy is the outcome of the natural tendency to experience our interpersonal relations fundamentally at the implicit level of intercorporeality: that is, at the level of the mutual resonance of intentionally meaningful sensory-motor behaviors.

It is perhaps worth emphasizing that embodied simulation not only connects us to others, it connects us to *our* world—a world populated by natural and man-made objects, with or without a symbolic nature, and with other individuals: a world in which, most of the time, we feel at home. The sense we attribute to *our* lived experience of the world is grounded in the affect-laden relational quality of *our* body's action potentialities, enabled by the way they are mapped in *our* brains.

EMPATHY, EMBODIED SIMULATION, AND AESTHETIC EXPERIENCE

The idea that the body might play an important role in the aesthetic experience of visual art is quite old. The notion of empathy (*Einfühlung*) was originally introduced to aesthetics in 1873 by the German philosopher Robert Vischer, well before its use in psychology. Vischer described *Einfühlung*, literally "feeling-in," as the physical response generated by the observation of forms within paintings. Particular visual forms arouse particular responsive feelings, depending on the conformity of those forms to the design and function of the muscles in the body, from our eyes to our limbs and to our bodily posture as a whole. Vischer clearly distinguished a passive notion of vision—*seeing*—from the active one of *looking*. According to Vischer, *looking* best characterizes our aesthetic experience when perceiving images, in general, and works of art, in particular.

Aesthetic experience implies an empathic involvement encompassing a series of bodily reactions of the beholder. In his book *On the Optical Sense of Form*, Vischer wrote: "We can often observe in ourselves the curious fact that a visual stimulus is experienced not so much with our eyes as with a different sense in another part of our body. ... The whole body is involved; the entire physical being [*Leibmensch*] is moved. ... Thus each emphatic sensation ultimately leads to a strengthening or a weakening of the general vital sensation [*allgemeine Vitalempfindung*]."[11]

Vischer posits that symbolic forms acquire their meaning predominantly because of their intrinsic anthropomorphic content. Through the nonconscious projection of her/his body, the beholder establishes an intimate relation with the artwork.

Developing Vischer's ideas further, Heinrich Wölfflin speculated on the ways in which observation of specific architectural forms engages the beholder's bodily responses.[12] Shortly afterward, Theodor Lipps discussed the relationship between space and geometry on the one hand, and aesthetic enjoyment on the other.[13]

The work of Vischer exerted an important influence over two other German scholars whose contributions are highly relevant for our proposal: Adolf von Hildebrand and Aby Warburg. In 1893, the German sculptor Hildebrand published a book entitled *The Problem of Form in Figurative Art*. In this book Hildebrand proposed that our perception of the spatial characters of images is the result of a constructive sensory-motor process. Space, according to Hildebrand, does not constitute an a priori of experience, as suggested by Kant, but is itself a product of experience. That is to say, artistic images are effective because they are the outcome of both the artist's creative production and the effect that the images elicit in the beholder. The aesthetic value of works of art resides in their potential to establish a link between the intentional creative acts of the artist and the reconstruction of those acts by the beholder. In this way, creation and artistic fruition are directly related. To understand an artistic image, according to Hildebrand, means implicitly grasping its creative process.

A further interesting and very modern aspect of Hildebrand's proposal concerns the relevance he assigns to the motor nature of experience. Through movement, the available elements in space can be connected; objects can be carved out of their background and perceived as such. Through movement, representations and meaning can be formed and articulated. Ultimately, according to Hildebrand, sensible experience is possible, and images acquire their meaning only because of the acting body.

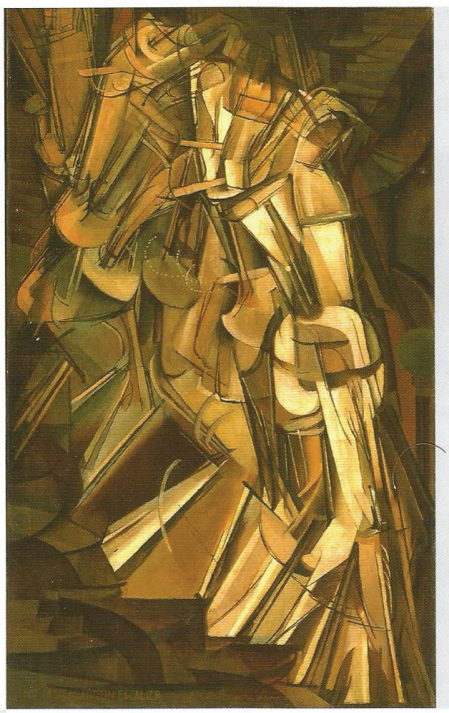
Hildebrand strongly influenced another famous German scholar, Aby Warburg. From 1888 to 1889 Warburg studied in Florence at the Kunsthistorisches Institut, founded by the art historian August Schmarsow. As Didi-Huberman emphasizes, Schmarsow (1853–1936) was determined to open art history to the contributions of anthropology, physiology, and psychology, and emphasized the role of body gestures in visual art, arguing that bodily empathy greatly contributes to the appreciation of visual arts.[14] As Andrea Pinotti writes, Schmarsow, "art historian and theoretician, centered his reflections, which exploited both the results of the theories of empathy and the analyses of the formal character of art works, on the idea of the transcendental function of corporeality as a constellation of material a priori, that is, on the idea of bodily organization as the condition of the possibility of sensory experience."[15]

Warburg clearly learned this lesson, as he conceived art history as a tool that would enable a deeper understanding of the psychology of human expressive power. His famous notion of a "pathemic form" (*Pathosformel*) of expression implies that a variety of bodily postures, gestures, and actions can be constantly detected in art history, from classical art

8.2 Laocoön and his sons. Vatican Museum, Rome.

to the Renaissance period, just because they embody, in an exemplary fashion, the aesthetic act of empathy as one of the main creative sources of artistic style. According to Warburg, a theory of artistic style must be conceived as a "pragmatic science of expression" (*pragmatische Ausdruckskunde*).

Warburg, writing about the classic marble group known as the *Laocoön*, identified transition as a fundamental element that turns a static image into one charged with movement and pathos. Years later, the Russian movie director Sergei Eisenstein, commenting on the same *Laocoön* sculpture in 1935, wrote that the lived expression of human sufferance portrayed in this masterpiece of classical art is accomplished by means of the illusion of movement.[16] Movement illusion is accomplished by means of a particular



8.3 Marcel Duchamp, *Nude Descending a Staircase (No. 2)*, 1912. Oil on canvas. The Philadelphia Museum of Art.

montage, condensing in one single image different aspects of expressive bodily movements that could not possibly be visible at the same time. A similar effect can be appreciated in Duchamp's *Nude Descending a Staircase*.

Maurice Merleau-Ponty further highlighted the relationship between embodiment and aesthetic experience by suggesting the relevance for art appreciation of the felt bodily imitation of what is seen in the artwork.[17] Consistent with the role of *Einfühlung*, Merleau-Ponty also emphasized the importance of the artist's implied actions for the aesthetic experience of the beholder, taking as his example the paintings of Cézanne, when he famously stated that we cannot possibly imagine how a mind could paint.[18]

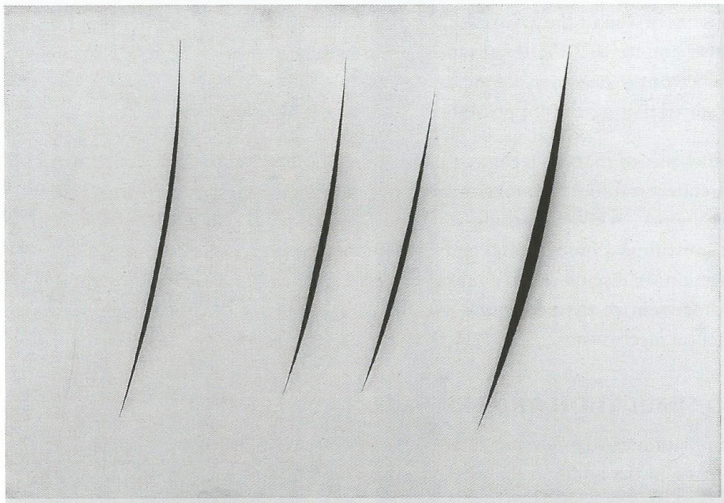
These scholars believed that the feeling of physical involvement with a painting, a sculpture, or an architectural form provokes a sense of imitating the motion or action seen or implied in the work, while enhancing our emotional responses to it. Thus, physical involvement constitutes a fundamental ingredient of our aesthetic experience of artworks. In the next section we discuss recent empirical evidence confirming bodily empathy as an important component of the perceptual experience of works of art, demonstrating its underlying neural mechanisms.

EMBODIED SIMULATION AND EXPERIMENTAL AESTHETICS

Embodied simulation can be relevant to aesthetic experience in at least two ways. First, because we relate to the bodily feelings triggered by works of art by means of the MMs they evoke. In this way, embodied simulation generates the peculiar "seeing-as" that characterizes our aesthetic experience of the images we look at. Second, the potentially intimate relationship between the symbol-making gesture and its eventual reception by beholders is enabled through the motor representation that produced the image by means of simulation.[19] When I look at a graphic sign, I unconsciously simulate the gesture that produced it.

Our scientific investigation of experimental aesthetics applied to visual arts began with this second aspect. In three distinct experiments, we investigated, by means of high-density electroencephalography (EEG), the link between the expressive gestures of the hand and the images produced by those gestures. We recorded beholders' brain responses to graphic signs like letters, ideograms, and scribbles, or to abstract art works by Lucio Fontana and Franz Kline.

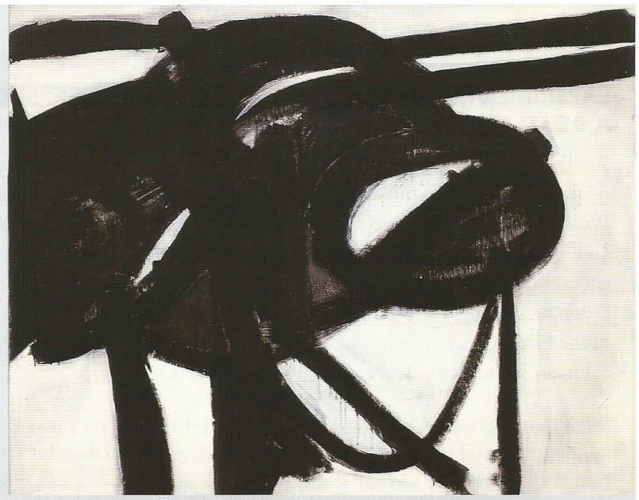
The results of the first study showed that observing a letter of the Roman alphabet, a Chinese ideogram, or a meaningless scribble, all written by hand, activated the hand motor representation of beholders.[20] In the two other studies we demonstrated that a similar motor simulation of hand gestures is evoked when beholding a cut on canvas by Lucio Fontana,[21] or the dynamic brushstrokes on canvas by Franz Kline.[22]



8.4 Lucio Fontana, *Spatial Concept #2*, 1960. Oil on canvas. The Philadelphia Museum of Art.

The visible traces of the creative gesture activated the specific motor areas that control the execution of that same gesture in the observer. Beholders' eyes not only capture information about the shape, direction, and texture of the cuts or strokes, by means of embodied simulation, they emulate the actual motor expression the artist used when creating the artwork. The sensory-motor component of our image perception, together with the jointly evoked emotional reaction, allows beholders to feel the artwork in an embodied manner.

A possible criticism of this model might point to the apparent passivity of this account of aesthetic experience, in which beholders are relegated to a deterministic empathic receptivity, hence losing sight of the peculiar individual quality of aesthetic experience that is largely determined by one's individual taste, background, memories, education, and expertise.



8.5 Franz Kline, *Chief*, 1950. Oil on canvas. The Museum of Modern Art, New York.

A second objection frequently raised against empathic-mimetic accounts of aesthetic experience consists of opposing the ambiguity and indeterminacy of art's symbolic content to the supposedly mechanistic quality of empathic responses, hence falling short of capturing the potential intrinsic ambiguity and polysemic quality of works of art.

We think it is possible to counter these criticisms by arguing that there is ample evidence that MMs and embodied simulation are dynamically modulated, and affected by contingent and idiosyncratic factors. Several studies have shown that one's previous experiences, memories, and expertise strongly determine the intensity of activation of MMs and the ensuing perceptual contents.[23]

We posit that embodied simulation, by virtue of its diachronic plasticity and modulation, might be also the vehicle for the projective qualities of our aesthetic experience—where our personal and social identity literally shape the way we relate to a given perceptual object. Embodied simulation, if conceived of as the dynamic instantiation of our implicit memories, can relate the perceptual object and beholder to a specific, unique, and historically determined quality. This projective quality of embodied simulation refutes both objections.

EXPERIMENTAL AESTHETICS AND ARCHITECTURE: SUGGESTIONS FOR A ROAD MAP

We have already referred to Heinrich Wölfflin as one of the earliest proponents of the relationship between our bodily nature and our experience of architecture. According to Wölfflin, if we were merely visual creatures, the aesthetic appreciation of works of art and architecture would be precluded. The very nature of our body allows us to experience gravity, force, and pressure, and thus makes the enjoyment of contemplating a Doric temple, or the feeling of being elevated when entering a Gothic cathedral, possible in the first place. Furthermore, we offered a concise account of why the available empirical neuroscientific evidence seems to support this view.

We can now empirically test this view by recording the brain and bodily responses of volunteers perceptually experiencing and exploring virtual architectonic environments by means of immersive virtual reality. Today, virtual caves can reproduce high-accuracy, three-dimensional and richly dimensioned digital versions of temples, squares, churches, and buildings in which individuals can not only enjoy a vivid and realistic experience but may also virtually explore as if they are moving around, directing their gaze at different details and spatial locations. The ecological plausibility of such virtual experience can be established in the absence of any active movement on the part of beholders, making these ideal conditions in which to record brain signals and autonomic bodily responses, thereby minimizing movement-driven artifacts and signal noise.

This experimental approach could enable us to empirically address important aspects of architectural history, like the evolution of architectonic style, by charting its potential biological bodily roots. The same approach could also shed light on the plausibility of hypotheses about the supposed biomorphic and /or anthropomorphic origin of architectonic elements and decorations.[24] A second possible application of this approach to architecture deals with the relationship between architectural spaces and the way they are experienced by the people living and working in them.

Juhani Pallasmaa has criticized Western culture's excessive "oculocentrism," the overriding tendency that assigns a cognitive privilege to vision. With the invention of perspective, the eye becomes at once the center of the perceptual world and the center of the subject perceiving that world.[25] According to Pallasmaa, the scopic regime instantiated by visual perspective exemplifies the disembodied nature of the Cartesian subject, whose solipsism segregates the mind from the body, the subject from the object, and the I from the Thou. Such a "purovisibilist" attitude deeply influenced contemporary architecture by predominantly adhering, according to Pallasmaa, to a purely formalist perspective; as a consequence it has lost contact with the very people for whom the architectural project was originally intended.

As Sarah Robinson comprehensively reviews the body schema earlier in this book, she writes: "peripersonal space describes the space immediately surrounding our bodies; extrapersonal space refers to the space just beyond the peripersonal."[26] The constant weighting of architectonic and peripersonal space is mainly processed by premotor neurons mapping visual space on potential action or motor schemata. Furthermore, MMs for action are modulated by proxemics, as the potentiality for interactions between agent and observer measured by the distance separating them can affect the intensity of the discharge of mirror neurons in the beholder's brain.[27]

As the experience of the built environment and its affordances is shaped through the precognitive activation of motor simulations, the role of embodied simulation in architectural experience becomes even more interesting if one considers emotions and sensations. A typical and recurring experience in everyday life is reacting with positive or negative feelings upon opening a door and going, for the first time, into a new architectural environment. Though, as Harry Mallgrave notes, to date little, if any, neuroimaging research has been done on the emotional experience of architectural environments.[28] The same applies to the haptic qualities of materials employed to design exterior and interior parts of architectonic spaces whose multimodal impact and desirability could be easily measured.

The knowledge acquired through experimental aesthetics might provide new insights, just to mention the most obvious ones, for the future design of office spaces or retail stores. Both are usually designed with strict and short deadlines by architectural firms specialized and routinized in this building typology. Such firms frequently need new fit-outs and refurbishments to stay ahead of challenging competitors.

The open office was originally conceived in the 1950s in Germany as *Bürolandschaft*, or office landscape, to facilitate communication and idea flow, and has since seen a dramatic growth in use (70 percent of all offices now have an open floor plan) as well as increasing levels of frustration in the employees who work in such environments. While proxemics contributed to more effective distribution of employees in open office layouts,

8.6 Office interior of Lombardini 22, DEGW Milano.

a neuroscientific approach to the study of peripersonal space could help architects shape working environments that ultimately promote employees' well-being and productivity.

As recently shown by architect Isabella Pasqualini, neuroscientist Olaf Blanke, and colleagues, "investigating bodily feelings, self-identification and self-location with respect to the architectonic unity or form and space of the observer may be confronted with architecture as an extension of the bodily volume."[29] According to this study, the experience of a narrow room increases the somatosensory sensation of verticality, "thus enhancing bodily stability," while conversely, a large room elicits "a destabilizing effect for the missing cue in peripersonal space provoking an illusory backwards movement."[30]

It is interesting to emphasize that these results prove to be coherent with Schmarsow's notion of space "from within." According to Schmarsow, "every spatial creation is first and foremost the enclosing of a subject."[31] Indeed, the motor system is also responsible for the phenomenal awareness of the body's relations with the environment. We are planning to study how daily actions or social interactions virtually presented within differently designed architectonic spaces are experienced differently by beholders. We will also study if and how such different experiences correlate with different profiles of bodily and brain responses.

CONCLUSIONS

Even if the notions of embodiment and empathy within the architectural field are much older than cognitive neuroscience itself, the latter is shedding new light on a topic that is otherwise dismissed or neglected by mainstream theory. The theory of empathy began to have an impact within the contemporary architectural field—as Harry Mallgrave insightfully described—in the "Garden City" of Hellerau, an experiment by Wolf Dohrn on the outskirts of Dresden in 1908–1914; in the Bauhaus in 1919–1933; and in Richard Neutra's book *Survival through Design* in 1954. Architects and architectural scholars such as Juhani Pallasmaa, Steven Holl, Alberto Pérez-Gómez, and Harry Mallgrave have revitalized and brought the topic of empathy back into contemporary discourse, some of them in this volume.

Architecture is among the fruits of the new way in which humans, at a given point in their cultural evolution, were able to relate to the external world. The material world was no longer exclusively considered to be a domain to exploit for the utilitarian satisfaction of biological needs. Material objects lost their unique status as tools to become symbols, public epiphanies able to make something that is absent visible—to make tangible something that apparently is present only in the mind of the creator and the beholder. Humans, thanks to the expression of their symbolic creativity, acquired the capacity to give shape to material objects, conferring on them the meaning they intrinsically lack. Such meaning is the outcome of the creator's action of collectively building a temple or a cathedral, laying colors on a canvas, or turning a marble block into a *David* or a *Rape of Proserpina*.

Today, cognitive neuroscience can reveal—from its own peculiar perspective and methodology—the aesthetic quality of human nature and our natural creative inclination. This new research will help us to understand how and why art and architecture are among the most fundamental expressions of our human nature.

NOTES

Many of the ideas and proposals presented in this chapter were published in a slightly different form in these recent papers: V. Gallese and C. Di Dio, "Neuroesthetics: The Body in Aesthetic Experience," in V. Ramachandran et al., *Encyclopedia of Human Behavior*, 2nd edn. (Amsterdam: Elsevier, 2012), vol. 2, 687–693; V. Gallese, "Bodily Selves in Relation: Embodied Simulation as Second-Person Perspective on Intersubjectivity," *Philosophical Transactions of the Royal Society B* 369 (2014): 20130177; V. Gallese, "The Hand and the Architect: Gesture and Creative Expression," in *Unplugged: Projects of L22 and DGW Italy* (Milan: L22, 2014), 14–17; V. Gallese, "Arte, corpo, cervello: Per un'estetica sperimentale," *Micromega* 2 (2014): 49–67.

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1. Architectural space “from within” The body, the space and the brain

Gallese, V., and Gattara, A. Architectural space “from within.” The body, the space and the brain. Abstract accepted. Manuscript in preparation.

Call for participation - Frontiers in Psychology, section Cognitive Science

Research Topic: Embodied space and bodily self-consciousness in art and architecture

Architectural space "from within". The body, the space and the brain.

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In this article the notion of "embodied space" is addressed within the broader notion of "embodied simulation", discussing some recently discovered multimodal properties of the motor system relevant to an embodied account of the architectural space around us. The same motor circuits that control the motor behavior of individuals’ bodies also map the space around them, and the objects at hand in that very same space with their shape, size, orientation and distance from the perceiver, thus defining and shaping in motor terms their representational content. The space around us is thus defined by the motor potentialities and confinements of our body, meaning also that perception always requires action.

We also show that the notion of architectural space "from within", although unitary when examined introspectively, is not represented in the brain as a single multipurpose map. Different and parallel parieto-premotor cortical networks create internal representations of bodily actions. These representations, mapped in bodily format, not only enable our navigation in space, but also contribute to shape how we represent the world we live in and the objects it contains. The implications for architecture are discussed.

CHAPTER 8
ITALIAN ABSTRACT

A brief summary of the dissertation in Italian

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1. Obiettivi della ricerca

L'attività di ricerca si è prefissata due specifici obiettivi. Il primo riguarda la descrizione della reazione empatica agli spazi architettonici. Il secondo riguarda la definizione della nozione di simulazione incarnata e le sue implicazioni per la progettazione architettonica. Anche se alcune posizioni teoriche nel campo dell'architettura oggi guardano alle neuroscienze cognitive per migliorare la qualità degli ambienti costruiti - siano essi un edificio o una città - la ricerca ora conclusa ha seguito un fine descrittivo e non prescrittivo. La ricerca si è svolta come un tentativo di descrivere la relazione reciproca tra gli edifici ed i loro utenti attingendo e facendo riferimento ad una letteratura basata su evidenze empiriche.

Un ulteriore fine della ricerca è stato quello di fornire la disciplina architettonica delle dimostrazioni scientifiche di alcune teorie e posizioni architettoniche tradizionalmente formulate come discorsi filosofici. Infine la tesi ha avuto lo scopo di promuovere un dialogo e un confronto tra discipline apparentemente diverse che possa eventualmente portare ad un linguaggio ed a un dibattito condiviso.

E' stato ritenuto necessario limitare l'indagine agli spazi per uffici per due fondamentali ragioni. La prima è che il numero di variabili fisiche è limitata, soprattutto per quanto riguarda le configurazioni spaziali interne. La seconda è per la sua natura performativa che implica la descrizione e la misura. Gli spazi per uffici sono stati sistematicamente studiati e analizzati a partire dall'inizio del XX secolo, e un'ampia letteratura è stata accumulata oltre che nelle discipline architettoniche anche nelle scienze gestionali e sociali. Per questi motivi è stato ritenuto un caso di studio ideale per la misurazione della risposta empatica di ambienti architettonici.

La ricerca si è basata su una impostazione teorica fondata su evidenze empiriche proposte nelle discipline dell'architettura, della cognizione spaziale e delle neuroscienze cognitive.

2. Parte prima

La prima parte della ricerca ha definito la nozione di reazione empatica agli spazi architettonici attraverso la descrizione, comparazione ed interpretazione delle principali teorie e posizioni teoriche. Queste sono state raccolte in tre diverse categorie, ognuna rappresentativa del contemporaneo dibattito architettonico e filosofico. A partire dalla moderna definizione di spazio architettonico elaborata da alcuni studiosi tedeschi alla fine del XIX secolo, sono state successivamente considerate la nozione di lived space elaborata da Maurice Merleau-Ponty e l'influenza che questa ha avuto sul dibattito architettonico, e la più recente nozione di embodied space ripresa anche dalle neuroscienze cognitive. La prima parte si è conclusa con l'interpretazione di queste definizioni e con una originale definizione della questione.

3. Parte seconda

La seconda parte della ricerca ha descritto l'evoluzione tipologica degli spazi per uffici degli interni aziendali attraverso la descrizione, comparazione ed interpretazione dei più rappresentativi modelli ed esempi in Europa e in Nord America. Questi sono stati raccolti secondo le tre diverse tipologie che hanno caratterizzato la configurazione di questi spazi nella storia moderna. A partire dal modello dell'ufficio tayloristico proposto alla fine del XX secolo a Chicago e a New York da architetti come Louis Sullivan e Frank Lloyd Wright, sono state poi considerate e comparate due delle sue principali variazioni, ovvero il Bürolandschaft proposto dal Quickborner Team in Germania e da Frank Duffy nel Regno Unito e in Nord America a partire dagli anni Sessanta, e il cosiddetto Office Playground, di cui sono stati descritti alcuni esempi americani a partire dagli anni Settanta. La seconda parte si è conclusa con alcune valutazioni comparative dei modelli e dei casi di studio esaminati.

4. Parte terza

La terza parte della ricerca ha raccolto una serie di considerazioni e di implicazioni per la progettazione degli spazi per uffici e ha proposto alcuni punti certi per l'avvio di una discussione generale dei risultati. In particolare sono stati verificati i principali obiettivi che la ricerca si era prefissata, ovvero la descrizione della reazione empatica agli spazi architettonici e la definizione della nozione di simulazione incarnata e le sue implicazioni per la progettazione architettonica. Sono stati descritti con molta cura anche i basilari meccanismi fisiologici cosiddetti "mirror" che definiscono la percezione dell'articolata configurazione degli spazi per uffici e sono state discusse alcune implicazioni per le discipline che si occupano degli interni aziendali. La terza parte si conclude con la discussione di alcune considerazioni generali su importanti questioni rimaste aperte, quali il rapporto tra biologia e cultura e un necessario aggiornamento della definizione di architettura, intesa come ponte tra arte e scienza.

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