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ISABELLA PASQUALINI / OLAF BLANKE

The self-conscious observer: embodiment and bodily feelings in architecture

I.

The notion of embodiment in architecture – coexisting with more or less rational, political and religious conceptions of architectonic space, has been a matter of debate since the *Ten Books of Architecture* by Vitruvius.[1] This ancient Roman architect assumed that sensations are stimulated by smallest image-particles sent off from the atoms of matter and intercepted by the atoms of the soul, thereby shaping human sensations through physical matter.[2] The Vitruvian idea of embodiment has been linked to different bodily experiences resulting from architectonic perception, or to the observer's bodily feelings and impressions conferred by the architectonic encounter. This can be traced through the extensive involvement with the Vitruvian idea during the Quattrocento,[3] during the 17th and 18th centuries debate about classical models versus modern scientific practices in architecture,[4] and, through the influence of empiricism in the late 19th century. The *Vitruvian man* (Figure 1) illustrates how the Vitruvian project has been received during the Quattrocento, namely as a vividly experienced contingency between architectonic geometry and bodily proportion.[5] Such propositions were extended via a more mathematical conception of architecture by the introduction of linear perspective,[6] requiring a new degree of abstraction in the artistic process that was by then

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1 See Marcus Pollius Vitruvius: De Architectura Libri Decem (Zehn Bücher über Architektur) [ca. 30 BC]. Darmstadt 2008.

2 See ibid. and Johannes Hirschberger: Geschichte der Philosophie-Altertum und Mittelalter. Vol. 1. Freiburg 1976.

3 See Leon Battista Alberti: De re aedificatoria (On the Art of Building in Ten Books) [1450]. Cambridge 1988.

4 See Claude Perrault: Ordonnance des cinq espèces de colonnes selon la méthode des anciens (Ordonnance for the five kinds of Columns after the Method of the Ancients) [1683]. Santa Monica 1993.

5 See Rudolf Wittkower: The centrally planned church and the Renaissance. In: Architectural Principles in the Age of Humanism [1962]. London 1971, pp. 1–32.

6 See David C. Lindberg: Alhazen's Theory of Vision and Its Reception in the West. In: Isis, 58 (1967), pp. 321–341 and Antonio di Tuccio Manetti: The Life of Brunelleschi [ca. 1480]. University Park, PA 1970.

focused on the application of classical patterns.[7] Against this novel background – consisting of mathematics, physics, and optics – architectonic proportions were conceived as the geometric expression of embodiment empowered through a unified viewpoint. By the end of the 17th century the extensive visitation of the Vitruvian text presented the scientific approach as the conceptual framework of architectural practice, with the intention to replace a sometimes still literal application of classical models.[8]

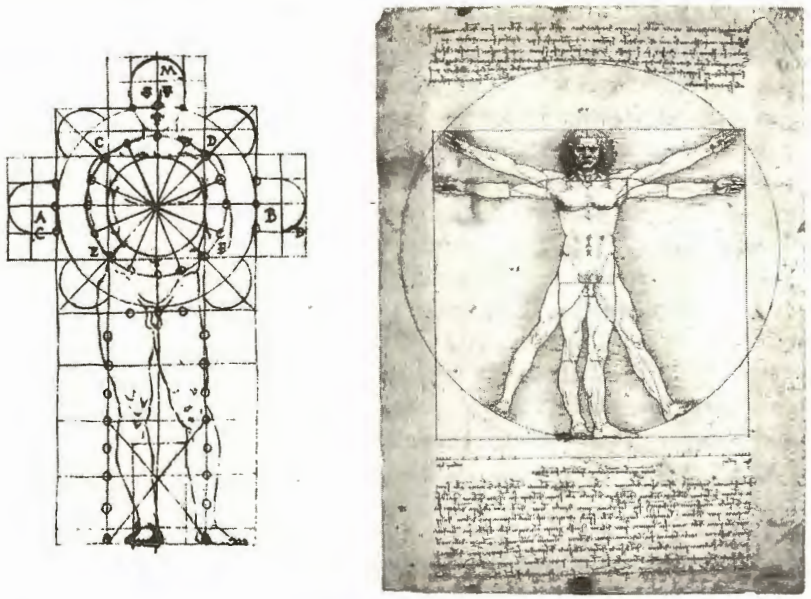


Figure 1: Vitruvian man, Francesco di Giorgio Martini, 15th Century and Vitruvian man, Leonardo da Vinci, ca. 1490. Two different concepts of architectonic space are merged: verticality and modularity.

Interpretations of the Vitruvian proposition by 19th century theoreticians and architects emphasized contemporary scientific findings in human psychology and physiology,[9] as well as anthropology. In *Style in the Technical and Tectonic Arts; or, Practical Aesthetics*, for example, Gottfried Semper concluded on the distinction between the fortified wall – *Mauer*, and the screen – *Wand*.[10] To him these elements seemed to involve distinct crafting and inhabitation modes since primordial times, generating specific connotations in the perception of interior and exterior space. In this context the wall referred to stereotomy – the art of shaping solids with ceramic materials (Figure 2), and the screen to tectonics – light timber frames combined to textile weavings (Figure 3). Semper's analogy between the screen – *Wand*, and clothing – *Gewand*, points explicitly to the architectonic shell as a transposition or extension of bodily space in architecture. Resuming Gottfried Semper's notion of style from the 1860s onwards, theorists attempted to introduce a connection between embodiment and a unity of style in art. The present text examines notions of embodied space in art and architecture at the end of the 19th century, establishing potential empirical links between the current notions of bodily self-consciousness and architecture based on recent insights into the cognitive neuroscience of embodiment and bodily space representation.

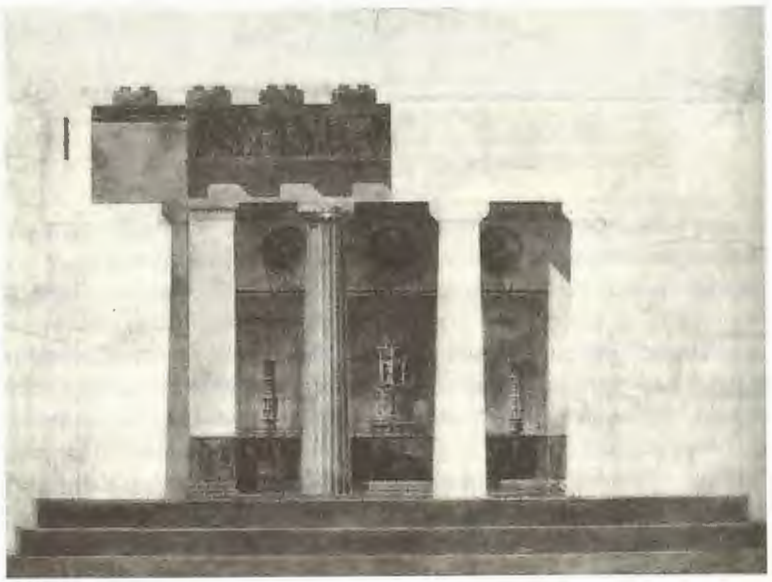


Figure 2: Theseion in Athens, Gottfried Semper, 1832. Scientific methods of investigation suggested new interpretations of the classical ornament, and, in consequence, of ancient theories.

7 See Giulio Carlo Argan: The Architecture of Brunelleschi and the Origins of Perspective Theory in the Fifteenth Century. In: Journal of the Warburg and Courtauld Institutes 9 (1946), pp. 99–121.

8 See Alberto Perez-Gomez: Introduction. In: Harry F. Mallgrave (ed.): Ordonnance des cinq espèces de colonnes selon la méthode des anciens (Ordonnance for the five kinds of Columns after the Method of the Ancients). Santa Monica 1993.

9 See Wilhelm Wundt: Grundzüge der physiologischen Psychologie. Leipzig 1874; Gustav Theodor Fechner: Elemente der Psychophysik. Leipzig 1860 and Hermann von Helmholtz: Handbuch der physiologischen Optik. Leipzig 1867.

10 See Gottfried Semper: Gesammelte Schriften. ed. Henrik Karge. Hildesheim 2008 (Der Stil in den technischen und tektonischen Künsten – oder Praktische Aesthetik [1860]) and G.S.: Style in the Technical and Tectonic Arts; or, Practical Aesthetics [1860]. Los Angeles 2004.

Theories explaining how form could evoke feelings were presented in the philosophical empathy debate starting in the 1870s. Robert Vischer based his theory of sympathetic projection or *Einfühlung* – later known as empathy, on different physiological responses to the environment.[11] Vischer argued that the comprehensive nature of form through symbolic content should be attributed beyond sensitive nervous modifications – a perceptive mechanism that he exemplified with after-images – to the reaction of physiological motor functions, as described by Wilhelm Wundt.[12]

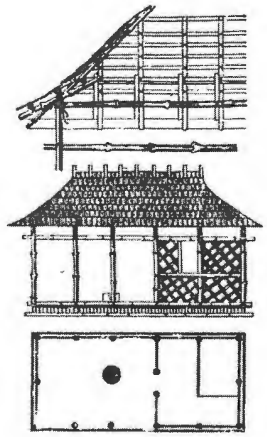


Figure 3: Primordial hut, Gottfried Semper, 1860. It was assumed that crafting techniques had evolved along with a specific sense for the interior space in the primordial shelter.

The observer's *felt* impressions, or, sensations, moods, emotions and passions, were assumed as physiological responses to form, arousing a subjective effect through objective stimuli. Vischer proposed that a „sense of form" was elicited through „optical stimulation" inducing an empathic, embodied resonance of the observer's bodily feelings within the observed form. Vision he defined a „sensory immediate feeling" and empathy a „kinesthetic responsive feeling", further suggesting that the latter was based on a minimal embodiment generated by movements and movement sensations of the eyes and head.[13] This resonant and sympathetic transmission of embodiment from the observer towards the observed object was supposed to generate an emotional affinity with the object's form. The observer was thought to locate herself within the inner structure of the observed stationary object and to thereby re-enact its volume with her body (embodiment) by tracing the object „from its center to the boundaries" (Figure 4).[14] Based on this empathic projection into the form of the object the observer was believed to gain a conscious idea encompassing a symbolic content.

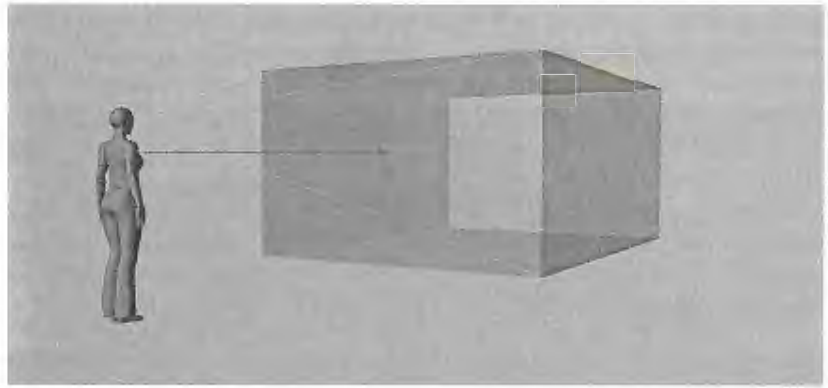


Figure 4: *Einfühlung* or empathy according to Robert Vischer in 1873. The observer reenacts the object from its center to the boundaries.

Along these lines art historian Heinrich Wölfflin argued that „our own bodily organization is the form through which we apprehend everything physical", and, to the question, „How can tectonic forms be expression?" he proposed that „physical forms possess a character only because we ourselves possess a body".[15] By linking empathy to the structural aspects of architecture Wölfflin mentioned verticality – formally opposing gravity, as well as orientation, proportion and symmetry to be crucial mechanisms of „formal self-determination" shared between the body of the observer and the architecture, allowing the perceived forms to resonate within the observer. Wölfflin's interpretation of empathy was based on the physiognomy of the human body that structured the stimuli perceived in the physical environment, seeking a congruence with Wilhelm Wundt's physiological psychology.[16] Wölfflin claimed that the „basic elements of architecture – material, form, gravity and force – are defined by the ex-

[11] See Robert Vischer: Über das optische Formgefühl – ein Beitrag zur Ästhetik. Leipzig 1873 and R.V.: On the optical sense of form: a contribution to aesthetics [1873]. In: Harry F. Mallgrave (ed.): Empathy, Form and Space. Problems in German Aesthetics 1873–1893. Santa Monica 1994, pp. 89–123.

[12] See footnote 9.

[13] See footnote 11.

[14] See ibid.

[15] See Heinrich Wölfflin: Prolegomena zu einer Psychologie der Architektur. München 1886 and H.W.: Prolegomena to a Psychology of Architecture [1886]. In: Harry F. Mallgrave (ed.): Empathy, Form and Space. Problems in German Aesthetics 1873–1893. Santa Monica 1993, pp. 125–148.

[16] See footnote 9.

perience of ourselves",[17] or, the experience of the physical body through associative aspects between observer and observed. While Vischer's notion of empathy proposed the observer's imagined *self-projection* into form, in Wölfflin's physiognomic terms the effects of empathy were inverted, suggesting that embodied perception results from a *resonance* of the architectonic parts within the observer's body through shared formal aspects between the body and the architecture – regardless of the observer's distance and point of view (Figure 5).[18] Notably Wölfflin's observer assumes a position *in front* of the architecture, whereby somatosensory and vestibular analogies – through verticality, symmetry and orientation, are highlighted. Moreover, through shared orientation and proportion perceptual affinities between the observer's body and particular architectonic forms seem to occur. Since an observer can never grasp the entire architecture at once, Wölfflin claimed that architectonic expression emerges from a formal coherence between the particular *tectonic* members and their incorporation into the architectonic whole. With reference to Semper's *Style* „tectonic" refers to a crafted element and was later interpreted as the consequence of a „closed" and structured form.[19]

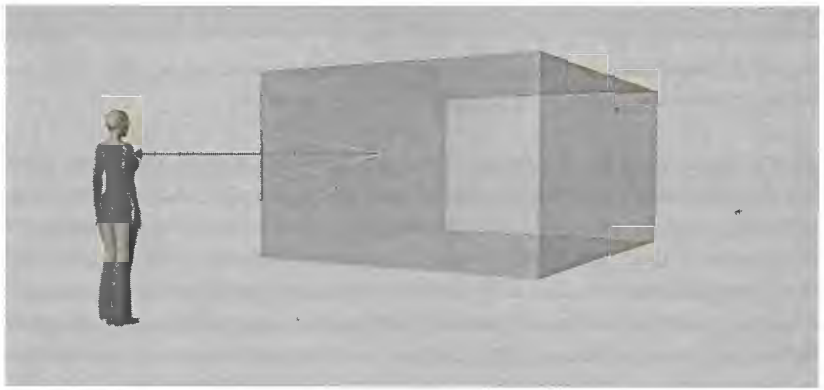


Figure 5: Empathy as interpreted by Heinrich Wölfflin in 1886. The form of the observed object resonates in the observer's body according to its physiognomic affinities.

[17] See footnote 15.

[18] Extramission theory, i.e. the projection of visual rays from the observer to the seen object as an active process, and intromission theory, i.e. the perception of visual rays in the perceptual organs as a passive process, have a long history in optics. (See footnote 30 and David C. Lindberg: Theories of Vision from Al-Kindi to Kepler. Chicago 1976.) In the empathy debate the bodily experience of architecture was reflected through related concepts.

[19] See Heinrich Wölfflin: Geschlossene Form und offene Form [1915]. In: Kunstgeschichtliche Grundbegriffe. Basel 2004, p. 175–180.

In a related example – the AEG Turbinenhalle, massively crafted – *tectonic* – corner pillars symmetrically frame a protruding, sleek – *atectonic* – glass curtain, conferring an expression of weightlessness to the whole structure despite its mass (Figure 6).[20]

Coherent with the Vitruvian tradition and by attributing the expressive power of architecture to the outline and proportion of the tectonic members, Wölfflin noted that effects contrary to the structure of the human body confer bodily discomfort. He proposed that „in our anthropomorphic perception of the object we identify with, it is just as if the symmetry of our own body were disturbed or a limb were mutilated".[21] [22]

Figure 6: AEG Turbinenhalle, Berlin, Peter Behrens, 1909. The massive corner pillars show different tectonic features than the protruding, sleek glass curtain wall. Copyright: Siemens AG©

[20] See Kenneth Frampton: Reflections on the Scope of the Tectonic. In: Studies in Tectonic Culture. The Poetics of Construction in Nineteenth and Twentieth Century Architecture. Cambridge 1995, p. 1–27.

[21] The common phantom limbs after limb amputation show that the somatosensory experience of the bodily limbs persists after loss or removal of the limbs. (See R. Melzack: Phantom limbs and the concept of a neuromatrix. In: Trends in neurosciences 13 (1990), p. 88–92; Peter Brugger et al.: Beyond re-membering: phantom sensations of congenitally absent limbs. In: Proc Natl Acad Sci U S A 97 (2000), p. 6167–6172 and V.S. Ramachandran, W. Hirstein: The perception of phantom limbs. (The D.O. Hebb lecture. In: Brain 121 (1998), p. 1603–1630.))

[22] See footnote 15.

Inspired by contemporary notions of style and empathy August Schmarsow proposed that the human sense of space had its origin in the primordial shelter. By relating architectonic expression to the observer's sense of space or *Raumgefühl*, a bodily sensation generated „from within" space, the distinction of architecture with respect to the other arts, its „essence", should be determined by its most compelling characteristic of expressivity – the interior.[23] According to Schmarsow the genuine architectonic quality of space was therefore to emerge with the observer's embodied experience of the in-between. Crucially, Schmarsow's embodied observer was not in front of the architectonic forms, like in other theories, but occupied the void (Figure 7).[24] In accordance with „the ideal forms of the human intuition of space", the sense of space was described as a self-conscious experience of the architectonic third dimension and was to be generated along the horizontal axis (the visual line) into depth. The vertical line was deemed the dominant coordinate within the axial system of human perception generating the sense of space, yet, for the architectonic void to unfold, „the meridian of our body" was not to be visibly represented.[25]

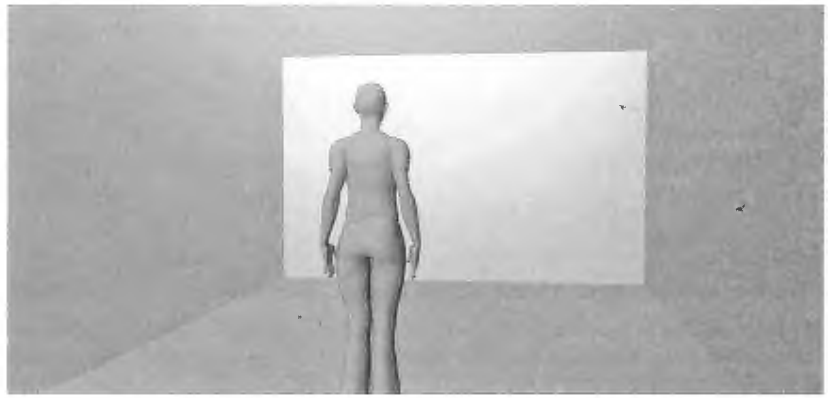


Figure 7: *Raumgefühl* or sense of space according to August Schmarsow in 1893. The observer is oriented towards the architectonic void based on Gottfried Semper's theories.

[23] See August Schmarsow: Das Wesen der architektonischen Schöpfung. Leipzig 1894 (Antrittsvorlesung, gehalten in der Aula der K. Universität Leipzig am 8. November 1893) and A.S.: The Essence of Architectural Creation [1894]. In: Harry F. Mallgrave (ed.): Empathy, Form and Space. Problems in German Aesthetics 1873–1893. Santa Monica 1994, p. 125–148.

[24] See ibid. and August Schmarsow: Grundbegriffe der Kunstwissenschaft [1905]. Berlin 1998.

[25] Ibid.

Rather, it should operate virtually by marking and defining the observer's *viewpoint* and *location* within the void. Such emphasis on a *felt* and not necessarily *seen* vertical axis, was supposed to enhance the bodily contingencies (somatosensory and vestibular) in the observer's response to the architecture. In Schmarsow's „four walls" the observer's sense of space emerges from the sequential evolution of several viewpoints through the interior, whereby the observer's vanishing point is shifted towards the architectonic void. This perception generates a view that is potentially oriented through the three-dimensional effect of the enclosure. By advancing from viewpoint to viewpoint, in Schmarsow's idea, the observer processes an „objectified" notion of architectonic depth by associating visual space with multisensory bodily space. Through this proceeding into the architectonic void Schmarsow's observer remains oriented and beholds a sense of space. Such an embodied perception seems comparable to a sequence of views in first-person, generating an abstract, „objectified" viewpoint in space related to third-person perspective and often described as elevated, distanced and rotated with respect to the observer's position and perspective.[26]

II.

The sculptor Adolf von Hildebrand introduced in our view a further argument supporting the idea of embodiment and empathy in the arts. He described how the shift of the visual focus of perception from objects close to those distant from the observer's body invokes perceptual differences that are relevant for the perception of form in space. He formulated his theory in particular for artists and extended findings that Herrmann von Helmholtz had described in the *Optics*, proposing that ocular mechanisms are crucial for the observer's three-dimensional sensation of depth and the formal comprehension of sculptural works.[27] The adjusting parallax from depth cues of near and far objects – induced by ocular movements, was described to induce an ocular „kinesthetic" effect through minimal movements of eyes and head, inducing a minimal form of embodiment. Hildebrand highlighted changes that could be observed when receding from an object in space: the diminishing eye parallax evokes the effect of a „remote image", since the more distant the object, the flatter it

[26] See ibid.

[27] See Adolf Hildebrand: Das Problem der Form in den bildenden Künsten. Strassburg 1893 and Adolf Hildebrand: The problem of form in the fine arts [1893]. In: Harry F. Mallgrave (ed.): Empathy, Form and Space. Problems in German Aesthetics 1873–1893. Santa Monica 1994, p. 125–148.

becomes.[28] Inversely, in the approaching observer, the near object generates a spatial effect through its „surface image". Objects closer to the body induced active looking through fast saccadic movements and the resulting representations were termed „kinesthetic" rather than visual. Such oculomotor differences supplied the artist with the „material for abstract representation and the representation of three-dimensional form".[29] Far visual and near „kinesthetic" representations were describing the object without intrinsic relation, since the metric dimensions of Euclidean space structure (i.e. sensorimotor, here „kinesthetic" perception) do not coincide precisely with the foreshortening of visual perspective. Noting integrative mechanisms, he wrote that the observer has to „piece the object together, partly from visual and partly from kinesthetic representations".[30] This mechanism was described as automatic and unconscious, as perception needed „just a few clues" to orientate in space. When approaching the artistic form in space the observer was supposed to relate far and close image, since two- and three-dimensional content could only converge into a coherent and integrated form across shifting vantage points of the observer.

Extending notions of far and near space, neuroscientists and psychologists have divided human space into personal space and different extra-personal spatial compartments: personal (or bodily) space has been defined as the part of space that is occupied by the observer's body and extrapersonal space as all space not overlapping with bodily space. The latter encompasses peripersonal (or grasping) space, as the space immediately surrounding the body, and far space, as the spatial compartment beyond seven meters from the subject's body.[31] In this context it was found that the space surrounding the body disposes over a Euclidean structure, while in far (visual) space two-dimensional flatness seems to dominate. How is embodiment in architecture associated with personal, near and far space and moreover with recent notions of own-body processing and bodily self-consciousness? Among others, Rudolf Arnheim, James Gibson and Ernst Gombrich have contributed in the 1970's to this extensive field of research,[32] converging in some aspects on the ideas of Gestalt theory, but also describing a self-conscious observer as suggested in the 19th century. In line with other authors Rudolf Arnheim mentioned the erection of a boundary separating the interior from exterior space as „the

28 Ibid. (english translation).

29 Ibid.

30 Ibid.

31 See Otto-Joachim Grüsser, Theodor Landis: Visual Agnosias and other Disturbances of Visual Perception and Cognition. Vol. 12. London 1991.

32 Ernst H. Gombrich, James J. Gibson, Rudolf Arnheim: Exchange of Letters. In: Leonardo 4 (1971), p. 195–203.

Figure 8: *Liberty Enlightening the World*, The Interior, Frédéric Bartholdi, New York, 1886. Photography by Jet Lowe, courtesy of Library of Congress, HAER, HAER NY, 31-NEYO, 89–220.

primeval architectural act". After a visit to the inside of the Statue of Liberty he wrote (Figure 8):

> Physically the shapes of the outside and the inside of that huge piece of sculpture [...] are identical. Perceptually, however, the inner surface presents a puzzling accumulation of concavities and convexities, without apprehensible meaning and surely without any resemblance to the human body. [...] Perceptually and practically, the worlds of outside and inside are mutually exclusive. [...] And yet, they border directly in each other.[33]

This description of the architectonic experience seems to emphasize an empathic response depending on the perspective of the observer and related to Schmarsow's notions of the observer *within*. Muscular responses were hereby assumed „as secondary reactions to the primary visual dynamics".[34] In contrast, James Gibson argued that human perception was based on the constant interaction between body and environment, excluding the separation of the observer's bodily states from perception.[35] Ernst

33 Rudolf Arnheim: The Dynamics of Architectural Form. Berkeley, Los Angeles 1977, p. 92–101.

34 Ibid.

35 See James J. Gibson: The Senses Considered as Perceptual Systems. Westport 1966 and J.J.G.: The Ecological Approach to Visual Perception. New York 1979.

Gombrich later related such notions of a multisensory, self-conscious observer to the history of art.[36] *Ungapatchket* is an example from contemporary architecture that automatically involves the observer's bodily space by operating with abstract perceptual associations. It displays a fragile and permeable condition of interiority inhabited by *Liberty Enlightening the World* or the statue's body reversed – metaphorically representing the statue's soul (Figure 9). The porosity of the elements and the chapped clay skin rather intend to signal a body of transgression than of intimacy and fragmented reclusion. At the same time it is the architectonic maquette of a grand hotel and the primordial hut in full-scale: the symbol of impetuous liberty and an instrument of spatial dialogue with the observer's body. Beyond its intrinsic artistic value, we argue that *Ungapatchket* illustrates how embodiment theory in architecture is predisposed to be linked to scientific notions of bodily self-consciousness through mechanisms of multisensory own-body processing, highlighting the many interactions between the observer and the environment.

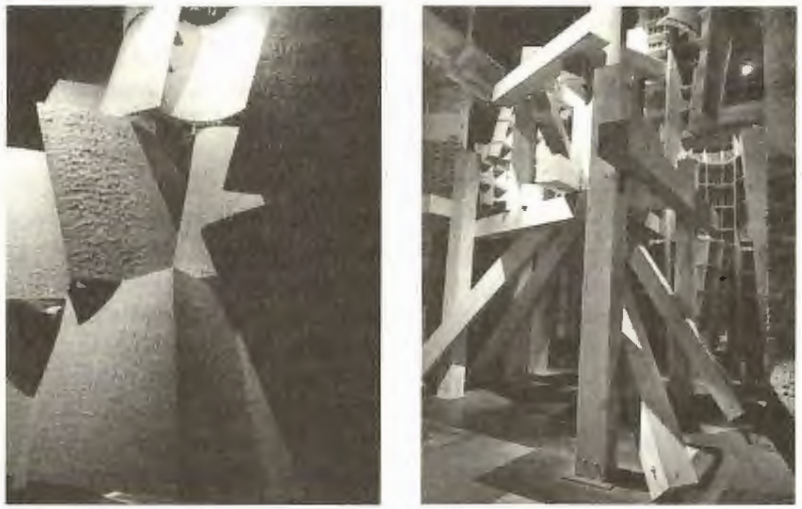


Figure 9: *Ungapatchket*, Frank Gehry, Venice Biennale, 2008
with kind permission by L. Forcucci

[36] See Ernst H. Gombrich: The Story of Art [1950]. New York 2006; E.H.G.: Western Art and the Perception of Space. In: Space in European Art. Council of Europe exhibition in Japan, 28 March – 14 June, 1987. Tokyo 1987, p. 5–12 and E.H.G.: The Psychology of Styles. In: The Sense of Order. A study in the psychology of decorative art [1978]. New York 2006, p. 195–216.

While in the past cognitive neuroscience focused on the investigation of visuo-spatial aspects in the visual arts and studied essentially painting[37] and sculpture,[38] the relation between bodily self-consciousness and the most spatial of arts – architecture, is astonishingly sparse or non-existent. By testing the essence of ancient embodiment theories through contemporary laboratory techniques, such as immersive virtual reality and cognitive neuroscience, former notions from architecture theory may be disclosed to empirical study.

III.

Self-consciousness, a private, first-person phenomenon, has been related to multisensory bodily processes and a mental self.[39] Philosophers defined the feeling of a unitary self and a unified first-person perspective as a main characteristic of self-consciousness.[40] Moreover, recent neuroscientific investigations extended these notions and linked bodily self-consciousness and its three major aspects – self-identification, self-location, and the first-person perspective – to the processing of multisensory own-body signals.[41] Several behavioral correlates of bodily self-consciousness have been studied: self-identification or body ownership, defined as the feeling of owning and identifying with a body;[42] self-location, defined as the ex-

[37] See S. Zeki: Essays on science and society. Artistic creativity and the brain. In: Science 293 (2001), p. 51f; Dahlia Zaidel: Art and brain: insights from neuropsychology, biology and evolution. In: Journal of anatomy 216 (2010), p. 177–183; Margaret Livingstone: Vision and Art. The Biology of Seeing. New York 2002; Olaf Blanke, Isabella Pasqualini: The riddle of style changes in the visual arts after interference with the right brain. In: Frontiers in human neuroscience 5 (2011), p. 154 and O.B.: I and me: self-portraiture in brain damage. In: Front Neurol Neurosci 22 (2007), p. 14–29.

[38] P.W. Halligan, J.C. Marshall: The art of visual neglect. In: Lancet 350 (1997), p. 139f.

[39] See A. Damasio: Mental self: The person within. In: Nature 423 (2003), p. 227.

[40] See Dan Zahavi: Subjectivity and Selfhood: Investigating the First-Person Perspective. Cambridge 2008.

[41] See Olaf Blanke, Thomas Metzinger: Full-body illusions and minimal phenomenal selfhood. In: Trends Cogn Sci 13 (2009), p. 7–13.

[42] See Olaf Blanke, T. Landis, L. Spinelli, M. Seeck: Out-of-body experience and autoscopy of neurological origin. In: Brain 127 (2004), p. 243–258; M. Tsakiris, M.D. Hesse, C. Boy, P. Haggard, G.R. Fink: Neural signatures of body ownership: a sensory network for bodily self-consciousness. In: Cereb Cortex 17 (2007), p. 2235–2244 and R. Salomon, M. van Elk, J.E. Aspell, Olaf Blanke: I feel who I see: visual body identity affects visual-tactile integration in peripersonal space. In: Conscious Cogn 21 (2012), p. 1355–1364.

perience to be located at a specific position in space;[43] and, first-person-perspective (1PP), defined as the subjective experience of perceiving the world from a specific location and direction.[44]

Visuo-tactile mechanisms in own-body processing have been investigated in a simple and fascinating illusion called the Rubber-Hand-Illusion (RHI) that elicits the experience in participants of feeling hand ownership for a hand that is not their own.[45] In the RHI participants view a (single left or right) rubber hand in front of them that is stroked synchronously with their corresponding own hidden hand. This manipulation causes the rubber hand to be self-attributed and to „feel as if it were the subject's own hand", suggesting visual capture of touch and visuo-tactile correlation to be a crucial component for the self-attribution of our limbs (with asynchronous stroking self-attribution of the rubber hand was suppressed).[46] The artificially induced ownership for the fake hand is usually accompanied by a recalibration of the subject's hand position, i.e. there is a shift in the experienced location of the real hand towards the rubber hand. This recalibration indicates that low-level and multisensory body representations are highly plastic and constantly updated.[47] Further studies of the RHI quantified automatic fear response when threatening the rubber hand[48] and found a modulation of temperature homeostatic control (i.e. cooling of the physical stimulated hand during the rubber hand illusion).[49] The extension of illusory hand-ownership to non-hand objects could also be observed.[50] Increased illusory hand ownership through vestibular stimulation was reported to depend on a vestibular interference with visuo-tactile mechanisms.[51]

Bodily self-consciousness of the entire body was studied in healthy participants by adapting the RHI to the full body (Full-Body-Illusion, FBI).[52] The experimental setup of the FBI was inspired by autoscopic phenomena of neurological origin including the Out-of-Body-Experience (OBE).[53] During an OBE patients experience disembodiment and the disruption of the spatial unity between body and self, or abnormal self-location, while the environment and the physical body are perceived from an embodied perspective (first-person perspective, 1PP), but from an ele-

43 See Olaf Blanke et al.: Linking out-of-body experience and self processing to mental own-body imagery at the temporoparietal junction. In: J Neurosci 25 (2005), p. 550–557 and S. Arzy, G. Thut, C. Mohr, C.M. Michel, Olaf Blanke: Neural basis of embodiment: distinct contributions of temporoparietal junction and extrastriate body area. In: J Neurosci 26 (2006), p. 8074–8081.

44 See P. Ruby, J. Decety: Effect of subjective perspective taking during simulation of action: a PET investigation of agency. In: Nat Neurosci 4 (2001), p. 546–550.

45 See M. Botvinick, J. Cohen: Rubber hands ‚feel' touch that eyes see. In: Nature 391 (1998), p. 756; H.H. Ehrsson, C. Spence, R.E. Passingham: That's my hand! Activity in premotor cortex reflects feeling of ownership of a limb. In: Science 305 (2004), p. 875–877; H.H. Ehrsson, N.P. Holmes, R.E. Passingham: Touching a rubber hand: feeling of body ownership is associated with activity in multisensory brain areas. In: J Neurosci 25 (2005), p. 10564–10573 and M. Tsakiris, P. Haggard: The rubber hand illusion revisited: visuotactile integration and self-attribution. In: J Exp Psychol Hum Percept Perform 31 (2005), p. 80–91.

46 See Tsakiris et al. (footnote 43) and F. Pavani, C. Spence, J. Driver: Visual capture of touch: out-of-the-body experiences with rubber gloves. In: Psychol Sci 11 (2000), p. 353–359.

47 See M.P. Kammers, F. de Vignemont, L. Verhagen, H.C. Dijkerman: The rubber hand illusion in action. In: Neuropsychologia 47 (2009), p. 204–211; M.R. Longo, F. Schuur, M.P. Kammers, M. Tsakiris, P. Haggard: What is embodiment? A psychometric approach. In: Cognition 107 (2008), p. 978–998; A. Serino, P. Haggard: Touch and the body. In: Neuroscience and biobehavioral reviews 34 (2010), p. 224–236 and P. Haggard, M. Taylor-Clarke, S. Kennett: Tactile perception, cortical representation and the bodily self. In: Current biology 13 (2003), p. R170–173.

48 See K.C. Armel, V.S. Ramachandran: Projecting sensations to external objects: evidence from skin conductance response. In: Proceedings. Biological sciences / The Royal Society 270 (2003), p. 1499–1506; H.H. Ehrsson, K. Wiech, N. Weiskopf, R.J. Dolan, R.E. Passingham: Threatening a rubber hand that you feel is yours elicits a cortical anxiety response. In: Proc Natl Acad Sci U S A 104 (2007), p. 9828–9833 and K. Hagni et al.: Observing virtual arms that you imagine are yours increases the galvanic skin response to an unexpected threat. In: PLoS One 3 (2008), p. e3082.

49 See G.L. Moseley et al.: Psychologically induced cooling of a specific body part caused by the illusory ownership of an artificial counterpart. In: Proc Natl Acad Sci U S A 105 (2008), p. 13169–13173 and R. Newport, H.R. Gilpin: Multisensory disintegration and the disappearing hand trick. In: Current biology 21 (2011), p. R804f.

50 See K.C. Armel (footnote 49) and J. Hohwy, B. Paton: Explaining away the body: experiences of supernaturally caused touch and touch on non-hand objects within the rubber hand illusion. In: PLoS One 5 (2010), p. e9416.

51 See C. Lopez, B. Lenggenhager, Olaf Blanke: How vestibular stimulation interacts with illusory hand ownership. In: Conscious Cogn 19 (2010), p. 33–47.

52 See B. Lenggenhager, M. Mouthon, Olaf Blanke: Spatial aspects of bodily self-consciousness. In: Conscious Cogn 18 (2009), p. 110–117; H.H. Ehrsson: The experimental induction of out-of-body experiences. In: Science 317 (2007), p. 1048; V.I. Petkova, H.H. Ehrsson: If I were you: perceptual illusion of body swapping. In: PLoS One 3 (2008), p. e3832; M. Slater, D. Perez-Marcos, H.H. Ehrsson, M.V. Sanchez-Vives: Inducing illusory ownership of a virtual body. In: Frontiers in neuroscience 3 (2009), p. 214–220 and B. Lenggenhager, T. Tadi, Thomas Metzinger, Olaf Blanke: Video ergo sum: manipulating bodily self-consciousness. In: Science 317 (2007), p. 1096–1099.

53 See Ernst H. Gombrich: Ambiguities of the Third Dimension. In: Art & Illusion. A study in the psychology of pictorial representation [1959]. New York 2002, p. 204–244; Jean Piaget, Bärbel Inhelder: La représentation de l'espace chez l'enfant (The Child's Conception of Space) [1948]. New York 1967 and Mark Wigley: Untitled: The Housing of Gender. In: Beatriz Colomina (ed.): Sexuality & Space. New York 1992, p. 327–389.

vated and distanced extracorporeal position that is rotated by 180° (as if perceiving the world from a third-person perspective, 3PP). The FBI studies revealed that bodily self-consciousness and the related bodily experience of self-identification, self-location and 1PP can be disrupted in the laboratory by inducing a visuo-tactile conflict between the body of the participant and a fake or virtual body using video and virtual reality technology. In these studies participants are filmed from behind at a distance of two meters (Figure 10).[54]

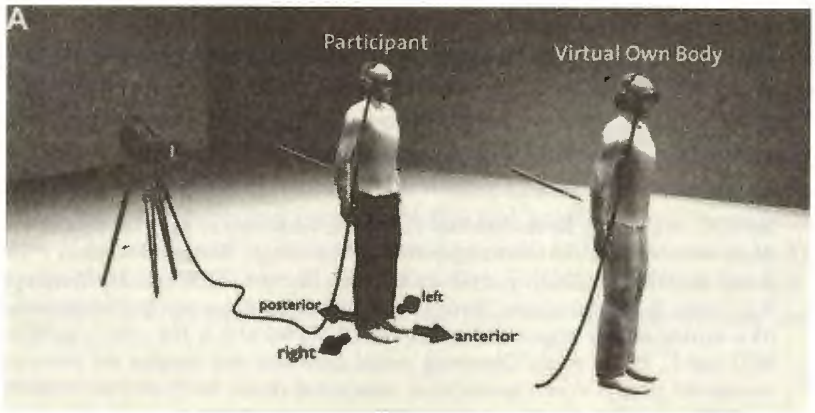


Figure 10: Video Ergo Sum, Lenggenhager and colleagues, 2007. In the Full-Body-Illusion, after synchronous visuo-tactile stimulation, participants self-identified with the virtual body and shifted their center of awareness (self-location) towards the virtual body.

The filmed scene is projected on the participant's Head-Mounted-Display (HMD). While participants are stroked on the back with a stick, they watch on the HMD their virtual body (i.e. their videotaped backside) being stroked either synchronously, i.e. real-time, or asynchronously, i.e. with the addition of a short delay. In the synchronous condition as compared to the asynchronous one, participants self-identify with the virtual body and report illusory touch. Next to these subjective changes, there is a recalibration of self-location characterized by a drift in self-location towards the virtual body (and the virtual environment surrounding the virtual body). These effects were abolished for asynchronous stroking, or, when the participants were presented a vertical human-sized box instead

[54] See B. Lenggenhager, T. Tadi, Thomas Metzinger, Olaf Blanke: Video ergo sum: manipulating bodily self-consciousness. In: Science 317 (2007), p. 1096–1099.

of a virtual body.[55] Self-consciousness has also been linked to the representation of internal states of the body, such as visceral and homeostatic systems, including one's heartbeat,[56] and it was shown that visuo-tactile conflicts can be extended to cardio-visual conflicts.[57]

Here, we briefly review recent experimental data in which we tested whether architectonic embodiment relates to the outlined notions of bodily self-consciousness.[58] The perception of the architectonic interior was investigated through the FBI with particular consideration of architectonic embodiment theory. We studied the empathic response of the observer in front of the massive architectonic forms (Figure 5),[59] and the sense of space orienting the observer within the architectonic void in-between the masses (Figure 7).[60] In particular, we tested whether *room-size*, a basic architectonic feature, modulates bodily self-consciousness and bodily feelings, such as illusory touch, self-identification and ownership through the position of the walls (close or far) or the interior void (large or narrow). Based on the position of the walls close or far from the body (in peri- or extrapersonal space), we expected different effects on self-identification with the virtual body. We assumed that synchronous visuo-tactile stroking would boost self-identification with the virtual body, and, since previous studies had proposed related results,[61] that self-identification would influence the way in which the room dimensions were perceived including a shift of first-person perspective. Particularly in the narrow room we expected an interference of the walls with peripersonal space due to increased stimulus detection.

[55] See ibid. and J.E. Aspell, B. Lenggenhager, Olaf Blanke: Keeping in touch with one's self: multisensory mechanisms of self-consciousness. In: PLoS One 4 (2009), p. e6488.

[56] See P. Rainville, A. Bechara, N. Naqvi, A.R. Damasio: Basic emotions are associated with distinct patterns of cardiorespiratory activity. In: International journal of psychophysiology: official journal of the International Organization of Psychophysiology 61 (2006), p. 5–18.

[57] See L. Heydrich et al.: Turning body and self inside out: visualized heartbeats alter self-consciousness and tactile processing in partietal cortex (in submission).

[58] See I. Pasqualini, J. Llobera, Olaf Blanke: „Seeing" and „feeling" architecture: how bodily self-consciousness alters architectonic experience and affects the perception of interiors. In: Frontiers in psychology 4 (2013), p. 354.

[59] See footnote 15.

[60] See footnote 23.

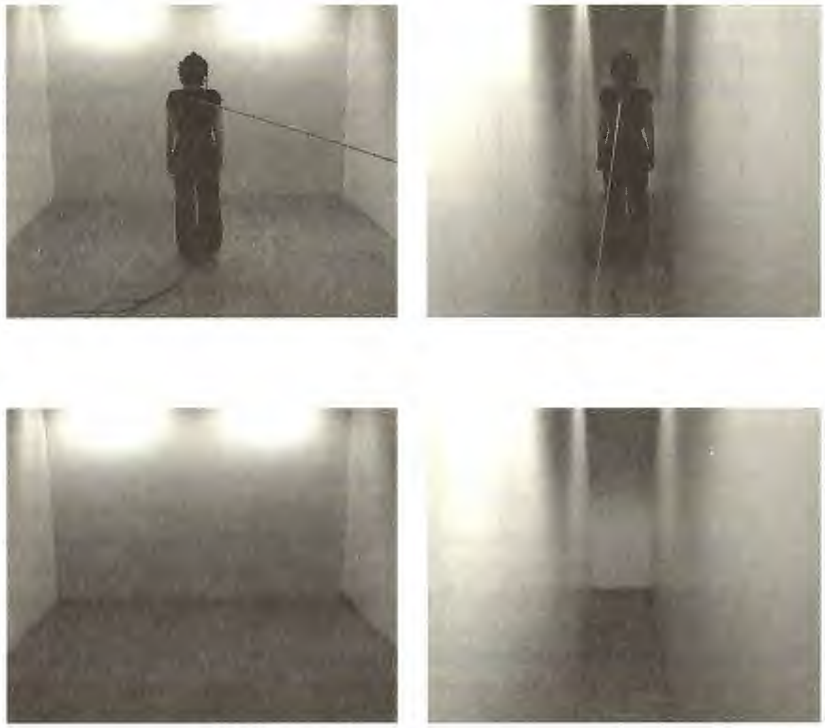
[61] See J.K. Witt, D.R. Proffitt: Perceived slant: a dissociation between perception and action. In: Perception 36 (2007), p. 249–257; S.A. Linkenauger, V. Ramenzoni, D.R. Proffitt: Illusory shrinkage and growth: body-based rescaling affects the perception of size. In: Psychol Sci 21 (2010), p. 1318–1325 and B. van der Hoort, A. Guterstam, H.H. Ehrsson: Being Barbie: the size of one's own body determines the perceived size of the world. In: PLoS One 6 (2011), p. e20195.

We introduced a mobile wall into an immersive VR setup with a virtual body in a filmed large and narrow space, and asked participants to perform length estimations after being exposed to the FBI (Figure 11).

Figure 11: The experimental setup used to test architectonic embodiment in immersive virtual reality. Participants were standing in two architectonic interiors with equal room depth (6m) one large (4m) (a) and one narrow (0.8m) (b).

We found significant self-identification with the virtual body confirming the effect of the FBI from previous studies.[62] Furthermore, participants reported a mild feeling of being touched by the sidewalls and an illusory drift of the sidewalls for the stimulus (sidewalls) presented in peripersonal space depending on *room-size*. The questionnaires showed no evidence for an interaction of the main factors however the length estimation task revealed an interaction between the main factors *stroking* and *room-size* (Figure 12). Length estimations of the stimuli presented in perspective (lateral and central to the room) showed a significant difference of estimation accuracy between large and narrow interior (Figure 13). For the narrow interior a significantly improved estimation was revealed after the FBI. We found that only in the narrow room self-identification with the virtual body reduced the probability to underestimate the bars.

Peripersonal space has been shown to dispose over increased stimulus detection.[63] When presenting the stimulus in the peripersonal space of our participants they experienced the feeling of being touched by the sidewalls and a room contraction. We speculate that together with the improved size estimation for the narrow room, a mild effect of embodiment of the walls (touch) and of containment (experienced retraction of the sidewalls) occurred, evoking a specific architectonic experience of the interior space as suggested by embodiment theory in architecture.



The entire scene was filmed from behind and large (c) and narrow room (d) with the entirely embedded virtual body shown on the Head-Mounted-Display (HMD). Participants were stroked on the back in synchronous or asynchronous way (factor *stroking*). For synchronous stroking the filmed image was directly relayed to the HMD, while for asynchronous stroking a delay (800ms) was inserted. Four experimental conditions were run in separate blocks with randomization of factors: *room-size* (large/narrow) and *stroking* (synchronous/asynchronous). Participants memorized a vertical reference bar. Then, they were filmed from behind and watched on the HMD their body being stroked in front of them for two minutes. After each experimental condition length estimation was tested presenting a black bar in different positions and orientations (e, f). Participants were asked to estimate each presented bar in comparison to the memorized reference bar. Following each experimental condition participants answered to a written questionnaire

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62 See footnotes 53, 56 and H.H. Ehrsson: The experimental induction of out-of-body experiences. In: Science 317 (2007), p. 1048.

63 See B. van der Hoort (footnote 62) and E. Ladavas, G. di Pellegrino, A. Farne, G. Zeloni: Neuropsychological evidence of an integrated visuotactile representation of peripersonal space in humans. In: Journal of cognitive neuroscience 10 (1998), p. 581–589.

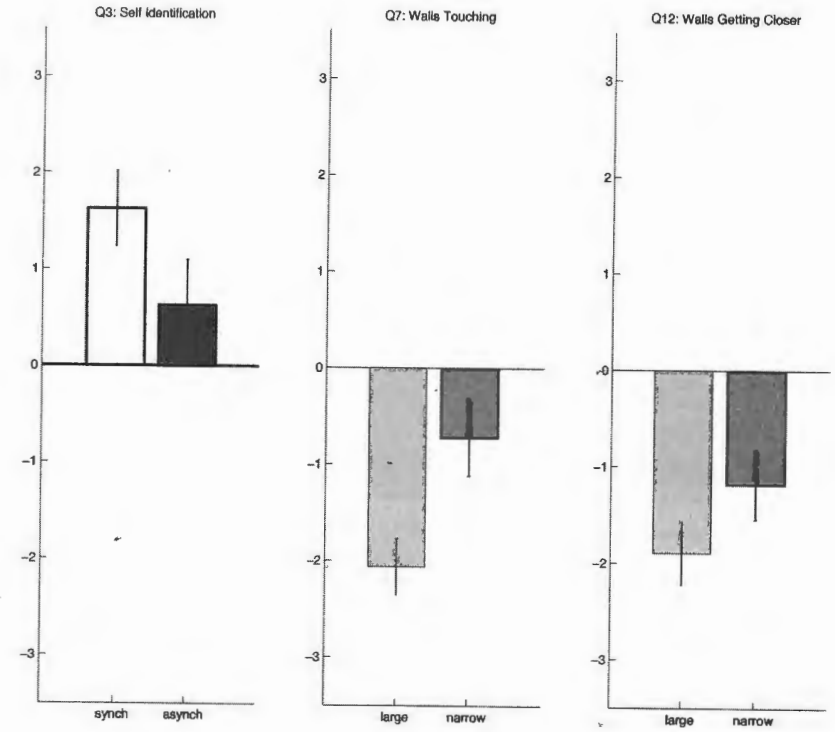

Figure 12

Figure 12: Questionnaire scores revealed a *question* by *room-size* ($p < 0.001$) and *question* by *stroking* ($p < 0.001$) two-way interaction. Further post-hoc testing revealed a significant variation with *stroking* for question 3 (... I clearly felt that the virtual body was my body; $p = 0.014$). Post-hoc testing of the *question* by *room-size* interaction showed a significant variation for question 7 and 12. Question 7 referred to the illusion of feeling touched by the architectonic interior (... I felt as if the walls of the room were almost lightly touching me). Although ratings were low we found question 7 to be significantly stronger ($p=0.002$) in the narrow versus the large room condition. Ratings for question 12 inquired about the feeling of the sidewalls drifting towards the body (... I felt as if the walls were getting closer to myself). Such effect was found to be significantly stronger ($p = 0.030$) in the narrow room than in the large room.

IV.

The Full-Body-Illusion (FBI) is characterized by self-identification with the virtual body and a measured drift in self-location towards the virtual body. In our experimental setup the FBI was induced through visuo-tactile conflicts between *felt* touches applied to the participants' back and *seen* touches applied to the back of a virtual body. Participants were filmed from behind and their image was dispatched on their HMD.[64] Our results confirm the outcome of previous studies with respect to illusory touch and self-identification. However, in the questionnaires we did not find these aspects of bodily self-consciousness to be directly modulated by the size of the room. We argue that our data suggest mechanisms similar to those mentioned in earlier work on embodiment in architecture, and that it may be linked to self-related (own-body) processing within architectonic space.

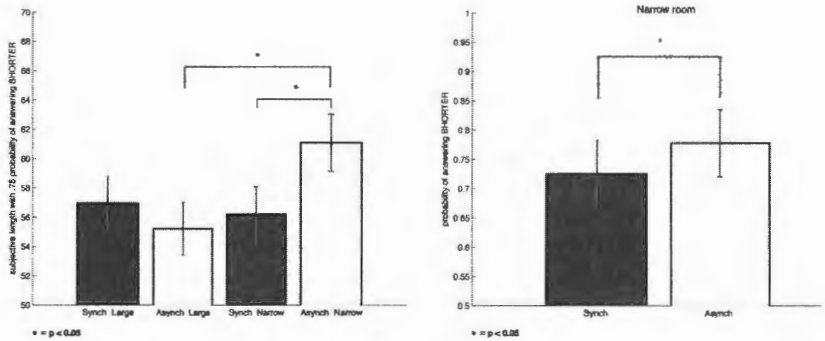

Figure 13: Length estimations showed the probability of perceiving the bars shorter than the reference bar given by the factor *room-size* ($p < 0.001$) and the interaction between *stroking* and *room-size* ($p = 0.018$) Further analysis of the *stroking* by *room-size* interaction revealed that the synchronous narrow room condition was the main driving factor for the interaction ($p = 0.049$).

By highlighting aspects of bodily self-consciousness and the architectonic experience based on a self-conscious observer, Heinrich Wölfflin and August Schmarsow emphasized fundamental aspects of architecture, namely massive forms and their structural effect the first, and, the void (cast or molded through the massive forms) the latter. Since Wölfflin's observer was located in front of the architectonic elements he particularly underlined the vestibular and somesthetic effects of the architectonic mass through verticality, symmetry and proportionality, while Schmarsow's observer standing in-between the architectonic mass described a contingency between egocentric perspective taking and an objectified observer's position related to the somesthetic experience of the interior space. Through visuo-tactile stimulation with a virtual body in our experimental setup we tested the somesthetic aspects of architecture in relation to first-person perspective (1PP). Our experimental findings revealed that syn-

64 See B. Lenggenhager, T. Tadi, Thomas Metzinger, Olaf Blanke: Video ergo sum: manipulating bodily self-consciousness. In: Science 317 (2007), p. 1096–1099.

chronous stroking of the participant's body and the seen virtual body (FBI) induces illusory touch and self-identification with the virtual body within large and narrow interiors. Self-identification and illusory touch were not directly modulated by the two different room-sizes. Furthermore, weak feelings of illusory touch with the sidewalls and the feeling of approaching walls (room retraction) could be induced experimentally and mediated *visually* to the architectonic envelope. Both sensations were stroking-independent and differed for both room sizes, being stronger in the narrow room-size condition. This finding may suggest a mild effect of embodiment of the walls (touch) and of containment (experienced retraction of the sidewalls) induced by *room-size* type. The subjective changes of embodiment with the architectonic elements were complemented by a stroking-dependent modulation of size estimations that was only found in the narrow room, with participants judging the room dimensions more accurately during conditions of illusory self-identification and illusory touch (Figure 13).

It has been argued that Heinrich Wölfflin introduced arguments from Robert Vischer's theory of empathy to conclude on the characteristics of architecture based on human perception.[65] Others have observed that Wölfflin later exemplified his theory describing a unity of architectonic style through linear and spatial effects in relation to tectonic and atectonic features.[66] Introducing the semantic pair tectonic and atectonic as stylistic arguments he attributed a more linear and graphic quality to Renaissance architecture, or, a spatial and pictorial character to the Baroque period, the latter strongly to bodily shapes.[67] Compared to related theories such approach to a unified style in architecture can be criticized as being elusive, for the temporal sequences of spatial perception given by a moving point of observation,[68] as well as the ambivalences evoked between structure and void, may not be comprehensively accounted upon.

Crucially, Wölfflin's interpretation of empathy implies aspects of multisensory embodiment and reveals some important notions related to own-body processing and a self-conscious observer. When studying multisensory integration of visual and tactile stimuli applied to a person's arm or body in cognitive neuroscience, self-identification and self-location have been related to the feeling of body ownership.[69] Body ownership has been linked to multisensory integration at the TPJ and to cognitive perspective taking.[70] In these studies, illusory self-identification with body parts and even non-bodily objects was found to depend on the precise alignment of the tested body part, or object, with the observer's own body or body part.[71] These findings apply to self-identification with imagined or real objects, body parts or a human body after visuo-tactile stimulation.[72] Of note, such spatial position and perspective taking abilities for the observer have also been linked to empathy[73] and emotion.[74] According to Wölfflin's theory architecture specific sensations are evoked through contingencies with the bodily limbs by symmetry – as a relationship between the whole body and the parts, as well as proportionality between the tectonic elements and the bodily limbs. Beyond visual perception Wölfflin highlights somesthetic processing in the architectonic experience, that is, the observer's self-attribution of the bodily limbs, and, moreover, of the tectonic parts through an empathic resonance in the observer's bodily limbs. Wölfflin also stressed the canonical importance of verticality with respect to bodily organization (for instance in gothic cathedrals).

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65 See Kurt Forster: Schwellen und Schleusen. Scheu und Ängste beim Übertritt. In: Michael Diers, Robert Kudielka, Angela Lammert, Gert Mattenklott (eds.): Topos Raum. Die Aktualität des Raumes in den Künsten der Gegenwart. Nürnberg 2005.

66 See Werner Oechslin: Der „evolutionäre" Weg zur modernen Architektur: Otto Wagner und das Paradigma von „Stilhülse und Kern" (The evolutionary Way to Modern Architecture: The Paradigm of „Stilhülse und Kern"). In: Harry F. Mallgrave (ed.): Otto Wagner. Reflections on the Raiment of Modernity. Köln 1993, p. 363–410 and Kenneth Frampton: The Rise of the Tectonic: Core Form and Art Form in the German Enlightenment, 1750–1870. In: Studies in Tectonic Culture. The Poetics of Construction in Nineteenth and Twentieth Century Architecture. Cambridge 1995.

67 See Heinrich Wölfflin: Renaissance und Barock [1888]. München 1926; H.W.: Die klassische Kunst [1898]. München 1904 and H.W.: Kunstgeschichtliche Grundbegriffe [1915]. Basel 2004.

68 See footnote 34 and Ernst H. Gombrich: Movement and Movement in Art. In: The Image & the Eye-Further studies in the psychology of pictorial representation [1960]. New York 2000, p. 40–62.

69 See Tsakiris (footnote 43), Botvinick (footnote 46) and footnote 52.

70 See Arzy (footnote 44) and C. Lamm, C.D. Batson, J. Decety: The neural substrate of human empathy: effects of perspective-taking and cognitive appraisal. In: Journal of cognitive neuroscience 19 (2007), p. 42–58.

71 See C. Lopez, L. Heydrich, M. Seeck, Olaf Blanke: Abnormal self-location and vestibular vertigo in a patient with right frontal lobe epilepsy. In: Epilepsy Behav 17 (2010), p. 289–292.

72 See footnotes 44, 47 and C. Spence, F. Pavani, A. Maravita, N. Holmes: Multisensory contributions to the 3-D representation of visuotactile peripersonal space in humans: evidence from the crossmodal congruency task. In: J Physiol Paris 98 (2004), p. 171–189.

73 See C. Mohr, A.C. Rowe, Olaf Blanke: The influence of sex and empathy on putting oneself in the shoes of others. In: Br J Psychol (2009).

74 See Ehrsson (footnotes 49, 63).

Investigation of visuo-spatial mechanisms revealed that self-attribution of the body or bodily parts are influenced through vestibular integration, as for instance shown for the RHI[75] and the FBI.[76] It was suggested that a non-visual, vestibular component contributes to the 1PP. The 1PP seems therefore to rely, at least partly, on distinct brain mechanisms from those involved in self-identification, which are based on visual and somatosensory input.[77] By integrating visual with somesthetic and vestibular cues, Wölfflin's embodied perception is thus based on trimodal experience associated with a precise control of the body posture.[78] In our experiment about architectonic room-size we found the narrow space, that is, vertical sidewalls close to the virtual body, to induce mild feelings of illusory touch, as well as the feeling of the walls drifting towards the participants (room retraction). Several studies showed in the past that peripersonal space disposes over increased visuo-tactile stimulus detection induced solely through visual stimulation, pointing to the circumstance that approaching stimuli may be more easily discovered.[79] We may therefore assume that the visual stimuli (the walls) perceived close to the body

75 See footnote 52.

76 See S. Ionta et al.: Multisensory mechanisms in temporo-parietal cortex support self-location and first-person perspective. In: Neuron 70 (2011), p. 363–374 and C. Pfeiffer et al.: Multisensory origin of the subjective first-person perspective: visual, tactile, and vestibular mechanisms. In: PLoS One 8 (2013), p. e61751.

77 See Olaf Blanke: Multisensory brain mechanisms of bodily self-consciousness. In: Nature reviews. Neuroscience (2012).

78 When studying the integration of vision, proprioception, touch and motor feedback, bi-and tri-modal neurons were found to encode the position of one's own arm when covered from view. (See M.S. Graziano, D.F. Cooke, C.S. Taylor: Coding the location of the arm by sight. In: Science 290 (2000), p. 1782–1786.) In the premotor cortex, where somatosensation is integrated with visual stimuli, visuo-tactile, as well as visuo-tactile and proprioceptive neurons responded to visual stimuli encoding visual space in body part centered, rather than eye-centered coordinate frames. (Pellegrino (footnote 81); M.S. Graziano, X.T. Hu, C.G. Gross: Visuospatial properties of ventral premotor cortex. In: Journal of neurophysiology 77 (1997), p. 2268–2292; T.R. Makin, N.P. Holmes, H.H. Ehrsson: On the other hand: dummy hands and peripersonal space. In: Behavioural brain research 191 (2008), p. 1–10 and J.R. Duhamel, C.L. Colby, M.E. Goldberg: Ventral intraparietal area of the macaque: congruent visual and somatic response properties. In: Journal of neurophysiology 79 (1998), p. 126–136.) Trimodal subpopulations of neurons also responding to vestibular signals were found to code for self-location and first-person-perspective At the TPJ. (See footnote 80.)

79 See Ladavas (footnote 64); C.F. Sambo, B. Forster: An ERP investigation on visuotactile interactions in peripersonal and extrapersonal space: evidence for the spatial rule. In: Journal of cognitive neuroscience 21 (2009), p. 1550–1559; L. Fogassi et al.: Space coding by premotor cortex. In: Exp Brain Res 89 (1992), p. 686–690 and G. di Pellegrino, E. Ladavas, A. Farne: Seeing where your hands are. In: Nature 388 (1997), p. 730.

mediated a tactile response of the observer to the architectonic elements through visuo-tactile integration with somesthetic sensation, as suggested earlier by Heinrich Wölfflin through the empathic resonance of the architectonic members within the bodily members. A similar relationship between the body and architectonic space was already commented by Gottfried Semper who linked the notion of the crafted *Wand* (light timber wall, screen) to *Gewand* (cloth) pointing with respect to our experimental outcomes to a possible somatosensory association of the bodily boundaries with the virtual interior through illusory self-identification.

August Schmarsow's notion of space is indeed less structural (or mechanical) in nature, but rather linked to the bodily experience of the interior through a fully immersed observer – as proposed by the modular ideal of classic architecture (for instance in the Pantheon). By introducing the direction of gaze as a „virtual vector of movement" that unfolds the architectonic „essence",[80] Schmarsow's observer responds through visual and somatosensory mechanisms of the entire body emphasizing the key importance of somatosensory perception through the sense of space.[81] The vanishing point of his observer is ideally shifted towards the void (and not towards the architectonic parts) indicating to potential points of location in space. Emerging with such perception Schmarsow supposes an „objectified" sense of space that may be associated to an embodied and highly subjective experience related to self-location as described for the FBI.[82] Experimentally induced drifts in self-location including a shift in 1PP along the direction of gaze have been compared to stronger, extracorporeal drifts for OBE's.[83] We propose that the objectified position of Schmarsow's observer may be related to a 3PP – similar to the position of an ideal observer suggested for linear perspective[84] – based on a more

80 See Schmarsow (footnote 21).

81 See footnote 42, Blanke (footnote 43), Arzy (footnote 44), S. Arzy, L.S. Overney, T. Landis, Olaf Blanke: Neural mechanisms of embodiment: asomatognosia due to premotor cortex damage. In: Arch Neurol 63 (2006), p. 1022–1025; Olaf Blanke, C. Mohr: Out-of-body experience, heautoscopy, and autoscopic hallucination of neurological origin Implications for neurocognitive mechanisms of corporeal awareness and self-consciousness. In: Brain Res Rev 50 (2005), p. 184–199; Olaf Blanke, Gustav Thut: Inducing Out-Of-Body-Experiences. In: G. Della Sala (ed.): Tall Tales about Mind and Brain. Oxford 2006, p. 425–439 and C. Lopez, P. Halje, Olaf Blanke: Body ownership and embodiment: vestibular and multisensory mechanisms. In: Neurophysiologie clinique = Clinical neurophysiology 38 (2008), p. 149–161.

82 See footnotes 42, 80.

83 Ehrsson (footnote 49).

84 See Egnatio Danti: Les deux règles de la perspective pratique de Vignole [1583]. Paris 2003; Ernst H. Gombrich: Ambiguities of the Third Dimension. In: Art & Illusion. A study in the psychology of pictorial representation [1959]. New York

complete remapping of space that projects the observer's center of perception from a position in front of the architecture (empathy) into the void in-between.

Our experimental findings revealed that increased illusory self-identification with the virtual body enabled a more accurate perception of the architectonic interior and therefore a more embodied perception of the void in the FBI condition. In our experimental setup directionality was more pronounced in the narrow room, due to the close position of the sidewalls along the direction of gaze. We therefore assume that through the FBI the translation of the center of perception – the architectonic ‚I', along the direction of gaze towards the virtual interior enhanced the visibility of the perspective cues in the narrow space. Two different elements can be therefore highlighted in Schmarsow's sense of space: the observer's objectified viewpoint in space linked to the sense of self-location, and, the directionality of 1PP oriented towards the void. Compared to Schmarsow's sense of space Hildebrand's observer moving *around* the forms within space disposed over more evolved motor properties based on full body displacements – including an ideal position towards figurative space occupied by the artist himself.

Recent opinions converged on the lasting effect of Vitruvian embodiment on architecture by its concrete reference to subjective bodily experience.[85] The *self-conscious observer* – whether determined by empathy, sense of space or spatial depth cues – may therefore be described as an observer, who constantly self-identifies with parts of the environment and who weighs the perceived architectonic stimuli with respect to personal space and bodily feelings.

In search for a conclusive definition of style fundamental questions about human space were inferred at the end of the 19th century. The seeming evidence for a unified style and its compelling meaning for the individual subject and human society furthered the attempt to provide a modern scientific background for art and architecture theory legitimating them as independent academic disciplines.[86] If, at the end of the 19th century, the notion of a unified style had occupied a certain amount of literature based on architectonic embodiment, one could argue that in the last two decades several theories focused again on experiential aspects of architectonic space and its representation on the one hand,[87] and, on empathy and embodiment on the other.[88]

Such re-emerged interest after an inconclusive empathy debate in the 20th century[89] is certainly based on a newly attained potential for clarification based on the availability of historical documents and novel scientific methods,[90] including interpretations of the historical and philosophical role of architectonic embodiment,[91] and, second, the arrival of advanced digital approaches and techniques implying a renewal of the adopted architectonic value criteria in analogy to its „mechanical" evolution hundred years earlier.[92] In such circumspect, the architect who relies on the conception of space based on a self-conscious observer seems to respond to a recurrently evolving and therefore timeless concern.

2002, p. 204–244 and Jean Piaget, Bärbel Inhelder: La représentation de l'espace chez l'enfant (The Child's Conception of Space) [1948]. New York 1967.

85 See footnote 19, Mark Wigley (footnote 54); Harry F. Mallgrave, Eleftherios Ikonomou: Introduction. In: H.F.M. (ed.): Empathy, Form and Space. Problems in German Aesthetics 1873–1893. Santa Monica 1994, p. 1–85 and Joseph Rykwert: Reason and Grace. In: On Adam's House in Paradise [1972]. Cambridge 1981, p. 43–74.

86 Gombrich (footnote 35), Alois Riegl: Stilfragen: Grundlegungen zu einer Geschichte der Ornamentik [1893]. Hildesheim, New York 1975 and A.R.: Spätrömische Kunstindustrie [1901]. Berlin 2000.

87 See Christian Norberg-Schulz: Architecture: Presence, Language, Place. New York 1980; Dalibor Vesely: Architecture in the Age of Divided Representation. Cambridge, Mass. 2004; Elizabeth Grosz: Architecture from the Outside. Essays on Virtual and Real Space. Cambridge 2001; Alberto Perez-Gomez, Louise Pelletier: Architectural representation and the perspective hinge. Cambridge 1997; Gottfried Boehm: Das spezifische Gewicht des Raumes. In: Michael Diers, Robert Kudielka, Angela Lammert, Gert Mattenklott (eds.): Topos Raum. Die Aktualität des Raumes in den Künsten der Gegenwart. Nürnberg 2005; Gernot Böhme: Architektur und Athmosphäre. München 2006; Colin Rowe: Neoclassicism and Modern Architecture. In: Kenneth Frampton, Peter Eisenman, Mario Gandelsonas (eds.): Oppositions. Vol. 1. New York 1973, p. 1–26; Joseph Rykwert: On Adams House in Paradise. The Idea of the Primitive Hut in Architectural History [1972]. Cambridge 1981 and Jonathan Crary: Techniques of the Observer. Cambridge 1992.

88 Oechslin (footnote 68), Wigley (footnote 54), Mallgrave (footnote 87), Frampton (footnote 19); Harry F. Mallgrave: Dancing with Vitruvius. Corporeal Fantasies in Northern Classicism. In: George Dodds, Robert Tavernor (eds.): Body and Building. Essays on the Changing Relation of Body and Architecture. Cambridge 2002, p. 126–137 and Harry F. Mallgrave: Introduction. In: Julia Bloomfield, Kurt W. Forster, Harry F. Mallgrave, Thomas F. Reese (eds.): Style in the Technical and Tectonic Arts; or, Practical Aesthetics. Los Angeles 2004, p. 1–70 and Dalibor Vesely: The Architectonics of Embodiment. in: George Dodds, Robert Tavernor (eds.): Body and Building. Essays on the Changing Relation of Body and Architecture. Cambridge 2002, p. 28–43.

89 See Marisa Dalai Emiliani: La question de la perspective, 1960–68. In: Architecture et perspective chez Brunelleschi et Alberti. Lagrasse 1968 and Alina A. Payne: Rudolf Wittkower and Architectural Principles in the Age of Modernism. In: Journal of the Society of Architectural Historians 53 (1994), p. 322–342.

90 Oechslin (footnote 68), Mallgrave (footnote 87) and Frampton (footnote 19).

91 Wigley (footnote 54), Grosz (footnote 89).

92 See Walter Benjamin: Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit. Frankfurt a.M. 1939.