SENSING BOUNDARIES

Exploring the role of the Bodily Senses in the Formation of Spatial Boundaries.

JACK CLAY

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fig.1 - Lygia Clark, O eu e o
tu (The I and the You), 1967.

ABSTRACT

'Philosophers interested in perception have traditionally been focused on how we look out at the world. We believe that much interesting work remains to be done on how we look within.'[1]

In recent years within architectural discourse interest in the role of the body and the senses has emerged. In his 1996 book, 'The Eyes of the Skin' Juhani Pallasmaa defined our body as the 'locus of perception.'[2] Drawing on neuroscience and phenomenology Pallasmaa argued that since our experience of the world is perceived through the five senses our architecture must be produced under consideration of these same senses.

Synonymous with Pallasmaa's argument this thesis argues that; since it is through our bodily sensations that we perceive our external world, we must design our environments through the consideration of our bodily sensations. Yet whilst architects have began to understand the role of the five senses in perceptual experience the role of the inner sensations remains under examined.

In 1906 the neurophysiologist C.S. Sherrington introduced the terms 'exteroception, interoception and proprioception'[3] to categorise what he called 'The Three Fields of Reception'[4];the multitude of sensory inputs that function throughout the human body. Beyond explorations of the five, exteroceptive, senses, this thesis aims to draw attention to the possibility of a reality prescribed by the body's multiple sensory inputs, taking the position that a world solely prescribed through the apertures of the five senses is keeping us from an awareness of interconnection.

Boundaries are understood in this thesis as the architects fundamental tool - the means through which he is able to cut space. Taking the form of a detailed study, I will look at how the bodily senses operate and how they bind together to inform our perception of our external environment. Through this I will be able to draw conclusions about how the senses interact with boundaries to create relationships. Specifically I will ask how our senses determine boundaries between inside & outside and how this effects the ways we connect and relate to one another in bounded spaces.

I will then explore how different boundary conditions are formed when a dominant sensory field is stimulated, suggesting that dominance of exteroceptive, interoceptive or proprioceptive stimulation lead correspondingly to the defining of boundaries as either distinct, entangled or blurred.

It is hoped that if we architects are aware of how the body's multiple senses interact to define spatial boundaries, we will be more conscious of how we curate connections and relationships in bounded space.

[1] J. B. Ritchie and P. Carruthers, 'The Bodily Senses', in M. Matthen (ed), The Oxford Handbook of Philosophy of Perception, Croydon, Oxford University Press, 2015, p.368.

[2] J. Pallasmaa, *The Eyes of The Skin*, Chichester, John Wiley & Sons, 2005, p.10.

[3] C. Sherrington, *The Integrative Action of the Nervous System*, New Haven, Yale University Press, 1906, p.114.

[4] Ibid., p.112.

KEYWORDS

Body

Boundary

Stimuli

Relationship

Proximity

Perception

Ownership

CONTENTS

It is via my sensorimotor powers that I encounter a world charged with meaning and organized into significant gestalts.[5]

Drew Leder

INTRODUCTION

'While the full range of the human sensorium play a role in the nature of aesthetic experience, isolating any of the five "primary" senses is conceptually problematic because the senses "bind" together to create an integrated, embodied experience.'[6]

iii (a). Argument/Question

We are sentient begins whose worlds are perceived through the uniting of senses from multiple receptors in the human body. Our skin is our 'largest sensory organ with very specific sensory receptors.'[7] The innate differences we each experience in terms of how sensitive we are to different types of stimulation contribute greatly to how we perceive the world. The attempt to rationalize experience in a shared reality has established a reality prescribed by the five exteroceptive senses. This has restricted our individual perception of the world and our personal engagement with it.

Moving beyond the five senses, this thesis aims to draw attention to the possibility of a reality prescribed by the body's multiple sensory inputs. Operating within the architectural discourse I will investigate how the internal bodily senses interact with external stimuli to define insides & outsides at external boundaries. I will discuss how particular boundary conditions affect the human relationships and connections that are established at boundaries and within bounded spaces.

iii (b). The Three Fields of Reception

Before going any further I would like to introduce Sherrington's three fields of reception. In 1906 the neurophysiologist C.S. Sherrington introduced the terms 'exteroception, interoception and proprioception'[8] to categorise what he called 'The Three Fields of Reception;'[9] the multitude of sensory inputs that function throughout the human body. They are most easily understood through the definitions given in the Oxford Dictionary of English:

1. Exteroceptive[10] - relating to stimuli that are external to an organism.

2. Interoceptive[11] - relating to stimuli produced within an organism, especially in the gut and other internal organs.

3. Proprioceptive[12] - relating to stimuli that are produced and perceived within an organism, especially those connected with the position and movement of the body.

[5] D. Leder, *The Absent Body, Chicago,* The University of Chicago Press, 1990, p.5.

[6] D. Gromala and A. Levishon, 'Taro(t)ception: Eliciting Embodied, Interoceptive Awareness through Interactive Art', British Columbia, 2008, http://teilab.tamu.edu/quek/Classes/Aware+EmbodiedInteraction/EmbodiedInteractionPAPERS/LevG09-Tarotception, (accessed 20 April 2018).

[7] J. Bolte Taylor, My Stroke of Insight, St Ives, Hodder & Stoughton, 2009, p.22.

[8] C. Sherrington, *The Integrative Action of the Nervous System*, New Haven, Yale University Press, 1906, p.114.

[9] Ibid., p.112.

[10] 'Exteroceptive', in E. S. C. Weiner, J. A. Simpson and M. Proffitt (eds.), *The Oxford English Dictionary*, 2nd edn, Oxford, Clarendon Press, 1989.

[11] 'Interoceptive', Ibid.

[12] 'Proprioceptive', Ibid.

iii (c). Methodology and Structure

The thesis takes the form of a detailed study and is structured in accordance with Sherrington's 'Three Fields of Reception'[13] to understand the effect they might have on defining boundaries. I will look at the different boundary conditions formed when a dominant sensory field is stimulated, suggesting that dominance of exteroceptive, interoceptive or proprioceptive stimulation lead correspondingly to the defining of boundaries as either distinct, entangled or blurred.

[13] C. Sherrington, *The Integrative Action of the Nervous System*, New Haven, Yale University Press, 1906, p.112.

Part I draws on the work of neuroscientists and phenomenologists, in order to form a understanding of how the senses overlap to inform our perspective of the world. This will not be an all encompassing study in phenomenology but will rather introduce the reader to a brief history of the intertwining of neuroscience and phenomenology and form the groundwork from which a focused study of the three fields of perception can be explored.

Parts II, III and IV, dealing with perception in exteroceptive, interoceptive and proprioceptive fields, will also explore the work of neuroscientists and pheomenologists to establish the origins of the corresponding receptive fields and the ways that the bodily senses operate in each. I will give examples (in the form of personal accounts by those in the medical profession, interactive artworks and spatial architectural proposals) where different boundary conditions have been determined as a result of stimulating particular bodily senses in each given field.

In the last few decades, artists, phenomenologists, anatomists and neuroscientists have began to explore the perceived world through the body's internal senses. Architects, on the other hand have failed to move beyond the traditional five senses in the exteroceptive field. In keeping with the theme of interconnection that runs throughout this text, the references I drawn upon here are from these interdisciplinary professions. I hope that by looking at the explorations already taking place in these external disciplines I will be able to suggest how architects might begin to engage with interoceptive and proprioceptive fields.

I will ask how the senses bind and interact with each other to define spatial boundaries, drawing attention to our current position as navigators of nuanced spatial boundaries.

iii (d). Why is it important to do this project?

In this essay the architect is understood as the primeval cutter of space, his tool is the boundary he inserts into the atmosphere's thick air. Take for example the solid wall which has the potential to connect people and inform relationships. If I place a solid wall in-between myself and another I have the power to deny a relationship. If however this wall is

less distinct, if it's material is translucent and there are small openings across its surface I will be able to communicate with someone on the other side. My ability to sense the presence of another might instigate the sensation of butterflies or acid reflux in my stomach, my proprioceptive sense will allow me to place myself in relation to this other person when combined with my sense of vision or sound.

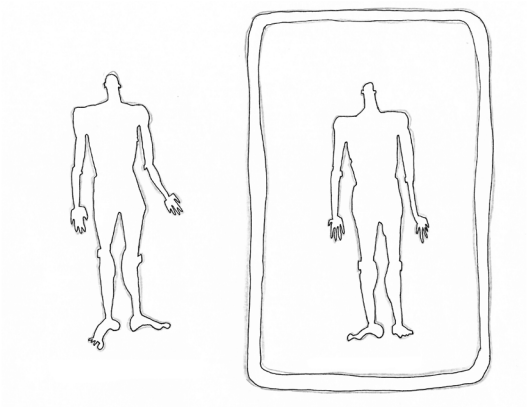
[13] C. Sherrington, *The Integrative Action of the Nervous System*, New Haven, Yale University Press, 1906, p.112.

The type of sensory stimulation offered at a boundary has the effect of creating certain boundary conditions. As architects it is therefore crucial that we understand how the bodily senses interact with certain types of boundaries. If architects are aware of how these multiple senses define spatial boundaries they will be more equipped in the curating of those boundaries. Thus more conscious of how we connect and relate to one another in buildings and spaces.

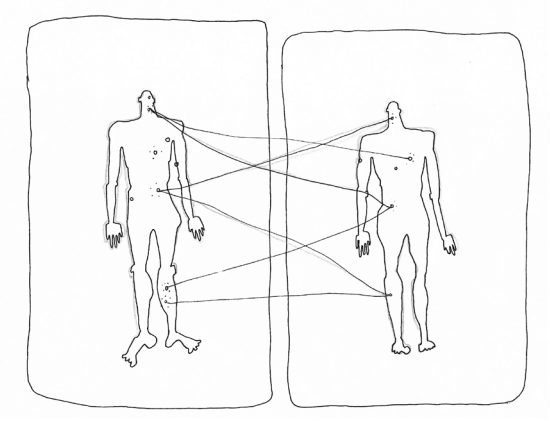
I am interested in an architecture that enhances the connections and relationships between people and their environments. An architecture that cuts space in order to curate connections and relationships between people in separate spaces. I believe that the boundaries we create have the potential to be more nuanced than the distinct boundaries that pervade our spaces.

[14] M. Merleau-Ponty, *Phenomenology of Perception*, 2nd edn, Guilford, Routledge, 2003.

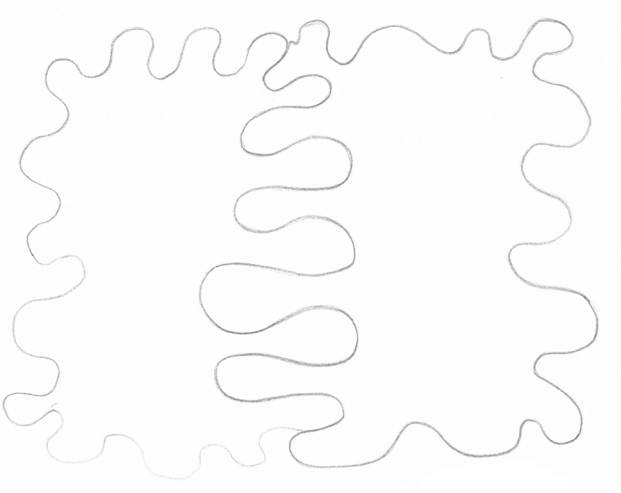
Since Merleau-Ponty's 1945 'Phenomenology of Perception',[14] interest in the body's senses has pervaded the disciplines of art, neuroscience and phenomenology. More recently, knowledge of the receptive fields of exteroception, interoception and proprioception is being established by artists and neuroscientists. It would appear to be an appropriate time for architects to begin engaging with these sensory fields and begin to understand how they might design external environments to be perceived by the body's inner, intangible and implied senses. Starting with the architects essential tool, the boundary, this essay aims to explore the potentials of high curation of interoception, proprioception and exteroception in the field of architecture.



Distinct Boundaries & The Exteroceptive Field



Entangled Boundaries & The Interoceptive Field



Blurred Boundaries & The Proprioceptive Field

fig.2 - Fields of Stimulation & their
Corresponding Boundary Conditions

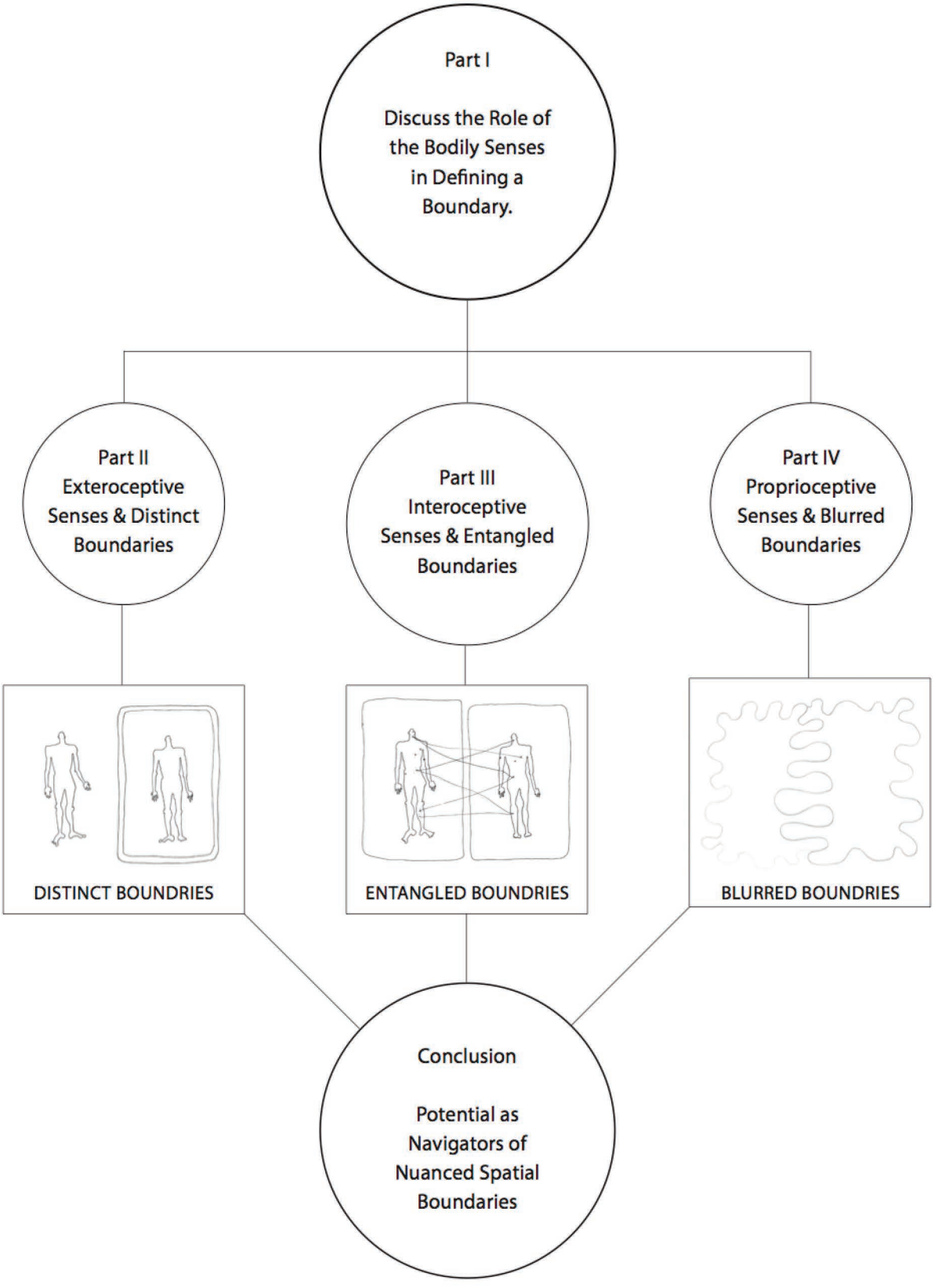


fig.3 - Theoretical Diagram

Western society is typified by a certain disembodied style of life. Our shelters protect us from direct corporeal engagement with the outer world.[15]

Drew Leder

PART I : THE ROLE OF THE BODILY SENSES IN DEFINING A BOUNDARY

1.1 Inside/Outside.

'The outside of a building is the specific mode by which it interacts with an environment from which it has been separated by the cutting act of the architect.'[16]

The creation of architecture relies on the bounding of space. The architect is, given by the root of the Greek word tektōn meaning to cut, the primeval cutter. As architects we cut space in order to create space. Our tool is not an axe or a pair of scissors, both objects which cleanly separate space, rather we insert a solid to create a boundary within our thick air. Boundaries are the architects tool. How we understand the form of these boundaries and their characteristics, how we choose to arrange them, where we allow connections between or create separations from, has a direct impact on the human relationships formulated within bounded spaces.

In an article entitled 'Inside and Outside' written for The Journal of Aesthetics and art Criticism, Wolfgang Zucker highlights the role of the human body (the sensing subject) in the definition of outside and inside. Zucker sets out to define the border between inside and outside through the narrative of a story by the German writer Jean Paul in which:

'A poor poet inherits a piece of land but has not the money to build a house. All he can afford is a wooden wall with a window cut into it. This wall he puts up in the middle of his land, seats himself behind the window, and now enjoys what was before simply nature under the aesthetic aspect of a landscape.' [17]

He explains that the poet, through the act of sitting behind the house-less window, looking out, has performed the primeval act of architecture, the separation of an inside from an outside. I would like to highlight the role of the body subject in this example; the position of which has defined a behind and an in-front. It is therefore the combination of body and object that has created a boundary. The definition of the word boundary relies on an analogous relationship between one object and another. In this example the body in combination with the wall has demarcated a boundary and not the wall itself.

As perceptual psychologist Rudolf Arheim points out the world 'as viewed from the introspectionist's station point is never truly outside; it is rather an extension of the inside - a collection of obstacles and opportunities.'[18] Arheim draws attention to the way in which we perceive the outside world as an extension of the inside world; I believe

[15] D. Leder, *The Absent Body, Chicago,* The University of Chicago Press, 1990, p.3.

[16] R. Arnheim, and W. M. Zucker., 'Inside and Outside in Architecture: A Symposium', *The Journal of Aesthetics and Art Criticism*, Vol. 25, no. 1, 1966, p10.

[17] Ibid, p.7.

[18] Ibid, p.3.

fig. 4 - Claude Cahun, Je tends les bras,
1931

that how we choose to navigate our bodily sensations is directly related to how we perceive the external world. I will argue that all of our bodily senses enlist a reaction which in their totality explain how we each individually perceive the external world.

1.2 The Role of the Senses

'We must recognize sensation as a living dialogue between the body-subject and its existential environment.'[19]

[19] M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.73.

Phenomenological thought is guided by the doctrine that human knowledge is confined to or founded on the realities or appearances presented to the senses. This thinking is in opposition to that held by the likes of Immanuel Kant who argued for knowledge as absolutely independent of all experience. The philosopher Merleau Ponty stated that 'prior to any intellectual conception of it, we experience the unity of the object as correlated to that of our body; and we experience our being in the world before we ever arrive at the idea of an external world.'[20] Our senses are the apertures through which we experience the world. The world as observed through a Cartesian mind/body lens is interpreted with reference to the theoretical constructs of pure bodies endowed with statistically determined chemical properties and free from any force. Contrastingly, the lens of perceptual experience allows for discovery of the world through a process of deduction from the clues given by the senses.

[20] Ibid, p.70.

It is crucial then for the architect to understand how he is offering sensory stimulation with the objects he uses to cut space. If we understand that a boundary only exists in combination with a body: rather than referring to 'boundaries' as the architects tool we ought to refer to 'potential boundaries' as the architects tool. Their potential comes from their ability to offer differing types of sensory stimulation. As Merleau-Ponty goes on to explain in the Phenomenology of Perception 'by virtue of having a body we are already in possession of sensory fields - that is, we open onto a sensible world within whose horizons all particular sensory givens are located, lending themselves to an unending exploration.'[21] The way potential boundaries interact with bodily sensations is responsible for the boundaries we draw between one another and thus the ways that we communicate and relate to one another in spaces. If we can understand the different ways that potential boundaries stimulate particular senses, we will better understand how we can create particular types of boundary.

[21] M. Merleau-Ponty, *Phenomenology of Perception*, Guilford, Routledge & Kegan Paul, 1961, cited in M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.74

The architect has the opportunity to direct the senses towards the construction of different types of spatial boundaries; according to the senses he targets, he can redefine our relationship of inside and outside.

1.3 Our Senses are Spatial & they Overlap

'The experience of the body itself is inseparably the outlining and perceiving of a certain sort of world in which each bodily sense has a spatial realm which overlaps.'[22]

Philosopher Peter Carruthers explains that there is no single sense for perceiving our own bodies, any more than there is a single sense for perceiving the external world:

'...folk wisdom groups bodily sensations together, unlike the five external senses, which are intuitively distinct. In part this may be because the systems that produce an experience of arm position, an itch, or an upset stomach, lack obvious sensory organs. In addition, bodily sensations are private (you can see what I see, but you cannot feel my body as I do).'[23]

In 1963 the cultural anthropologist Edward T. Hall introduced the study of proxemics which he defined as 'the interrelated observations and theories of humans use of space.'[24] Hall described the interpersonal distances of bodies to determine the limits of intimate, personal, social and public space. Further to categorizing space through proximity, hall used concepts from biometrics to propose that; the spaces surrounding a body could be defined by tactile, auditory, visual, kinaesthetic and thermal factors, thereby highlighting that the senses are spatial. Thermal space for example is perceived by thermoreceptors located throughout the body in the dermis, skeletal muscles, liver, and hypothalamus which each have a spatial range.

When a blind person acquires sight through a corrective operation they typically reach out their hands towards any objects shown them and may try to touch even a sunbeam falling across a pillow. Evidently their tactile experience must be spatial 'else they would not reach out to touch whatever is presented.'[25]

Our senses have an inherent limit of operation that is determined by their spatial range and in order to perceive space all the senses co-exist and interact so that the contribution of each becomes indistinguishable. We perceive boundary conditions through the overlapping of our senses which each have a spatial range.

1.4 The Interaction of multiple Senses extends Boundaries

'If we suspend our philosophical prejudices, we will acknowledge readily enough that there is no thinker standing behind our ears or hands when we hear or touch something, or when we stretch out on the grass or the sand and lose ourselves in the azure sky overhead. Who among us has not had the experience of becoming one with the sky or the sea on a clear summer's day.'[26]

If each sense has a spatial realm, like any other space that is experienced it is a space with a boundary, the combination of the

[22] M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.80.

[23] J. B. Ritchie and P. Carruthers, 'The Bodily Senses', in M. Matthen (ed), The Oxford Handbook of Philosophy of Perception, Croydon, Oxford University Press, 2015, p.368.

[24] E. T. Hall, *The Hidden Dimension*, New York, Doubleday and Company, 1966, p. 94

[25] M. Merleau-Ponty, *Phenomenology of Perception*, Guilford, Routledge & Kegan Paul, 1961, cited in M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.77

[26] M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.74.

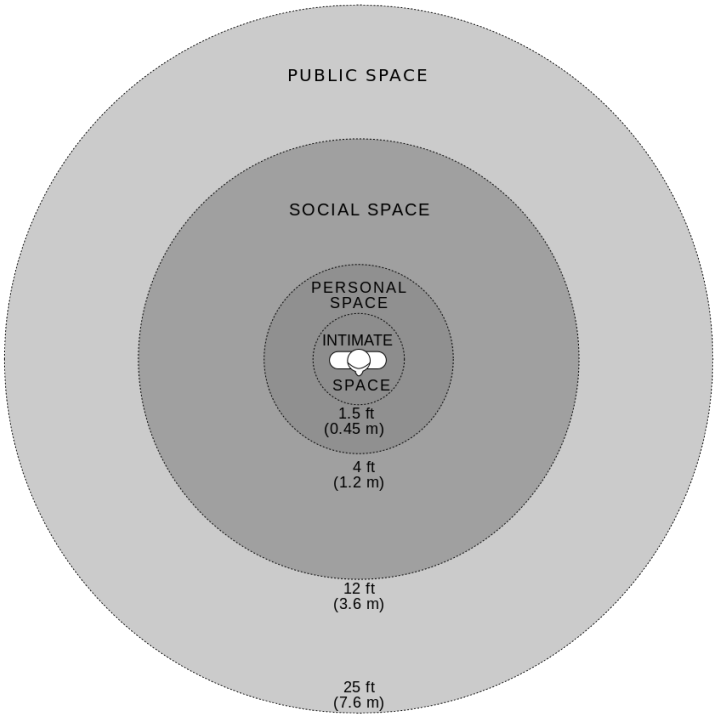


fig. 5 - Edward T. Hall, Chart depicting interpersonal distances of man.

Hall described the interpersonal distances of man (the relative distances between people) in four distinct zones:

1. Intimate space
2. Personal space
3. Social space
4. Public space

senses as we have seen is responsible for extending boundaries.

Juhani Pallasmaa has highlighted the dominant sense of vision over all other senses in the exteroceptive plane. He claims that focused vision is responsible for the lack of sensory stimulation we experience in our existential environments. Pallasmaa proposes that stimulation of peripheral vision which 'envelops us in the flesh of the world'[27] will incite the sense modality of touch, address all the senses simultaneously and fuse our image of self with our experience of the world. If focused vision disallows the overlapping of senses then unfocused vision might allow an overlap.

[27] J. Pallasmaa, *The Eyes of The Skin*, Chichester, John Wiley & Sons, 2005, p.10.

If we understand vision as a peripheral system we might allow each of the senses to reach its spatial limit. We will then perceive an external environment as the combination of these senses opened onto the same all embracing space.

With the development of new technologies came the development of new design interests. In 1848 a process of casting plate glass was invented which allowed very large windows and later curtain walls. Ludwig Mies van der Rohe's was part of a group of early modernists whose architectural explorations intensely explored the distinctions and relationships of inside and outside space. Mies' two Villas, Haus Lange and Haus Esters are an interesting example of where internal boundaries create transitions between rooms serve to mirror external transitions between inside and outside.

In Haus Lange a sequence of large doorways and windows generates a staggered opening up of views, which perambulated one after the other become the boundaries between internal and external space. The feeling of being inside a building remains however, unambiguous and 'the architecture focuses equally emphatically on the fact that this is also a transitional zone.'[28] Since the doors are large in size and extend right to the ceiling in the same way as the windows; there is a similarity between the transitions from room to room and those from inside to outside. The world outside is thus not only present in the form of different views from windows, but also through the harmonisation of boundaries and transitions from one space to the next. Anyone moving around the house is be equally aware of the outside, without in any way being deceived by the factual difference between inside and out.

[28] J. Heynen, *Ein Ort der denkt: Haus Lange und Haus Esters von Ludwig Mies Van der Rohe*, Krefeld, Krefelder Kunstmuseen, 2000, p.27.

Moving around the house the senses of proprioception are stimulated to create a well established sense of place between internal and external environments. When static in the rooms however, boundaries become distinct and vision becomes focused in an attempt to seamlessly blend internal architectural space and external nature space. Whilst Mies is undoubtedly a pioneer of explorations in bounded space, I would argue that his architecture privileges vision above other senses which can prevent the overlapping of senses in all fields of reception.

fig. 6 - Haus Lange, man's room towards living room, built 1927.

1.5 Spheres of Perception & Interacting Senses

'The sensation of being surrounded is primary and universal: the maternal womb, the room, the house, the valley, the canyon of the street, the final enclosure of the horizon and the hemisphere of the sky they all belong together and are always with us.'[29]

I would like to introduce the idea that we perceive the world through what I will term Spheres of Perception. The limits of these spheres are defined by the senses active within them and by the limits of their spatial ranges. These Spheres are what connect our inner environments to the external environments of the much larger universe. When presented with a potential boundary, certain senses within our perceptual sphere are activated and we perceive the world accordingly. Since we perceive the world through an overlapping of our senses, boundaries imposed by vision alone are limited.

Let's take for example that there is a clear blue sky and I'm at the top of a mountain looking out over a valley and off into the sea. My field of vision is relatively unobstructed yet my sensory receptors don't allow me to perceive the whole universe at once. When we set up the boundaries enclosing a space, we are placing boundaries in-between our limited Sphere of Perception and the external spheres that make up our universe. Through meditation we can extend our sense of connection to the environment. This highlights that it is through the addition of senses that we extend our boundaries.

Since the bodies sensory receptors have different spatial ranges, some are capable of extending further distances before reaching a boundary. Boundaries in this case are measured by distance. Inside and outside are defined by an interaction of the senses with an environment to determine a boundary. We must understand that every time we cut a space we are cutting a relationship to the universe.

How our potential boundaries direct the senses towards a connection with the universe is important, for example, if we are sat in the back of a windowless van, and our only connection back to the earth is via the vibrations that come pass through the rubber wheel, into the wheel axle and up into our bottom seated above, we will no doubt feel nauseous.

Our ability to determine a boundary therefore relies on our understanding of our own bodily sensations.

Neuroscientist Jill Bolte has discussed the potentials of extending the boundaries we impose through the exteroceptive senses. Whilst our ability to process data about the external world begins at the level of the external senses she states that 'although most of us are rarely aware of it, our sensory receptors are designed to detect information at the energy level.'[30]

[29] R. Arnheim, and W. M. Zucker., 'Inside and Outside in Architecture: A Symposium', *The Journal of Aesthetics and Art Criticism*, Vol. 25, no. 1, 1966, p3.

[30] J. Bolte Taylor, My Stroke of Insight, St Ives, Hodder & Stoughton, 2009, p.20.

[31] M. M Langer, *Merleau Ponty's Phenomenology of Perception*, Hong Kong, The Florida State University Press, 1989, p.74.

1.6 Variables that lead to a Boundary

'It is not a disembodied observer but rather, a body-subject who sees and hears and touches the sensible. Sensing is neither a passive registering nor an active imposing of a meaning; to sense something is to co-exist or 'commune' with it, to open oneself to it and make it one's own prior to any reflection or specifically personal act.'[31]

The senses interact with the boundary to mediate the limits of inside and outside. Our proximity to the boundary, our sensory stimulation at the boundary, the ways in which our different senses interact at the boundary is then responsible for how this boundary is defined as either distinct, entangled or blurred.

There are inherent spatial limitations to senses which in turn limit our sensory responses when in the presence of external potential boundaries. Being able to recognise the ways that the senses interact holds the key to how we extend limits and create relationships across both sides of a boundary.

Through this investigation I have identified four key variables that lead to the formation of spatial boundaries.

1. Proximity & Direction of Body
2. Senses Stimulated by Potential Boundary
3. Ability of Senses to Overlap at Boundary
4. Awareness of Bodily Sensations within 'Sphere of Perception'

The whole trend goes in a direction where a way will finally be found to vaccinate bodies so that these bodies will not allow the inclination towards spiritual ideas to develop and all their lives people will believe only in the physical world they perceive with the five senses.[32]

Rudolf Steiner

PART II: EXTEROCEPTIVE SENSES & DISTINCT BOUNDARIES

2.1 Clarity & Dominance

'Our ability to process data about the external world begins at the level of the external senses.'[33]

Exteroceptors provide the brain with information from outside the body, in this thesis, when referring to senses in the exteroceptive field, I am referring to the five senses; sight, touch, sound, smell and taste.

As neuroscientist Jill Bolte has highlighted, perception 'begins' with stimulation of the external senses. As architects we recognise the five senses as the most reliable method of perception and we value our spaces accordingly. Our inability to progress beyond this beginning is responsible for the dogma of a world perceived through stimulation in the exteroceptive field. We are thus predominantly afferent beings, who conduct inwardly and establish our sense of place from external worlds. We shall see in later sections that we also have the ability to act as efferent beings conducting outwards from the inner senses and indirectly influencing our external worlds.

2.2 The Translational Field

Considering art a 'field of being and events,'[34] the Brazilian artist Lygia Clark produced works that aimed to resist demarcations. In the 1960s she created a series entitled 'Objetos Sensoriais' (Sensory Objects) that focused on perception through touch. In this period Clark designed sensory hoods that would allow wearers to experience scents, noises, or tactile sensations, and clothing that would influence motion, as well as breathing experiments and sensory books. 'Hand Dialogue' is an band in the form of a Möbius strip connecting the hands of two people to form a tactile relationship; users becoming aware of the boundaries between their bodies. Speaking of the series Clark explains that for her 'everything is connected...The object no longer is there in order to express any concept whatsoever, but so that the spectator can reach, more deeply, his own self.'[35]

In the image shown, one person engaged in 'Hand Dialogue' has their eyes closed, Drew Leder has drawn attention to the spatiotemporal continuity of exteroception, although 'if I abandon one sense perhaps closing my eyes, the other senses help to maintain the continuity of the world.'[36] Exteroceptive senses since they work on multidimensional planes help to maintain the spatial continuity of the world.

As we have seen, perception is not through any one sensory channel, i.e, not through touch alone. Neuroanatomist Jill Bolte explains that

[32] R. Steiner, *The Fall of the Spirits of Darkness: Fourteen Lectures given in Dornach 1917,* Wiltshire, Rudolf Steiner Press, 1993, p.194.

[33] J. Bolte Taylor, My Stroke of Insight, St Ives, Hodder & Stoughton, 2009, p.20.

[34] C. Macel, *Part 1: Lygia Clark: At the Border of Art,* [website], 2017, http://post.at.moma.org/content_items/1005-part-1-lygia-clark-at-the-border-of-art, (accessed 20 April 2018).

[35] L. Clark, 'Querido Hélio, 14.11.1968,' in Figueredo, Luciano (ed.), Lygia Clark e Hélio Oiticica: cartas, 1964-74, Rio de Janeiro, Editora UFRJ, 1996, p85.

[36] D. Leder, *The Absent Body, Chicago,* The University of Chicago Press, 1990, p.42.

'for any two of us to communicate with one another, we must share a certain amount of common reality. As a result, our nervous systems must be virtually identical in their ability to perceive information from the external world.'[37] Exteroception is the plane through which we communicate in a shared or common reality. We therefore are able to translate our personal perception of the world in the exteroceptive field but this is not the same as the field through which we construct our own individual reality. The five dominant senses in the exteroceptive field works as devices of translation, translating experience into a language that can be shared with others.

Our unique perception is diluted as it undergoes a translation before it can be either projected through or informed by the apatures of the five senses, to be experienced in what we call a shared reality. This system of communication is inherently reductive, a notion inevitably succumbing to a loss in translation.

Lygia Clark's Hand Dialogue which aims to connect two people is translating their interoceptive and proprioceptive sensory fields through the sense modality of touch. The point at which hands touch forms the distinct boundary between bodies. It is consciousness shared through simultaneous experience in the language of bodily interaction.

Clark's begins at the level of exteroception but sets up a network for the possible overlapping of senses in other receptive fields. Let us take for example the ability of a masseuse perceiving the tense psychological state of their client. The hand of the masseuse receives information through the sense of touch that this person is stressed or anxious, since inner sensations in their body have caused their muscles to contract, the body acts as a medium through which interoceptive feelings are communicated. In this example we see senses in the interoceptive field being mediated through the exteroceptive field.

This translational tendency is discussed by philosophers J. B. Ritchie and P. Carruthers: 'held in isolation, thermoception might give us little in the way of a sense of an external object independent of haptic feedback and proprioceptive awareness. We might have little sense of a thermal object. For example, imagine that a deafferented patient is touched on her back (out of her vision field) with an cold iron rod (thermoception is typically not altered in deafferented patients). We can imagine: does the subject feel a cold object, or feel some body part as being cold? Absent a tactile sensation of the contact of the cold rod, or an ability to spatially localize the sensation (from proprioception), it seems the sensation would be felt as a state of her body.'[38]

We see that combination of fields does not make one a part of the other and that all planes are constantly at work even when only one particular sense is explicitly stimulated. Pure interoceptive and exteroceptive fields are interacting whilst translations are also occurring.

[37] J. Bolte Taylor, My Stroke of Insight, St Ives, Hodder & Stoughton, 2009, p.11.

[38] J. B. Ritchie and P. Carruthers, 'The Bodily Senses', in M. Matthen (ed), The Oxford Handbook of Philosophy of Perception, Croydon, Oxford University Press, 2015, p.356.

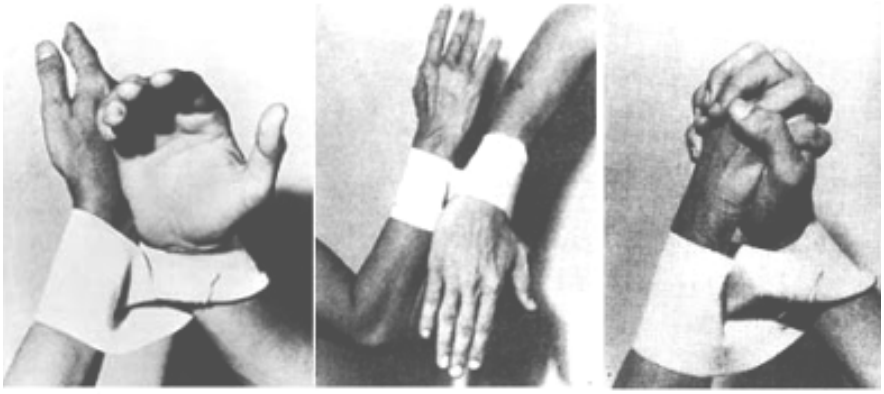


fig. 7 - Lygia Clark, Hand Dialogue, 1966.

fig. 8 - Ibid.

The seat of the soul is where in the inner world and outer worlds touch each other. For nobody knows himself, if he is only himself and not also another one at the same time.[39]

Henry Miller

[39] H. Miller, *Sexus*, New York, Grove Press, 1965, p.250.

PART III : INTEROCEPTIVE SENSES & ENTANGLED BOUNDARIES

3.1 Subconscious Senses. Imprecise, Inferential & Ambiguous.

'Reflective awareness rests on that which necissarily eludes it.'[40]

[40] D. Leder, *The Absent Body, Chicago,* The University of Chicago Press, 1990, p.37.

Interoceptive senses* are difficult to communicate since they are individual by nature and most of the time remain subconscious. I cannot tell my liver to secrete more bile in the same way I can tell my arm to lift above my head. Still our understanding of these sensations contributes greatly to how we perceive the world and we will see that they are capable of entering our conscious experience. When referring to interoceptors I am only speaking of the ones that are capable of entering conscious experience.

*Interoceptors mediate sensation from the viscera as well as visceral pain and pressure or distention, giving information about the body's internal organs. Some known receptor functions are: stretch receptors controling respiratory rates, chemoreceptors monitoring carbon dioxide, salt, sugar and hormone levels, cutaneous thermo and mechanoreceptors responding to temperature and stretch receptors in the gastrointestinal tract, bladder, and rectum sensing distension of these organs.[41]

[41] E. Lemche, *The sensory perception of the total body interior,* [website], 2017, https://www.researchgate.net/post/Which_are_the_brain_areas_responsible_for_interoception_and_bodily_emotional_self-awareness, (accessed 20 April 2018).

In this section I will explore the crossover point where internal sensory receptors meet with external sensory stimuli, and vice versa; the boundary at which internal individual worlds and external social worlds become entangled. I will argue that the crossing over, back-and-forth, interactions at these boundaries, whilst producing knowledge that is implied or ambiguous, nonetheless establishes empathetic relationships.

In order to gain a better understanding of the field of interoceptive senses that operate within the body I would like to discuss the body's enteric nervous system which is separate from the central nervous system.

In 1917 German pharmacologist Ulrich Trendelenburg showed that the bowels of a guinea pig could function in isolation, independent from the central nervous system. He discovered that 'if outside nerves are not required then inside nerves must be the ones that do the job.'[42] The bowel survived in an organ bath, performing the same reflex behaviour required within living the organism for digestion to take place. This proved that sensory receptors are intrinsic components of the organ system, lining of the wall of the gut. That they all should be there was striking because a 'similar neural apparatus does not exist in any other organ; cut the connections between the bladder, the heart, or the skeletal muscles and the central nervous system, and all reflex activity ceases.'[43] Trendelenburg's experiment demonstrated that the intrinsic nervous system of the gut actually has properties that are like those of the brain and it's subservient appendage, the spinal cord.

[42] M. D. Gershon, *The Second Brain*, New York, Harper Collins Publishers, 1998, p.5.

[43] Ibid, p.7.

[44] *Nervous System of the Digestive System*, [website], 2016, https://courses.lumenlearning.com/boundless-ap/chapter/nervous-system-of-the-digestive-system/, (accessed 20 April 2018).

This experiment lead to the understanding of the enteric nervous system, the mesh-like system of neurons that govern the function of the gastrointestinal tract.[44] The enteric nervous system is an independent site of neural integration and processing and this is what makes it 'the second brain.'[45] Our two brains, the one in our head

[45] M. D. Gershon, *The Second Brain*, New York, Harper Collins Publishers, 1998, p.17.

and the one in our bowel, must cooperate. If they do not, there is discomfort in the gut and distress in the head. In comparison to the number of nerve cells in the bowel, the number of motor nerve fibres connecting the brain or spinal-cord to the gut is incredibly small. In humans for example, There are only about two thousand nerve fibres that connect the brain to the bowel. In contrast, there are over one hundred million nerve cells in the human small intestine. This disparity indicates that 'the majority of nerve cells in the gut do not receive any input from the central nervous system.'[46]

It is thus through the sub-conscious functioning of the viscera that our consciousness is enabled. As the anatomist Dr. Michael D. Gershon states 'when the enteric nervous system runs the bowel well there is bliss in the body. When the enteric nervous system fails and the gut acts badly all syllogisms, poetry and Socratic dialogue seem to fade into nothingness.'[47] We perceive the external world in parallel to our internal visceral world.

What this shows is that within our body there is a boundary between what is inside of our conscious experience and what is outside of our conscious experience. Although we are not always consciously aware of the functioning of our inner worlds, we no doubt rely on them to operate and whilst they remain relatively quiet they are still capable of entering conscious experience. Interoceptive senses are primarily sensitive to disturbances*, becoming active when things in the body go wrong; the body is awash with interoceptive sensations if I eat contaminated food, catch the flu or overly exert myself.

Drew Leder discusses the lack of conscious connections in the interoceptive field and the resulting ambiguity it causes in our ability to perceive our external environments. The spatial ambiguity of the visceral depths is accentuated by the phenomenon of referred pain. A process taking place in one organ can experientially radiate to adjacent body areas or express itself in a distant location: 'hence the pain of a heart attack may originate in the chest area but quickly spread down the left arm. This reflects embryological origins;...the level that the viscus occupied in the developing foetus before it descended, dragging nerves along.'[49] As we have discussed earlier we rely on the overlapping of each of our spatial senses to perceive the world. A world perceived through the interoceptive senses is therefore ambiguous and implied; The perceptual field of interoception is limited in it's ability to asses spatial and qualitative external properties.

Exteroceptive senses open onto distinct multidimensional perceptual worlds, i.e. touch, smell, sound all operation in a different spatial dimension, giving a different relationship to space. Contrastingly, interoceptive senses are experienced as modulating a single dimension of perception, i.e., inner bodily sensation.

An experience of tightness in the chest could signal any of a number of cardiac, respiratory or muscular problems given the imprecision of

[46] M. D. Gershon, *The Second Brain*, New York, Harper Collins Publishers, 1998, p.15.

[47] Ibid, p.17.

*Interoception is most familiar to philosophers through the conscious bodily sensations it produces. Itches, thermal sensations, sensations of orgasm, heart-beat, thirst, indiges- tion, shortness of breath, and any form of pain, along with aspects of moods, emotions, and a ect more generally, are all forms of interoceptive experience. [48]

[48] J. B. Ritchie and P. Carruthers, 'The Bodily Senses', in M. Matthen (ed), The Oxford Handbook of Philosophy of Perception, Croydon, Oxford University Press, 2015, p.354.

[49] D. Leder, *The Absent Body, Chicago*, The University of Chicago Press, 1990, p.41.

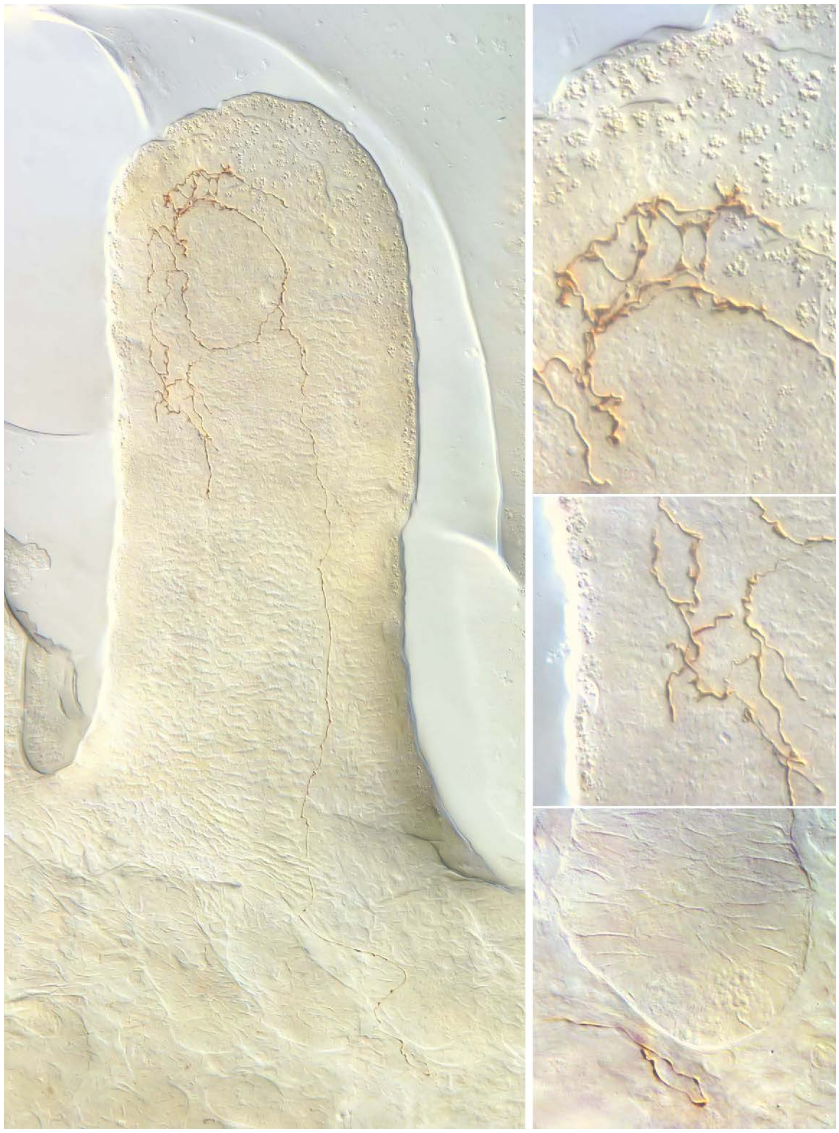


fig. 9 - Terry L. Powley, Vagus nerve supply to the gastrointestinal tract, 2011.

The Image shows rarity of vagus nerve bers in the gut. The vagus nerve bers are seen because the intrinsic nerve bers are not. If in the same image all nerve bers were stained it would be covered by an obscuring vast broad swipe of colour. (Gerhson, p.16).

interoceptive senses. The boundaries within the body are themselves entangled. Stimulation of the interoceptive senses would be therefore a convoluted stimulation and would result in entangled boundaries.

In physical terms, my body surface envelops a hidden mass of internal organs and processes. These visceral functions are largely unavailable to my conscious awareness and command. Visceral sensations are often vaguely situated within indistinct borders. The relatively small amount of afferent nerves in the digestive system, explains this inability to define distinct borders. Qualitative range and spatial precision are reduced in the interoceptive field since 'there is no clear place where they begin or end, and no precise center.'[50] Generalized stimulations take place, involving substantial portions of the organ as opposed to registering localized events.

[50] D. Leder, *The Absent Body, Chicago*, The University of Chicago Press, 1990, p.41.

Using the example of eating an apple, referring to a bite entering the body at the mouth and leaving the body at the anus, Leder discusses that 'visceral functions surface not just at orifices of initiation and termination but at multiple points along the way.'[51] Leder reveals that interoceptive senses offer inferential perceptual readings, for example since one's arteries approach close enough to the surface of one's skin in several places for a pulse to be externally palpable. Here the proximity of interoceptive senses with the exteroceptive sense of touch allows an indirect reading of one's heart function. The interoceptive senses thus represent a way of perceiving that is inferred, indirect and ambiguous. Similarly while one cannot perceive most of the vegetative process one can see what one eats and later excretes. One can infer the process of digestion.

[51] Ibid, p.51.

3.2 Interoception and the Perceived World

'What a surprising effect food has on our organisms. Before I ate, I saw the sky, the trees, and the birds all yellow, but after I ate, everything was normal to my eyes...I was able to work better. My body stopped weighing me down...I started to smile as if I was witnessing a beautiful play.'[52]

[52] C. Maria de Jesus, cited in D. Leder, *The Absent Body, Chicago*, The University of Chicago Press, 1990, p.52.

The Brazilian writer Carolina Maria de Jesus draws our attention to the power of the inner bodily sensations to permeate the experience of our external environments. In this case, the bodies visceral cravings have distorted our perception in the exteroceptive field. Our internal and external environments establish a reciprocal relationship with one another; a shift in inner sensations mirrors a shift in external environments.

Correspondingly, the opposite is true and a change in my relation to an external environment can swiftly change my visceral state. Let's take for example that I suddenly find myself in a hostile external environment; in front of me is a large, cold, wet concrete wall. My eyes traverse it's width and height to the limits of my peripheral vision where the wall disappears into a cloud of darkness. If I am experiencing a distressing environment my visceral senses will affect other bodily sensations.

The distress causing an increase in my heartbeat or butterflies in my stomach will spread to distress experienced as tensing in my limbs, tiredness of my eyes and an altered mood. As the inner sensations intertwine with a series of sensorimotor functions they effect the entire corporeal field. My inner sensations therefore have an effect on my external actions.

Evaluating something in one's immediate environment as a threat stimulates a reaction in interoceptive senses that causes a distinctive set of physiological changes. The psychologists William James and Charles Langue argued that it is one's conscious interoceptive experience that constitutes one's fear, subtracting these interoceptive experiences, leaves nothing of one's fear.[53]

In order to function, the body must maintain physiological parameters within certain boundaries. Interoception is the collection of sensory systems that 'monitor the physiological state of the body in order to maintain this internal homoeostasis.'[54] This internal homoeostasis regulates a relatively stable equilibrium between internal and external boundaries and manages the entangling interactions at these boundaries. Leder reveals that there is an external wisdom at work in all of us: 'in effect, it is extraordinary that life functions in me without me...I am a problem resolved as though by a greater wisdom than myself.'[55] The interoceptive senses that are the subconscious life forces functioning within our body act as a communicator between this mystic world of of external wisdom, and our conscious world. It is the wisdom that pumps our blood, the wisdom that invokes acid reflux in the stomach to warns us of threatening situations that cause anxious psychological states. Moreover, arousal itself plays an important role in judgements about our external worlds, rather than solely our external worlds themselves.

Our external and inner worlds mirror one another across the stimulation of interoceptive receptors and one can indirectly manage the visceral through controlling one's conscious acts or environments.

3.3 Inducing an Empathetic Relationship

'As Merleau-Ponty elucidated, it is our lived body itself, not an intellectual mind, that first perceives objects, knows its way around a room, senses the sadness in another's face. Such sensorimotor abilities are not merely a form of conception; they do not depend on explicit judgements, categories or rules. Rather, they exhibit a more primordial intentionality, which must be accorded its own logic.'[56]

Since knowledge presented to the interoceptive senses is imprecise and ambiguous, a world perceived in the interoceptive field is difficult to convey or communicate. Our knowledge of the world has, for decades, been dominated by the Cartesian premise that consciousness in through thoughts in the mind. There is, however, a dichotomy between thought in the mind and experience in the body.

[53] C. Izard, 'Basic emotions, natural kinds, emotion schemas, and a new paradigm', *Perspectives on Psychological Science*, vol. 2, 2007, pp.260-280.

[54] J. B. Ritchie and P. Carruthers, 'The Bodily Senses', in M. Matthen (ed), The Oxford Handbook of Philosophy of Perception, Croydon, Oxford University Press, 2015, p.353.

[55] D. Leder, *The Absent Body, Chicago,* The University of Chicago Press, 1990, p.46.

[56] Ibid, p.7.

Our inner embodied knowledge is formulated in the interoceptive field. While this knowledge reaches conscious experience in implied or ambiguous ways, a way of communicating this knowledge of the inner sensations is via corporeal demonstrations, i.e. through shared embodied experiences. The philosopher Joe Cruz has drawn attention to the a-symmetry in conscious knowledge that exists in the mind and in the body. He states that there is something that can't be known about experience through description alone. For example 'my knowledge of myself is different to your knowledge of me;'[57] experience is a different type of knowledge to the knowledge stored in the mind.

Cruz proposed that our inner knowledge can be communicated through shared experience that is processed by mirror neurons in the brain (the one in our skull). Mirror neurons are thought to be 'specialized brain cells that allow us to learn and empathize with another by observing their actions.'[58] A part of our nervous system that allows us to share sensations with external bodies by using narrative to transfer consciousness from one person to another.

The neurophysiologist Giacomo Rizzolati discovered mirror neurons in 1992 by observing that brain cells in monkeys appeared to be activated both when the monkey did something itself and when the monkey simply watched another monkey do the same thing. Experience of the same actions stimulates the same bodily senses.[59] The dancer and theorist Barbara Montero argues that recent discoveries about the function of mirror neurons are evidence that an audience at a performance has a corporeal, kinaesthetic experience as well as a visual one; the same neurons that are active in the performer are the same as those active in the audience.[60]

Another example of transferring consciousness in the interoceptive field is observed in patients who have undergone an organ transplant. It is common for organ recipients to seek to empathise with the body where that their organ has come from, to understand the reality constructed around this organ and therefore its inherent view of life. Claire Sylvia is one such a recipient who received a heart-lung transplant in1988 at the age of forty-eight, inheriting certain attitudes, habits, and tastes from her eighteen-year-old male donor.[61] Her example 'provides evidence for cellular memory'[62] and shows that our consciousness is embedded throughout the organs of our bodies. Organ Transplants reveal the possibility of a transferring of consciousness by knowledge stored in the organ themselves.

The examples of mirror-neurons and organ transplants reveal that in order to empathise with others, we must to observe how they act, imitate their actions and therefore have the same experiences at them. This will close the gap between thought in the mind and experience in the body. Relationships established in the interoceptive field are based on our resonances of feeling and perspective in our inner worlds.

[57] J. Cruz, *Why there is no mind/body problem*, [online lecture], 2004, https://www.youtube.com/watch?v=luJqHjqOBsM, (accessed 20 April 2018).

[58] C. Bergland, *Do "Mirror Neurons" Help Create Social Understanding?*, [website], 2014, https://www.psychologytoday.com/us/blog/the-athletes-way/201402/do-mirror-neurons-help-create-social-understanding, (accessed 20 April 2018).

[59] A. M. Glenberg, *Monkey See, Monkey Do? The Role of Mirror Neurons in Human Behavior*, [website], 2011, https://www.psychologicalscience.org/news/releases/monkey-see-monkey-do-the-role-of-mirror-neurons-in-human-behavior.html, (accessed 20 April 2018).

[60] B. Montero, 'Proprioception as an Aesthetic Sense', The Journal of Aesthetics and Art Criticism, vol. 62, no.2, 2006, p.232.

[61] C. Sylvia, *A Change of Heart*, New York, Warner Books, 1998.

[62] S. E. Braude, *Transplant Cases Considered as Evidence for Postmortem Survival*, [website], 2017, https://psi-encyclopedia.spr.ac.uk/articles/transplant-cases-considered-evidence-postmortem-survival, (accessed 20 April 2018).

fig. 10 - Daria Martin, At the Threshold, 2014-2015.

fig. 11 - Ibid.

Daria Martin's lm explores mirror-touch synaesthesia.

Our interoceptive senses provide the body with knowledge that allows us to empathise with others. Shared experiences formulate entangles boundaries that cross over between bodies. Whilst establishing push-pull interactions, communication in the interoceptive field induces empathy.

3.4 Consciousness of the Visceral

'Ordinarily that which enters the interoceptive field is simultaneously lost to the exteroceptive...the incorporation of an object to the visceral space involves its withdrawal from exteroceptive experience.'[63]

[63] D. Leder, *The Absent Body, Chicago*, The University of Chicago Press, 1990, p.39.

Since we must tailor our actions to visceral rhythms our interoceptive senses already define certain spatial and behavioural aspects of our external worlds. The day-to-day functioning of the body manifests most notably in eating patterns and bathroom habits, moments where the borders of our inner word interact with the exteroceptive field, when digestion comes full circle. Food which exists in te exteroceptive field enters the mouth and is lost to the body's interoceptive field. Resurfacing again, after excretion, to the level of consciousness in the exteroceptive field.

These are processes that must happen and whilst they exhibit a foreign mindedness, while seemingly other to the self, they are nonetheless integral to the self's existence. Our culture dictates that we close off our consciousness to the activities of the viscera. The spatial boundaries we draw around these functions, therefore, are always in a way to relegate their importance. It is precisely their due to their foreignness that they are regarded as private and taboo.

[64] *The Phantom of Liberty*, Luis Buñel, France, Fox, 1974, [streaming].

In Luis Buñel's 1974 film 'The Phantom of Liberty'[64], a film that deals with the bourgeois separation from the body, he explores cultural views towards eating and excretion and the spatial boundaries we construct around the two. In a scene depicting a dinner party the dining room table is ringed not by chairs but by toilets. The table is not for dining but rather provides a space for communal excretion and eating takes place in a private cubicle. Public defecation and discussion of waste are acceptable at the table, while even the subject of food is taboo. Perhaps unknowingly, Buñel, highlights our tenancy to draw away from consciousness of the viscera and to deny its very presence.

Diane Gromala is a designer and researcher whose work aims at awakening consciousness of the viscera. Her work deals specifically with the communication of senses in the interoceptive field born out of her desire to communicate the sensations she experiences as a result of chronic pain.

[65] D. Gromala, Curative Powers of Wet, Raw Beauty, [online lecture], 2011, https://www.youtube.com/watch?v=cRdarMz--Pw, (accessed 20 April 2018).

She argues that our dependence on senses in the exteroceptive field has 'driven us away from our more primordial senses, including our inner senses'[65] and her interactive artworks aim to provoke inner sensations as a way to establish an empathetic relationship between

subject and participant.

Gromala's Meat book is an interactive art installation that explores the use of a biological tangible interface to provoke a visceral response in the viewer. It takes the form of a traditional book but instead of pages constructed from paper and words it is made from various types of meat sewn together following traditional book binding procedures. Users interact with an animated piece of flesh. The Meatbook uses sensors to determine the location of the user. It provides biofeedback based on the proximal distance of the viewer to the book and quivers when approached in a threatening way.[66]

[66] D. Gromala and A. Levishon and J. Cochrane, *Tangible and Embedded Interaction*, Los Angeles, Baton Rouge, 2007, p.92.

Gromala argues that our reliance on language and books has driven us away from has driven us away from our more primordial senses in the interoceptive field:

'Books are the ne plus ultra of writing, the archival aspect that remains after its authors are gone. Unlike the presence demanded of our cave-dwelling ancestors in order to communicate, it is no longer necessary when or after an author writes. Thus, we no longer rely on facial expressions or gesticulations of authors; we no longer hear the timbre of their voices, see their spittle fly, smell them or sense their pheromones, mirror their kinaesthetic movements, or touch them.'[67]

[67] D. Gromala, *Meatbook*, [website], 2004, http://www.sfu.ca/~dgromala/VR/index.html, (accessed 20 April 2018).

The reciprocal exchange between the Meatbook and its user, your approach to it affecting its approach to you establishes a cross-over of boundaries. Entangling inner worlds of the user with the outer worlds of the book. It reveals that is not a phenomenon achieved through any one sense; rather it is an ontological one, 'a co-constitution, a condition formed at the confluence of mind, body and world.'[68]

[68] D. Gromala and A. Levishon, 'Taro(t)ception: Eliciting Embodied, Interoceptive Awareness through Interactive Art', British Columbia, 2008, http://teilab.tamu.edu/quek/Classes/Aware+EmbodiedInteraction/EmbodiedInteractionPAPERS/LevG09-Tarotception, (accessed 20 April 2018).

The senses stimulated by the Meatbook move from visual to tactile and by forcing a simultaneous confrontation between the nature of technology and the nature of the body, the user is made aware of each one's respective limitations. Mirror neurons are activated by the meat book when observing its kinaesthetic movement. Simultaneously generating revulsion and fascination, as well as stimulating the visceral senses the user therefore undergoes an embodied experience which highlights the viscera as having a perceptual qualia with a role in constructing experience.

fig. 12 - Luis Buñel, The
Phantom of Liberty, 1974.

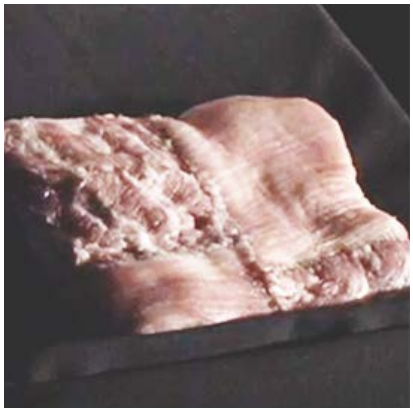
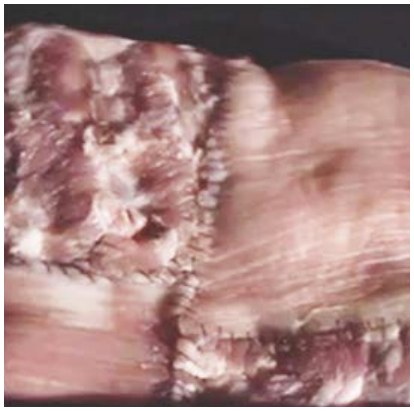





fig. 13, 14, 15, 16 - Diane Gromala, Meatbook, 2004 2007.

Now when he closes his eyes he can really look at himself. He no longer sees a mask. He sees without seeing, to be exact. Vision without sight, a fluid grasp of intangibles: the merging of sight and sound: the heart of the web. Here stream the distant personalities which evade the crude contact of the senses; here the overtones of recognition discreetly lap against one another in bright, vibrant harmonies. There is no language employed, no outlines delineated.[69]

Henry Miller, speaking of looking at oneself in the mirror.

[69] H. Miller, *Sexus*, New York, Grove Press, 1965, p.263.

PART IV : PROPRIOCEPTIVE SENSES & BLURRED BOUNDARIES

4.1 Proprioception & Body Ownership

'Not man as the king of creation but rather as the being who is in intimate contact with the profound life of all types of being, who is responsible for even the stars and animal life, and who ceaselessly plugs an organ machine into an energy machine, a tree into his body, a breast into his mouth, the sun into his asshole: the eternal custodian of the machines of the universe.'[70]

[70] G, Deleuze, and F, Guattari, *Anti-oedipus*, London, Bloomsbury Academic, 1984, p.5.

Derived from the Latin 'proprius,' meaning 'own,' proprioception is the awareness of one's own body position and location, one's sense of place in the world.* In order to understand our place in the world we relate to the position of things external to ourselves. Proprioception therefore relies on the reciprocal interaction of one thing and another. In this section I will discuss the inherent separation that is required when placing something in relation to something else and discuss how a loss of proprioception could be a way to connect, or rather blur the boundaries that create separations.

*Proprioceptors work together to establish cognitive awareness of the body in space; they include muscle spindles which provide information about muscle length, and organs in the tendons which provide information about muscle stretch.[71]

[71] J. L. Oschman., Energy Medecine, New Hampshire, Elsevier Ltd, 2016, p.4.

Proprioception is what makes us aware of our body's position and motion. This sense is relayed through nerves and other processes in the joints, muscles, tendons and skin which provide postural information including the angles at which our limbs are bent, where we are in space, and how we feel our bodies' limits and ranges of motion. With this information, we construct a body map that gets continuously updated as we move in the world. This map also provides us with an awareness of our body in relation to objects around it.

Proprioception and our ability to detect the movement and location of our body parts contribute strongly to our sense of body ownership, or the knowledge that our body belongs to us and not someone else.

For Deleuze and Guattari, the body is inherently open and dynamically interconnected with phenomena outside of corporeal boundaries. They argue that every actual body has a limited set of traits, habits, movements, affects, etc, but that every actual body also has a virtual dimension: a vast reservoir of potential traits, connections, affects, movements, etc. This collection of potentials is what Deleuze calls the Body without Organs. To make oneself a Body without Organs is to actively experiment with oneself to draw out and activate these virtual potentials.[72]

[72] G, Deleuze, and F, Guattari, *Anti-oedipus*, London, Bloomsbury Academic, 1984, p.309.

In order to become a Body without Organs and we must give up our sense of body ownership and blur the boundaries of where our body ends and another begins. This singularity and collectivity no longer at odds evokes a sense of what Henry Miller wrote in his 1949 novel Sexus; 'if man is connected to the machines of the universe, if he is in tune with his desire, if he is anchored, he ceases to worry about the fitness of things, about the behaviour of his fellow-men, about right and wrong or justice and injustice. If his roots are in the current of life he will float on the surface like a lotus and he will blossom and give forth fruit. The life that's in him will manifest itself in growth, and growth is an endless, eternal process. The process is everything.'[73]

[73] H. Miller, *Sexus*, New York, Grove Press, 1965, p.427.

Awareness of our proprioceptive sense of place in the world allows us to acknowledge the idea of being part of something larger. It enables us to couple and connect with the organisms we co-exist with, eliminating the gap in the man nature dichotomy.

4.2 The Potential to Connect

'By a change in the preponderance of the life forces, the centre of interest and attraction may shift from material fact to the idea, from the idea to the object; and in this continuous flux any other shift is possible.'[74]

In 1996 the neuroanatomist Jill Bolte Taylor experienced a stroke when a blood vessel exploded in her brains left hemisphere. Over the course of a few hours her consciousness shifted to a reality prescribed through her right cerebral hemisphere. She explains that 'there are cells in our left hemisphere's orientation association area that define the boundaries of our body, where we begin and where we end relative to the space around us.'[75] She explains that because she could not identify the position of her body in space she felt enormous and expansive. Without the ability to determine where the boundaries of her body ended and another began Bolte was 'not capable of experiencing separation or individuality'.[76] Her experience, as well as becoming a Body without Organs, suggests that a loss of proprioception is responsible for establishing a blurred spatial boundary condition.

Bolte explains that this blurred spatial condition is possible by the ability of our sensory receptors to 'detect information at the energy level.'[77] Our atmosphere is a turbulent sea of electromagnetic fields; everything around us, within us and between us is made up of atoms and molecules vibrating in space. In a world perceived through connections with the energy of our internal and external worlds, our spatial boundaries are always blurred. Bolte's revelations bring to mind the works of the architect Frederick Kiesler whose proposals deal with this kind of interconnection.

Kiesler through his theory of Correalism searched for underlying continuity, and proposed that man inhabits his world as a participant, where senses and imagination become one for reinterpreting the environment of architecture.[78] Kiesler's correalism manifesto held the promise for an architecture as a kind of second body, capable of reciprocating human sensitivities and capacities through symbiosis of biomorphic form and technology.[79] His bioteqhnique referring to the interrelation of a body to its spiritual, physicial, social, and mechanical environments. Art historian Dieter Bogner points out that in Correalism 'the differentiation of autonomous elements and the tension in the intervals between them are elemental determining factors in this vision of a system created for correlation.'[80]

In his Manifesto on Correalism published in 1947 Kielser reveals that The Endless House is a 'living organism, not just an arrangement of

[74] F. Kiesler, 'Pseudo-Functionalism in Modern Architecture', *The Partisan Review*, vol. 16, no.2, 1949, p.738.

[75] J. Bolte Taylor, My Stroke of Insight, St Ives, Hodder & Stoughton, 2009, p.35.

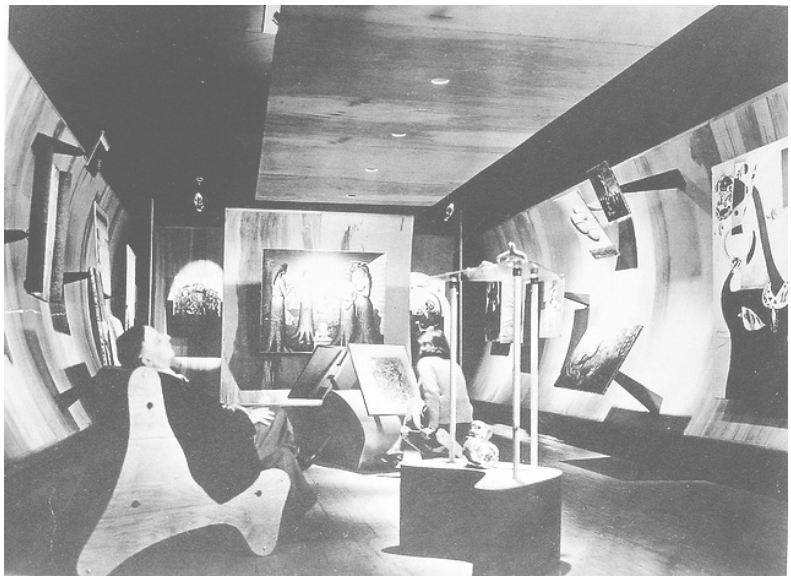
[76] Ibid, p.69.

[77] Ibid, p.20.

[78] F. Kiesler,'Manifeste du Corréalisme', *L'architecture d'Audjourd'hui*, vol. 2, 1949, pp.80-105.

[79] M. Wihart, 'The Architecture of Soft Machines', PhD Thesis, University College London, 2015, p.208.

[80] D. Bogner, *Frederick J. Kiesler. Endless Space,* Ostfildern-Ruit, Hajte Cantz Verlag, 2001, p.25.



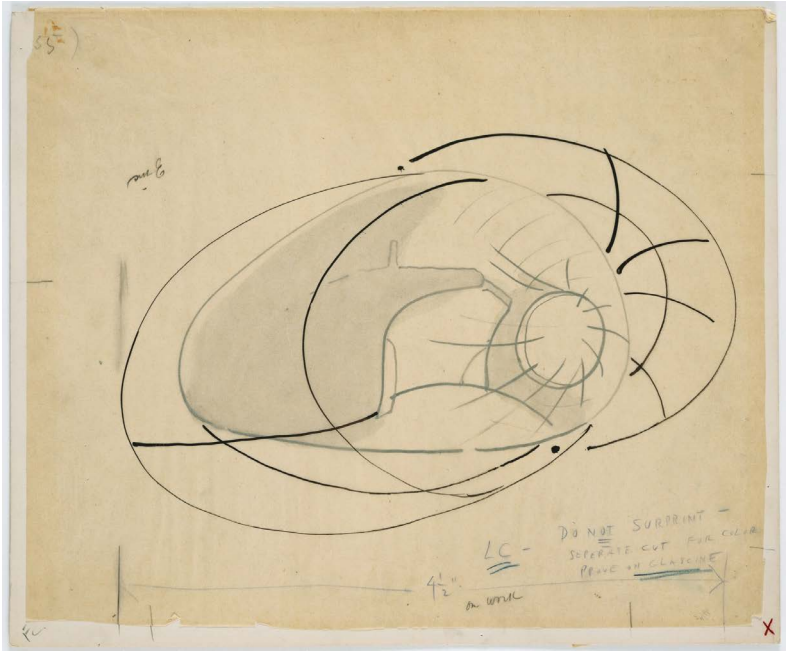
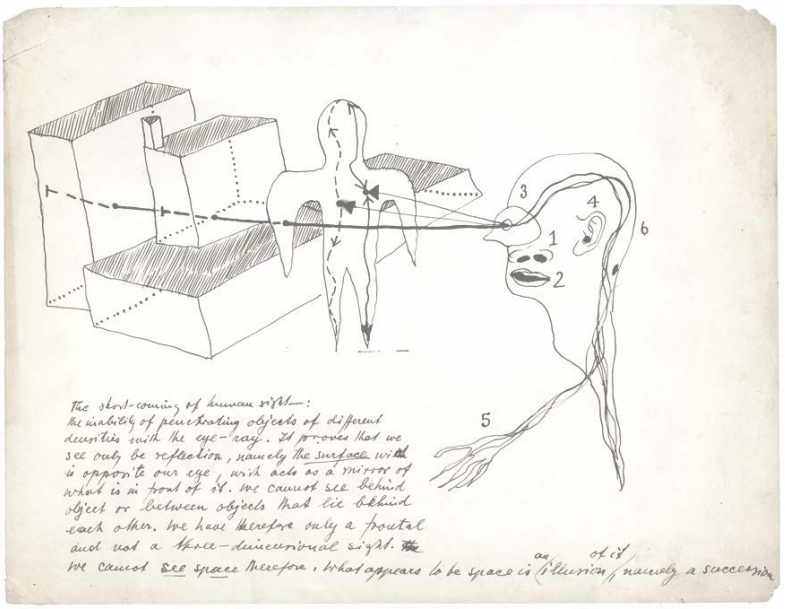


fig. 17 - Frederick Kiesler, seated in the foreground of Peggy Guggenheim's gallery, Art of This Century, 1942.

fig. 18 - Frederick Kiesler, Endless House Sketch, Interior perspective 1951.



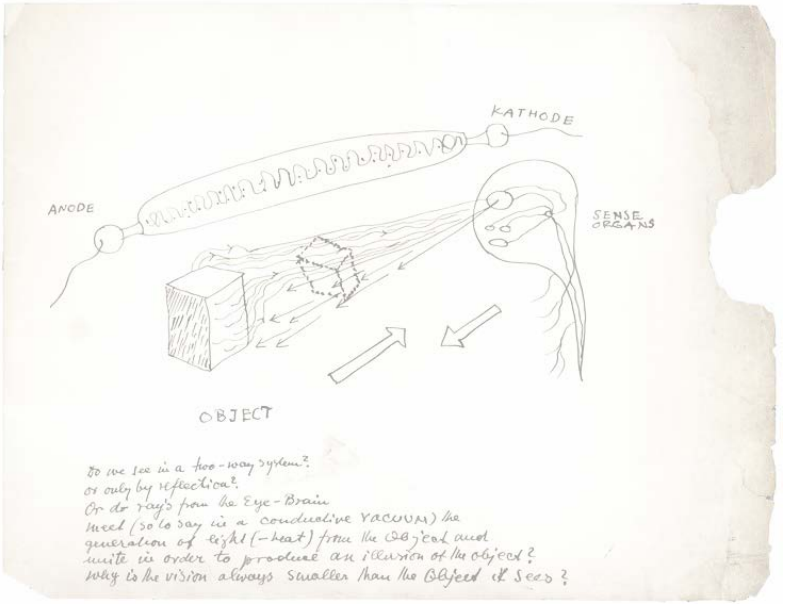


fig. 19 - Frederick Kiesler,
Vision Machine
Study on Perception, (1),
1938/42.

fig. 20 - Frederick Kiesler,
Vision Machine
Study on Perception, (2)
1938/42.

dead material: it lives as a whole and in its details. The house is the skin of the human body.'[81] He defined architecture as a system of spans (tension) in free space, a definition that he later adapted to the spatial organization of the complex pictorial exhibition designs of the 1950s and 1960s.

With the house as the skin of the human body the individual becomes a a part of a novel inner environment, the individual is an freely floating organ traversing the space of the house. In The Endless House the human psyche is as important as the paintings mounted on the walls and the spaces between them, space itself is a medium, air a thick volume. Defined tensions between objects both separate them and create interrelationships. The individual is an element of the unity that makes the cosmos of the house, bounded together within the labyrinth of art, sculpture, painting and one interconnected bounded space, where no outlines are delineated.

4.3 Proprioceptive Drift

We have seen that proprioception is what makes us aware of our body's position, limits and motion. With this information, we construct a body map that gets continuously updated as we move in the world. We are also capable of experiencing something called proprioceptive drift, a sensation where our body map is warped or extended, claiming ownership of external bodies beyond the limits of our biological bodies.

The rubber hand illusion is a well-established paradigm to manipulate the sense of body ownership in healthy individuals. When one's own occluded hand and an anatomically congruent dummy hand are stroked synchronously, this leads to a feeling of ownership over the dummy hand that is interpreted as a momentary incorporation of the seen dummy hand into the participant's body representation.[82] The rubber hands feel 'touch that the eyes sees.'[83]

Proprioceptive drift is also observed in phantom limb patients, who still feel as though the amputated limb is present. Subjects report vividly the experience of a limb that they can see is not there.[84] Philosopher Peter Carruthers suggests that the effects of proprioceptive drift might be interpreted in terms of an unconscious representation determining our conscious experience. It suggests at least that form and posture representations are 'built up' out of proprioceptive components, creating distortions of form when not integrated with vision.[85]

Proprioception, and indeed the bodily senses in general, seem to be of central importance not just for our perception of our bodies, but of ourselves. Since we know that boundaries are created through an overlap of senses, we can deduce that if an overlap is prevented between proprioceptive and visual senses the body schema* will warp, blurring the boundaries between a separate self and a connected

[81] F. Kiesler,'Manifeste du Corréalisme', *L'architecture d'Audjourd'hui*, vol. 2, 1949, p.92.

fig. 1 - Vision Machine
Study on Perception
Ink on paper, 21,5 x 28 cm
New York, 1938/42

"The inability of punctuating objects of different densities with the eye. It proves that we see only a reflection, namely the surface which is opposite our eye, which acts as a mirror of what is in front of it. We cannot see behind objects or between objects that lie behind each other. We have therefore only a frontal and not a three-dimensional sight. We cannot see space, therefore what appears to be space is an illusion of it, namely a succession."

[82] A. Wold, *Proprioceptive drift in the rubber hand illusion*, [website], 2014, https://www.frontiersin.org/articles/10.3389/fnhum.2014.00390/full#B7, (accessed 20 April 2018).

[83] M. Botvinick, and J. Cohen, 'Rubber hands 'feel' touch that eyes see', *Nature*, vol. 391, 1998, p.756.

[84] F. de Vignemont, 'Bodily Awareness', Stanford Encyclopedia of Philosophy, Fall (ed.), 2011, http://plato.stanford.edu/archives/fall2011/entries/bodily-awareness/, (accessed 20 April 2018).

*Body schema refers to a representation of the positions of body parts in space, which is updated during body movement.

being.

In an isolated sequence of spaces we have the ability to curate proprioception, this is most easily understood in the preliminary massing of a building or the diagram of masses that speak of different interactions of bodies across buildings.

The phenomenon of proprioceptive drift is also evidence for our bodies ability to take ownership of potential boundaries, merging and mingling spatial territories as an extension of the body. In architectural terms this posits the idea that buildings and spaces might be designed as prosthesis for the body, connecting multiple bodies through prosthetic physical boundaries.

Like Kiesler's Endless House, a building that curates the stimulation of the proprioceptive sense might induce a feeling of interconnection between the bodies that are in it. Through embodied experience we act on behalf of the building, to be able to understand itself, mediating its energy. Becoming a part of an interconnected system with others who carrying its energy will aid the buildings understanding of itself.

CONCLUSION

In this study I have explore how different boundary conditions are formed when a dominant sensory field is stimulated, suggesting that dominance of exteroceptive, interoceptive or proprioceptive stimulation leads correspondingly to the defining of boundaries as either distinct, entangled or blurred.

Architects deal with the configuration of bounded spaces and the 'potential boundary' is the cutting tool of the architect. The types of human relationships established within bounded spaces are a result of how these boundaries stimulate sensory receptors in a particular receptive field.

All of the senses coexist and overlap so that the contribution of each becomes indistinguishable in the total configuration of perception. Exteroceptive sensory responses to potential boundaries can be more accurately predicted than those in the interoceptive or proprioceptive fields (which in order to establish a spatial boundary require a translational binding with the exteroceptive field.) Therefore perception of our external environments is dominated by stimulants in the exteroceptive field.

a. Defining a Boundary

The architect cuts space with a 'potential boundary' he inserts into thick air. The position of the human body relative to a potential boundry defines an inside and outside and this combination of body/object defines the limits of a boundary. The field of senses stimulated at a boundary effects the relationships that people can have between one side of a boundary and the other.

Our boundaries can be extended by combining senses and through conscious awareness our inner senses. Thereby going beyond the senses prescribed by the architect at a 'potential boundary.' Boundaries require active participation from the user to determine limits i.e. projecting inner world to define outer worlds.

Edward T. Hall used concepts from biometrics to propose that; the spaces surrounding a body could be defined by tactile, auditory, visual, kinaesthetic and thermal factors, thereby highlighting that the senses are spatial. Our senses have an inherent limit of operation that is determined by their spatial range. Since we perceive boundary conditions through the overlapping of our senses, if we understand that all of our senses are peripheral systems (as well as the dominant visual sense) we can deduce that 'Spheres of Perception' are formed around our body.

Through investigations into the intertwining of neuroscience and phenomenology I have determined four variables that lead to the

formation of spatial boundaries:
1. Proximity & Direction of Body
2. Senses Stimulated by Potential Boundary
3. Ability of Senses to Overlap at Boundary
4. Awareness of Bodily Sensations within 'Sphere of Perception'

b. Distinct Boundary Conditions

Perception begins with stimulation of the exteroceptive senses which is a relatively clear field of communication compared to the proprioceptive and interoceptive. It is thus our most reliable method of perception in the realm of shared reality.

Translations of senses take place through the in exteroceptive field in an attempt to define distinct boundary conditions for clarity of communication. The subjectivity of individual perception is diluted as it undergoes a translation before it can be either projected through or informed by the apertures of the five senses. Communications across distinct boundaries in the exteroceptive field are thus inherently reductive.

c. Entangled Boundary Conditions

The perceptual field of interoception is limited in it's ability to asses spatial and qualitative external properties. This is since the boundaries of interoceptive receptors within the body are themselves entangled.

Within our bodies is an enteric nervous system that is separate from the our central nervous system. Visceral bodily sensations remains most of the time subconscious. We can, however, indirectly manage the visceral through controlling our conscious acts or environments. The way we perceive the external world is dependant on the operations of interoceptive sensations in our internal visceral world. The crossing over of worlds and back-and-forth interactions at entangled boundaries creates empathetic relationships.

Our interoceptive senses provide the body with knowledge that allows us to empathise with others and a way of communicating this knowledge is through shared embodied experiences.

Mirror-neurons and organ transplants reveal that in order to empathise with others, we must to observe how they act, imitate their actions and therefore have the same experiences at them. Relationships established at entangled boundaries are based on our resonances of feeling and shared embodied experiences which are implied.

d. Blurred Boundary Conditions

Blurred boundaries involve: loss of body ownership, no awareness of separation or proximity and a sense of interconnection. Proprioception provides us with an awareness of our body in relation to objects around

it, relying on an inherent separation in order to interrelate one thing to another. Loss of the bodies proprioceptive sense leads to blurred boundary conditions where a sense of the bounded individual gives way to an interconnection with the perceivable environment.

This blurred boundary condition is observed in the ambitions of Frederick Kiesler's Endless House and Jill Bolte Taylor's experience of a stroke. In both examples, a world is perceived through interconnection with the energy of our internal and external worlds.

Since proprioception establishes body ownership, distortion of the sense leads to distortion of the bodies physical limits. The ability to experience proprioceptive drift, is evidence for our bodies ability to take ownership of potential boundaries, merging and mingling spatial territories as an extension of the body. This posits the idea that buildings might be designed as prosthesis for the body, connecting multiple bodies to mediate the energy of the building.

e. Navigators of Nuanced Boundaries

The sensory stimulation offered by our external world affects our perception of its reality, its limits and its borders. We have seen through this study that it is also how we attune our senses that determines our perception of boundaries as much as it is through stimulation of senses by external stimuli.

This study has provided examples of how those working in spatial professions might begin to curate sensory stimulation beyond the exteroceptive field and into the fields of interoception and proprioception. Highlighting the opportunity for the architect to design environments that awaken a collective awareness of the inner sensations that subconsciously operate within us. We have been conditioned to privilege a world perceived in the exteroceptive field to the point where we neglect entirely our inner sensations and sense of interconnection. Findings brought to attention here suggest the authenticity of human relationships founded on implicit knowledge and experience, resulting from relationships established in interoceptive and proprioceptive fields that are by nature implicit, spatially ambiguous, entangled and blurred.

With a new found understanding of how we perceive bounded spaces through Sherrington's 'Three Fields of Reception' we find ourselves in a position as navigators of nuanced spatial boundaries. Being aware of them will help us design for our multitude of bodily senses, enriching our perception of bounded space.

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fig. 20 - Frederick Kiesler, Vision Machine Study on Perception, (2) 1938/42, https://lebbeuswoods.wordpress.com/2009/12/22/kieslers-double-vision/, (accessed 20 April 2018).