Malleable mind and matter and reciprocal interpretation of spatial geometries in physical reality

Are buildings fixed objects?

Taking no time to reflect upon this, intuition tempts us to immediately focus on buildings as physical objects and interpret the term 'fixed' to refer to shape or materiality. A one-dimensional consideration could quickly and easily lead us to draw a conclusion and respond 'yes, buildings are fixed objects.' The truth, however, is that we have understandably fallen into the trap which architectural observation and contemplation have been lured towards; architecture tends to be self-referential, isolating itself from human life. Architecture, as a philosophy and a creative discipline, has severed itself from the reason it exists – human users. This solipsistic mode of theorizing and practicing runs in circles and will unlikely yield a deeper understanding of (architectural) space and buildings. The posed question of buildings' fixity begs for a more complex analysis; pondering this needs to incorporate rather intricate thought.

What a wonderful place from which to emerge a new architectural debate based on a relative rather than an absolute viewpoint. We will use the duration of this philosophic-scientific research paper as a starting point and confront the question whether architecture is fixed not concerning spatial manifestation and tangible transformance in Euclidean space, but from the perspective of human perception. Our investigation straddles multiple disciplines and deals with epistemological and experiential topics, as well as cognitive and neuroscientific questions and experiments.

Which starting-off point do we choose to assemble our contemplation around for a systematic investigation? The logical answer is time; time is the lynchpin on which every single human experience hinges. Time progresses, is continuous, and a building in progressing time cannot be as fixed as our initial and ignorant reaction assumed. The user experiences (architectural) space in time, continuously promoting change of usage, participation, and appropriation of a building. The intuitive answer we were tempted to give wavers further.

The next step we need to take towards a complete picture of the user is, of course, to acknowledge the user as a human, a subjective being with subjectively tinted emotions and personal views of the world. These views are shaped and defined by life experience.

By shifting our perspective on a building's fixity from an objective to a subjective point of view, the assumed fixed object becomes one that changes in accordance with whoever's subjective experience is relevant respectively. The differentiation between the objective and the subjective character of our architectural observation is crucial to this reflection. From an objective - intuitive - point of view a building may appear to be fixed, the realization drawn from a subjective observation, however, differs

greatly. A simple question ‘Are buildings fixed objects?’ has led us directly to a dichotomy which is rooted into our very way of perceiving the outer world. This dichotomy is that of the objective and the subjective, the fixed environment and its malleable perception.

Every one of us, as a user and a thinker, moves through and thinks about the real world under the impression that its experience is independent from our wilful influence. Modern neuroscience views every human’s (seemingly) independent reality and personal ‘me’ to be the product of a complex process in the human brain. Reality appears to be absolute and we believe our individual experiences to be embedded into this common ground and shared by everyone around us. In actual fact, reality is relative and is embedded into each experiencing system. Considering that reality revolves around each human and not each human around it, we need to understand the process of perception in order to be able to offer an answer to why intuition leads us to believe that buildings are fixed, when an analytical reflection tells us otherwise.

Human beings make sense of space and process it by breaking its experience down into a chronology of events. We effortlessly perceive the world around us and are mostly unaware of the complexities involved. Vision, as an example, is an intricate series of events. Essentially, the three dimensional world around us is converted into a code of symbols and then transmitted to the brain, which in turn creates an image representation for us internally. Communicating this experience again involves transformation; we interpret our internal image representation and relay the information in a linear manner, our linguistic flow creating not only succession by means of our timeline, but also defining a hierarchy. This, of course, varies from user to user and from time to time and is deeply individual and dependent on internal as well as external factors. It is important to now investigate where these factors come together and are coordinated. Where we place focus and how we make combinations and come to conclusions varies from human to human and from instance to instance.

The human brain’s principal task is to be conductor to a complex orchestra of living matter and to mediate between the inner milieu of our bodies and the outer world these bodies inhabit. It achieves this by creating and coordinating sensual compositions.
The outer world is the source of a broad variety of input into our minds and bodies. Experiencing the environment around us happens via the neuronal channels which receive impulses from the bodies’ sensory organs and it is through these connections that the brain stores information about its surroundings. Storing information in the form of ‘internal images’[1] for future reference is vital for a system in order to recognize and understand the world it inhabits.

[1] Gerald Hüther (2010), *Die Macht der Inneren Bilder*, Vandenhoeck & Ruprecht

The neurobiologist Gerald Hüther uses the term 'internal images' to encompass all physical, emotional, and cognitive building bricks human beings store in their bodies and minds in the course of their lives. These building bricks of course depend on the network in which they are embedded.
The brain's systems operate based on a constant feedback loop of self-monitoring and environment-monitoring. Each action, thought, or feeling is the consequence of previous experiences and is weighted against information which has been stored for comparative reasons.[2] Identical triggers will always result in differing (re)actions from one occasion to the next, as the progression of time brings with it additional layers of information and influence.

Neurophilosophical models treating human perception grades and their hierarchical interconnectivity (such as Bernard Baars' *global workspace theory*[3], which offers that humans are all equipped with a basic, shared plan of the world) have led us to the assumption that architecture is predominantly situated in unconscious lower-order experience.[4]
Neuroscience makes the distinction between (e)motions[5] and emotions, illustrating how some feelings and their designation are hard-wired into our genes to equip us with a basic fight or flight programme, while others depend on the lives we lead and the circumstances involved.
We believe that the relationship between architecture and user relies on the subtle process of perception, reserving target-oriented apperception for social interaction or aberrations in environmental context. This makes sense when reasoning from an evolutionary viewpoint and when referring to neurobiological economy.

Perception happens on many different levels; therefore, we need to speak of the perceptive spectrum. At one end lies unconscious perception, at the other conscious apperception. Momentarily static perception, superimposed appetition and consequential re-evaluation determine the occurrence of apperceptive states. Architectural perception and apperception rely on sensual experience. It is the idiosyncratic composition of sensual patterns – visual, auditory, tactile, olfactory and proprioceptive - which forms each unique perceptive semblance. Each composition imprints itself differently on individuals due to their respective background and varying accumulation of 'internal images'.
Architectural impact is rarely – in the greater scheme of things – a conscious occurrence; it is our unconscious – lower-order consciousness - which processes most of the architecture around us. We

[2] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World. An introduction to the neuroscience of subjective experience,* Other Press, LLC, New York, p.26

[3] Thomas Metzinger (2003), *Being no one*, The MIT press, p.120

[4] A detailed explanation of this hypothesis can be found in Clemens Plank's doctoral dissertation *The Conscious User of Architecture*, 2010.

[5] evolutionary motions, Brain Science Podcast 65 (2010), *Affective Neuroscience with Jaak Panksepp. The Foundations of Human and Animal Emotions*

only become aware when associating the unconscious information with something immediately apperceivable.

Sigmund Freud offered an explanation for the transition from unconscious to conscious through the routes of 'Wortvorstellungen' (word presentations) to 'Dingvorstellungen' or 'Sachvorstellungen' (thing presentations); we become consciously aware by expressing ourselves, for example through words or images.[6] By communicating our experience of architectural space, we realize aspects of space that were previously only present in our unconscious, as we are actively devoting directed attention and not simply passively receiving. Communication of space can of course happen in an internal thought process, it suffices to express one's experience to oneself without the presence of another human being.

Regardless of the prevailing perceptive state tending to each of the multitude of ongoing impressions, the information these states yields is always stored in our brains and bodies as memory.

Unconscious storing of impressions and memories is referred to as implicit memory, where explicit memory is a conscious process which draws upon the brain's capacities of working memory. Working memory is the ability to hold onto information consciously. Generally seven units of information can be retained simultaneously; visuo-spatial information retention is far more restricted with only four units in most humans.[7]

In other words, implicit memory happens at the perceptive end of the aforementioned spectrum, explicit memory at the apperceptive end.

When creating memories, the brain first encodes the information received, which enables it to store the data and later retrieve it, sometimes at will, sometimes haphazardly, sometimes circum- or happenstantially. Conscious experience happens in a buffer zone before the consciously perceived moves into short-term and eventually long-term memory. Why and how some information is filed away in long-term memory is not fully understood, however consensus exists that both importance and impact of content as well as recurrence and repetition are responsible (although these do not all need to concur). Consciousness stretches beyond the present both into the past and the future and we are able to re-play and pre-play interaction with the space around us. Apperception occurs when our internal simulations of past and future move to the forefront of our attention; perhaps when we are reminded of past events (of space) or when weighting possible future scenarios against one another.

David Chalmers talks of intensions to refer to the parallel – often counterfactual - paths of options we create in our brains for reference and comparison. We apperceive space when we actively note our

[6] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World. An introduction to the neuroscience of subjective experience*, Other Press, LLC, New York, p.253

[7] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World. An introduction to the neuroscience of subjective experience*, Other Press, LLC, New York, p.81, 83

specific world and ourselves within it.[8] Noting the status quo of self and environment is dependent on the internal existence of alternatives from which the present situation is set apart. Our imagination constructs these alternatives based on accumulated knowledge about the world; the more we know, the more concrete our pool of constructed versions becomes. By the time adulthood is reached, it has become second nature to calibrate one's present state against one's 'internal images' and spatial experiences do not need to happen at the forefront of attention; if everything adheres to - informed - expectations, experience relies on established facts rather than actual immediacies. Said calibration and the stretch between actuality and construction become subtler the more experienced the human in question is. Children have yet to amass an inner pool and so tend to not only experience more directly and forcefully, but also construct rather fantastical – uninformed – counter-options.

Imagine now the vast amount of intelligence processed on a daily basis. It is more than reasonable to accept that the majority is handled on an unconscious level; unconscious occurrences form every conscious moment of our lives. It is our unconscious which receives and stores images of the architectural environment. It is then our unconscious self, which is involved in the amassing and converting of information, which seeps into our conscious self and influences us. A sufficiently changed human system can re-encounter a familiar environment and perceive it differently, however subtle this transference may be and however unaware the system may appear to be.

Humans differ from other species in that we are extremely capable of what Antonio Damasio[9] terms 'extended consciousness'. Core or primary consciousness describes the aspect of consciousness that refers to simple – immediate - perception. Extended, reflexive, or secondary consciousness is thinking about and considering perception, which of course involves the past and the future and the programming, regulating, and verifying of action. It is these re-representations which are enabled by Chalmers' intensions.[10] Only by be being able to create counterworlds of possibilities and options, are we capable of reflecting and considering.

Retrieved – stored - information is selected from either episodic[11] or semantic memory[12], as opposed to procedural memory[13], which is part of the brain's working memory process. Episodic memory provides the basis for personal re-experience, semantic memory supports this with objective facts; they are constantly projected onto procedural input for comparison and evaluation. The accumulation of

[8] David J. Chalmers (1996), *The Conscious Mind, In Search of a Fundamental Theory*, Oxford University Press, New York Oxford, p. 57

[9] Antonio Damasio (1999), *The Feeling of What Happens*, Heinemann, London

[10] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World. An introduction to the neuroscience of subjective experience*, Other Press, LLC, New York, p.96

[11] Episodic memory is reserved for personal events, memory of events rather than facts.

[12] Semantic memory is "a network of associations and concepts that underlies our basic knowledge of the world – word meanings, categories, facts and propositions, and the like"
Daniel Schacter (1996), *Searching for Memory*, Basic Books, New York, p.151

[13] Procedural memory "allows us to learn skills and know how to do things"
Daniel Schacter (1996), *Searching for Memory*, Basic Books, New York, p.135

memories makes up an individual's life-story and each unit of memory information is linked to a mainly unconscious perception of its respective surroundings.
Declarative memory (memory which we actively remember acquiring) constitutes only a very marginal part, however it is then more often than not linked to the spatial context in which it was generated. By referring to space, humans indeed place their memories.
Considering that each unit of memory also has feelings attached to it and that these feelings vary from incident to incident, each piece of episodic information changes our overall impression of individual spaces and then their immediate experience.

In *Questions of King Milinda*, a Buddhist work dating from the second or first century B.C., a passage describes an analogy of the self's state of flux, which accords with the viewpoint that while the self is constantly changing it also remains itself. Humans are compared to chariots made of single elements. None of these elements is the single essence of the chariot, it is only together that they form it. Humans can be seen as an amalgam of five elements – the physical body, feeling and sensation, ideation and mental activity, mental formations and perception, and consciousness. These elements are in dynamic flux, never static, the self is attributed to the aggregation of these elements.[14]
The current state of self - the 'id' - and the extended self - the 'ego' - appraise the world in feedback and feedforward unison.
In relation to the architecture which surrounds the human self we can speak of architectural 'id' and architectural 'ego'. The 'ego' is each space in its entirety in time, the 'id' refers to the immediate snapshot in which it is being experienced.

How does this relate to our preliminary question? Fluctuation in our experience of the architectural environment depends on the state of our 'internal images'.
Re-experiencing architectural environments brings with it the element of time. Events, (even those which occurred outside of the space concerned) happening between one point in time to another influence the brain and can so prompt the system to re-perceive the same environment under light of its own development while the environment remains the same. The time which passes between each architectural encounter brings with it an accumulation and addition of 'internal images'; this means the point of reference changes constantly, therefore the perception of environment happens against a constantly changing backdrop. Architectural environments and their intentions and circumstances change; buildings and their perception are at first rooted in the context in which they were conceived of and created, they then immediately become involved in a process of interpretation due to temporal modifications and changes of and by users.

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[14] Sharon Begley (2009), *The Plastic Mind*, Constable, London, p.88

Time is not only important in its property of embedding architectural space into a context.
Immanuel Kant concerned himself with space in an all-encompassing manner, choosing to not solely focus on its property as an 'empirical reality', but suggesting the additional concept of its 'transcendental identity'. Time is this transcendence, providing diachronous sequence in addition to synchronised juxtaposition.[15]
How we process space can be examined by how language is used contextually, as language ultimately is one of the evolved brain's operative modes of sense-making. Psycho-linguist Willem Levelt explains the succession of spatial structures predominantly to be ordered from origin to destination when these are communicated (to oneself or an opposite); the mind transforms space into time, each spatial structure is converted into temporal succession, emphasizing differences in the spatiality of objects and organizing these as temporal functions in linguistic – conceptual - representations. This process is known as known as linearization.[16]

Linear it may be, nevertheless the relationship between environment and brain needs to be appreciated as a two way street of causality. Humans influence their environments by living it them; in turn, existence in and experience of an – architectural - environment have been shown to lead to systematic mental activity, which in turns changes actual brain structure. This is known as neurogenesis – the birth of new neurons or (re)wiring or strengthening of synaptic connections.
Experimental psychologist William James introduced the word plasticity (1890) when referring to the science of the brain. His observations shaped his view that "organic matter, especially nervous tissue, seems endowed with a very extraordinary degree of plasticity" and the brain was a "structure weak enough to yield to an influence".[17]
One of the most interesting and important discoveries made in the last years of the twentieth century shows that each individual possesses the power to expand and diminish designated cortical areas according to requirement and use.[18] Neuroscientist Mriganka Sur has shown through a series of experiments that even functional designation of brain areas needs to be reconsidered. "Whether function is localized in the brain is one of the deepest questions in neuroscience. We are now seeing that localization is not as fundamental as we once believed. The outside world has the potential to change the brain, and it does. The brain is dynamic; stasis is illusory."[19]
The main way of influencing and shaping the sectioning of our brains is by way of our experience of the outer world. The lives we live in the architectural spaces we live in compose the very make-up of our brains. In order to make a considerable impact either repetition of sorts, or prolonged immersion in

[15] Herausgegeben von Jörg Dünne und Stephan Günzel (2006), *Raumtheorie, Grundlagentexte aus Philosophie und Kulturwissenschaften*, Suhrkamp Taschenbuch Verlag, Frankfurt am Main, p.30

[16] Karin Wenz (1997), *Raum, Raumsprache und Sprachräume: zur Textsemiotik der Raumbeschreibung*, Gunter Narr Verlag, Tübingen, p.58

[17] William James (1983), *The Principles of Psychology*, Harvard University Press, Cambridge MA, p.110

[18] Sharon Begley (2009), *The Plastic Mind,* Constable, London, p.8

[19] Sharon Begley (2009) , *The Plastic Mind*, Constable, London, p.57

the triggering circumstance is required. Comparably, a highly stimulating and challenging environment can prompt change in a singular instance. Having undergone the process of neurogenesis, the perceiving system then experiences a mentally established environment from a familiar yet different viewpoint rather than an entirely fresh one. The relationship has changed; assimilation prompts acceptance and repositioning, adjustment, or conversion. Human and environment through no active control are engaged in a life-long loop of mutual influence, be it driven by novel impulses or by familiarity.

Neuroscientist Fred Gage puts it well in saying that "the environment and our experiences change our brain, so who you are as a person changes by virtue of the environment you live in and the experiences you have."[20]

Architecture influences brain structure and complexity by its own structure and complexity. The more intricate a space, the more it engages the user both physically and mentally and so promotes greater neuronal and synaptic changes. We feel these changes by way of a transformation of perceptive experience, whether conscious or unconscious.

Neuroscience has come far in explaining the physiological mechanisms of perception by gathering objective data and empirical results of observations of brain activity and performance. The great epistemological question of why perception feels the way it does, however remains. The explanatory gap between subjectivity and objectivity – first person and third person perspective - by its very nature can understandably never be bridged.

That said, an approximation of the materialism of the brain and the mentalism of the mind are possible and each scientific step taken provides further insight.

Consensus exists among modern neuroscientists that brain and mind are made of only one type of 'stuff'. This 'stuff' is perceived in two different ways, comparable to either surface of a moebius strip. It appears a mere illusion that the mental apparatus consists of two separate components. Dual-aspect monism (or neutral monism)[21] views humans and their brains to be physical, when viewed from the outside (object) and mental, when viewed from the inside (subject). Observing one's own reflection means simultaneously perceiving one's body externally and one's mind internally, the differentiation is simply one of perception. The implication for the perception of architecture is obvious. Viewed from a physical, objective, and external viewpoint the tangible structure and layout may remain the same, introducing an observing system, which processes the experience internally - under consideration of feelings and impressions - counteracts the fixity of architectural space. Assuming, for argument's sake, that space itself continues to be entirely static, in correspondence with a human

[20] Sharon Begley (2009) , *The Plastic Mind*, Constable, London, p.87

[21] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World. An introduction to the neuroscience of subjective experience*, Other Press, LLC, New York, p.56

Vilayanur Ramachandran (2003), *The Emerging Mind*, Profile Books Ltd, London, p.37

counterpart it forever shifts and evolves. Space and the experience thereof are not merely inextricably interwoven, they are essentially one. The unifying point of reference for this monism is the human, who is caught in a unified unbroken experience of space and time as a single entity. Appraising architectural space for its constancy is relative to the human.

Experience and how we feel about it, is in its most basic interpretation what we view as consciousness. External perception influences the content of our consciousness (and on occasion variation in cortical zones); the qualitative state of our consciousness pertains to our internal situation. The exterior guides the conception of inner representational maps. Concrete changes in the outer environment are echoed in the content of human consciousness, but more importantly create internally produced thoughts and corresponding images. These patterns are not only constructed through external perception, but also affect that very information itself and thus alter its origin and themselves.

Consciousness and unique conscious viewpoints emerge from each individual's mind, which resides in brain structure. We have established that brain structure is in a constant state of modification, it follows that consciousness too is subject to change. The fact that we live dynamic, rather than static lives and are engaged in continuous alteration and development results in adjustment, even reconfiguration, of our neural connections and their conscious and perceptual expression.[22] The most effective procedure actualising change is dynamic attention.[23] Diligence and mental effort influence our skills and abilities, exposure to and impact of environments, both new and old, influence our view of the outer world.

In his book *The Feeling of What Happens*, Antonio Damasio[24] deduces that consciousness is not simply awareness of the inner state of the self, but rather a fluctuating correspondence between the current state of the self and the current state of the world. The unifying point of reference is always caught in its current state and relates to its surroundings in this state.[25] Damasio shows that each unit of conscious information - generated by rhythmical oscillations, pulses of activation of cortex - forms a momentary link between the self and a respective object. These couplings create our feelings concerning circumstances. We constantly project these feelings onto the world and connect the so-perceived to our state of self-awareness. Contemplated this way, our view of the outer world constitutes how we feel about our environments, as much as it constitutes how we feel about ourselves and who we are.

As adults, we project expectations, which are derived from previous experiences, onto the world and therefore perceive individually determined constructions. Small infants have yet to learn and gather

[22] The Dalai Lama, Howard Cutler (1998), *The Art of Happiness: A Handbook for Living*, Riverhead, New York, p.44, 45

[23] Sharon Begley (2009), *The Plastic Mind*, Constable, London, p.28

[24] Antonio Damasio (1999), *The Feeling of What Happens*, Heinemann, London

[25] p.90, Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World, An introduction to the neuroscience of subjective experience*, *Other Press, LLC, New York*

experiences, they perceive directly rather than through such a filter. Adults view the world 'top-down' through a mist of ever growing baggage, whereas babies see an untainted world 'bottom-up'. The philosopher Thomas Metzinger uses the *Self-Model Theory of Subjectivity*[26] to depict how subjective experience is composed. He believes three key components to be at play. First, there is a *globally available model of the world*, which is installed into our very make-up, acquired through evolution. Then, there is a *virtual window of presence* and finally there is *transparency*. The model of the world is embedded into this window and viewed through a transparent veil, which we ourselves fashion through and throughout our lives. The overall model provides the basis for both simultaneous and successive perceptive operations and is fertile ground for the acquisition of knowledge. It is the context into which we file our experiences and learn.
Each human user generates a uniquely shifting layer of interpretation and projects this onto the experience of space. The life-long learning process that accompanies us may attenuate as our age progresses, it does however consistently densify and intensify this transparent layer and so changes our image of the world. In the mind, architectural space therefore is never fixed.

A synthesis of flexibility and standardisation are of key importance when navigating through life. To have an – apperceptive - impact, architectural experience needs to offer both (acquired) predictability, as well as deviation from conformity. The brain manages to tap into its malleable nature when it is in the mental state of attention and focus, which is the requirement for change and adaptation. The standards which are installed into our DNA account for phenomena of universal application or reception. Elements of flexibility help shape our cultural, social, and individual view. What we think of as changing the brain is actually simply the affection from one brain state to another in a Newtonian cascade, composed of electrical and chemical reactions. Interactionalism states that body and mind are involved in continuous interaction, mental events cause physical events and vice versa.[27]
Comparatively, body, mind, and environment also engage in constant interaction, where anthropogenic occurrences effect external changes in the outer world, tangible or perceptive, as well as the other way around.

The fluctuation architecture undergoes and promotes in the cerebral processing of the human brain is not always mirrored in a spatial – material - sense. Neuroscience is beginning to be able to quantify and depict this fluctuation through the channel of observations of changing brain matter and action patterns. Brain matter, however, can only exist in combination with the elusive intangibility of the mind, which gives a qualitative feel to reality. Reality does not depend on physicality. Immateriality is as real as materiality, it is simply a question of state and angle of mind. We live our lives through

[26] Thomas Metzinger (2003), *Being no one,* The MIT press

[27] Mark Solms, Oliver Turnbull (2002), *The Brain and the Inner World, An introduction to the neuroscience of subjective experience*, Other Press, LLC, New York, p.52

experience, after all, and it is phenomenal experience by which we see and feel the space around us. The immediate product of how environmental – architectural – stimulation makes us feel and experience is our perceived event of space. The point therefore is not whether architectural space itself is fixed, but that our connection to space is in constant flux.

Is then changing experience not changing space?