2024
volume 21 | issue 2

The ARCC Journal for Architectural Research

Between Objective and Subjective Architectural Experiences: Conceptualizing Refractive Neuroarchitecture Phenomenology

Yongjun Shin

Abstract

This essay aims to develop a conceptual framework to assess how people experience the built environment through a critical review of neuroarchitecture, architectural phenomenology, and neurophenomenology. Our experiences with the environment are mediated by our brains, such as through neurophysiological responses to colors, shapes, or heights. These experiences are conventionally defined as “universal” and “objective.” Additionally, our experiences are constantly refracted by our unconscious subjective cognitive filters in the brain.

Based on the critical literature review and synthesis, this study conceptualizes our phenomenological, natural, everyday architectural experience as refractive neuroarchitecture phenomenology, defined as a study of humans’ subjective architectural experiences through an epistemological and methodological convergence of the first- and second-person phenomenological and third-person neuroscientific methods. This conceptual framework maintains that architectural experience is fundamentally subjective and predominantly unconscious; however, it can be assessed through objective neuroscientific and subjective phenomenological methods. It holds intellectual significance as it seeks to integrate both objective and subjective epistemologies and methodologies into architectural research, fostering methodological innovations for empirical studies.

Keywords: neuroarchitecture, architectural phenomenology, neurophenomenology, refractive neuroarchitecture phenomenology, sense of place

Stable URL: https://arcc-journal.org/index.php/arccjournal/article/view/1222

DOI 10.17831/enq:arcc.v21i2.1222

Corresponding Author: Yongjun Shin< umaysay@gmail.com >, <yongjun.shin@bridgew.edu>

INTRODUCTION

The built environment has a significant impact on human life as people generally spend up to 90 percent of their time within it (Altman 1975; Klepeis et al. 2001; Rapoport 1982). Abundant studies in various disciplines have demonstrated its impacts in areas such as, physical and mental health, well-being, and social integration (see Bertram and Rehdanz 2015; Evans 2003; Fullilove 1996; Guite, Clark, and Ackrill 2006; Gumpert and Drucker 2001; Matte and Jacobs 2000; Roux and Mair 2010; Sarkar and Webster 2017; Schweitzer, Kim, and Mackin 1999; Shin 2009). Therefore, it is essential to invest more resources and efforts into designing and making improved public places, as they can enhance people's lives regardless of their backgrounds or social positions.

To improve placemaking by offering knowledge and insights into how the built environment affects human behavior and mentality, various research approaches and methods have been developed and applied. Among these approaches, advancements in neuroscience have led to increased research uncovering the detailed mechanisms by which physical environments affect our lives, specifically by demonstrating their impacts on brain activity (Arbib 2021; Aspinall et al. 2015; Assem, Khodeir, and Fathy 2023; Eberhard 2009; Higuera-Trujillo, Llinares, and Macagno 2021; Lee, Shin, and Park 2022; Maleki and Bayzidi 2017; McCoy and Evans 2002; Meyers-Levy and Zhu 2007; Ritchie 2020; Robinson and Pallasmaa 2015; Vartanian et al. 2015; Wang et al. 2022).

This type of neuroarchitecture research tends to focus on assessing humans' "universal" and "objective" experiences with the built environment, such as neurophysiological responses to physical environments. However, humans also experience the built environment in subjective ways. Indeed, each of our brains actively interprets the built environment with different emotions and meanings as they are composed of numerous subjective and intersubjective interpretative or sense-making filters, lenses, or frames, existing in the form of neural networks (Javanbakht 2011).

In this context, phenomenology, as a philosophical inquiry into experience and consciousness, helps us assess our subjective experiences with the world, including architecture, from a first-person perspective. It holds that our experiences are interpreted differently based on our subjective and intersubjective interpretive filters (Abawi 2012; Dilthey 1976; Heidegger 1988; Husserl 2012; Merleau-Ponty 1962; Seamon 2000). Therefore, our experiences with the built environment should be evaluated not only through objective, third-person scientific methods but also through subjective, first-person phenomenological approaches.

As neuroscience addresses the relationships between our subjective experiences and objective bio-physical embodiment, neurophenomenology has emerged as a complementary approach to studying consciousness within phenomenology (Rudrauf et al. 2003, 21). This approach helps us overcome the limits of the current neuroarchitecture research and architectural phenomenology. Based on a critical and synthetic discussion of neuroarchitecture, architectural phenomenology, and neurophenomenology, this study explicates how people experience the built environment with the concept of a sense of place, which refers to a subjectively and intersubjectively created, but universally detected emotion in the human mind. Regarding the sense of place, human geographer Yi-Fu Tuan provided two intriguing constructs: public symbols and fields of care, which are rooted in architectural phenomenology. Finally, the study conceptualizes this epistemological convergence of architectural experience as refractive neuroarchitecture phenomenology.

NEUROARCHITECTURE

Neuroarchitecture is an emerging field within architectural studies that seeks to scientifically assess the interactions between humans and the built environment through interdisciplinary collaboration among architecture, neuroscience, and environmental psychology (Ezzat Ahmed, Kamel, and Khodeir 2021; Karakas and Yildiz 2020). The concept of neuroarchitecture has deep historical roots, drawing from early insights into how special design influences human experience. A significant example is Jonas Salk, the virologist who developed the polio vaccine. During the 1950s, Salk experienced a significant breakthrough while spending time at the Monastery of San Francisco de Assis in Italy. This led him to recognize the profound impact that architectural environments can have on creativity and mental clarity. Inspired by this insight, Salk partnered with architect Louis Kahn to design the Salk Institute in California. The institute's design aimed to promote innovative scientific work by creating an environment that enhances cognitive function and creativity (Ritchie 2020).

Decades later, with the turn of the new millennium, Fred Gage, a neuroscientist from the Salk Institute, founded The Academy of Neuroscience for Architecture (ANFA) in San Diego. This center is dedicated to researching how environmental factors influence our brains. Gage coined the term "neuroarchitecture" and asserted that "changes in the environment affect our brain and, by extension, change our behavior" (Ritchie 2020). Consequently, it is logical that in recent years, neuroscience has become a significant ally of architecture, highlighting the profound impact of design on cognitive and emotional well-being.

ANFA was established in 2002 as a Legacy Project for the American Institute of Architects (AIA) Convention. This event, held in June 2003 in San Diego and hosted by the local AIA Chapter in collaboration with its Architectural Foundation, featured a significant keynote address on the intersection of architecture and neuroscience by Dr. Fred Gage, a principal investigator at the Salk Institute for Biological Studies in La Jolla. Following this convention, ANFA was officially recognized ("History of ANFA"). Several ANFA members published a book of edited conference papers, entitled "Mind in Architecture" (Robinson and Pallasmaa 2015). It was edited by Juhani Pallasmaa, an eminent Finnish architect and scholar, and Sarah Robinson, an inspiring architect and counter-culture educator.

Neuroarchitecture has been influenced by the evidence-based design (EBD) movement, which started gaining traction in the late 1990s and early 2000s. EBD focuses on using empirical research to inform design decisions, with the aim of creating environments that improve health outcomes and overall well-being. Notably, the work of Eve Edelstein and Esther Sternberg has contributed to a deeper understanding of how design elements can be optimized to enhance human performance and quality of life, making them key figures in the intersection of architecture, neuroscience, and healthcare.

Edelstein's work has informed the design of healthcare facilities with a focus on addressing the needs of neurological patients (Edelstein 2015, 2008). Sternberg's research has focused on the impact of the built environment on health, wellness, and healing by demonstrating that exposing patients to natural scenes, light, and scents can promote faster recovery and better overall outcomes and illustrating how to optimize our workspaces for well-being in terms of stress and resilience, movement, sleep, relationships, environment, nutrition, and spirituality (Sternberg 2009, 2023).

In addition, through neuroscientific research, numerous researchers have found a positive relationship between ceiling heights and human creativity (Meyers-Levy and Zhu 2007), as well as a positive effect of high ceilings on human aesthetic judgment (Vartanian et al. 2015). Research has also examined brain reactions to contemplative architecture (Bermudez et al. 2017), the effects of different lighting conditions on mood and cognitive performance (Viola et al. 2008), and the positive effects of biophilic hospital design on patients' recovery (Totaforti 2018). Additionally, spending time in nature has been associated with the improvement of various health outcomes and overall well-being (Oh et al. 2017).

Ann Sussman and Justin B. Hollander (2021) have even integrated recent discoveries from psychology and neuroscience to aid architects and planners in understanding their clients as sophisticated beings equipped with innate environmental responses. They explore essential biometric tools that enable designers to 'see' subconscious human behaviors and propose innovative methods for evaluating designs before construction. The ANFA website also provides an extensive list of publications related to neuroarchitecture. In short, current neuroarchitecture research demonstrates that "a place's influence on our behavior is mediated by our brain's interpretation of it" (Techau et al. 2016, 26). The influence of evidence-based design (EBD) on neuroarchitecture extends to the use of physiological biometrics to understand and measure the impact of architectural spaces on human brain function and behavior by using various technologies such as electroencephalography (EEG), functional magnetic resonance imaging (fMRI), and other physiological measurements (Lee, Shin, and Park 2022).

In addition, neuroaesthetics, a field that explores the neural basis of aesthetic experiences, has seen remarkable advancements and offers critical insights relevant to neuroarchitecture and architectural phenomenology. Key figures in this domain include Anjan Chatterjee and Semir Zeki. Chatterjee's lab at the University of Pennsylvania has produced seminal work on how aesthetic experiences are processed in the brain, offering valuable perspectives on how architectural design can influence human perception and well-being (Chatterjee 2014). Similarly, Semir Zeki's research on art and the brain has provided foundational knowledge on the neural correlates of aesthetic experiences, underscoring the importance of integrating aesthetic considerations into architectural design (Zeki 2002).

Recently, the Intentional Spaces Summit, organized by the Johns Hopkins IA+M Lab in November 2023, further underscores the interdisciplinary nature of these discussions. This summit brought together experts from various fields to explore how design impacts human experience. Notable sessions included discussions on our responses to design and the role of curiosity and collaboration in shaping our environments (International Spaces Initiative 2023). These discussions highlight the ongoing convergence of neuroscience, architecture, and psychology, offering practical insights into the field of neuroarchitecture.

Furthermore, it is crucial to acknowledge that neuroarchitecture has significantly been influenced by the foundational work of Vittorio Gallese and Antonio Damasio on our understanding of how neuroscience can inform architectural experiences. Gallese's research on embodied simulation and mirror neurons has provided critical insights into how we understand and empathize with others' actions, emotions, and sensations, which directly relates to how people experience architectural spaces (Gallese 2001). This concept of embodied simulation suggests that the design of spaces can evoke shared neural responses, enhancing social connectivity and emotional resonance within built environments. Damasio's work on the neural basis of emotions and consciousness has also been transformative. His somatic marker hypothesis, which posits that bodily feedback is integral to decision-making and emotional experiences, underscores the importance of sensory and emotional engagement in architectural design (Damasio 1994). This framework can help architects create environments that resonate on an emotional level, enhancing users' overall experience and well-being.

While these neuroscientific approaches have driven substantial advancements in how architectural spaces are designed and evaluated, current neuroarchitecture research tends to focus on the brain's neurophysiological responses to the built environment, emphasizing the biopsychological dimension of architectural efficacy. This type of neuroarchitecture research is embedded in a purely positivist approach, employing neuroscience as a scientific research tool to measure humans' universal experiences with the built environment, such as its effects on efficiency, creativity, productivity, cognitive function, and other aspects of the built environment (Karandinou and Turner 2017). However, as mentioned in the introduction, architectural experiences are also subjective and intersubjective. Indeed, our brains unconsciously use cognitive filters to make sense of the world, processing only 40-50 bits of information per second out of 11 million bits of information at any given moment (Simon 1984). Since we have different sense-making filters, it is essential to address our subjective and intersubjective architectural experiences.

ARCHITECTURAL PHENOMENOLOGY

Architectural phenomenology was first developed by a group of architects and theorists, such as Christian Norberg-Schulz, Juhani Pallasmaa, and Steven Holl, in the 1960s and 1970s, focusing on humans' subjective, embodied experience of architectural environments. This approach to embodied experience and cognition is related to the work done in semiotics during the 1970s and 1980s. Semiotics, the study of sign processes and the communication of meaning, has long emphasized the role of the body and physical context in the construction of meaning and understanding. For instance, theorists in the semiotic tradition, such as Umberto Eco (1976) and Roland Barthes (1957), provide foundational insights into how buildings and spaces act as cultural signifiers, shaping our cognitive and emotional responses. This semiotic perspective laid important groundwork for later ideas about the embodied and embedded nature of cognition, which are central to the concept of 4E cognition: embodied, embedded, enacted, and extended cognition (Carney 2020). Shaun Gallagher's "How the Body Shapes the Mind" (2006) and Alva Noë's "Action in Perception" (2004) illustrate how cognitive processes are deeply integrated with our physical and social environments.

In addition, the phenomenological approach focuses on how people make sense of the world by actively interpreting their experiences with things and events, in contrast to the traditional social scientific methods, which are based on the epistemological assumption that objective realities exist that ordinary people are unable to know and understand in their daily experiences (Merleau-Ponty 1962). By taking our actual lived experiences as the fundamental data of reality, phenomenology delves into how our experiences with the world appear as they are, without assessing them with pre-determined categories or variables (Palmer 1969).

In this vein, architectural phenomenology is defined as "the study of architecture as it presents itself to consciousness in terms of so-called archetypal human experiences, such as the bodily orientation of up and down, the perceptions of light and shadow, or the feelings of dryness and wetness" (Otero-Pailos 2012, 136). The lived experience, which is a first-person, subjective, and intersubjective experience without any intervention from third-person objective judgment, becomes tangible through our sensory organs. In other words, architectural experiences entail embodiment processes since our body, consisting of muscular and sensory systems, is the medium that connects bodily and sensory experiences with the brain. Hence, from a phenomenological perspective, people experience built environments as lifeworlds, which are "the ordinary, everyday taken-for-granted experiences, events, and worlds within the building or associated with the building" (Seamon 2016, 83).

For instance, David Seamon examined the Seattle Public Library through an architectural phenomenology approach by assessing how his students in an undergraduate course experienced the library during their naïve, first-time encounters. He found that many students perceived the building more as a commercial structure than as a civic space, often attributing this perception to on the building's glass sheathing (Seamon 2016). In contrast, the users of the library shared their thoughts on its architectural aesthetics and various functions (Seamon 2016). Additionally, Peter Herschock (1999, 2000) explored the relationship between Buddhism and the built environment from an architectural phenomenological perspective. He found that Buddhist practice is intimately connected to the physical spaces in which it occurs, emphasizing that understanding the architectural context of Buddhist practice—including the use of symmetry, building orientation, and the incorporation of natural elements like water and gardens— is essential for grasping the religion as a whole.

As these case studies suggest, architectural experiences can vary widely depending on people's relationships with built environments. Such relationships are crucial to understanding people's subjective and intersubjective experiences with the built environment. Yi-Fu Tuan, a leading human geographer whose work is rooted in phenomenology, provides a framework for exploring this issue. Tuan's approach to human geography emphasizes that our sense of the built environment is created through our phenomenological experiences with them. We will elaborate on such varying experiences using his concepts.

SENSE OF PLACE

Tuan (1996) conceptualized the varying degrees of our experience in and engagement with physical spaces through the concepts of public symbols and fields of care. Public symbols, such as sacred places, monuments, and monumental architecture, cater to cognitive and sensory capacities, commanding feelings of awe or attention. In contrast, fields of care like parks, taverns, and street corners evoke affection, making them less easily identified with external characteristics like physical appearance (Tuan 1996).

What is significant is that places emerge from fields of care, as zones of human attachment, which develop through the emotional investments that people make in different places (Tuan 1996). For instance, a place like the Grand Canyon evokes "awe" as "something sublime and objective, existing independently of human needs and aspirations." In contrast, a neighborhood park "evokes affection" as people continue to use and cherish it (Tuan 1996, 446). Hence, public symbols "can be seen and known from the outside," while, fields of care can be recognized "in essence only from within" (Tuan 1996, 459). In other words, public symbols can be defined as the experience in or the engagement with built- environments or places by outsiders like visitors or passersby, whereas fields of care reflect the experience and engagement by insiders, such as residents, who are more likely to personalize these environments through emotional attachment.

Therefore, we need to be aware that public symbols and fields of care do not necessarily refer to fundamentally different places. Instead, a place's nature is shaped by the degree of human interaction and engagement with it. As people personalize a place through continuous experiences and engagement, a public symbol can turn into a field of care in their minds. Thus, we can infer that varying levels of experience and engagement with the built environment impact our lives in different ways.

For this reason, fostering a sense of community is considered essential in urban planning and design for public spaces, such as parks, plazas, and streets, as these areas provide common ground where people from diverse backgrounds can come together, interact, and form social bonds through events, festivals, markets, and more (Francis et al. 2012). In short, people's sense of community is mainly shaped by their experiences and interactions with others in a place, which ultimately affects people's relationships with the built environment and their sense of place.

Phenomenological research methods help us assess people's relationships with the built environment and their sense of place from a first-person perspective. Generally, such methods include researchers actively participating in experiences within the built environment, conducting in-depth interviews with individuals or groups who have relevant experiences, or carefully observing and describing situations that support or relate to these experiences, as phenomenology focuses on subjective and intersubjective experiences (Seamon 2000).

LIMITATIONS OF ARCHITECTURAL PHENOMENOLOGY

While phenomenological methods provide valuable insights into individuals' subjective experiences of the built environment, these methods face limitations inherent to self-report research. Since self-report research relies on participants' reporting their thoughts, feelings, behaviors, or experiences through interviews, journals, questionnaires, surveys, or other forms of self-report measures, it is subject to social desirability bias. This bias can lead participants to offer responses that they believe are more socially acceptable or desirable, rather than their true thoughts or feelings (Chung and Monroe 2003). Also, research participants may not accurately remember events or experiences, especially if they occurred a long time ago; this can result in incomplete or inaccurate responses (Thomas and Diener 1990). Moreover, we can anticipate response bias as participants may provide responses that reflect their current mood or situation rather than their true thoughts or feelings (Furnham and Henderson 1982).

These limitations resonate with another significant critique of phenomenology due to its lack of attention to the biological and neural mechanisms that determine humans' conscious experiences. Neuroscientific research has shown that consciousness is closely associated with specific patterns of neural activity in the brain and that alterations to these patterns can affect the subjective experience (Dehaene et al. 2006; Metzinger 2000; Tononi 2008). In other words, while phenomenology maintains that our experiences are subjectively conscious, they are essentially refracted by unconscious sense-making filters (Abawi 2012). We cannot even understand how our subjective interpretative filters are formed because the filters are unconsciously formed in our lives. Social cognition in cognitive psychology explains that our schemas, or cognitive mental structures, organize our perceptions and judgments and that schemas are formed based on the information gained throughout our lives and stored in our memories (DiMaggio 1997; Bartlett 1995).

Indeed, our interpretive filters or schemas are complicatedly formed by the interactions among our biological, including cognitive-neurological attributes, psychological traits, personal life experiences, informal and formal learning, human relationships, and social and physical environments. All these factors unconsciously shape our sense-making filters, which can interfere with or refract our physiologically universal/objective and subjective/intersubjective experiences of the built environment.

Given the epistemological and methodological challenges, neurophenomenology can provide a breakthrough as it attempts to assess "the relationships between subjective experience and objective bio-physical embodiment" through neuroscience in a complementary fashion to phenomenology's study of consciousness (Rudrauf et al. 2003, 21). This approach can be applied to assess humans' objective and subject architectural experiences. Architectural philosopher and researcher Julio Bermudez (Bermudez 2014) also argues that phenomenology, which focuses on the subjective and qualitative aspects of human experience, and science, which emphasizes objective and quantitative analysis, can complement each other. He even advocates for the application of scientific methods such as neuroscience to test phenomenological claims, a move that mirrors the endeavors of "experimental philosophy," which aims to empirically investigate philosophical questions that have traditionally eluded rigorous examination through standard analytical reasoning (Knobe and Nicholas 2008). Technological innovation in neuroscience enables us to scientifically tackle phenomenological inquiries. This endeavor was initiated by Chilean scientist Francisco Varela and his colleagues in the early 1980s.

NEUROPHENOMENOLOGY

The concept of neurophenomenology, coined by Francisco Varela, presents a sophisticated framework that integrates first-person subjective experiences with third-person objective measurements, aiming to bridge the gap between phenomenology and neuroscience (Varela 1996). Varela's approach emphasizes the importance of incorporating lived experiences into the study of cognitive processes, which is essential for a holistic understanding of neuroarchitecture. Based on the enactive approach in cognitive neuroscience, which views human cognition as the result of embodiment (see Varela, Thompson, and Rosch 1991), neurophenomenology highlights three key ideas:

The first idea is that organisms are autonomous agents that actively generate and maintain their identities, and thereby define their own cognitive domains. The second idea is that the nervous system is an autonomous system: it actively generates and maintains its own coherent patterns of activity, according to its operation as an organizationally closed sensorimotor network of interacting neurons. The third idea is that cognitive structures emerge from such recurrent sensorimotor couplings of body, nervous system, and environment (Thompson, Lutz, and Cosmelli 2005, 42).

Hence, drawing from the phenomenological perspective of human beings' conscious experience, which views them as autonomous individuals actively engaging in sense-making, neurophenomenology examines how our sense-making schemas, developed through embodied processes consisting of continual interactions between our bodily experiences, nervous system, and environment, interact with our conscious experience of the world.

To this end, neurophenomenological research encourages researchers to examine the mutual constraints and interactions between biophysical data and data produced by interpretations of subjective experience (Thompson, Lutz, and Cosmelli 2005; Lutz 2002; Rudrauf et al. 2003). In neurophenomenology, the concept of mutual constraints refers to the reciprocal relationship between first-person (phenomenological) and third-person (neuroscientific) data. This approach aims to bridge the gap between subjective experiences and objective measurements by allowing each to inform and refine the other. By integrating first-person and third-person perspectives, neurophenomenology aims to provide a more comprehensive understanding of consciousness and cognitive processes. Phenomenological data (first-person accounts) and neuroscientific data (third-person measurements) are used to mutually inform and constrain each other. This means that insights from subjective experiences can guide neuroscientific investigations and vice versa (Varela 1996). Hence, this approach helps to address the "hard problem" of consciousness by linking subjective experiences with their neural correlates (Ramstead et al. 2022).

As neurophenomenology provides significant implications for phenomenological architectural research, several scholars have applied the approach to their studies. For instance, by recognizing Merleau-Ponty's efforts to naturalize phenomenology, Bermudez (2014) provides a comprehensive discussion on the relationship between phenomenology and science, emphasizing the need for empirical validation of phenomenological insights in architectural practice. This approach allows for a more rigorous and scientifically grounded understanding of how architectural spaces influence human perception and experience.

Additionally, the work emerging from Bob Condia's lab at Kansas State University, particularly the projects by Elisabetta Canepa further enriches our understanding of the intersection between neuroscience and architecture. Their research explores how architectural design can be informed by cognitive science to enhance the human experience of built environments (Canepa and Condia 2022). On the other hand, Art Seeking Understanding, the work being produced by the awardees of the Templeton Religion Trust grant program, explores how art, including architecture, can deepen our understanding of human experience and spirituality through empirical research and theoretical exploration such as phenomenology, neuroscience, and physiological biometrics (Art Seeking Understanding).

Furthermore, the 2023 symposium on neurophenomenology and sacred architecture in Washington, DC, has provided significant insights into the application of these principles in architectural contexts. Particularly, the empirical work from Jonathan Berger, Julio Bermudez, Matthew Niermann, and Zakaria Djebbara highlighted how sacred spaces can be understood and designed through the lens of neurophenomenology. These presentations underscored the importance of integrating cognitive science with architectural design to create environments that resonate with human experiences.

Jonathan Berger's study investigates whether sensory mismatches between auditory and visual perceptions of architectural size and space can evoke deep emotional responses, focusing on sacred spaces and their associated music (Berger 2023). The research involves in situ measurements, virtual acoustic models, and virtual reality to analyze how spatial proportions are inferred without visual cues, as well as how visual and auditory information interplay in perception. In addition, it examines how music performers adapt to virtual acoustic environments. Julio Bermudez's research investigates the differences in spiritual cognitive-aesthetic effects elicited by sacred versus secular architecture (Bermudez 2023). Using advanced mobile electroencephalography, ambulatory eye-tracking technology, and biosensors, the study measures the physiological and visual responses of participants in two architectural settings in Washington, DC: the Basilica of the Immaculate Conception (religious) and Union Station (secular). This research aims to empirically explore the links between architectural cause and effect, inspired by Francisco Varela's neurophenomenology, through both physiological data and phenomenological experiences.

Matthew Niermann (2023) examines how both religious and non-religious participants perceive church architecture. The study identifies key research methods to investigate pre-cognitive understandings and the impact of personal constructs on different populations. This research highlights the potential effects of church design on the plausibility and internalization of religious beliefs, suggesting that architecture plays a critical role in shaping religious experiences and perceptions.

Finally, Zakaria Djebbara's research focuses on the unconscious influence of architecture on behavior, positing that most architectural experience operates at an automatic, unconscious level (Djebbara 2023). His study explores how architecture impacts sensory and motor dynamics, primarily through a thalamo-cortical network that integrates environmental cues with motor behavior. Using virtual reality, mobile EEG, and dynamic causal modeling, the research aims to uncover the neural basis of these unconscious adaptive processes by examining how participants' brains respond to controlled sensory environments. Early findings highlight the significant potential of this methodology for understanding the deep connection between architecture and unconscious behavior. It is particularly important to note Djebbara's emphasis on the unconscious influence of architecture on human behavior, for it sheds light on the limitations of Varela's neurophenomenology and the need to complement his approach with a new conceptual framework of refractive architecture phenomenology.

CONCEPTUALIZING REFRACTIVE ARCHITECTURE PHENOMENOLOGY

Despite the significant epistemological and methodological contributions of Varela and his colleagues, their approach overlooks the fact that much of human experience, including architectural experience, emerges at an unconscious level, as Djebbara (2023) demonstrates. Even our conscious experience is shaped and intervened by multiple unconscious factors (Bargh and Morsella 2008; Wilson 2002), including attention networks (Posner and Rothbart 2007); default mode network (Guldenmund et al. 2012); sensory input (Purves and Lotto 2003); emotion (Damasio 1994), cognitive biases (Kahneman and Egan 2011); core affect (Russell 2003); cultural and social context (Markus and Kitayama 2014); memory (Tulving 2002); expectations and beliefs (Frith and Frith 1999); and others. Numerous neuroscientists of consciousness have demonstrated that human conscious perception is essentially an optimized guess about an object, derived from the interaction between sensory signals and prior beliefs (see Barlow 1990; Crick and Koch 1990; Knill and Pouget 2004). These elements demonstrate the complex interplay of various factors intervening in our conscious experience.

Also, critics highlight significant methodological challenges, emphasizing the difficulty in integrating first-person subjective experiences with third-person objective measurements (Zahavi 2008). The subjective nature of phenomenological data makes it difficult to verify and quantify, leading to concerns about the reliability and reproducibility of findings. Others highlight the practical difficulties in applying neurophenomenological methods. The process of training subjects to provide reliable phenomenological data is time-consuming and requires a high level of expertise, which may not be feasible in large-scale studies (Lutz and Thompson 2003).

Indeed, Varela emphasizes the importance of incorporating lived experiences into the study of cognitive processes while underscoring the significance of collecting first-person data from subjects who are phenomenologically trained to fully concentrate on their conscious perceptual experiences and articulate their subjective experiences. He employs this original first-person data to discover new third-person data about biophysical phenomena (Thompson, Lutz, and Cosmelli 2005). Furthermore, this methodological incorporation was detailed by Varela (1996), who incorporates the second-person method into the first-person method. The second-person method basically indicates phenomenological interview techniques, through which researchers gather participants' verbal and non-verbal information about their experiences as systematic and thorough subjective reports, to gain keen insights into the first-person experience of consciousness (Olivares et al. 2015).

For instance, the elicitation interview technique developed by Pierre Vermersch (2009), guides interviewees to redirect their attention to specific aspects of their experiences and describe them precisely (Petitmengin and Lachaux 2013). The first-person data gathered through second-person methods should then be cross-checked with third-person data to see how the interviewer's and interviewee's descriptions of the lived experience correlate with the third-person data (Froese 2013).

However, their first-person method, which requires exceedingly conscious experiences enabled by special training such as meditation (see Varela and Shear 1999; Wallace 1999), does not seem to align with phenomenology's foundational inquiry into lived experiences. This is because, in reality, our lived (conscious) experiences are almost always interfered with and refracted by ceaseless unconscious cognitive processes as mentioned above. Indeed, the prefrontal cortex, which is vital to consciousness, rationality, and logical thinking, takes up only 4 percent of total brain volume, while most human thinking and behaviors are unconscious, heuristic, impulsive, and operate on automatic pilot (Rock 2009). In short, the unconscious precedes the conscious (Bargh and Morsella 2008; Wilson 2002).

Hence, to investigate human beings' everyday architectural experiences using neurophenomenology, we need to adapt our methods, particularly the first-person approach, by allowing participants' experiences to remain as natural and unaltered as possible during the research process. This is why we must adopt Abawi's notion of refractive phenomenology (see Abawi 2012) to conceptualize this phenomenological, natural, everyday architectural experience as a refractive neuroarchitecture phenomenology through methodological convergence. In particular, drawing on hermeneutic phenomenological foundations, refractive phenomenology emphasizes "the use of interpretive filters, taking individual depictions of lived experience and viewing, reflecting, redirecting, and channeling these through a series of filters and reductive lenses until the 'essence' of the phenomenon has been brought into view" (Abawi 2012, 141). Geniusas (2022) also highlights the significance of the unconscious in phenomenological inquiry, suggesting that understanding the unconscious enriches our grasp of lived experience and the workings of the mind by examining Husserl's and Fink's perspectives on the concept of "Versunkenheit" (absorption), which indicates the ego's capacity to experience the world from a displaced standpoint.

Therefore, six propositions in refractive neuroarchitecture phenomenology can be summarized as follows. First, architectural experience is fundamentally subjective. Phenomenologists argue that experiences are shaped by perceptions and are inherently subjective. Husserl's concept of the "lifeworld" (Lebenswelt) captures this notion, referring to the world as experienced from individual perspectives. In his famous article "What Is It Like to Be a Bat?" Thomas Nagel (1974) argues that conscious experience is uniquely subjective, with each being having an inaccessible unique perspective. Neuroscientific research supports this by demonstrating that sensory input is interpreted by the brain, and integrated with past experiences, expectations, and context (Gregory 1980). Embodied cognition theories in cognitive science further support this view, suggesting that bodily interactions with the world shape cognition and experiences individually and subjectively. Research shows that emotions, personal histories, and physical states influence perception and cognition (Barsalou 2008).

Second, this perspective asserts that phenomenological, subjective architectural experiences within the lifeworld are predominantly unconscious. While traditional phenomenology, as proposed by scholars like Husserl, emphasizes conscious experiences, including those related to architecture—refractive neuroarchitecture phenomenology recognizes that most architectural experiences occur at an unconscious level. This approach does not attempt to separate conscious and unconscious architectural experiences; rather, it acknowledges that these experiences are fundamentally intertwined and inseparable. This view aligns with contemporary neuroscientific and cognitive science research, which shows that much of our interaction with, and perception of architectural spaces happens below the level of conscious awareness. Our sensory systems continuously process environmental stimuli, and the brain integrates this information with past experiences, expectations, and contextual factors in a largely unconscious manner. Consequently, refractive neuroarchitecture phenomenology underlines the seamless integration of conscious and unconscious experiences, providing a more holistic understanding of how we engage with architectural spaces.

Third, while refractive neuroarchitecture phenomenology primarily focuses on subjective, unconscious architectural experiences, it pursues "an objective science of subjective experience" (Stew 2020). This approach is not based on the belief that scientific methods are flawless; instead, it posits that they provide the most rigorous means for investigating the complexities of the world. However, this does not imply an exclusive reliance on scientific methods such as neuroscience, nor does it advocate for the exclusion of other phenomenological research methods. Refractive neuroarchitecture phenomenology recognizes the value of integrating diverse methodologies to gain a comprehensive understanding of architectural experiences. Scientific methods, including neuroimaging and physiological biometrics, offer valuable insights into the unconscious processes that underlie our interactions with architectural spaces. These methods enable researchers to measure and analyze the brain's responses to environmental stimuli, providing empirical data that can enrich our understanding of how architecture affects us on a neurological level.

Fourth, refractive neuroarchitecture phenomenology seeks to achieve epistemological and methodological convergence in assessing subjective, unconscious architectural experiences. This convergence involves using objective neuroscientific methods alongside first- and second-person phenomenological approaches to evaluate these experiences comprehensively. The premise is that subjective phenomenological experiences of architecture can be effectively analyzed through a collaborative methodology that integrates both neuroscientific data and subjective reports. This integrative approach enables a cross-examination or mapping between third-person objective data, such as neuroimaging and physiological measurements, and first-person phenomenological accounts, including personal narratives and introspective reports. This cross-examination is not merely about juxtaposing two types of data but about creating a dialogue between them. The objective neuroscientific data can provide empirical evidence about the unconscious processes and neural correlates underlying architectural experiences. Meanwhile, phenomenological methods can capture the richness and nuance of individuals' lived experiences in architectural spaces. By adopting this interdisciplinary methodology, refractive neuroarchitecture phenomenology aspires to advance our understanding of architectural experiences in a manner that is both scientifically rigorous and deeply attuned to human subjectivity.

Fifth, refractive neuroarchitecture phenomenology endeavors to develop and employ creative first-person and second-person research methods to obtain more precise, subjective data, which can then be cross-referenced with third-person neuroscientific data. While self-report studies have their limitations, first-person data remains invaluable for assessing individual interpretations of the built environment. This approach emphasizes understanding the meanings of architectural spaces as they emerge in individuals' minds, influenced by subjective and intersubjective interpretive filters. Heidegger's hermeneutic phenomenology (1977) critiques Husserl's purely descriptive, experimental, and transcendental method, arguing that any description is inherently interpretive.

Similarly, Merleau-Ponty (1962) noted that humans form mutual relationships with objects by assigning meanings to them. Therefore, the refractive phenomenological approach seeks to integrate these interpretive insights by employing and innovating first-person and second-person research methods. This integration allows for a comprehensive investigation of individuals' architectural experiences, encompassing their emotions, memories, and interpretations. By advancing and diversifying these research methodologies, refractive neuroarchitecture phenomenology aims to create a richer, more nuanced understanding of how individuals experience and

and interpret architectural spaces ensuring that both subjective and objective perspectives are considered.

Lastly, refractive neuroarchitecture phenomenology adopts an inductive neuroscientific approach rather than a positivistic, deductive methodology reliant on pre-determined variable testing. This inductive approach aligns with the phenomenological perspective, which posits that researchers enter investigations without preconceived notions about the attributes or outcomes of lived experiences. Phenomenology argues that these experiences are unknown and must be uncovered through open-ended inquiry rather than confirmed through hypothesis testing. By embracing inductive methods, refractive neuroarchitecture phenomenology allows for the emergence of insights directly from the data, facilitating a more genuine understanding of how individuals interact with and interpret architectural spaces.

This approach is particularly well-suited to the study of architectural experiences, which are inherently complex and multifaceted, often involving unconscious processes that cannot be easily predicted or measured through traditional deductive frameworks. Moreover, the inductive method fosters flexibility and responsiveness in research design, enabling investigators to adapt their methods based on emerging patterns and findings. It encourages a more exploratory and holistic investigation, capturing the nuanced and subjective nature of human experiences within architectural environments.

CONCLUSION: FOR EMPIRICAL RESEARCH AND ITS IMPLICATION

Based on the critical review and synthesis of neuroarchitecture, architectural phenomenology, and neurophenomenology, this study conceptualized refractive neuroarchitecture phenomenology. This conceptual framework holds intellectual significance as it endeavors to integrate both objective and subjective epistemologies and methodologies into architectural research, fostering methodological innovations for empirical studies. This study advocates for collaborations with neuroscientific research, as further empirical studies are necessary to validate the proposed conceptual framework. Building on previous research, it outlines potential avenues for neurophenomenological collaborations within the framework of refractive neuroarchitecture phenomenology.

Most previous neuroscientific research has been conducted to assess people's instantaneous perceptual responses to and emotional evaluations of physical settings as an outsider. However, an inductive neuroscientific study examined how people respond to pleasant and non-pleasant environments as well as beautiful and non-beautiful environments by measuring neural activity through functional magnetic resonance imaging (fMRI) (Vedder et al. 2015). The researchers relied on individual representations of beauty and pleasure, instead of using predefined environmental stimuli. Drawing upon episodic memories, they found that the research participants' brain activations are more distributed for non-pleasant and non-beautiful environments than for pleasant and beautiful environments, compared to the pleasant and beautiful conditions.

Moreover, regions in the left lateral prefrontal cortex were activated in non-pleasant environments, while the supplementary motor area and anterior cortical midline structures were activated in non-beautiful environments; indeed, these brain regions are known to be involved in self-regulation and top-down cognitive control (Vedder et al. 2015). While such spontaneous perceptual and emotional responses to physical surroundings can provide us with meaningful and practical implications for architectural research, we also need to address people's long-term architectural experiences, which may develop unique affections, memories, and relationships between people and the environment. The outcomes of such long-term experiences can be explored in the fields of care, as Tuan terms it, alongside the corresponding brain activations. Refractive neuroarchitecture phenomenology can address this through empirical studies.

A neuroscientist and a human geographer have explicated the brain parts related to various dimensions of a phenomenological sense of place and place identity through an extensive literature view on a sense of place and neurobiological associations of a phenomenological sense of place, (Lengen and Kistemann 2012). They have linked specific brain parts, such as the hippocampus, entorhinal, parahippocampal, and parietal cortex), subregions (parahippocampal place area, lingual landmark area), and types of cells (place cells, grid cells, border cells, head direction cells) to ten dimensions in a phenomenological sense of place/place identity model: behavior, body, emotion, attention, perception, memory, orientation, spirituality, meaning/value and culture/sociality (Lengen and Kistemann 2012). This study provides an analytical framework for evaluating a sense of place by examining various attributes and their corresponding brain area activations, contributing to phenomenological neuroarchitecture research.

Also, an interdisciplinary study has revealed that the built environment can induce contemplative states in people's minds by examining human brains prompted by architecture aimed at fostering contemplative experience (Bermudez et al. 2017). By scanning twelve architects' brains, which responded to photographs of ordinary and contemplative architectures, theresearchers identified that the research participants' occipital lobe, precentral gyrus, and inferior parietal lobule were activated while the prefrontal cortex region's engagement decreased when they watched the photographs of contemplative buildings. In contrast, when the participants viewed ordinary buildings, cortical areas of the brain were activated, which are mainly connected with goal-oriented and semiotic-driven undertakings. This study exemplifies an inductive approach to neuroscientific architectural research, providing valuable insights for empirical studies in refractive neuroarchitecture phenomenology.

In addition, a study has used portable electroencephalography (EEG) devices as a third-person method to assess the neural responses from the brain for mapping the human experience in everyday spaces by looking into how people navigate in an urban environment (Karandinou and Turner 2017). The researchers found that the participants displayed a short and intense peak of the beta brain wave frequency, where they made a critical way-finding decision. On the other hand, when participants encounter other people, which seems to require intensive cognitive function, the beta is also increased. Furthermore, it is related to a transient increase of the theta/alpha range activities. Alpha activity is related to attentive brain processing, while beta activities reflect activities involving the brain's cognitive processing (Ray and Cole 1985). Also, the increases in theta/alpha range activities have been known to be related to cognitive and memory performance (Klimesch 1999). Prompted by these findings, it is expected that beta activity might be associated with perceptual attentive response to the built environment while the increases in theta/alpha range activities might be related to interpretive response to the built environment, such as bringing up memory and/or creating meaning. This study serves as an example of empirical research in refractive neuroarchitecture phenomenology by using EEG as a third-person, objective method in neurophenomenology, analyzing the EEG recordings in terms of frequency, amplitude, and distribution (third-person method), and then comparing the results with participants' answers to a short interview (second-person method), and to their live and video-recorded observations (semi first-person method).

These studies present empirical research examples and methodological opportunities for utilizing neuroscientific technologies within the framework of refractive neuroarchitecture phenomenology. Further empirical studies in refractive neuroarchitecture phenomenology will enhance our understanding of architectural efficacy from a human experience-centric perspective, aligning with the ethical function of architecture. In this context, it is essential to recognize the architectural movement advocating for the ethical function of architecture (Fisher 2018; Harold 2023; Harries 1998; Pallasmaa 1996). Particularly, Pallasmaa (1996) emphasizes the need for architecture to be human-centric, meaning that buildings and spaces should be designed to enhance human experience and well-being. He argues that architecture should not only focus on aesthetic and functional considerations but must also engage deeply with the ethical and existential dimensions of human life. Therefore, forthcoming empirical studies in refractive neuroarchitecture phenomenology are anticipated to yield more reliable and comprehensive evidence, providing valuable insights for human-centric architects and other stakeholders.

REFERENCES

Abawi, Lindy-Anne. 2012. "Introducing refractive phenomenology." International Journal of Multiple Research Approaches 6 (2): 141-149.

Altman, Irwin. 1975. The Environment and Social Behavior: Privacy, Personal Space, Territory, and Crowding. Monterery, CA: Brooks/Cole Publihsing.

Arbib, Michael A. 2021. When Brains Meet Buildings. Oxford, UK: Oxford University Press.

"Art Seeking Understanding." Accessed July 16th. https://templetonreligiontrust.org/areas-of-focus/art seeking-understanding/.

Aspinall, Peter, Panagiotis Mavros, Richard Coyne, and Jenny Roe. 2015. "The urban brain: Analysing outdoor physical activity with mobile EEG." Br J Sports Med 49 (4): 272-276.

Assem, Hala Medhat, Laila Mohamed Khodeir, and Fatma Fathy. 2023. "Designing for human wellbeing: The integration of neuroarchitecture in design–A systematic review." Ain Shams Engineering Journal 14 (6): 102102.

Bargh, John A, and Ezequiel Morsella. 2008. "The unconscious mind." Perspectives on Psychological Science 3 (1): 73-79.

Barlow, Horace. 1990. "Conditions for versatile learning, Helmholtz's unconscious inference, and the task of perception." Vision Research 30 (11): 1561-1571.

Barsalou, Lawrence W. 2008. "Grounded cognition." Annu. Rev. Psychol. 59 (1): 617-645.

Barthes, Roland. 1957. Mythologies. Translated by

Annette Lavers and Colin Smith. Vol. 4. New York: Hill and Wang.

Bartlett, Frederic Charles. 1995. Remembering: A study in experimental and social psychology. Vol. 14. London, UK: Cambridge University Press.

Berger, Jonathan. 2023. "Cross-Sensory Ambiguity as a Factor in Eliciting Deep Affective Aesthetic Response." Paper presented at the Interdisciplinary Symposium: Neurophenomenology & Sacred Architecture: Toward an Experimental Theological Aesthetics, Washington, DC, USA, March 24, 2023.

Bermudez, Julio. 2014. "Considering the Relationship Between Phenomenology and Science." Environmental & Architectural Phenomenology Newsletter 25 (3): 51-54.

---. 2023. "Empirical Studies of Cause and Effect in Sacred vs. Secular Architecture." Interdisciplinary Sym posium: Neurophenomenology & Sacred Architecture: Toward an Experimental Theological Aesthetics, Wash ington, DC, USA, March 24, 2023

Bermudez, Julio, David Krizaj, David L Lipschitz, Charles Elliott Bueler, Jadwiga Rogowska, Deborah Yurgelun Todd, and Yoshio Nakamura. 2017. "Externally-induced meditative states: an exploratory fMRI study of archi tects' responses to contemplative architecture." Fron tiers of Architectural Research 6 (2): 123-136.

Bertram, Christine, and Katrin Rehdanz. 2015. "The role of urban green space for human well-being." Ecological Economics 120: 139-152.

Canepa, Elisabetta, and Bob Condia, eds. 2022. Genera tors of Architectural Atmosphere. Manhattan, KS: New Prairie Press.

Carney, James. 2020. "Thinking avant la lettre: A Re view of 4E Cognition." Evolutionary Studies in Imagina tive Culture 4 (1): 77-90.

Chatterjee, Anjan. 2014. The Aesthetic Brain: How we Evolved to Desire Beauty and Enjoy Art. Oxford, UK: Oxford University Press.

Chung, Janne, and Gary S Monroe. 2003. "Exploring social desirability bias." Journal of Business Ethics 44: 291-302.

Crick, Francis, and Christof Koch. 1990. "Towards a neu robiological theory of consciousness." Seminars in the Neurosciences 2: 263-275.

Damasio, Antonio. 1994. Descartes' Error: Emotion,

Rationality and the Human Brain. New York: Put nam.

Dehaene, Stanislas, Jean-Pierre Changeux, Lionel Naccache, Jérôme Sackur, and Claire Sergent. 2006. "Conscious, preconscious, and subliminal processing: a testable taxonomy." Trends in Cogni tive Sciences 10 (5): 204-211.

Dilthey, Wilhelm. 1976. Dilthey–Selected readings. Cambridge, UK: Cambridge University Press.

DiMaggio, Paul J. 1997. "Culture and cognition." Annual Review of Sociology 23 (1): 263-287.

Djebbara, Zakaria. 2023. "On the Neuroscience of the Unconscious in Architecture." Interdisciplin ary Symposium: Neurophenomenology & Sacred Architecture: Toward an Experimental Theological Aesthetics, Washington, DC, USA, March 24, 2023

Eberhard, John P. 2009. Brain Landscape the Coex istence of Neuroscience and Architecture. Oxford University Press.

Eco, Umberto. 1976. A Theory of Semiotics. Lon don: Macmillan.

Edelstein, Eve. 2008. "Building health." HERD: Health Environments Research & Design Journal 1 (2): 54-59.

---. 2015. "Neuroscience and architecture." In The Routledge Companion for Architecture Design and Practice, 301-320. Routledge.

Evans, Gary W. 2003. "The built environment and mental health." Journal of Urban Health 80 (4): 536-555.

Ezzat Ahmed, Dina, Shaimaa Kamel, and Laila Khodeir. 2021. "Exploring the contribution of Neu roarchitecture in learning environments design." International Journal of Architectural Engineering and Urban Research 4 (1): 67-94.

Fisher, Thomas. 2018. The Architecture of Ethics. Routledge.

Francis, Jacinta, Billie Giles-Corti, Lisa Wood, and Matthew Knuiman. 2012. "Creating sense of com munity: The role of public space." Journal of Environmental Psychology 32 (4): 401-409.

ENQ

Frith, Chris D, and Uta Frith. 1999. “Interacting minds—a biological basis.” Science 286 (5445): 1692-1695.

Froese, Tom. 2013. “Interactively guided introspection is getting science closer to an effective consciousness meter.” Consciousness and Cognition 22 (2): 672-676.

Fullilove, Mindy Thompson. 1996. “Psychiatric implica tions of displacement: Contributors from the psychol ogy of place.” American Journal of Psychiatry 153 (12): 1516-1523.

Furnham, Adrian, and Monika Henderson. 1982. “The good, the bad and the mad: Response bias in self-re port measures.” Personality and Individual Differences 3 (3): 311-320.

Gallagher, Shaun. 2006. How the Body Shapes the Mind. Clarendon Press.

Gallese, Vittorio. 2001. “The ‘shared manifold’ hypoth esis: From mirror neurons to empathy.” Journal of Con sciousness Studies 8 (5-6): 33-50.

Geniusas, Saulius. 2022. “Towards a phenomenology of the unconscious: Husserl and Fink on Versunkenheit.” Journal of the British Society for Phenomenology 53 (1): 1-23.

Gregory, Richard Langton. 1980. “Perceptions as hy potheses.” Philosophical Transactions of the Royal Society of London. B, Biological Sciences 290 (1038): 181-197.

Guite, HF, Charlotte Clark, and Gill Ackrill. 2006. “The impact of the physical and urban environment on men tal well-being.” Public Health 120 (12): 1117-1126.

Guldenmund, Pieter, Audrey Vanhaudenhuyse, Mela nie Boly, Steven Laureys, and Andrea Soddu. 2012. “A default mode of brain function in altered states of con sciousness.” Archives Italiennes de Biologie 150 (2/3): 107-121.

Gumpert, Gary, and Susan Drucker. 2001. “A plea for chaos: Controlled unpredictability, uncertainty and the serendipitous life in the urban community.” Qualitative Research Reports in Communication 2 (2): 25-32.

Harold, James. 2023. The Oxford Handbook of Ethics and Art. Oxford University Press.

Harries, Karsten. 1998. The ethical function of architec ture. Cambridge, MA: MIT Press.

Heidegger, Martin. 1977. Basic writings: from Being and time (1927) to the task of thinking (1964). San Francisco: HarperCollins.

---. 1988. The Basic Problems of Phenomenology. Vol. 478. Bloomington, IN: Indiana University Press.

Herschock, Peter. 1999. “Built space as Bodhimandala: The Architectural Meaning of a Practised Buddhism—Part 1.” Architectural Theory Review 4 (2): 71-86.

---. 2000. ““Built space as Bodhimandala: The Architec tural Meaning of a Practised Buddhism—Part 2.” Archi tectural Theory Review 5 (1): 69-82.

Higuera-Trujillo, Juan Luis, Carmen Llinares, and Edu ardo Macagno. 2021. “The cognitive-emotional design and study of architectural space: A scoping review of neuroarchitecture and its precursor approaches.” Sen sors 21 (6): 2193.

“History of ANFA.” The Academy of Neuroscience for Architecture. Accessed July 9th. https://anfarch.org/about/history.

Husserl, Edmund. 2012. Ideas: General introduction to pure phenomenology. Translated by W. R. Boyce Gib son. New York: Routledge.

Initiative, International Spaces. 2023. “Dialogue, Stra tegic Thinking, and Learning “. Accessed July 11th. https://intentionalspaces.org/the-summit/.

Javanbakht, Arash 2011. “A neural network model for schemas based on pattern completion.” Journal of the American Academy of Psychoanalysis and Dynamic Psy chiatry 39 (2): 243-261.

Kahneman, Daniel, and Patrick Egan. 2011. Thinking, Fast and Slow New York: Farrar, Straus and Giroux.

Karakas, Tulay, and Dilek Yildiz. 2020. “Exploring the influence of the built environment on human experi ence through a neuroscience approach: A systematic review.” Frontiers of Architectural Research 9 (1): 236–247.

Karandinou, Anastasia, and Louise Turner. 2017. “Archi tecture and neuroscience; what can the EEG recording of brain activity reveal about a walk through everyday spaces?” International Journal of Parallel, Emergent and Distributed Systems: 1-12.

Klepeis, Neil E, William C Nelson, Wayne R Ott, John P Robinson, Andy M Tsang, Paul Switzer, Joseph V Behar, Stephen C Hern, and William H Engelmann. 2001. “The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pol lutants.” Journal of Exposure Science & Environmental Epidemiology 11 (3): 231-252.

Klimesch, Wolfgang. 1999. “EEG alpha and theta oscil lations reflect cognitive and memory performance: a review and analysis.” Brain Research Reviews 29 (2-3): 169-195.

Knill, David C, and Alexandre Pouget. 2004. “The Bayes ian brain: the role of uncertainty in neural coding and computation.” TRENDS in Neurosciences 27 (12): 712-719.

Knobe, Joshua, and Shaun Nicholas, eds. 2008. Experi mental Philosophy. Oxford, UK: Oxford University Press.

Lee, Sanghee, Wooree Shin, and Eun Joo Park. 2022. “Implications of neuroarchitecture for the experience of the built environment: a scoping review.” Archnet IJAR: International Journal of Architectural Research 16 (2): 225-244.

Lengen, Charis, and Thomas Kistemann. 2012. “Sense of place and place identity: Review of neuroscientific evidence.” Health & Place 18 (5): 1162-1171.

Lutz, Antoine. 2002. “Toward a neurophenomenology as an account of generative passages: A first empirical case study.” Phenomenology and the Cognitive Sci ences 1 (2): 133-167.

Lutz, Antoine, and Evan Thompson. 2003. “Neurophe nomenology integrating subjective experience and brain dynamics in the neuroscience of consciousness.” Journal of Consciousness Studies 10 (9-10): 31-52.

Maleki, Mohammad Reza, and Qader Bayzidi. 2017. “Application of Neuroscience on Architecture: The emergence of new trend of Neuroarchitecture.” Kurdis tan Journal of Applied Research 2 (3): 383-396.

Markus, Hazel Rose, and Shinobu Kitayama. 2014. “Cul ture and the self: Implications for cognition, emotion, and motivation.” In College Student Development and Academic Life, 264-293. Routledge.

Matte, Thomas D, and David E Jacobs. 2000. “Housing and health—current issues and implications for re search and programs.” Journal of Urban Health 77 (1): 7-25.

McCoy, Janetta Mitchell, and Gary W Evans. 2002. “The potential role of the physical environment in fostering creativity.” Creativity Research Journal 14 (3-4): 409-426.

Merleau-Ponty, Maurice. 1962. Phenomenology of Per ception. Translated by Colin Smith. New York: Humani ties Press.

Metzinger, Thomas. 2000. Neural Correlates of Con sciousness: Empirical and Conceptual Questions. MIT Press.

Meyers-Levy, Joan, and Rui Zhu. 2007. “The influence of ceiling height: The effect of priming on the type of processing that people use.” Journal of Consumer Re search 34 (2): 174-186.

Nagel, Thomas. 1974. “What is it like to be a bat?” The Philosophical Review 83, no. 4: 435-450.

Niermann, Matthew. 2023. “Priming Effect of Church Architecture: Empirical Investigation of the Relation ship between Christian Church Design and Belief Plausibility Structures.” Interdisciplinary Symposium: Neurophenomenology & Sacred Architecture: Toward an Experimental Theological Aesthetics, Washington, DC, USA.

Noë, Alva. 2004. Action in Perception. MIT Press.

Oh, Byeongsang, Kyung Ju Lee, Chris Zaslawski, Albert Yeung, David Rosenthal, Linda Larkey, and Michael Back. 2017. “Health and well-being benefits of spend ing time in forests: Systematic review.” Environmental Health and Preventive Medicine 22 (1): 1-11.

Olivares, Francisco A, Esteban Vargas, Claudio Fuentes, David Martínez-Pernía, and Andrés Canales-Johnson. 2015. “Neurophenomenology revisited: Second-person methods for the study of human consciousness.” Fron tiers in Psychology 6 (673): 1-12.

Otero-Pailos, Jorge 2012. “Architectural Phenomenol ogy and the Rise of the Postmodern.” In The SAGE Handbook of Architectural Theory, edited by C. Greig Crysler, Stephen Cairns and Hilde Heynen, 136–151. London, UK: Sage.

Pallasmaa, Juhani. 1996. The Eyes of the Skin: Archi tecture and the Senses. Chichester, UK: John Wiley & Sons.

Palmer, Richard E. 1969. Hermeneutics: Interpretation theory in Schleiermacher, Dilithey, Heidegger and Ga damer Evanston, IL: Northwestern University Press.

Petitmengin, Claire, and Jean-Philippe Lachaux. 2013. “Microcognitive science: bridging experiential and neu ronal microdynamics.” Frontiers in Human Neurosci ence 7: 617. https://doi.org/https://doi.org/10.3389/fnhum.2013.00617.

Posner, Michael I, and Mary K Rothbart. 2007. “Re search on attention networks as a model for the inte gration of psychological science.” Annu. Rev. Psychol. 58 (1): 1-23.

Purves, Dale, and R Beau Lotto. 2003. Why we see What we do: An Empirical theory of Vision. Sinauer Associates.

Ramstead, Maxwell JD, Anil K Seth, Casper Hesp, Lars Sandved-Smith, Jonas Mago, Michael Lifshitz, Giuseppe Pagnoni, Ryan Smith, Guillaume Dumas, and Antoine Lutz. 2022. “From generative models to generative pas sages: a computational approach to (neuro) phenom enology.” Review of Philosophy and Psychology 13 (4): 829-857.

Rapoport, Amos. 1982. The Meaning of the Built Envi ronment: A Nonverbal Communication Approach. Bev erly Hills, CA: Sage Publications.

Ray, William J, and Harry W Cole. 1985. “EEG alpha activity reflects attentional demands, and beta activity reflects emotional and cognitive processes.” Science 228 (4700): 750-752.

Ritchie, Ian. 2020. Neuroarchitecture: Designing with the mind in mind. John Wiley & Sons.

Robinson, Sarah, and Juhani Pallasmaa. 2015. Mind in architecture: Neuroscience, embodiment, and the fu ture of design. MIT Press.

Rock, David. 2009. Your Brain at Work: Strategies for Overcoming Distraction, Regaining Focus and Working Smarter All. New York: Harper Business.

Roux, Ana V Diez, and Christina Mair. 2010. “Neighbor hoods and health.” Annals of the New York Academy of Sciences 1186 (1): 125-145.

Rudrauf, David, Antoine Lutz, Diego Cosmelli, Jean Philippe Lachaux, and Michel Le Van Quyen. 2003. “From autopoiesis to neurophenomenology: Francisco Varela’s exploration of the biophysics of being.” Biologi cal Research 36 (1): 27-65.

Russell, James A. 2003. “Core affect and the psycho logical construction of emotion.” Psychological Review 110 (1): 145-172.

Sarkar, Chinmoy, and Chris Webster. 2017. “Urban envi ronments and human health: current trends and future directions.” Current Opinion in Environmental Sustain ability 25: 33-44.

Schweitzer, John H, June Woo Kim, and Juliette R Mackin. 1999. “The impact of the built environment on crime and fear of crime in urban neighborhoods.” Jour nal of Urban Technology 6 (3): 59-73.

Seamon, David. 2000. “Phenomenology, place, envi ronment, and architecture: A review of the literature.” Phenomenology Online 36: 1-29.

---. 2016. “A phenomenological and hermeneutic read ing of Rem Koolhaas’s Seattle Central Library: Build ings as lifeworlds and architectural texts.” In Take one building: Interdisciplinary research perspectives of the Seattle Central Library, 83-110. Routledge.

Shin, Yongjun. 2009. “Understanding spatial differen tiation of social interaction: Suggesting a conceptual framework for spatial media.” Communication Theory 19 (4): 423-444.

Simon, Herbert A. 1984. Models of Bounded Rational ity: Economic Analysis and Public Policy. Vol. 1. Cam bridge, MA: MIT Press.

Sternberg, Esther M. 2009. Healing Spaces: The Science of Place and Well-Being. Harvard University Press.

---. 2023. Well at work: Creating wellbeing in any work space. Boston, MA: Little, Brown Spark.

Stew, Graham. 2020. “Phenomenology: Questioning consciousness and experience.” In Critical Qualitative Health Research, edited by Kay Aranda, 125-141. New York: Routledge.

Sussman, Ann, and Justin Hollander. 2021. Cognitive Architecture: Designing for how we Respond to the Built Environment. London: Routledge.

Techau, David, Ceridwen Owen, Douglas Paton, and Roger Fay. 2016. “Buildings, Brains & Behaviour To wards an affective neuroscience of architecture: The Hedonic Impact of Sustainable Work Environments on Occupant Well-being.” World Health Design January: 24-27.

Thomas, David L, and Ed Diener. 1990. “Memory accuracy in the recall of emotions." Journal of Personality and Social Psychology 59 (2): 291-297.

Thompson, Evan, Antoine Lutz, and Diego Cosmelli. 2005. "Neurophenomenology: An Introduction for Neurophilosophers " In Cognition and the Brain: The Philosophy and Neuroscience Movement, edited by Andy Brook and Kathleen Akins, 40-97. New York and Cambridge: Cambridge University Press.

Tononi, Giulio. 2008. "Consciousness as integrated in formation: a provisional manifesto." The Biological Bul letin 215 (3): 216-242.

Totaforti, Simona. 2018. "Applying the benefits of biophilic theory to hospital design." City, Territory and Architecture 5: 1-9.

Tuan, Yi-Fu. 1996. "Space and place: Humanistic per spective." In Human Geography: An Essential Antholo gy, edited by J. Agnew, D. N. Livingstone and A. Rogers, 444-457. Cambridge, MA: Blackwell Publishers.

Tulving, Endel. 2002. "Episodic memory: From mind to brain." Annual Review of Psychology 53 (1): 1-25.

Varela, Francisco J. 1996. "Neurophenomenology: A methodological remedy for the hard problem." Journal of Consciousness Studies 3 (4): 330-349.

Varela, Francisco J, and Jonathan Shear. 1999. "First person methodologies: What, why, how." Journal of Consciousness Studies 6 (2-3): 1-14.

Varela, Francisco J, Evan Thompson, and Eleanor Rosch. 1991. The Embodied Mind: Cognitive Science and Hu man Experience. Cambridge, MA: The MIT Press.

Vartanian, Oshin, Gorka Navarrete, Anjan Chatterjee, Lars Brorson Fich, Jose Luis Gonzalez-Mora, Helmut Leder, Cristián Modrono, Marcos Nadal, Nicolai Ros trup, and Martin Skov. 2015. "Architectural design and the brain: effects of ceiling height and perceived en closure on beauty judgments and approach-avoidance decisions." Journal of Environmental Psychology 41: 10-18.

Vedder, Aline, Lukasz Smigielski, Evgeny Gutyrchik, Yan Bao, Janusch Blautzik, Ernst Pöppel, Yuliya Zaytseva, and Edmund Russell. 2015. "Neurofunctional correlates of environmental cognition: An fMRI study with images from episodic memory." PloS one 10 (4): e0122470. https://doi.org/10.1371/journal.

Vermersch, Pierre. 2009. "Describing the practice of introspection." Journal of Consciousness Studies 16 (10-11): 20-57.

Viola, Antoine U, Lynette M James, Luc JM Schlangen, and Derk-Jan Dijk. 2008. "Blue-enriched white light in the workplace improves self-reported alertness, per formance and sleep quality." Scandinavian Journal of Work, Environment & Health: 297-306.

Wallace, B Alan. 1999. "The Buddhist tradition of Samatha: Methods for refining and examining con sciousness." Journal of Consciousness Studies 6 (2-3): 175-187.

Wang, Sheng, Guilherme Sanches de Oliveira, Zakaria Djebbara, and Klaus Gramann. 2022. "The Embodiment of Architectural Experience: A Methodological Perspec tive on Neuro-Architecture." Frontiers in Human Neu roscience: 236.

Wilson, Timothy D. 2002. Strangers to Ourselves. Cam bridge, MA: Harvard University Press.

Zahavi, Dan. 2008. Subjectivity and Selfhood: Investi gating the First-Person Perspective. MIT Press.

Zeki, Semir. 2002. Inner Vision: An Exploration of Art and the Brain. Oxford, UK: Oxford University Press.