

# Neuroscience of Proportion in Architecture

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**Abstract-** This research investigates how the human brain perceives architectural proportion, symmetry, and geometric order as harmonious, establishing a link between architectural design and cognitive neuroscience. Moving beyond purely aesthetic or historical interpretations, the study examines how numerical ratios, modular systems, and spatial hierarchies influence perception, emotion, memory, and well-being through measurable neural processes. Drawing on historical proportional theories—from Vitruvian humanism and classical Greek modular systems exemplified by the Parthenon to the symmetry-based geometry of the Taj Mahal—the research reinterprets these traditions using contemporary tools such as EEG, fMRI, eye-tracking, and environmental psychology. Findings indicate that the brain demonstrates consistent preferences for symmetry, hierarchical scaling, rhythmic repetition, moderate complexity, and human-scaled ratios, as these reduce cognitive load, enhance visual fluency, and support emotional regulation. Fractal patterns and biophilic geometries further contribute to stress reduction and attention restoration, while embodied cognition and mirror neuron theory explain how spatial proportion is experienced through the body as well as visually. At the urban and architectural scale, well-proportioned environments improve wayfinding, social interaction, healing outcomes, and perceived safety. However, the study also critiques universalist claims—such as the deterministic use of the Golden Ratio—by highlighting cultural variability in aesthetic interpretation and symbolic meaning. The research concludes that neuroarchitecture provides a framework for integrating ancient geometric wisdom with empirical science, enabling evidence-based design strategies for human, cognitively supportive built environments. Future directions include incorporating neuroscience methods into architectural education and conducting real-world post-occupancy studies to translate laboratory findings into practical design guidelines.

**Keywords-** Neuroarchitecture; Architectural proportion; Symmetry; Cognitive load; Visual perception; Fractals; Biophilic design; Embodied cognition; Spatial memory; Evidence-based design; Human-scaled ratios; Environmental psychology;

**Golden Ratio; Modular systems; Well-being in architecture**

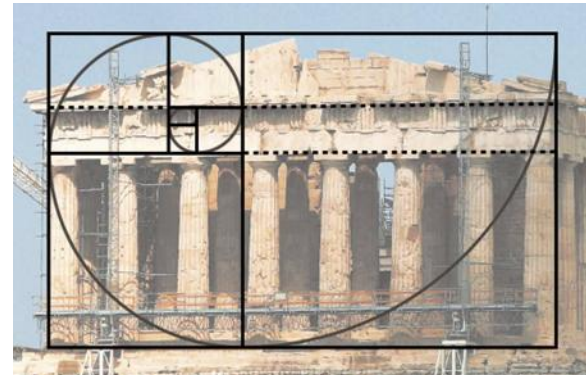
**Problem Statement:** Examine how the human brain perceives certain ratios and symmetries as more harmonious, linking architectural design with cognitive psychology.

## I. INTRODUCTION

The Neuroscience of Proportion in Architecture explores how numerical and geometric relationships within a built environment influence human perception, emotion, and well-being. This field investigates the subconscious and conscious brain responses to architectural elements, moving beyond subjective theories to apply scientific tools like brain imaging and psychophysics. The goal is to understand how harmonic proportions can reduce cognitive load and create feelings of pleasure, while disproportions can evoke negative responses, ultimately aiming to design more effective and humane spaces.

### Background

Proportion in architecture is the relationship of a building's elements to each other and to the whole, achieved through mathematical ratios and a standard module to create harmony, balance, and aesthetic appeal. Influenced by classical figures like Vitruvius



and incorporating concepts like the Golden Ratio, it aims to connect the human body, nature, and the

structure, with historical traditions from Egypt, Greece, and Rome developing sophisticated proportional systems. While a technical principle, proportion also functions as a symbolic language, imbuing buildings with meaning and shaping user experience.

#### Key Concepts

- Perception and Cognition:

Proportions guide our interpretation of visual information, such as scale, balance, and rhythms, influencing how we understand and navigate spaces.

- Emotional Response:

Harmonious proportions can reduce cognitive load and evoke feelings of pleasure or security, while others might trigger negative responses, affecting mood and behavior.

- Cognitive Load:

Harmonic proportions create a more at-ease experience by reducing the mental effort required to process visual information.

- Predictive Processing:

Humans are constantly making inferences about their environment, and architectural proportions influence these predictive processes as we move through space.

#### Research Objectives:

1. To analyze how humans cognitively and neurologically respond to architectural proportions.
2. To identify whether ratios like the Golden Ratio or fractal patterns trigger measurable neural responses.
3. To explore implications for contemporary design and well-being.

## II. LITERATURE REVIEW

### Historical Theories of Proportion

Historical theories of proportion, particularly in architecture and art, focus on creating visual harmony through the application of mathematical ratios and geometric forms, evolving from the

ancient Greek pursuit of divine order to the Renaissance embrace of human and classical proportions, the Medieval emphasis on divine symbolism, and modern systems like Le Corbusier's Modular. Key concepts include the Golden Section (a ratio of approximately 1:1.618), the Classical Orders used in Greek and Roman structures, Vitruvian proportions based on the human body, and symbolic geometric figures like the square and circle. Ancient Greece and Rome

- Euclid and the Foundation of Geometry:

Ancient Greek mathematician Euclid established fundamental principles of geometric proportion and ratios in his work Elements.

- The Golden Section:

This mathematical ratio (approx. 1:1.618) was used in the Parthenon and the Great Pyramid of Giza to create aesthetically pleasing designs.

- Classical Orders:

Greek and Roman architecture used standardized column and entablature proportions based on a unit of measurement (often the column's diameter), creating harmonious and ordered structures.

### Medieval Europe

- Divine Harmony:

Medieval church builders saw proportion to reflect a cosmic, divine order, integrating it into the symbolic design of structures.

- Symbolic Geometry:

Simple geometric forms were used to create proportions and symbolize theological concepts; for example, the square symbolized divine unity and the circle represented eternity.

### The Renaissance

- Re-emergence of Classical Principles:

Renaissance thinkers and artists, like Leon Battista Alberti and Andrea Palladio, revived interest in classical ideals and explored mathematical systems of proportion.

- Humanism and the Vitruvian Man:

Leonardo da Vinci's famous Vitruvian Man illustration embodied Renaissance interest in ideal human proportions defined by the ancient Roman architect Vitruvius.

#### Modern Systems

- Le Corbusier's Modulor: In the 20th century, French architect Le Corbusier developed the Modulor system, a scale of proportions based on human measurements and the Golden Section to create a unified system for designing architecture and objects. Major theories of perception in psychology include Constructivism, which emphasizes top-down processing and prior experience, and Direct Perception, which proposes bottom-up processing where sensory data is sufficient for understanding the environment. Other key perspectives are Gestalt theory, which focuses on how the whole is more than the sum of its parts, and the broader concept of Empiricism, which states that all knowledge comes from experience.

#### Psychological Theories of Perception

- Constructivist Theory (Top-Down Processing)
- Pioneer: Richard Gregory
- Core Idea: Perception is a data-driven process where the brain uses past experiences and existing knowledge to interpret sensory information, forming hypotheses or "guesses" about the world.
- How it Works: Because sensory information is often incomplete, the brain actively constructs a perception by filling in the gaps with prior knowledge, making it an experience-driven process.
- Direct Perception (Bottom-Up Processing)
- Pioneer: J. J. Gibson
- Core Idea: Perception is a direct, bottom-up process where sensory data itself is rich and sufficient for accurate environmental interpretation, negating the need for extensive interpretation or inference.

- How it Works: The environment provides an "optical array"—patterns of light that directly contain all the information needed to perceive the world.

- Gestalt Theory

- Pioneers: Max Wertheimer, Wolfgang Köhler, and Kurt Koffka

- Core Idea: The fundamental principle is "the whole is greater than the sum of its parts".

- How it Works: This theory focuses on how people naturally organize sensory information into unified, meaningful wholes or patterns (Gestalts) rather than separate components.

- Empiricism

- Historical Roots:

- Dating back to ancient times, with philosophers like John Locke and David Hume.

- Core Idea:

- All knowledge, including our understanding of the world, is derived from sensory experience.

- How it Works:

- The mind starts as a blank slate, and experiences fill it with knowledge, shaping our perceptions and understanding of reality.

#### Neuroscientific Studies

Neuroscientific studies on architectural proportion investigate how geometric relationships in buildings influence the brain and emotional responses, using tools like EEG and eye-tracking to quantify emotional states and brain activity in response to different spatial designs. Research indicates that aspects of space, including proportion, curvature, and scale, significantly impact human feelings and cognitive processes, even though effects on the unconscious mind may not be immediately apparent. This emerging field of neuroarchitecture seeks to bridge the gap between architectural design and human experience by providing empirical, neuroscience-based insights into how built environments can foster well-being and an optimal human experience.

Brain imaging techniques like functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) reveal that the brain processes symmetry and patterns through a distributed network, including early visual areas (V1, V2, V4), the lateral occipital complex (LOC), and the intraparietal sulcus (IPS). While fMRI, with its high spatial resolution, identifies specific regions like the LOC, EEG, with its excellent temporal resolution, can track the rapid, unfolding neural processes involved in pattern recognition and symmetry perception. Combining EEG and fMRI provides complementary insights into the brain's complex spatio-temporal dynamics.

Mirror neurons and embodied cognition link our internal experiences of action with our perception of the world, suggesting that understanding architecture involves simulating the actions associated with a space within our own bodies, creating an empathetic and experiential connection rather than just a visual one. This means the way a space is designed impacts our emotions and behaviors through an embodied understanding that goes beyond mere sight, influencing our physical well-being and our sense of connection to the built environment.

#### How They Apply to Architecture

- Embodied Simulation:

This process, mediated by mirror neurons, allows us to understand actions and intentions by simulating them within ourselves. When we see or navigate a space, our mirror neurons become active, allowing us to inwardly "perform" the actions that space suggests, such as reaching for a handrail or sitting in a particular chair.

- Emotional and Behavioral Responses:

This embodied simulation influences our feelings and actions in a space. An inviting architectural feature might trigger positive embodied experiences, while a cramped or unwelcoming one could lead to negative ones.

- A Deeper Connection to Space:

Instead of just a visual experience, our engagement with architecture becomes a more profound, felt

experience. Architecture can evoke reactions through this inherent, pre-reflective connection to our physical selves and our potential actions within that space.

- Influence on Design:

Understanding these principles can help architects design spaces that foster empathy and connection by considering the "we-centric space" our bodies create and how it mediates our experience of the world.

Proportions in an environment can influence spatial memory and emotional responses; for example, the geometry of an architectural space can elicit different feelings and be remembered differently, while the valence (positive or negative) of emotional stimuli can prioritize them in memory, potentially altering spatial representations and the memory for those spaces. Emotional content can enhance the retention of spatial information, and the brain's amygdala plays a crucial role in linking emotions, memory, and learning.

#### How Proportions and Geometry Affect Emotion and Memory

- Spatial Cues:

The shape and size (proportions) of environments act as spatial cues that people use to navigate and remember their surroundings.

- Emotional Response to Geometry:

Research shows that changes in the geometric properties of architectural spaces can evoke distinct emotional responses, which can be measured and quantified.

- Enhanced Spatial Memory:

Emotional information, including the inherent value of a location, can influence spatial memory. For example, spaces associated with strong positive or negative emotions might be remembered more vividly.

#### The Role of Emotions in Spatial Cognition

- Emotional Valence:

The positive or negative quality of an emotional experience can affect how accurately spatial information is encoded and remembered.

- Emotional Arousal:

The intensity of an emotional state also plays a role. High arousal from emotional content can improve memory for details, but its interaction with emotional valence can affect outcomes.

- Cognitive Maps:

Our internal representations of space, or "cognitive maps," become integrated with emotional experiences, with positive or negative feelings being associated with specific locations.

Brain Mechanisms

- Amygdala and Memory:

The amygdala, a brain region central to emotion, is also involved in linking emotions to memories and learning processes.

- Brain Regions:

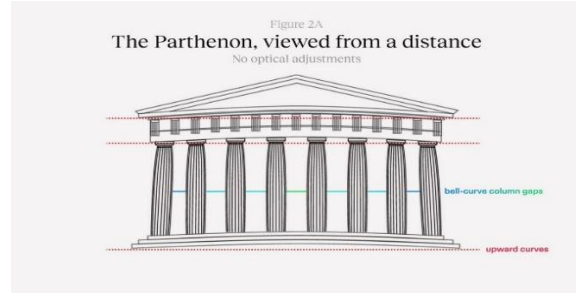
The brain regions involved in vision (occipital lobe), spatial positioning (parietal lobe), and emotion and decision-making (prefrontal cortex) are all interconnected in how emotions influence spatial decision-making and memory.

Gaps in Existing Research

Gaps in the neuroscience of architectural proportions include the lack of objective, standardized methods to assess aesthetic preferences and their neurological correlates, the under-exploration of the impact of specific proportions on diverse cognitive and emotional responses, and limited research translating neuroscientific findings into actionable, predictive design tools, particularly in translating controlled studies to real-world, complex environments like schools or hospitals. Furthermore, there is a significant need for studies that not only analyze aesthetics but also explore the impact of proportions on functionality, wayfinding, and the long-term health and social outcomes associated with built environments.

### III.CASE STUDIES

#### 1. Parthenon – The Golden Ratio Debate



The Parthenon (447–432 BCE), designed by Ictinus and Callicrates under the supervision of Phidias, is one of the most frequently cited examples in discussions of architectural proportion. It is often claimed to embody the Golden Ratio ( $\phi \approx 1.618$ ), though this remains a subject of scholarly debate.

- They depend on selective measurement points
- No surviving Greek texts confirm intentional use of  $\phi$  in the Parthenon

Classical Greek architects used:

- Integer ratios
- Geometric constructions
- Modular grids

rather than irrational numbers like  $\phi$ .

### 3. Optical Refinements and Perceptual Proportion

The Parthenon's real proportional sophistication lies in its optical corrections, which refine visual harmony:

Optical refinements include:

- Stylobate curvature (slight upward bow)
- Entasis (column swelling)
- Corner column thickening
- Inward column inclination

These adjustments:

- Correct visual distortion
- Create a dynamic proportional perception
- Demonstrate that proportion was perceptual, not purely mathematical\*\*

### 4. Geometric and Modular Method

Evidence suggests the use of:

- A basic module derived from column diameter
- Repetition of simple ratios (2:1, 3:2, 4:9)
- Geometric layout using squares and rectangles

This aligns with Greek mathematical thinking based on:

- Commensurable ratios
- Harmonic relationships

rather than the later Renaissance fascination with  $\phi$ .

### 5. Scholarly Positions

Supports Golden Ratio:

- 19th–20th century theorists
- Popular architectural history narratives

Rejects intentional Golden Ratio:

- Most contemporary classical scholars
- Archaeological measurement studies
- Lack of textual evidence from Greek sources

Current consensus:

➡ The Parthenon does not deliberately use the Golden Ratio

➡ Its beauty derives from modular proportion, harmonic ratios, and optical refinement

### 6. Architectural Significance

The Parthenon represents:

- A system of relational proportion
- Integration of structure, geometry, and perception
- Early example of mathematical harmony in architecture

It influenced:

- Roman proportional systems
- Renaissance theories of ideal proportion
- Modern architectural analysis of modular design

### 7. Conclusion

- Proportion in Greek architecture = ratio-based, modular, geometric
- Golden Ratio = later interpretative overlay, not proven design tool
- Visual harmony achieved through optical corrections
- Importance of human perception in proportional design

### 2. Taj Mahal – Symmetry and Proportion

The Taj Mahal (1632–1653), commissioned by Shah Jahan and designed by Ustad Ahmad Lahori (attributed), is one of the most refined examples of bilateral symmetry, modular planning, and hierarchical proportion in world architecture.



### 1. Overall Geometric Order

The Taj Mahal complex is organized on a strict axial symmetry along the north–south axis:

- Main gateway → Charbagh garden → Reflecting pool → Mausoleum
  - All major elements mirror across the central axis
  - Even subsidiary buildings (mosque and jawab) balance composition
- ➔ This creates visual equilibrium and cosmic order, reflecting Mughal concepts of paradise.

### 2. Charbagh Proportional Planning

The garden follows the Persian charbagh (four-part garden) geometry:

- Square garden divided into four equal quadrants
- Water channels forming a cross-axis
- Each quadrant further subdivided into smaller squares

Proportional logic:

- Garden = perfect square
- Mausoleum placed at the northern edge, not centre (unique Mughal adaptation)
- Reflecting pool reinforces the central visual axis

### 3. Mausoleum Proportion System

The mausoleum is based on clear volumetric ratios:

Key proportional relationships:

- Plinth height : total building height  $\approx 1 : 1$
- Dome height  $\approx$  height of main façade (creating a near cube + hemisphere composition)
- Central iwan (pishtaq) repeated on all four sides
- Corner minarets placed symmetrically at plinth corners

The structure can be read as:

- ➔ Cube (tomb chamber)
- ➔ Octagonal transition zone
- ➔ Double dome (hemispherical + bulbous profile)

This creates a hierarchical vertical proportion.

### 4. Modular Grid and Repetition

The design uses a modular bay system:

- Repetition of pishtaq arches
- Consistent spacing of chhatris and minarets
- Jali patterns based on geometric grids

The central bay is:

- Larger and taller → establishes visual dominance
- Flanked by smaller identical bays → rhythmic balance

### 5. Symmetry at Multiple Scales

Symmetry operates at four levels:

(a) Site level

Charbagh layout and axial alignment

(b) Building level

Four identical façades

(c) Structural level

Octagonal tomb chamber with radiating spaces

(d) Detail level

- Pietra dura inlay patterns
  - Calligraphy increasing in size with height to maintain visual proportion
- ➔ Even the optical scaling of calligraphy shows perceptual proportion.

### 6. Minaret Proportion and Optical Correction

The four minarets:

- Slightly tilt outward
- Are proportionally shorter than the main dome mass
- Frame the mausoleum without overpowering it

This ensures:

- Structural safety (in case of collapse)
- Visual framing of the central volume

### 7. Ratio and Harmony

Unlike Greek integer ratios, Mughal proportion combines:

- Geometry (square, octagon, circle)

- Symmetry
- Hierarchical scaling

The Taj Mahal's beauty comes from:

- Perfect bilateral symmetry
- Centralized massing
- Balanced vertical-to-horizontal proportion
- Controlled repetition

#### 8. Symbolic Proportion

Proportion also has cosmological meaning:

- Square garden → earthly order
- Dome → celestial vault
- Raised plinth → separation from mundane world

Architecture becomes a metaphor for paradise.

### IV.. CONCLUSION

- Taj Mahal = symmetry-based proportional system
- Use of cube + dome geometry
- Hierarchy through central emphasis
- Optical scaling in calligraphy and minarets
- Integration of site planning + building proportion

### V.FINDINGS & DISCUSSION

Certain architectural proportions have been shown to produce measurable positive responses in the human brain, particularly those that balance order and complexity. Compositions approximating the Golden Ratio ( $\phi \approx 1.618$ ) are often processed more efficiently by the visual system, leading to smoother eye movements, lower cognitive effort, and higher aesthetic preference. This occurs because the ratio creates a balanced relationship between unity and variation, avoiding both monotony and visual chaos, and it resembles growth patterns commonly found in nature. Similarly, fractal geometries—self-similar patterns that repeat at multiple scales—have been linked to reduced stress, increased alpha brain wave activity, and improved attention restoration. Research indicates that mid-range fractal complexity (fractal dimension around 1.3–1.5), which is typical of natural landscapes, is especially beneficial, supporting biophilic design principles. More broadly, the brain prefers environments with “ordered complexity,” where rhythmic repetition, hierarchical scaling, and human-scaled proportions enhance spatial legibility,

comfort, and memory. While responses to symmetry and natural fractal patterns appear to be largely innate, appreciation of specific ratios such as the Golden Ratio may also be influenced by cultural exposure and design training. For architects, this suggests that proportion is not only a formal or aesthetic tool but also a cognitive one, capable of reducing mental fatigue, improving wayfinding, supporting well-being, and creating emotionally resonant spaces.

Symmetry plays a significant role in how the human brain processes and evaluates visual information, leading to faster recognition and greater aesthetic pleasure. From a cognitive perspective, symmetrical forms are easier for the brain to decode because they reduce informational complexity; once one half is processed, the other half can be predicted, lowering cognitive load and speeding up visual comprehension. This efficiency is reflected in eye-tracking and neuroimaging studies, which show quicker fixation patterns and reduced neural effort when people view symmetrical compositions compared to asymmetrical ones. Symmetry also activates reward-related areas of the brain, contributing to a sense of visual satisfaction and perceived harmony. Evolutionary psychology suggests that humans may be predisposed to prefer symmetry because it is associated with stability, balance, and biological fitness in natural forms. In architectural space, symmetrical layouts improve spatial legibility, wayfinding, and memory, as users can form clear mental maps based on mirrored organization. Monumental buildings such as the Taj Mahal demonstrate how bilateral symmetry reinforces focus, hierarchy, and emotional impact, guiding movement along a central axis while creating a sense of order and calm. However, while symmetry enhances clarity and pleasure, slight controlled asymmetry is often introduced to avoid monotony and to create visual interest, suggesting that the most successful designs balance symmetry with variation.

Responses to proportion and spatial order show important variations across cultures, yet they are grounded in shared neurological mechanisms. Different architectural traditions prioritize different proportional systems—for example, modular ratios in classical Greek temples, geometric symmetry in Mughal architecture such as the Taj Mahal, and recursive fractal hierarchies in many Hindu temple

forms—reflecting distinct cosmologies, construction methods, and aesthetic philosophies. Cultural training influences what is perceived as “ideal” proportion, the preferred level of ornamentation, and tolerance for visual complexity; a viewer accustomed to minimal modernist spaces may respond differently from one familiar with richly patterned traditional environments. However, underlying these differences are common neurological tendencies: the human brain universally processes symmetry more efficiently, prefers moderate complexity over randomness or monotony, and shows positive physiological responses to hierarchical scaling and nature-like fractal patterns. These shared perceptual mechanisms support spatial legibility, reduce cognitive load, and enhance emotional comfort regardless of cultural background. Thus, while proportional systems are culturally expressed and symbolically interpreted, their effectiveness is partly rooted in universal aspects of visual cognition, allowing diverse architectural languages to achieve comparable experiences of harmony, balance, and aesthetic pleasure.

Evidence-based design research from environmental psychology and neuroaesthetics indicates that harmonious architectural spaces emerge when proportion, symmetry, hierarchy, and biophilic patterning are deliberately integrated to support human perception and well-being. Spaces organised with clear axes and balanced bilateral symmetry—such as those seen in the Taj Mahal—enhance spatial legibility, reduce cognitive load, and improve wayfinding by allowing users to form predictable mental maps. The use of modular proportional systems and rhythmic repetition, exemplified by colonnaded structures like the Parthenon, creates visual coherence and ordered complexity, which the brain processes efficiently and experiences as aesthetically pleasing. Incorporating mid-range fractal patterns through screens, landscape layouts, or surface articulation supports stress reduction and attention restoration, aligning with biophilic design principles. Human-scaled ratios in ceiling heights, room widths, and circulation paths improve comfort, social interaction, and perceived safety, while hierarchical scaling—from overall massing to detail—helps users intuitively understand spatial importance. Natural light aligned with geometric order, proportional openings, and framed vistas further enhance emotional response and

orientation. Together, these strategies demonstrate that proportion is not merely a formal composition tool but a measurable contributor to psychological comfort, behavioural efficiency, and holistic spatial harmony.

Proportion is a critical determinant of comfort, legibility, and social vitality in urban spaces, shaping how people perceive enclosure, movement, and monumentality. In public squares, the relationship between building height and plaza width influences the sense of spatial containment; ratios close to 1:1 to 1:2 typically create a feeling of enclosure and sociability, while overly large, unbounded spaces feel exposed and discourage lingering. Historic squares such as Piazza del Campo demonstrate how consistent building heights and curved edges generate a coherent “outdoor room” that supports gathering and visual focus. Street design similarly depends on height-to-width proportions; a ratio of approximately 1:1 to 1:3 maintains human scale, provides shade, and enhances walkability, whereas excessively wide roads relative to building height reduce pedestrian comfort and spatial definition. Monumental urban axes—such as Kartavya Path—use elongated proportions, symmetry, and terminating landmarks to create ceremonial movement and symbolic hierarchy. At the human level, proportional street furniture, colonnades, and tree spacing introduce rhythmic scaling that improves orientation and visual continuity. Evidence from urban behavioural studies shows that well-proportioned public realms increase dwell time, social interaction, and perceived safety, confirming that urban proportion operates as both a spatial ordering system and a psychological framework for collective experience.

In healing architecture—such as hospitals, rehabilitation centres, and meditation spaces—proportion plays a measurable role in reducing stress, supporting recovery, and improving emotional stability. Environments designed with clear spatial hierarchy, moderate ceiling heights, balanced room proportions, and symmetrical layouts help patients form cognitive maps easily, lowering anxiety and enhancing perceived safety. Access to natural light, framed views, rhythmic structural bays, and biophilic elements organised through coherent geometric order have been shown to reduce cortisol levels, improve pain tolerance, and shorten hospital stays. Meditation spaces often employ centralized plans, square or

circular geometries, and calm proportional relationships to encourage stillness, slow breathing, and focused attention, demonstrating how spatial harmony can influence physiological states. However, a critical reflection is necessary: while neuroscience suggests shared human responses to symmetry, natural patterns, and human-scaled proportions, the idea of a single “universal” formula for beauty—such as the Golden Ratio—has clear limitations. Cultural conditioning, symbolic meaning, climate, material traditions, and social practices all shape how spaces are perceived and valued. A proportion that feels serene in one cultural context may feel empty or monotonous in another that associates richness and layered complexity with well-being. Therefore, evidence-based design should not impose rigid universal standards but rather combine shared perceptual principles with culturally specific spatial languages, ensuring that healing environments are both neurologically supportive and socially meaningful.

#### VI. CONCLUSION

The growing dialogue between neuroscience and architecture highlights the need to move beyond purely formal or stylistic interpretations of proportion toward an evidence-based understanding of how spatial geometry affects human cognition, emotion, and behaviour. The central problem has been the historical separation between ancient proportional theories—developed intuitively in works such as the Parthenon and the Taj Mahal—and contemporary scientific methods capable of measuring brain responses to space. Current research demonstrates that the brain shows measurable preferences for symmetry, hierarchical scaling, moderate complexity, and human-scaled ratios, as these reduce cognitive load, improve visual fluency, and support emotional regulation. These findings provide a neurological basis for why certain spatial organizations are repeatedly perceived as harmonious across cultures, while also confirming that cultural meaning and learned experience shape aesthetic interpretation. The key contribution of this emerging field is the bridging of ancient geometric wisdom with modern neuroimaging, environmental psychology, and behavioral studies, allowing architects to design spaces that are not only formally coherent but also

physiologically supportive. Future directions include the integration of basic neuroscience laboratories and perception studies within architectural education, enabling students to test spatial configurations using eye-tracking, VR simulations, and post-occupancy evaluation, as well as conducting more real-world experiments in hospitals, schools, workplaces, and public spaces to measure long-term impacts of proportion on well-being, productivity, and social interaction. This interdisciplinary approach positions architecture as both an art and a science grounded in human experience.

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