The Psychology of Architecture
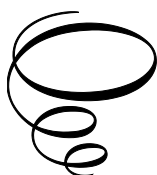
The Psychology of Architecture:

On Brains and Spaces

By

Ulaş Başar Gezgin
and Nguyễn Thị Bích Vân

The Psychology of Architecture: On Brains and Spaces

By Ulaş Başar Gezgin and Nguyễn Thị Bích Vân

This book first published 2025

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

TABLE OF CONTENTS

1. INTRODUCTION TO PSYCHOLOGY AND ARCHITECTURE

The interdisciplinary study of psychology and architecture provides insights into how the built environment shapes human experience. By integrating psychological principles into architectural design, we can create spaces that promote health, foster positive behaviors, and reflect individuals' and communities' diverse needs and identities.

Architecture is not just the physical embodiment of culture and history; it is an intimate dialogue between space and the human psychology. "The Psychology of Architecture: On Brains and Spaces" explores this profound connection, delving into how the built environment shapes our thoughts, emotions, and behavior.

Imagine entering a grand cathedral with towering ceilings and intricate stained-glass windows. The awe and reverence you feel are not just reactions to beauty but are also deeply rooted in the neurological and psychological responses caused by such spaces. In contrast, consider the oppressive weight of a cramped, dimly lit basement; its impact on your mood and mental state is equally profound, although very different.

"Psychology of Architecture" is not only for architects and psychologists but also for anyone curious about the invisible threads that connect our brains to the surrounding space. Whether you are designing a building, redecorating a room, or simply interested in how your surroundings affect your mental state, this book will provide important insights, valuable points and practical knowledge.

As we delve into the complex relationship between the brain and space, let us open our minds to the possibility that architecture is not just about constructing buildings but also about creating experiences, and shaping lives. Architecture is not only the art of construction but also the science of space and people.

Key topics include how light, color, and sound influence emotions; the impact of open and closed spaces on behavior; the role of architecture in creating a healthy living and working environment; and the interaction between architecture and culture.

This book bridges psychology and architecture, exploring how design can influence our happiness, productivity, and social interactions. From the harmonious layout of ancient temples to the sleek lines of modern skyscrapers, every architectural choice has the power to evoke various human experiences.

Although some of the researchers believe the behavioral sciences has little to the with architecture (see the discussion in Mert, 2019), a growing number of other researchers capitalize on data offered by behavioral sciences (Charehjoo et al., 2018). The former believe so, due to fact that there is no methodological unity across various relevant disciplines (Lawrence, 1983). Nevertheless, it is known that architecture is not given as it is, it is interpreted by human minds.

This topic would be expected to be hotter due to Covid 19 lockdowns, but surprisingly the lockdowns did not accelerate research in this field. An exception is Martín López and Fernández Díaz (2022) which developed design solutions for those who stay home in order to protect our mental health. In fact, we know that buildings have effects over people's psychology (Alharbi & Basaad, 2022). Variables such as place attachment, place identity and sense of place contribute to these effects (Al-Mohammedi, et al., 2022; Ariannia et al., 2024; Cole et al., 2021; Devine-Wright, 2009; Eskandari et al., 2019; Hashemnezhad et al., 2013; Meier, 2013; Mousighichi et al., 2024; Mojdehe et al., nd.; Ruhizar et al., 2023; Sattarzadeh & Balilan Asl, 2015). Fractals in architecture is an example of how human perception affects the way we interpret the architectural styles (Abboushi et al., 2019; Janetius and Mini, 2019; Joh, 2006; Joye, 2006; 2007b; Murteza, 2019; Peeters, 2021; Stalker, 2020; Taylor, 2021; Taylor et al., 2018). Color (Caivano, 2006; Joshi and Rawat, 2020; Mahnke, 2012; Nazeri et al., 2023; Radwan, 2015; Van den Berg et al., 2016; Zhang & Deng, 2021) and light (Chantzopoulou, 2022; Geurtjens, 2024; Hague, 2015; Karaman & Avci, 2022; Kharismawardani et al., 2022; Linders, 2023;

Moazzeni et al., 2022; Naser and Al-Mamoori, 2023; Younis et al., 2019) are considered to be significant factors in architectural perception (Babakhani, 2017; Oberascher, 2001; Ostadzamani et al., 2016; Rahimi & Dabagh, 2018; Wang et al., 2020). How they affect our psychology is exemplified by Clooney (2020) and McAndrew (2020) who conducted research on how architectural elements are utilized to scare us in horror movies.

Although the senses and sensations of colors are disputable, Anbari and Soltanzadeh (2015) list the following for colors:

> "Red: Warm color and stimulating passion and love, sincerity
>
> Orange: Energizing and stimulating color
>
> Pink: indicating Love and romance
>
> Blue: Expresses the sense of relief - represents peace, security and order- expresses the feeling of sorrow, introspection and isolation in some people
>
> Yellow: Warm and happy color- stimulating thought- making eyes bored more than other colors
>
> Green: Cool color and a symbol of nature - represents peace, happiness, health and jealousy, gaining the ability to read
>
> Purple: The most spiritual color represents harmony between reason and emotion and border between spirituality and materialism" (Anbari and Soltanzadeh, 2015, p.143).

Joshi and Rawat (2020) in field research, discover that local people prefer blue-white color combination for their houses with 5 motivations: Psychological, environmental, sociocultural/traditional, quality, no specific reasons/other reasons. Under the psychological motivation, they found the following: "Indicates purity and calmness; most soothing effect and releases stress; most appealing to people/favorite color; color of authority; symbolizes trust, loyalty, cleanliness, and understanding; invoked feelings of confidence, success and reliability" (Joshi and Rawat, 2020, p.98). Environmental motivation matched the following: "Indicates snow (water) in Himalaya as distant mountains appear white and blue" (Joshi and Rawat,

2020, p.98). Sociocultural/traditional motivation comprised of "symbolizes heaven (sky) and water; keeps evils and bad spirits away from house; being used since generations and has become part of tradition and they feel connected with customs" (Joshi and Rawat, 2020, p.98). Finally, the quality motivation corresponded to "draws attention in deep forest houses, and keeps wild animals and pests away from the house" (Joshi and Rawat, 2020, p.98). Furthermore, while psychological motivation is the most stated, gender differences were found in color mix motivations: Males mostly prefer the color mix for psychological reasons, while the females prefer it for sociocultural/traditional reasons (Joshi and Rawat, 2020). Psychological reasons still tops second after sociocultural/traditional reasons among females (Joshi and Rawat, 2020).

These considerations led to the development of various concepts such as sensory architecture, experiential architecture (Dhingra, 2017; Thwaites, 2001), emotional architecture (Ren et al., 2024; Wang, 2016), affective architecture (St. John, 2020), and empathic architecture (Banerji, 2016; Hong, 2021). Despite the fact that sense of sight is frequently mentioned, other senses such as sense of temperature is influential in people's perception of architectural design (Alonso et al., 2012). Papale et al. (2016) report studies on haptic perception (e.g. warm design) as a byproduct of visual appreciation.

Another branch of research under the title of experimental aesthetics revealed that curiosity, hedonic aspects and familiarity are significant in architectural perception (Oostendorp and Berlyne, 1978a; 1978b). People are found to prefer curvilinear rather than rectilinear designs (Vartanian et al., 2013). Furthermore, attention is found to be one of the major variables for aesthetic appreciation (Zhang et al., 2018). Under cognitive science, the concept of spatial cognition is studied to understand the perceptions of 'end-users' of architectural designs (Emo and Hölscher, 2020).

Architectural design is even related to certain mental disorders (Bil and Pawłowski, 2016; Connellan et al., 2013), although research on this subject rare and lopsided (i.e. focusing on particular disorders, understudying others) (Aljunaidy and Adi, 2020). Not only mental health, but physical health can be influenced by the built environment (Raghani et al., 2022).

Therapeutic interventions need to be supported by various types of architectural designs (Bazhrang & Mahdavinia, 2015).

Another line of relevant discussion draws a distinction between hard determinist views that assumes that architecture determines human psychology (Golembiewski, 2014), and soft determinist view which allows the mediation of individual characteristics (Giber, 1980). In that sense, the latter is open to interpretation. Golembiewski (2014) lists a set of failures of hard deterministic thinking, but then concludes that that thinking was rejected too soon. Although it is hard to provide evidence for psychological effects of architecture, there are some cases showing certain effects (Golembiewski, 2014). In that sense, Blau (1991) claims that with its behavioristic orientation, it is easier for psychology to collaborate with architecture, compared to sociology. However, the soft view above extends beyond behavioristic model. It is more cognitivistic than sheer behaviorism. We assign meanings to architecture, that makes a building 'a place' (Raghani et al., 2022).

The conflict between function (or commercial considerations) and aesthetics is a major issue in architectural design (Al-Akkam, 2013; Blau, 1991). The design can be ornamental, but dysfunctional; it can also be functional, but not beautiful. Old buildings, in this context, sparks our attention: Bishop (1982) finds, in a survey, that people do not want to keep old buildings just because they are old. They should either be continuing to serve their function or of aesthetic quality. On the other hand, ideological architecture such as Nazi architecture can have different connotations (Espe, 1981) surpassing the function-aesthetics conundrum. In this vein, it is found that Black people mostly dislike ante-bellum architecture, i.e. architecture of the American slavery period, as it reminds them of slavery ideology (Driskell and Trawalter, 2021). Secondly, under socialist realism, architecture had undertaken a new mission: that is, to transfer consciousness about 'building' of a new socialist society (Tomita and Ishii, 2014). In that sense, buildings can reflect the thinking of their times, their zeitgeist. Thus, the relationship between psychology and architecture should no longer stand as unidirectional: Psychologists too can learn from architecture (Foster, 2013). Thus, it is notable that Uzunoğlu and Özer (2014) report the success of an

architectural psychology course to fill the gap between psychology and architecture.

Specialized knowledge is another parameter: Architects' and lay persons' perceptions do differ (Devlin and Nasar, 1989; Gifford et al., 2000; Groat, 1982; Hubbard, 1996; Karmanov & Hamel, 2009), as well as architects' and engineers' (Akalın et al., 2009, 9p.; Garip & Garip, 2012; Todoroff et al., 2021), although some other research focused on commonalities between architects and other majors (e.g. Imamoglu, 2000). Through such an understanding, Groat (1985) researched contextual compatibility, whereby buildings look like they align with each other or some of them stand out negatively as 'ugly' outgrowths. Of course, we cannot expect all buildings of city to have the same design characteristics, but it is known that some of the cities keeping continuity in design such as Hoi An Ancient Town (Vietnam) is considered to be attractive by public. Groat (1985) observes perception differences based on architectural expertise, converging with Gifford et al. (2000).

The literature on psychology and architecture is mostly cognitivist (e.g. Sato-Wang, 2006; Zhang & Xu, 2021). Gestalt has a considerable influence over the field, while other theories are less common (Jules, 1984). Even though the relevant literature tries to connect psychology and architecture through a more cognitivist perspective, a psychodynamic approach and psychoanalysis is rarely associated with architecture. In such a rare occurrence, Gezgin (2023b) investigates what he calls as 'phallic architecture' which refers to the distinction between vertical and horizontal buildings. High rises, according to this account, represents the phallus, while horizontal buildings such as stadiums represent wombs, where one feel safe from outside nuisances. Following the psychodynamic tradition, Nuttall (2002) interprets a building from a Jungian notion of archetypes. In another study, Sperber (2014) compares buildings with Winnicottian transitional objects.

Just like we need cross-cultural psychology to question the so-called 'universality' of globally Western statements, Memmott & Davidson (2008) propose development of cross-cultural theory of architecture to underline the influence of culture on architecture. In that sense, a cross-cultural

understanding would once more allow marriage of psychology and architecture in both practical and theoretical ways. This has implications for the notion of cultural sustainability (Memmott and Keys, 2015). One should also keep globalization in mind as an influential factor on cultural decisions in architectural design (Eldemery, 2009). Cultures vary, so would be the architectural designs (Rand, 1983).

One of the leading theories in the field is the prospect-refuge theory. It proposes that people prefer prospects where they can observe the surrounding with refuges which keep them unseen by others (Dosen & Ostwald, 2013). People accordingly feel safe in such a design. However, the empirical support for the theory is weak, and the theoretical foundations need to be strengthened (Dosen & Ostwald, 2013).

The distinction between outside and inside is a major issue in architecture (Shahlaei and Mohajeri, 2015). Upon further reflection, it can even be connected to that of ingroup and outgroup in social psychology. In general, we expect 'inside' to be safe. One of the findings in the field is that interior patterns do make a difference in terms of people's behaviors (Rodemann, 2009).

Iskander (2023) provides a comprehensive checklist to provide healing design solutions for hospitals. It is an excellent work that can be adapted to other buildings with different functions with minor adaptations. Below are the components of the checklist:

"Location of Hospital: Proximity, ease of navigation, and traffic.

Accessibility: Pedestrian, vehicular, parking, and ambulance accessibility.

Wayfinding and Navigation within the Hospital: Signs, clear visible indication of each department, layout, and color coding.

Noise Control: Walls and doors that limit the noise from traveling through, surface materials that absorb sound, and soothing sounds.

Indoor Air Quality: Smell, temperature, and natural ventilation

Lighting: Allow sunlight to enter the building with control of glare, color of surfaces, color lighting, and distribution of lighting

Positive Distractions: Access to natural gardens both outdoor and indoor, paintings/photographs, and indoor landscape.

Waiting Area: Television control, and furniture.

Cleanliness and Maintenance: Keeping spaces organized and properly functioning; odor should be monitored especially during the cleaning process, and placing alcohol dispensers and sinks close to movement patterns.

Patient Room: View from window: natural vegetation or busy city streets, features to make patients feel like they are home, photographs or paintings on the wall, landscape views, calm and happy faces, nothing abstract or left open for interpretation, control of patient within room, privacy versus creating a temporary community, movable furniture, amount of sunlight that enters the room, Ease of access from bed to other features within the room" (pp.49-51).

In one of the interesting works in the intersection of psychology and architecture, Lara-Moreno et al., (2021) identifies 3 psychological profiles regarding architectural elements:

"endopathic (characterized by higher levels of psychosocial resources and well-being indicating a highly adapted and successful profile, and architectural preferences corresponding to their identities and experiences—expression through spaces), assimilative (characterized by average levels in all regulatory parameters indicating moderately adaptive individuals, and architectural preferences of spaces created in interactive processes—introjection of spaces), and additive individuals (characterized by a comparatively dysfunctional, poorer psychosocial profile, and architectural preferences in line with provoking a restorative effect—change with spaces)" (p.1).

The introductory chapter of "The Psychology of Architecture: On Brains and Spaces" sets the stage for a transformative exploration of the profound relationship between our built environments and our psychological well-being. By delving into how architectural elements such as light, color, and spatial design influence our emotions, behaviors, and social interactions, this chapter reveals the immense potential of thoughtful design. It invites

readers to view architecture not merely as a functional or aesthetic pursuit but as a crucial element of human experience and mental health.

This chapter underscores the interdisciplinary nature of this field, emphasizing the necessity of collaboration between architects, psychologists, and other stakeholders. Such partnerships are essential for creating spaces that are both visually appealing and psychologically enriching. As we journey further into this book, we will explore the scientific principles and practical applications that illuminate how we can design environments that foster well-being.

This introduction serves as a compelling call to action, urging us to rethink our approach to architectural design. It challenges us to recognize the invisible threads that link our minds to the spaces we inhabit, and to understand the profound impact these connections have on our daily lives. By embracing the principles outlined in this book, we can aspire to create environments that enhance our happiness, productivity, and overall quality of life. This paves the way for a future where architecture truly meets the needs of the human spirit, shaping spaces that nurture and inspire.

2. PSYCHOLOGY OF HEALTHY ARCHITECTURE

The "Psychology of Healthy Architecture" is an interdisciplinary field that explores the relationship between architectural design and human psychological well-being. It integrates principles from psychology, architecture, environmental science, and urban planning to create spaces that promote mental and physical health. Key aspects of this field include:

Biophilic Design: Incorporating natural elements like plants, water features, and natural light into built environments to enhance connection with nature, reduce stress, and improve mood.

Lighting: Using natural and artificial lighting to support circadian rhythms, improve sleep quality, and boost mood and productivity.

Color Psychology: Understanding how different colors affect mood, behavior, and well-being, and applying this knowledge to create conducive environments for various activities.

Air Quality and Ventilation: Ensuring good air quality and proper ventilation to reduce pollutants and allergens, which can improve cognitive function and overall health.

Acoustics: Designing spaces to manage noise levels, as excessive noise can lead to stress, decreased productivity, and impaired cognitive function.

Spatial Layout and Ergonomics: Creating layouts that support ease of movement, accessibility, and ergonomic design to prevent physical strain and promote comfort.

Social Interaction: Designing spaces that encourage social interaction and community, which can enhance mental well-being and reduce feelings of isolation.

Restorative Environments: Creating spaces that offer opportunities for relaxation and mental restoration, such as quiet zones or meditation areas.

Sustainability: Incorporating sustainable materials and practices to create environments that are healthy for both occupants and the planet.

Personalization and Flexibility: Allowing for personal customization and flexibility in spaces to cater to individual needs and preferences, thereby increasing comfort and satisfaction.

The goal of healthy architecture is to create environments that not only meet functional needs but also enhance the psychological and emotional well-being of their inhabitants. This approach recognizes that our surroundings significantly impact our mental and physical health, and by designing with this in mind, we can create healthier, more supportive living and working environments.

Although there is a growing interest in the notion of healthy architecture, the number of relevant research studies is still limited (Liu et al., 2023). According Lin et al., (2022), "Healthy buildings are a deep-level development of green buildings, which can effectively help relieve stress and improve occupants' physical and mental health. In addition, they are likely to play an important role in preventing the spread of respiratory infectious diseases" (p.1). Contrary to the aim of constructing healthy buildings, Ryd (1991) points out 'sick' buildings that are detrimental to occupants' health. Iskander (2023) mentions the key point in that sense: "While architecture has the power to heal when designed and maintained, it also has the power to harm if not done right" (p.3). In that sense, Quesada-García et al. (2023) delineate a new conceptualization of healthy architecture in the aftermath of Covid 19 outbreak which stressed the need for healthy designs. A part of healthy architecture discussions involves epidemic-resistant architecture in the wake of Covid-19 outbreak (Al-Delfi and Salman, 2024; Al-Nuaimi and Mohammed, 2022). Ibrahim Mohamed Hendawy (2022), in this context, claims that the architectural design of governmental buildings in Egypt do not promote health in the case of Covid-19 outbreak, and outlines a set of solutions.

Public health is considered to be a function of "the use of resources, site location, and green spaces" (Azzopardi-Muscat et al., 2020, p.9). However, Evans and McCoy (1998) failed to find a relationship between certain

design elements and humans' health. On the other hand, while Petermans & Pohlmeyer (2014) set the ground for theoretical discussions on 'positive design' approach which aims at designs to boost people's happiness, Petermans & Nuyts (2016) discover an association between architectural design and people's happiness.

In the previous chapter, we pointed out people's preference for curvilinear rather than rectilinear designs (Vartanian et al., 2013). Following this research program, Ho & Chiu (2021) found that curvilinear designs are found to be interesting, but fail to relieve stress, while rectilinear designs are more associated with stress. Let us also note that, Shemesh et al. (2017) discover that non-experts in design prefer curvy-shaped designs, while experts tend to choose sharp-angled designs.

The research on the subject is not theoretically diversified. Albeit that, there are a few examples contrary to this point. For example, Kennedy (1981) applies feminist principles into architectural design, and come up with an interesting model, while Roessler (2012) undertakes a psychodynamic and existential approach to the notion of healthy architecture.

Despite of being a minority among the group of architects, Mazuch & Stephen (2005) design architectural projects with therapeutic effects. Likewise, Osama (2020) develops a model of asylum to reduce mental health disorders. Convergingly, Singh et al. (2021) discuss and present 'healing spaces'. Stevens et al. (2019) present and discuss designs that promote people's wellbeing, while Xie et al. (2017) focus on a similar theme. Stigsdotter (2005) details healing gardens and urban green spaces for their healing properties.

With a historical approach to pandemics and healthy architecture, Fezi (2020) concludes that

> "Solutions for health engaged architecture and urbanism are indicated at
> different scales: object scale—hygiene; people scale—distancing and
> isolation; interior spaces—air control by ventilation, filtering and
> humidifying; residential—intermediate housing, public spaces between
> buildings—the key for social interactions; working—telecommuting, size
> and dispersion; shopping—proximity and downscaling; transportation—

walking, bicycling, shared mobility and robo-taxies; and higher scale-mixed use neighborhoods" (p.185).

Horn (2021) discusses the notion of healthy buildings in relation with green building certifications and sustainability considerations, whereas Hovel (2021) lists a set of healthcare projects designed for healing with a positive light. Folger (2023) describes a wellness center project to promote mental health, while Garay (2008) portrays a hospital project for healing including a trauma center and emergency care. Leyten (2008) delineates a healthy architecture project based on Chinese Five Elements (Wood, Fire, Earth, Metal, and Water) to maintain the balance of the body. The outcome is unsurprisingly interesting.

Rice (2019) sadly notes that architects are not trained in health and wellness issues, and these issues are rarely considered during design process. Rice & Drane (2020) observe that among architectural health indices, mental health issues are underexplored with a focus on physical health involving communicable diseases.

Healthy architecture does not merely stop at meeting the functional needs of living and working spaces but also focuses on enhancing the psychological and emotional well-being of the residents. Recognizing that the surrounding environment has a significant impact on human mental and physical health is the basis for applying these supportive design principles. By incorporating natural elements, light, color, air quality, sound, spatial layout, and sustainability, healthy architecture creates comfortable, serene, and uplifting living and working environments. Personalization and flexibility in design also play an important role, making spaces more suitable for the needs and preferences of each individual. As a result, not only is the overall health of the residents improved, but it also brings a sense of happiness and satisfaction in daily life. Thus, approaching healthy architecture is an essential and sustainable direction in building healthy and thriving communities.

3. PSYCHOLOGY OF BIOPHILIC ARCHITECTURE

In recent years, there has been a growing recognition of the profound impact that our built environments have on our psychological and physical well-being. This has led to an increasing interest in biophilic architecture, a design philosophy that seeks to reconnect humans with nature through the integration of natural elements into the built environment. The psychology of biophilic architecture delves into the deep-seated human affinity for nature, exploring how design strategies that incorporate natural light, greenery, water features, and organic materials can significantly enhance our mood, reduce stress, and improve overall mental health. This chapter will explore the principles and benefits of biophilic design, backed by scientific research, and provide practical insights into how these principles can be effectively applied to create healthier, more nurturing spaces that foster well-being and productivity.

It can be stated that, evolutionarily speaking, we have a natural inclination for nature (Abdullateef, 2023; Dalay, 2020) which is a hypothesis originally proposed by Erich Fromm for love for living beings (Amat et al., 2020; Aouadi et al., 2023; Audu & Ahmed, 2023; Düzenli et al., 2017; Kayıhan, 2018). Therefore, we have an inherent inclination for biophilic architecture which is the adaptation of biophilia hypothesis to architecture (Abdelaal, and Soebarto, 2018; Aksoy & Selçuk, 2021; Akyıldız, 2023; Alam, 2023; Gohiya, 2023; Hayles, and Aranda-Mena, 2018; Hung & Chang, 2021; Joye, 2006; 2007a; Jung et al., 2023; Kabinesh et al., 2024; Söderlund & Newman, 2015). Biophilic designs are found to influence people's perceptions of restorative qualities of a building (Azan & Ismail, 2022; Ele-Ojo & Lawal, 2023). Biophilia is associated with attention restoration theory which "assumes that when an individual's ability to concentrate or direct attention has become depleted, then nature is well-equipped to replenish this capacity" (Joye & Dewitte, 2018, p.1), although more research studies are needed for further clarification (Vance, 2023). Even a short time spent with viewing a natural sight is known to reduce stress levels (Berto, 2014; de Paiva & Jedon, 2019; DeLauer et al., 2022). This has

implications for window designs as well (Drobne et al., 2022; Hague, 2015; Heye, 2021; Ko et al., 2020; Parsaee et al., 2021b; 2021c; Zhang et al., 2023). Nature, in this sense, has a healing property. Biophilic architecture, likewise, reduces stress (Chamu, 2023; Gray & Birrell, 2014; Lowe, 2020). Another consequence of biophilic design is that it supports nature preservation efforts (Dillon, 2008; Kahl, 2016) and pro-environmental behavior (Mousapour, 2023). On the other hand, Gillis & Gatersleben (2015) conclude that "there exists much evidence supporting certain attributes of biophilic design (such as the presence of natural elements), while empirical evidence for other attributes (such as the use of natural materials or processes) is lacking" (p.948). However, let us note that a lot of research has been conducted after 2015. Furthermore, humankind had applied various biophilic principle into architecture before the term was officially coined in academic circles (Aksoy & Selçuk, 2021; Haidamous, 2022; Movahed, 2015; Tereci, 2019). On the other hand, we should keep mind that biophilic designs are costlier due to maintenance needs etc. (Larsson and Krishnaraj, 2023), but it compensates the costs by the benefits for health (Ibenna et al., 2021). As stated by Terrapin (2012) "Biophilic design has often been regarded as a luxury for property owners who want the best possible workplace for their employees, or who want to showcase their efforts to be more environmentally responsible. In reality, improving community well-being through biophilia can impact productivity costs and the bottom line" (p.3).

Abdelaal, and Soebarto (2018) lists the following biophilic elements: "Environmental features, natural shapes and forms, natural patterns and processes, light and space, place connections, and evolved relations to nature" (p.144). Abdulkadir, and Olagunju (2023) mention "natural lighting and ventilation, presence of water, presence of animals, contact with weather through sit-out, vegetations and natural ecosystem" (p.107) as biophilic direct experience components. Abdulkadir, and Olagunju (2023) "recommends the use of well landscaped courtyard/atrium with fountains, green roofs, balconies to ensure contact with weather, and gardens to promote natural ecosystem" (p.107). Khanzadeh (2024)'s recommendations include:

"- Incorporate natural elements: Strategic placement of indoor plants, utilization of natural materials (wood, stone), integration of natural lighting and views.

- Consider spatial layout: Create open and flexible floor plans, allocate dedicated spaces for rest, work, and social interaction.

- Prioritize sustainability: Integrate energy-efficient systems (smart lighting, heating/cooling), use recycled and low-impact materials.

- Emphasize user engagement: Involve residents in decision-making, provide opportunities for personalization and customization" (p.164).

Biophilic arhitectural designs have been discussed in various settings and with diverse concepts including hospitals (Acosta Arista, 2021; Avinç & Selçuk, 2021; Husain & Salim, 2022; Muhamad et al., 2022; Verma, and Singh, 2023), public hospitals (Akrami & Habibi, 2018), children's hospitals (Sabaa et al., 2022), pediatric hospitals (Maigari, 2023), child-friendly open spaces (Nugroho, 2021), childcare facilities (Park & Lee, 2019), cultural environments for children (Sadafi, and Azhdari, 2020); children in general (Ünal & Özen, 2021), healthcare environments (Manfrin, 2023; Turki et al., 2023; Valdez, 2022), health facilities (El Sheikha et al., 2023), rehabilitation centers for the disabled people (Montenegro Paredes & Quinteros Pinedo, 2022), rehabilitation center for addiction (Rhoda & Ambrose, 2019), resorts (Abraham et al., 2023; Gana, 2023), medical resorts (Ancona, 2017), hotels (Khozaei et al., 2022), luxury hotels (Yusuf et al., 2024); business hotels (Aldjaidi et al., 2021), hotel lobbies (Abreu, 2015; Bilgic, 2019), student hostels (Asim and Shree, 2019), vernacular architecture (Adenaike, 2024), office buildings (Afify et al., 2022; Audu & Ahmed, 2023; Cripps, 2016; Gray & Birrell, 2014; Karaman & Avci, 2022; Mohd Idris et al., 2021; Verma, 2023), high rise office buildings (Wong, 2011), open office (Smith, 2013), co-working space (Suharjanto et al., 2020) and work places (Al-Dmour, 2023; Hähn et al., 2020; Klotz & Bolino, 2021; Sanchez et al., 2018; Tahoun, 2019; Zulkifli et al., 2023), schools (Almusaed et al., 2022a; 2022b; Mustafa, and Yaseen, 2019; Walimbe, and Chitgopkar, 2018; Watchman et al., 2020; Watchman et al., 2021a; 2021b; Yaseen, and Mustafa, 2023), primary/elementary schools (Agarwal & Chadda, 2023; Awad, 2022; O'Connor & O'Connor,

2024; To, 2022; Watchman, 2021; Watchman et al., 2021c), kindergartens (Huizi et al., 2024; Yeler, 2022) and preschool environments (Jabbarioun Moghaddami, 2019), apartments (Ardiani et al., 2020; Larsson and Krishnaraj, 2023; Nguyen, 2023; Rukwaro, 2021; Tiwagar & Prawata, 2018), green roofs (Niroumand et al., 2020), heritage shophouses (Bahauddin et al., 2019) and heritage workplaces (Ong & Bahauddin, 2018), residential centers for the elderly (Changa et al., 2023), urban senior living (Colley, 2015), elderly homes (Mari et al., 2022), aged care (Miller & Burton, 2023), shopping malls/centers (Cheng & Marzuki, 2023; Lailatunnaja, 2022; Ortegón-Cortázar & Royo-Vela, 2019), lifestyle centers (Rosenbaum et al., 2018); urban university districts (Cobreros et al., 2023), residential college campuses (DeLauer et al., 2022) and university campuses (Mousighichi et al., 2024; Yılmaz & Ayten, 2023), campus master plan (Tacto, 2020), learning spaces (Determan et al., 2019; Matteson, 2013), educational spaces (Elmashharawi, 2019) and buildings (Siham, 2023; Yağcıoğlu, 2022), university learning environments (Peters & D'Penna, 2020), libraries (Dewi et al., 2020); mental rehabilitation and healing centers (Mentari et al., 2023), mental health centers (Puren et al., 2021), cancer healthcare spaces (Ebaid, 2023) and cancer hospitals (Isyworo et al., 2019); rehabilitation buildings (Merylova et al., 2024); mosques (ElAttar et al., 2019; Movahed, 2015; Tereci, 2019), colonial churches (Rai et al., 2019; 2020), ancient and Islamic Egyptian architecture (Elraghy, 2023), retail stores (Esan-Ojuri, and You, 2021), traditional bazaars (Esmaili et al., 2019; Esmaili et al., 2021), subarctic architecture (Espinoza-Sanhueza et al., 2024), workplaces in the tropics (Reng, 2016), urban landscape (Flores & Aguayo, 2023; Hussein & Al-Khafaji, 2023), urban residential spaces (Khanzadeh, 2024), residential building complexes (Lease, 2023), residential environments (Lee, and Park, 2022; Nota et al., 2017), residential typologies (Orman, 2017), residential housing (Shaliha et al., 2023), unused garages (Fortes, 2023), dormitories (Hasa & Husain, 2023), home workspaces (Heye, 2021), tourism (Ibenna et al., 2021), institutional buildings (Isaac & Mokunfayo, 2023), conversion of a former paper mill into a university campus (Jóźwik & Jóźwik, 2020), construction sites (Obiozo & Smallwood, 2014), adaptive building façades (Parsaee et al., 2021a), single-family homes (Peralta Rentería, 2021), urban parks (Razafiarison et al., 2020; Ristianti et al., 2024), hortitherapy (people-plant

interaction) (Reis et al.,2020), furniture design with living organisms (Sayuti et al., 2021), spa (Schmidtberger, 2023); rehabilitation and restoration of buildings (Shaheen, 2023), energy efficiency (Shrestha & Bajracharya, 2022), prisons (Söderlund, and Newman, 2017), construction projects (Subramaniam et al., 2021), restorative gardens (Tarek, 2021); environmentally sustainable design (Wijesooriya & Brambilla, 2021), and green spaces (Zhong et al., 2024).

The health benefits of the biophilic elements are long, including "stress reduction; relaxation and attention restoration; pleasure and satisfaction; attention and cognitive restoration; promoting health, mental restoration and inspiration; positive distraction; less period of stay in hospital; pain relief; social restoration; reduced mental fatigue; improved concentration, attention and perception of safety; reduced boredom, irritation, and fatigue" (Abdelaal, and Soebarto, 2018, p.144). Wijesooriya & Brambilla (2020) add that it "induces pro-environmental behaviour, enhances social interaction, increases happiness, reduces heart rate, decreases blood pressure, decreases skin conductance" etc. (p.19). Interestingly, Lutrin et al. (2022) discover that biophilic art is as effective as biophilic designs on human health, which may useful for future research.

14 patterns of biophilic design are mentioned under 3 categories: nature in the space, natural analogues and nature of the space (Afify et al., 2022). For the first one, the authors list the following: "Visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, presence of water, dynamic and diffuse light, and connection with natural systems" (Afify et al., 2022, p.1933). Natural analogues consist of "biomorphic forms and patterns, material connection with nature, and complexity and order"; whereas nature of the space comprises "prospect, refuge, mystery, and risk/peril" (Afify et al., 2022, p.1933). Based on these characterizations, the authors identify biophilic design elements such as roofs (e.g. "rainwater catchment and filtration"), walls (e.g. "smart green walls"), floors (e.g. "ecofriendly materials"), ceilings (e.g. "responsive acoustic panels"), openings, ventilation, lighting, furniture, accessories, and sensory-stimuli systems (Afify et al., 2022, p.1934).

In another study, Agarwal, and Chadda (2023) explain these 14 patterns and note that non-visual connection involves other senses; and random sensory stimuli are needed (we can say, it can be like birdsongs which never repeat themselves). About the less well-known category, which is the nature of space category, they comment that "Unobstructed long- distance vision for planning and observation" (p.1274) is meant by 'prospect', while "a place of refuge where one may retreat from their surroundings or the main activity stream while yet being protected from above and behind" (p.1274) is meant by 'refuge'. Mystery involves "a sensory device or partially veiled views that entice a person to explore their surroundings more deeply by promising more information", whereas risk/peril corresponds to "a recognized threat and a trustworthy defense" (Agarwal, and Chadda, 2023, p.1274). Agarwal, and Chadda (2023) propose that biophilic design can enhance cognitive growth, reduce stress, and serve emotional well-being, promote physical exercise and connection, and foster social interaction and empathy; and recommend outdoor-overlooking windows, green walls, balconies, fountains and aquarium, paintings, daylight, rooftop gardens etc.

Salingaros (2019) develops a biophilic index that consists of

"1. Sunlight: preferably from several directions.

2. Color: variety and combinations of hues.

3. Gravity: balance and equilibrium about the vertical axis.

4. Fractals: things occurring on nested scales.

5. Curves: on small, medium, and large scales.

6. Detail: meant to attract the eye.

7. Water: to be both heard and seen.

8. Life: living plants, animals, and other people.

9. Representations-of-nature: naturalistic ornament, realistic paintings, reliefs, and figurative sculptures—including face-like structures.

10. Organized-complexity: intricate yet coherent designs—and extends to symmetries of abstract face-like structures" (np.).

Naturalness of an architectural design is found to be a variable that can be manipulated experimentally (Coburn et al., 2019). The positive effects of biocompatible architecture on citizens are well-known as a response to various social problems such as increased population, increased construction, high energy consumption, pollution, reduced green areas per capita etc. (Mahmoodi et al., 2021). Biophilic designs can also reduce stress and increase productivity (Ramzy, 2015a). On the other hand, one should note that biophilic design differs from biomimicry as the latter involves inspiration, while the latter is about imitation (Ramzy, 2015b; Zari, 2009). Beijing National Stadium (a.k.a. Bird's Nest) and Singapore's Helix Bridge are considered to be examples of biomimicry (Janetius and Mini, 2019).

While Asgarzadeh et al. (2010) unsurprisingly find that trees are more effective that greenery on the façades of buildings, biophilic design extends beyond vegetation use in buildings (Zhong et al., 2022). Biophilic design is considered to be a way to transfer therapeutic properties of healing gardens to other living arrangements (Asim et al., 2021). In that sense, Zhong et al. (2023) present the idea of 'green pockets' which means 3D green spaces.

Amat et al. (2020) lists the following biophilic design principles:

- "Repeated and sustained engagement of nature."

- "Focuses on human adaptations to the natural world that over evolutionary time have advanced people's health, fitness and well-being."

- "Encourages an emotional attachment to particular settings and places."

- "Promotes positive interactions between people and nature that support an expanded sense of relationship and responsibility for the human and natural communities."

- "Encouraging mutual reinforcing, interconnected, and integrated architectural solutions" (Amat et al., 2020, p.3).

Huizi et al. (2024) list biophilic design elements as follows:

"- Large windows, skylights, maximizing natural light.

- Green vegetation, lawns, gardens, etc., adding natural beauty to the environment.

- Adoption of wood, stone, bamboo, etc., enhancing the natural feel of indoor environment.

- Incorporating elements such as water bodies, terrain, natural landscapes etc. into building design" (p.3).

Biophilic design principles are universal, but of course there may be cultural differences in implementation. For instance, Wang (2022) compares biophilic designs in China and Canada, whereas several studies research historical buildings built before the rise of the notion of biophilic design (ElAttar et al., 2019; Movahed, 2015; Rai et al., 2019; 2020; Tereci, 2019). For one thing, climates do differ which brings diverse design solutions (cf. Espinoza-Sanhueza et al., 2024; Reng, 2016; Watchman, 2021; Watchman et al., 2020; Watchman et al., 2021a): "In cold climates prolonged periods of precipitation, restricted sunshine and low temperatures represent non-ideal conditions for fostering a connection with nature" (Watchman et al., 2020, p.1).

Wijesooriya & Brambilla (2020) list the following weaknesses of biophilic design based on an extensive literature review: "Increased requirement of land, lack of knowledge, lack of agreed method, lack of evaluation tools, index or guidance, dependent on subjective perception, increased maintenance cost, dependence on cultural diversity for perception, increased cost, decreased structural stability, requirement of strong design response for perception, and reduced lifecycle" (p.15).

The psychology of biophilic architecture highlights the intrinsic connection between humans and nature, demonstrating the significant benefits of integrating natural elements into our built environments. By understanding and applying biophilic design principles, we can create spaces that not only meet our functional needs but also promote mental and emotional well-being. The research and insights presented in this chapter underscore the importance of natural light, greenery, water features, and organic materials in reducing stress, enhancing mood, and improving overall health. As we continue to navigate the complexities of modern living, incorporating

biophilic design into architecture offers a sustainable and effective approach to fostering healthier, more fulfilling environments. Embracing these principles can lead to the creation of spaces that support human flourishing, ultimately contributing to the development of resilient and vibrant communities.

4. PSYCHOLOGY OF RESIDENTIAL ARCHITECTURE

The spaces we inhabit play a crucial role in shaping our daily experiences, emotions, and overall well-being. Residential architecture, in particular, holds a unique place in our lives as it forms the backdrop of our most intimate moments and personal routines. The psychology of residential architecture delves into the profound impact that home design has on our mental and emotional health. By examining how elements such as spatial layout, natural light, color schemes, and material choices influence our sense of comfort, security, and happiness, this chapter aims to uncover the principles that make a house a nurturing home. Understanding these psychological aspects is essential for architects, designers, and homeowners alike, as it provides the foundation for creating living spaces that not only meet practical needs but also enrich the human spirit. Through a blend of scientific research and practical applications, we will explore how thoughtful residential design can enhance quality of life and foster a deeper connection to the places we call home.

Lei et al. (2023) rightly states that home is the refuge for the individual who may suffer psychological troubles during our turbulent times. In their research, they compared healing properties of two residential designs and found a significant difference (Lei et al., 2023). Li (2022) is a similar study where residents' anxiety and depression levels were compared on the basis of two different residential garden designs. Homes should not only meet basic needs, but ideally higher needs in Maslow's hierarchy (Ekama, 2010). Sense of belonging and security are key concepts in that sense. Through psychological processes such as personalization, a house becomes 'my home' (Farahat & Alaeddine, 2023). Home is a house with personal meanings attached into it (Zane, 2017). It is supposed to be a place where we are stress-free (Gong et al., 2023). A lot of time is spent by residents to accommodate a place as home (Graham et al., 2015). While homeownership is associated with various health benefits, Cairney & Boyle (2004) discover that home owners with mortgages are stressed as well, and tenants are more

stressed than home owners. Temporary housing research reveal that housing type influences residential satisfaction and attachment among a group of earthquake survivors (Caia et al., 2010). Tenants who become home owners record an increase in their housing satisfaction (Diaz-Serrano, 2009).

Oskouei et al. (2020) study psychology of privacy in residential architecture, while Banaei et al. (2015) investigate psychological comfort as a result of residential interior design. In their empirical study, Choi et al. (2021) reveal that environmental psychological factors "such as openness, safety, noise, territoriality, and crime prevention" (p.966) positively influence design factors in residential architecture. Housing insecurity is a major factor influencing residents' mental health (Elrayies, 2022), in addition to the design elements. Related factors such as threat of eviction and payment problems negatively contribute to residents' psychological health (Taylor et al., 2007). Another factor is crowding (Ryt, 2020) or person per square in a residential building. During lockdown, some people complained that their home is too small for all family members to live simultaneously. In another study, housing inadequacy, crowding, and perceived housing stress are found to be related (Campagna, 2016).

Among the elderly, housing quality is found to be associated with positive affect through the mediation of place attachment (Evans et al., 2002). Another study finds that factors such as structural adequacy and maintenance quality affect subjective housing quality evaluations for a group of elderly people (Christensen et al., 1992). Oswald et al. (2006) reveal that housing perceptions among the elderly consist of 4 components: "housing satisfaction, usability in the home, meaning of home and housing-related control beliefs" (p.187). In a multi-national study about health aging and housing, it was concluded that "Participants living in better accessible homes, who perceive their home as meaningful and useful, and who think that external influences are not responsible for their housing situation are more independent in daily activities and have a better sense of well-being" (Oswald et al., 2007, p.96).

Design of green roofs and balconies have positive effect on apartment residents' psychological states (Shoohanizad & Haghir, 2016). On the other hand, in early study, Gillis (1977) observes gender differences: As the floor