



Article

Conceptual Parametric Relationship for Occupants' Domestic Environmental Experience

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Abstract: Today's architectural design approaches do not adequately address the relationship between users' spatial, environmental and psychological experiences. Domestic environmental experience generally indicates users' cognitive perceptions and physical responses within dwelling spaces. Therefore, without a clear perception of occupants' experiences, it is difficult to identify proper architectural solutions for a domestic environment. To understand notions of these domestic experiences, the current study explores the theoretical relationship between spatial and environmental design factors within domestic settings which led to the concept of "Environmental Experience Design (EXD)". Extensive data exploration was conducted using a combination of thirty keywords through different databases (e.g., Scopus, ScienceDirect, PubMed, Google Scholar, Mendeley and Research Gate) to categorise the relevant literature regarding thematic study areas such as human perception and phenomenology, environmental design and psychology, residential environment and design, health-wellbeing and user experiences. This study has identified theoretical associations between spatial and environmental design factors of different domestic spaces that can stimulate occupants' satisfaction and comfort by reviewing eighty-seven studies from the literature. However, occupants' contextual situations significantly impact domestic spaces, where spatial and environmental design attributes may be connected to diverse sociocultural factors. The scope of explanation about user context is limited, to some extent, in environmental design theories. Thus, combining occupants' contexts with spatial and environmental design factors will be a future research direction used to explore the notion of "Domestic Environmental Experience Design"

Keywords: domestic environment; spatial factors; environmental factors; occupants' experiences; theoretical relationship



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1. Introduction

Generally, people spend more than 60% of their time in domestic indoor environments [1]. In the domestic setting, occupants' living experiences and household activities are diverse in every step of their daily lives and there are numerous preferences related to occupants' spatial needs and demands [2–4]. These preferences are connected to multiple aspects of domestic settings and are perceived through occupants' living experiences. Every component of the domestic environment has a negative or positive impact on occupants' psychological responses. Several studies also identified that these factors stimulate humans' mediative capacities in their living environments [5]. Therefore, it is necessary to explore occupants' perceptions and living experiences in domestic settings to enhance their mental wellbeing [6]. Domestic environmental experience generally indicates users' experiences of cognitive perceptions and physical responses in domestic settings [6]. The environmental design concept may be enriched by integrating rigorous perceptions and systematic data associated with occupants' experiences in different spaces of the built environment [7].

The literature has identified that the domestic environment serves various purposes and has meaningfulness related to occupants' spatial and environmental aspects. A domestic setting generally has different spatial zone distributions. Each area has specific characteristics related to its spatial and environmental factors that affect occupants' physical and psychological wellbeing in living environments [6]. Thus, every domestic component has a significant spatial and environmental relationship that may enhance occupants' emotions [6,8,9]. These spatial and environmental factors may vary from one space to another, associated with occupants' multidimensional preferences (e.g., needs and demands) [6]. Consequently, the valuation of these factors is critical in designing domestic environments according to different living spaces. However, without a clear perception of occupants' spatial and environmental experiences of different areas in a domestic setting, it is difficult to identify overall environmental design solutions to enhance their mental wellbeing.

This study has been conducted using a comprehensive literature review based on occupants' domestic environments and their household experiences. Various aspects of occupants' spatial and environmental experiences in domestic settings have been elaborated in this study. This study's primary research question is *"What is the theoretical parametric relationship for occupants' domestic environmental experiences that enhance their wellbeing?"* This study's main objective is to explore the theoretical parametric relationship between occupants' spatial and environmental design factors through the household experience of different areas in domestic settings that may stimulate occupants' quality of life. To develop a conceptual framework or associations to identify a correlation among various spatial and environmental design factors in a domestic setting, emphasising space-wise household experiences is the primary focus of this study.

2. Literature Selection Criteria and Research Methods

A literature review is a pedagogical study linked to a particular theme or research question [10,11]. Several studies found significant impacts of domestic environments on human perceptions [1,6,8,12]. This study explores theoretical relationships of different domestic spaces between spatial and environmental design factors through occupants' household experiences based on the literature, which may stimulate living quality. The study was conducted using a comprehensive background of 30 keywords based on occupants' domestic environments and their household experiences. The keywords encompassed domestic environment and occupants' experiences as well as a diversity of psychological and behavioral aspects related to residential settings (Figure 1). "Human Perception and Phenomenology, Environmental Design and Psychology, Residential Environment and Design, Health and Wellbeing and User Experience" are the main thematic study areas that were considered to explore occupants' spatial and environmental experiences in domestic settings in this study.

The following 30 keywords associated with the thematic study domains have been used: domestic environment, housing, dwelling, home, occupant experiences, occupant spatial experiences, occupant environmental experiences, household activities, high rise residential apartment, dwelling environment, apartment building, residential function, household functions and activities, space use behavior, occupant psychology, occupant behavior, residential comfort, residential satisfaction, indoor environment, environmental quality, mental wellbeing, physical environment, post-occupancy evaluation, human perception and phenomenology, ecological design, human emotions, feelings and moods, consumer behavior, user experience, and product user experience.

This study is limited to scholarly research articles published between 1970 and 2020. An extensive data search was conducted using a combination of different keywords related to domestic environmental experiences through Scopus, Science-Direct and PubMed databases to categorise relevant studies based on the research theme, titles, abstracts, keywords and findings that fell into the thematic study areas. Supplemental cross-searches were also conducted through Google Scholar, Mendeley, Research Gate and other academic search engines. All the literature referring to the domestic environment and occupants'

psychological or behavioral experiences in residential buildings in their title, abstract or keywords were categorised for screening. The collected studies were separated according to the following five criteria: (a) focus on the domestic environment and occupant perception, (b) occupant experiences in different spaces of a domestic environment, (c) environmental design and occupant's psychology in a domestic setting, (d) human factors in built environments, and (e) peer-review. After the final screening, duplicate and non-relevant studies were omitted from the selection and the significant relevant references list was formed according to this study's scope and limitation.

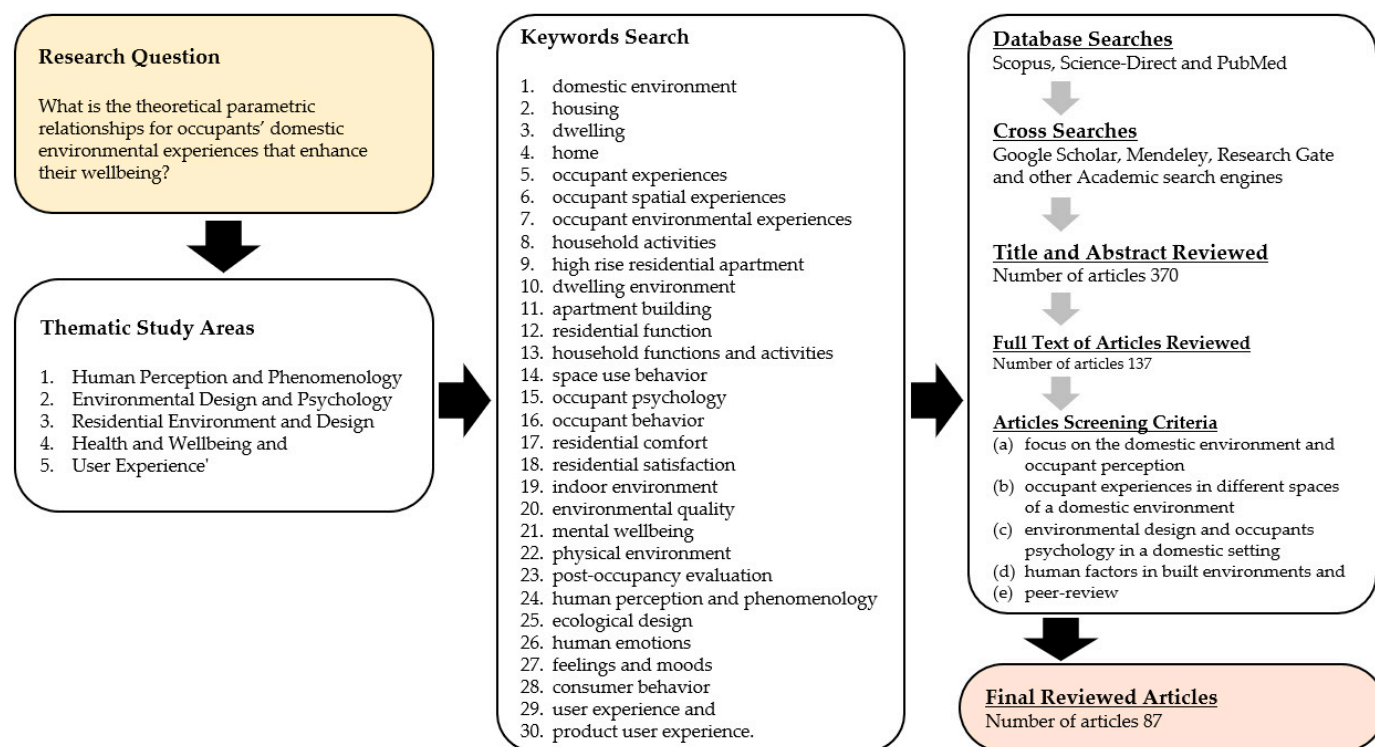


Figure 1. Literature selection strategies and research methods.

The following sections first analyse the background to spatial and environmental design factors regarding occupants' experiences. It then analyses these according to the different spaces of a domestic environment based on the literature. The review provides a systematic and comprehensive assessment of the domestic environment and occupants' experiences regarding spatial and environmental design aspects to enrich the state-of-the-art of existing knowledge and explore the potential for future investigations into "*Domestic Environmental Experience Design*".

3. Theoretical Background

This literature review mainly explores the theoretical relationships between spatial and environmental design factors in the domestic living environment, addressing occupants' wellbeing. In this study, the component considering perceived spatial factors focuses on users' spatial experiences linked to user preferences (needs and demands) in their living environments. The other component, which concerns the environmental design factors, deals with architectural design elements primarily related to indoor environmental physical design aspects. It also encompasses not only indoor environmental qualities but also the psychological aspect of occupants' feelings. In the following sections, space-related user preferences (spatial factors) and environmental design components (environmental factors) were elaborated through the literature to explore the theoretical parametric relationship in occupants' experiences in their domestic living environments.

3.1. Spatial Factors for Occupants' Experiences

McClure et al. mentioned seven domains: “products, interiors, structures, landscapes, cities, regions and earth” in the built environment. Every field has its own identity and these identities closely correlate to each other. The domestic environment design reflects interior and structure domains as part of the total built environment [13]. Additionally, indoor architecture's history suggests that human social, psychological and physical perceptions attach numerous qualities of living to environments, where the core concern is human scale and performance [14]. According to Blossom, human nature has two characteristics, functional and behavior; thus, designers need to realise how the built environmental design element affects individual perception, considering psychological aspects, for the different zones, as Hall mentioned [14].

Philosophically, space reflects human perceptions of physical existence. According to the earliest theoretical perspective of space, perception reflects the human-centric dimension. German philosopher August Schmarsow addressed the spatial interaction of beings with the world and quoted space as a place for physical and mental projection [2]. Further, Edward T. Hall, founder of the study of anthropological space named “Proxemics,” in the book “The Hidden Dimension”, mentioned the relationship between spatial setting and human beings [2]. According to environmental psychology, human beings always interact and perceive their immediate environments by sensory dimensions such as smell, vision, touch, hearing, haptic and kinesthesia [14]. When experiencing a space or place, sensory organs play a fundamental role for a human being. In that sense, spatial design attributes impact human perceptions in numerous ways within the total built environments [2,5].

Again, the literature review shows that place-attachment theory is a vital perception and the core concept of environmental psychology which affects people and places [15]. Human beings create a robust understanding of place attachment within their immediate environment, which supports physical and psychological wellbeing [16]. Place attachment is the personal interaction with the environment and the central concept of human emotional responses [16]. According to Stedman, an individual's satisfaction is another element of place attachment, which defines the value of meeting basic human needs in a living environment [15]. Stokols describes “Home” as a dwelling place where individuals can fulfill their psychological, physical and social needs to keep themselves connected [17]. Seemingly, Hayward emphasised psychological concepts, with significance given to privacy, identity, socialisation, continuity and personalisation, as a home attachment [18]. Dovey highlighted the phenomenon of “Home” considering three themes: order, identification and dialectic processes, in the article entitled “Home and Homelessness” [19].

While most home environmental studies begin with people who already live in a home and deal with satisfaction, Rapoport identified a previous question about how they reach this point. Rapoport observed that the consequence of the environment was addressed improperly. In reality, the near environment's real effect on a human being is habitat selection according to their needs and preferences [20]. In the meantime, Pennartz described the home atmosphere as focusing on communication, accessibility, relaxation and individual experiences [21]. Mallett addressed the notion of “Home” in an article entitled “Understanding Home: A Critical Review of the Literature” considering people's relationship with spaces and objects. Home is a dwelling interaction space between people, places and things associated with a comfortable feeling, intimacy, security, relaxation and persecution [22]. The importance of human needs and spatial hierarchy, such as territoriality, physical and psychological comfort, privacy and function, provide the designer with an understanding of human nature and satisfaction [13].

In a nutshell, “Home” as a domestic setting indicates varied meaningfulness, functions, purposes and aims. Human needs include identity, control, security, privacy, order, variety, sociability, aesthetics and choice, integrated into environmental psychology and interpreted by human experiences (Figure 2) [5,23]. However, it is critical to understand the assessing and prioritising of these human physical and psychological needs [2]. In short, the domestic

experience is a medium that may connect occupants' needs and demands with their living environments.

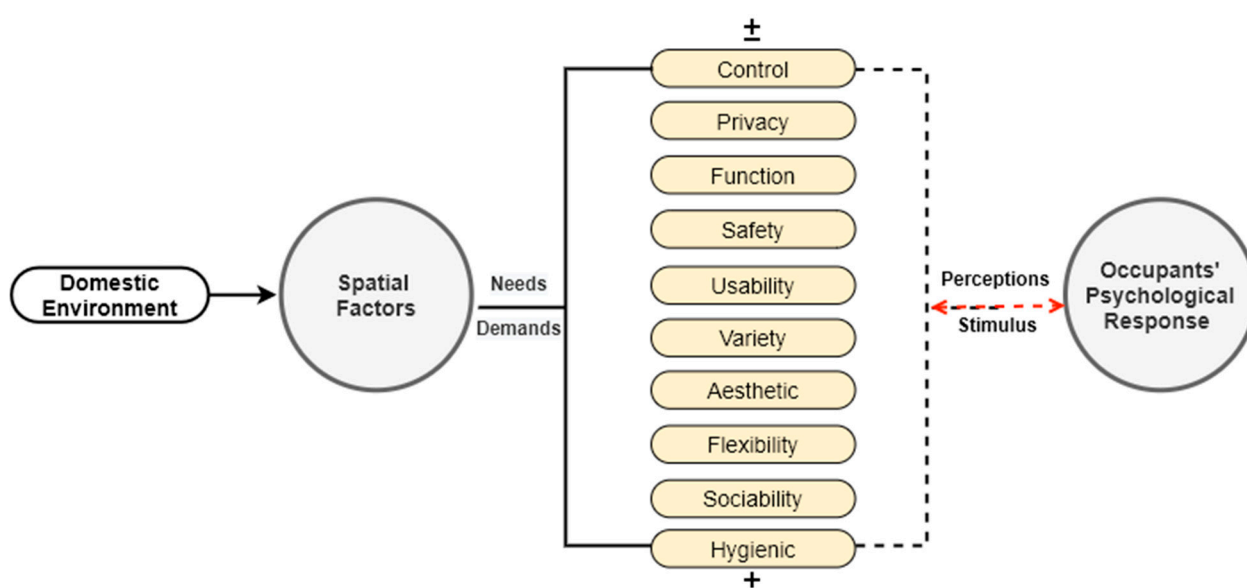


Figure 2. Relationship between spatial factors and occupants' response. Here, the sign (\pm) indicates adding/decreasing the number of factors according to user needs and demands. (Illustration: Author, based on literature)

3.2. Environmental Factors for Occupants' Experiences

The domestic setting has indoor and outdoor environmental characteristics that reflect occupants' spatial needs and demands in their living environments. Several studies indicate that each design element directly or indirectly impacts the occupants' overall physical and psychological wellbeing [16]. Several studies focusing on indoor environmental conditions such as noise, lighting, material, air, odors and color; conclude that environmental psychology bridges design and human response at the indoor environment scale.

Kaplan's "Attention Restoration Theory (ART)" proposed a framework that differentiates between stress and attentional components of human experiences in their environments. Emphasising the critical role of natural environments, this integration contributes towards human-environment interaction. According to Kaplan, experiencing a natural environment reduces human stress [24]. In addition, Ulrich's "Stress Reduction Theory (SRT)", focusing on the role of nature in wellbeing, indicates an evolutionary perspective that suggests that natural experiences have an immediate benefit on human mental wellbeing. Ulrich emphasises affective and aesthetic human responses to the natural environment [25]. Both Kaplan and Ulrich identify natural settings or environments as stimulating components for human wellbeing in numerous ways.

In the book entitled "A Home for the soul: a guide for dwelling with spirit and imagination", Lawlor describes the interaction of human emotions and feelings with architectural design components based on human spiritual perceptions in their dwelling environments [26]. Lawlor also discussed interconnectedness and perception of human cognition and architectural design elements such as earth, fire, air, space and water, as five spiritual elements, through human experiences in their dwelling environments. Consequently, Lawlor reveals how the eight fundamental building elements of architecture can be related to different aspects of human thinking and feeling. The author mainly explores everyday household traditions and symbolism, rather than exploring dwellers' situational or practical experiences with restrictions or limitations.

Furthermore, Evans argues that every element of the built environment directly or indirectly affects occupants' mental health [8]. According to Evans, most research on housing focused mainly on physical health. Nonetheless, different house types (e.g., highrise)

and housing quality impact occupants' mental wellness. Evans identified that the natural environment affects occupants' psychological perceptions in highrise residential environments [8]. Poor quality of housing and indoor environments increases the negative impact of psychological stress and illness. Still, this is not enough to draw a clear methodological perception and conclusion.

Ergan et al. examined that occupants' emotional reactions to color, light, noise, air quality and crowding are distinctive and momentary in the living environment [27]. Levels of illumination, pollution and daylight exposure affect occupants' psychological wellbeing in numerous ways [8,28]. Several studies and randomised experiments are prioritised to evaluate the physical environment's potential role in occupants' mental wellbeing. As Evan stated, some methodological problems may create conflicting prejudice, triggering the undervaluation of housing–wellbeing associations. The author noted that ambient environmental interactions with architectural components positively impact human physical, biological and psychological aspects [28]. For instance, noise affects users' privacy, while smell impacts human memory [28]. Meanwhile, indoor lighting variation also affects and triggers human moods, feelings and psychological growth [28].

Moreover, other studies also describe that features of different domestic spaces, such as the bedroom, kitchen, dining, living, toilet, game room, guest room, guest bath, study, media room, entrance, utility room, backyard and garage, stimulate occupants' daily household activities and interact with emotional states [9,29]. In contrast, crowded enclosed spaces with no ventilation increase personal psychological stress, while space adjustability decreases mental stress [9]. Other services and utility facilities also impact the occupants' mental satisfaction in the residential environment [2]. Seemingly, spatial ergonomics also affect usability and occupants' emotional perceptions, such as relaxation and pleasantness within domestic environments [2].

According to Amérigo and Aragonés' interpretation, domestic satisfaction is essential for the quality of life and indoor environment elements can stimulate human feelings [30]. In their research, a theoretical approach was applied to explore a general view of a person's satisfaction within a residential environment and a conceptual framework of individual interaction in a residential setting was presented. They developed an empirical model of residential satisfaction; a question arises regarding the trustworthy dimensions for residential pleasure or happiness, which might direct future environmental research on domestic settings. However, the concept of residential quality integrating different human factors and occupants' comfortable domestic environments indicates a direction for future research [30]. Considering the literature reviewed, the environmental experience is a multilayered phenomenon requiring different kinds of sensory involvement and interaction. The domestic environment influences occupants' wellbeing and needs to accommodate occupants' daily household activities. As discussed above, the synthesis of previous research studies leads to major categories of human experiences in various architectural design spaces. The literature gap still exists in the understanding of how spatial and environmental design features impact occupants' experiences in different spaces of domestic settings according to their household activities.

In Figure 3, a conceptual relationship is derived from the literature describing the environmental factors that contribute to stimulating occupants' emotions in their domestic environments [6,23].

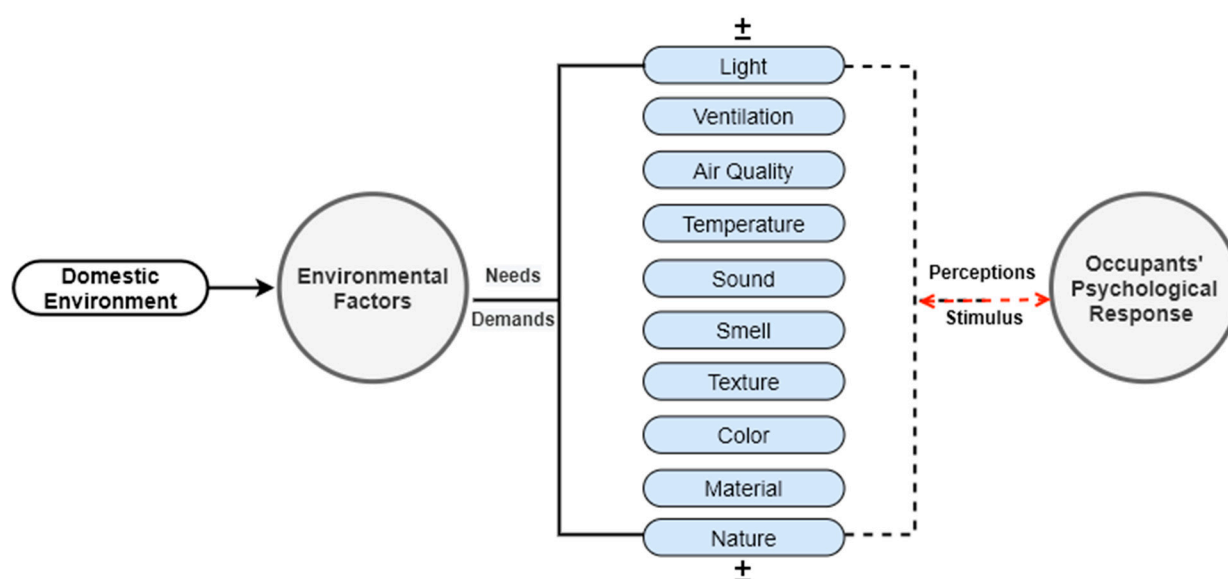


Figure 3. Relationship between environmental factors and occupants' response. Here, the sign (\pm) indicates adding/decreasing the number of factors according to user needs and demands. (Illustration: Author, based on the literature).

4. Domestic Spaces and Occupants' Experiences

4.1. Domestic Environment and Its Functional Aspect

Several psychological and phenomenological studies have been conducted to define the meaning of "Home" as a domestic environment [31]. According to Pallasmaa, the phenomenology of "Home" is not just an architectural effort. It has an aesthetic view, considering physical, psychological and sociocultural phenomenon. Pallasmaa believes that "Home" has multilayered characteristics, integrating memories, desires, intimacy, privacy, identity, function and even language [32]. Continuing this exploration, the domestic environment becomes an essential feature of "Self-identification" for peoples, where privacy, comfort and domesticity are the occupants' core achievements [31,33]. Moore and Caan described their views within psychological and sociological debates: domestic environments reflect numerous human behaviors and preferences because of different physical, psychological and social contextual human experiences. These experiences are essential to mediating tangible and intangible design aspects in the living environment [2,31]. Considering several studies, the term "*Domestic Environmental Experience*" was defined briefly as user experiences of cognitive perceptions and physical responses to their domestic built environment with a diversity of daily household activities [6]. In short, domestic environmental experience connects occupants' physical, psychological and social needs and demands, correlated with different factors of the built environment, such as spatial and environmental factors.

The above literature identified that the domestic environment has various purposes, meaningfulness and aims related to occupants' different spatial and environmental aspects. A domestic setting generally has mainly three types of spatial zones distribution. For example, private areas (e.g., bedroom, study, attached toilet and balcony), used independently by family members only; semi-private areas (e.g., family space, kitchen space, dining room, storage, utility and prayer room), commonly used by only family members; and public areas (e.g., foyer, living room, guest room, balcony and powder room), used by guests beyond family members [6]. It has also been identified that these indoor spatial arrangements can be connected with external additions, such as a balcony, garden and porch, which fall into private, semi-private or public spaces [6]. A domestic setting is interconnected with its different areas, for example, the kitchen has close connectivity with the dining space. The guest room, toilet and dining room have a positive relationship

with the living room. Each area also has spatial characteristics related to environmental design factors that accelerate occupants' physical and mental wellbeing in living circumstances [6,9]. Thus, every indoor area of the domestic environment has a significant spatial and environmental relationship that may enhance occupants' psychological responses. These factors, in the domestic setting, are associated with occupants' needs and demands and vary from space to space; they are elaborated below according to the literature.

4.1.1. Entrance

The entrance is a transitional space from outside to inside or one room to another in a dwelling [34]. The front entrance door is the most noticeable demarcation between the public and private realm, where the inhabitants' culture or tradition has a strong impact [35]. The indoor privacy of a residence depends on how people enter it. Internal privacy is compromised if such a place has too many entrances [36]. Evans, Kalantari and Shepley identified that the chance of social contact is better when entering residential units that are adjacent or directly connected to significant pedestrian paths [8,37]. Graham et al. identified the invitation approach as the most frequently selected ambiance for an entryway, whereas other factors, such as sophistication, family, quiet and cosy, also impact human psychology [9]. Ochodo et al. mentioned that the materials (i.e., steel) used for the entry doors reduce occupants' stress and susceptibility compared to a wooden door, regarding safety issues. According to the study, inhabitants living in homes with wooden entrances experience anxiety and distress from attacks by thieves or robbers at night [38]. Oswald et al. also mentioned that entrance and accessibility impact occupants' behavior, significantly enhancing positive wellbeing and satisfaction for aged people and children in a family. From several studies, the researchers found that negative psychological symptoms increase among inhabitants because of poor accessibility, which is also noticeably connected to diverse characteristics of healthy aging [39]. The relationship between spatial and environmental design factors of the domestic entrance and occupants' response is illustrated in Figure 4.

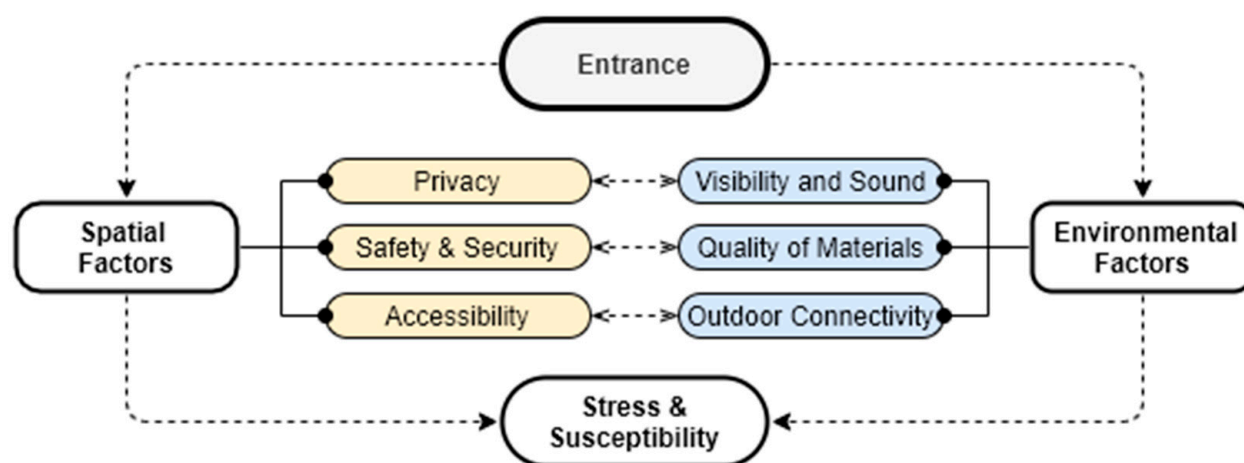


Figure 4. Relationship between spatial and environmental factors of entrance. (Illustration: Author, based on literature).

4.1.2. Living Room

In 1981, Alexander described the living room as the occupants' relaxation and entertainment space and traditionally, the largest area seen upon entering a dwelling [34]. The living room is primarily used to meet and share leisurely events with family members and others [12,40]. Hereafter, interactions and communication are the two main activities experienced in the living room, where comfort and relaxation are the occupants' primary preference [41]. Graham et al. also mapped relaxation, togetherness and comfort as the main factors in occupants' desired psychological ambiance in their living room [9].

Thus, indoor environmental quality and the spatial arrangement of furniture reflect the family's personality and preferences in the living room [42]. According to Saruwono et al., this space develops interaction opportunities between house owners and guests, where the room capacity, spatial organisation and furniture arrangement create different physiological responses among the users. Studies found that homeowners can control guests' communication boundaries through specific furniture layouts [42,43]. Comfort is vital for inhabitants' psychological and physical experience in their living room. Consequently, furniture choice and arrangement affect the occupants' diverse personal comfort levels and preferences and encourage social interaction [8]. As space is a primary point of emphasis in a domestic setting, the living room should also reflect safety for the users. Therefore, circulation by the flexible spatial arrangement of furniture is considered a priority [42].

In the living room, family members communicate with each other by doing various activities such as reading, watching television or just chatting [44]. Living room design is fundamental to supporting occupants' intimacy and comfort, with colors playing an essential role in stimulating mental wellbeing. Warm colors perform well in the living room. These colors evoke a sense of comfort and stimulate dialog [45]. As well as this, wall materials and lighting fixtures also have a strong correlation with occupants' overall satisfaction level in terms of spatial comfort issues [46].

Banaei et al. found that pleasure is an essential human factor for a living room, where room shape and size play a vital role in enhancing occupants' wellbeing [47]. According to the study, PAD correlation identified that daylight and nature-connectedness have a significant association with enhanced pleasure and arousal for the inhabitants. The author also found that the curved roof has a vital role in pleasure, affecting the inhabitant's emotional experiences [47]. Seemingly, studies also identified that using many curved lines may create stress. Flexible walls in living spaces enable individuals to create a friendly environment where people can perform activities and share their experiences with others according to their preferences [48].

Moreover, views of nature have a diverse effect on aesthetic value and the functional aspects. They provide cumulative influences and micro-restorative benefits to occupants' wellbeing in a shared or common space [49]. Built environmental design needs to be incorporated with nature and its components to improve this integrity [50]. In the housing context, it has also been proposed that sunlight and a view of nature, indoor potted plants and photos of plants or small landscapes enhance residents' sense of satisfaction and positive emotions [24,51,52]. The literature also identifies that highrise buildings with large windows may create discomfort, anxiety, stress and unhappiness among inhabitants [27].

Females in low and middle-income families, mainly involved in the indoor household and outdoor gardening, experience higher emotional wellbeing. However, in a real scenario, occupants with socioeconomic constraints often remain in compact living spaces and have limited ability to own indoor greenery [53]. By contrast, residents with higher incomes tend to reside in homes with more greenery [54]. Furthermore, several studies reported that room shape and size significantly impacted occupants' emotions in the smaller domestic setting during the quarantine period. Indoor gardening in a living space and maintenance can be one of the most effective enjoyable activities to mitigate social isolation's stressful and unpleasant impacts on emotional wellbeing in the COVID-19 situation [53].

Privacy is another essential human factor for male and female guests to maintain social aspects and safety for occupants and outcomes. Therefore, design interventions such as entrance door location, window size and position, room height, balconies and internal courtyard may help to achieve privacy in a living space [35]. Zanjani et al. elaborated on three essential factors, safety, aesthetics and memories, by evaluating participants' experiences to enhance relaxation feelings. Here, occupants' traditional values evoke security factors, the aesthetics value stimulates occupants' imagination and fosters individual personalization, and memories reflect familiar feelings. These factors may shape human experiences in a living environment [55]. The overall relationship is illustrated in Figure 5.

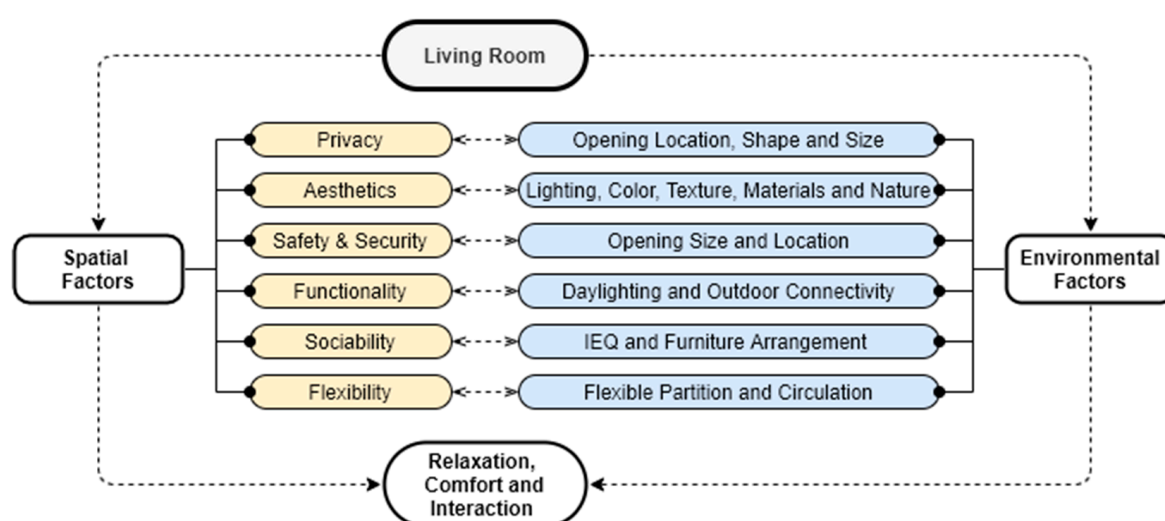


Figure 5. Relationship between spatial and environmental factors of living room. (Illustration: Author, based on the literature).

4.1.3. Dining Room

Habitually eating together as a family has a startling impact on occupants' health and wellbeing. Family bonds become more vigorous and children adjust better and are less likely to use drugs where the family members share meals. Therefore, the eating environment needs to be stimulated by developing a more pleasant dining area (e.g., outside view, good air and daylight) that is more accessible from the kitchen and living room [56].

The dining room is another prominent space where inhabitants gather in a domestic setting. It is a space to accommodate the activities of eating as well as everyday casual things like chatting [45]. The dining space is a crucial element of design in a domestic setting. In general, the dining space acts as a transitional space between the unit's private and public zone and indicates the center of activities in a dwelling setting. As the center of activities, adequate space is necessary for proper circulation to enhance occupant satisfaction [57]. Graham et al. emphasises family togetherness as the prominent psychological ambiance for occupants in a dining space. According to the study, other psychological ambiances, such as sophistication, entertainment and relaxation are closely interrelated in this particular space to the enhancement of occupants' positive emotions [9].

According to Hendrassukma, the dining room's indoor color can arouse occupants' eating habits and inspire conversation between family members and other guests. The author identified that warm colors such as red could stimulate appetite, whereas yellow can increase starving [45]. In another experiment, Ritterfeld and Cupchik identified that a decorative room has a complex and stimulating phenomenon, whereas a sophisticated room is perceived as logical, contemporary, and relaxed [58]. This perception may help develop a dining space in a domestic setting to promote occupants' positive emotions.

Madsen explained that this space is the family's social gathering place, where family members all take a seat, have dinner and make conversation [44]. Relaxing, sitting comfortably and enjoyment are the most critical factors that enhance occupants' positive psychology. Madsen also described that, in a dining space, displaying photos and quotes promotes homemaking attitudes that contribute to occupants' emotions and comfort: relaxing, reading, watching, drinking, eating, etc. [44]. Studies also identified that a short depth of space and high-density results in mental distress and social withdrawal. Another factor found in the literature was the ceiling height, where a room with a higher ceiling was observed as more spacious than a room with a lower roof, leading to a lower sense of stress and crowding [8]. The spatial and environmental design relationship of the dining room is demonstrated in Figure 6.

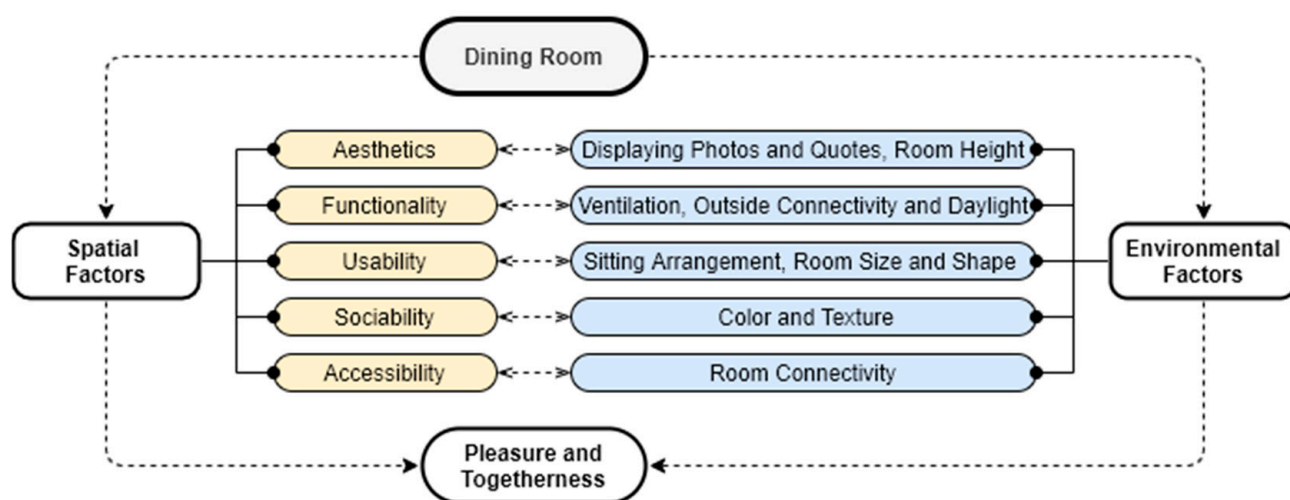


Figure 6. Relationship between spatial and environmental factors of dining room. (Illustration: Author, based on the literature).

4.1.4. Kitchen

Alexander, in 1981, elaborated on the cooking space, where occupants of the household prepare their food and defined it as a kitchen. Today, this place is more prominent and complicated in the domestic setting, where different household activities occur, such as food preparation, cooking, storing and garbage. The author identified that easy accessibility, convenient location, circulation and connection with other spaces within the domestic environment are the most significant factors to consider in a kitchen's functionality [34]. The kitchen is one of the homeliest places, where family members do activities together. It is the place where occupants spend most of their time cooking a meal or getting something. The kitchen is a space where occupants feel comfort, mostly because they enjoy cooking after coming home from outside work or activities [44]. Several studies identified that the kitchen promotes positive interaction and inspires healthy eating among family members. Food preparation can serve as a mediator of social activity and sufficient cooking space facilities improve positive collaboration between the occupants [56].

According to Altas and Özsoy, the kitchen's location in the domestic setting added value to occupants' satisfaction with their living environment [36]. Walters mentioned that an open kitchen (e.g., no wall or door between the kitchen and living-dining spaces) stimulates positive feelings and facilitates family activities and encourages family members to spend more time together [41]. Usually, a kitchen mainly consists of two functional spaces, such as the pantry and central food preparation zone. According to Graham et al., spatial organisation and abundance are the prominent factors in creating psychological ambiance for a pantry. In contrast, spatial organisation, family togetherness, productivity and richness are the most essential and frequent psychological aspects for the central kitchen zone [9].

Pleasant lighting is also essential for safety and creating an enjoyable environment in the kitchen, as well as a view from the windows, which is vital to the occupants' feeling of comfort. Studies also showed that suitable daylight levels in kitchen interiors connect occupants' moods and behavior during cooking activities [59]. There is a close connection between the kitchen and dining space, where color can influence the occupant's feelings. Preferably, light colors in the kitchen prevent risk during food preparation. Clean paint can also stimulate passion during food-processing and eating. Cool colors create a hygienic appearance and warm colors evoke a positive mood when applied to the kitchen walls or cabinet [45]. In 2011, Cho et al. emphasised the importance of a proper ventilation system in the kitchen [60]. Without adequate ventilation (opening windows or using extractor fans), pollution, dampness, mold and fungi growth can be seen, which may create structural defects and have respiratory effects on children [61,62]. This may also impact the behavior

of the occupants [63]. Therefore, proper ergonomics, as well as enough maintenance and waste management facilities, can prevent this problematic scenario [41,64,65]. The overall relationship is illustrated in Figure 7.

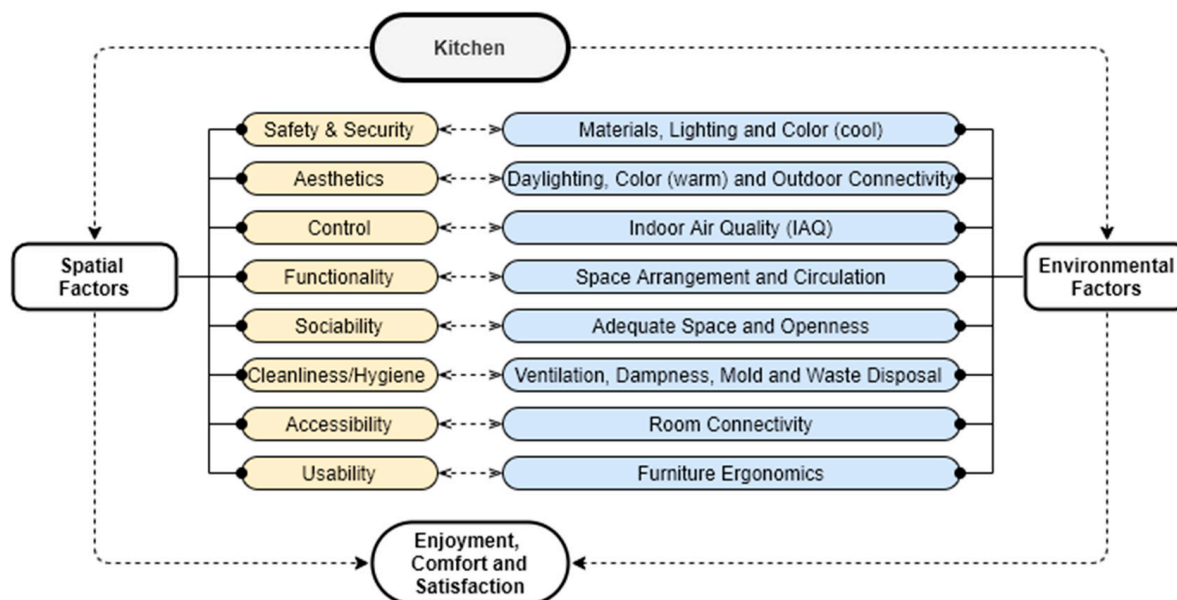


Figure 7. Relationship between spatial and environmental factors of domestic kitchen. (Illustration: Author, based on the literature).

4.1.5. Bedroom

In general, residents use the bedroom for sleeping, dressing activities, quiet retirement and socialising with dearest friends and family members [66]. However, there are various debates and complexities regarding the bedroom's location and function concerning other spaces and occupants' psychological aspects in a domestic setting. According to data from multiple studies, a domestic environment may have three types of bedrooms: the master bedroom, child bedroom and guest bedroom. There is a psychological interrelationship with each bedroom's physical environment, which has been described below based on literature.

Master Bedroom

People in high-density urban residential settings face social pressure in their living environments, so they prefer a particular space to remain alone when they return home [12]. A master bedroom's primary function is relaxation, rest and healthy sleep for adults or parents, where privacy is essential for confirming harmony in family life [12]. The definition of sleeping space changes over time and usually identifies a bedroom as one of the most private areas in a domestic environment, where freedom from excessive noise is desired [34]. It is a space where the occupant can take a step back from various in-house activities and enjoy privacy and noiselessness [48]. The bedroom also responds to human circadian rhythms [56]. According to Hendrassukma, the bedroom, for adults or parents, has the primary purpose of calming activities such as resting or sleeping, where the indoor environment strongly influences these activities [45].

The bedroom relates to occupants' feelings of comfort at home. Madsen explained that when a person becomes sick, the bedroom is the only homely spot in the domestic environment where the occupant feels comfort and relaxed. The author further described that suitable sounds and smells also make it a homelier place. If anyone changes the same bed to a different location, he/she may not feel the same comfort, with space security and belongingness influencing occupants' psychology [44]. This is because occupant habits

such as lying, reading, relaxing, watching and other activities before going to sleep are closely correlated with existing bedroom scenarios. Consequently, the bedroom indicates an image of comfort, warmth and relaxation, with the bed as a prominent factor in that homely spot [44].

On the other hand, room shape and size influence the occupants psychologically in master bedrooms. A square room seems to be more crowded than a rectangle shape within an equal area. Not only that, but longitude direction may create vision rigidity and have a psychological impact [12]. According to Mridha, most developers generally prioritise making the master bedroom more comfortable and attractive than other domestic spaces within the apartment unit to attract local clients. In that case, the rooms' location, size and shape are essential to design factors in ensuring occupants' comfort in a master bedroom [57].

Indoor environmental elements, such as proper daylight, noise level, color and ventilation are essential for occupants' mental wellbeing in a master bedroom. According to Kennedy et al., noise at night in a bedroom is not desirable and another vital factor to consider for occupants' wellbeing. It is directly related to the quality of sound sleep. The author also recommended well-ventilated bedrooms for sleep health, whereas having a balcony creates extra facilities for the occupants' refreshment [67].

For daylight, window location is the most significant criterion for a bedroom. Not only the wall between the bedroom and balcony, but window louvers and height, and window glass type and opening system are correlated with ensuring natural ventilation, daylight and the external vision of a bedroom [41,57]. A room with outer vision seems more spacious than rooms without such an image—a window connected to the bedroom to guide people's sight [12]. Hendrassukma also mentioned that color significantly impacts occupants' psychology in personal spaces like a master bedroom [45].

Besides these, several studies emphasised the psychological comfort of familiar objects and pictures in bedrooms that may retell past events and positive memories. According to the literature, displaying memories and photographs is an integral part of visual relief and establishing personal spaces within the domestic setting. Bao also mentioned that the photos and mirrors on the wall could transfer vision and provide a sense of space expansion [12]. In personal spaces like bedrooms, occupants have different choices based on their sex, age and behavior. In general, women tend to beautify or decorate their private rooms more than men do in their domestic settings. Gosling elaborated that women have various choices, such as photos, lotions, jewelry, candles and others.

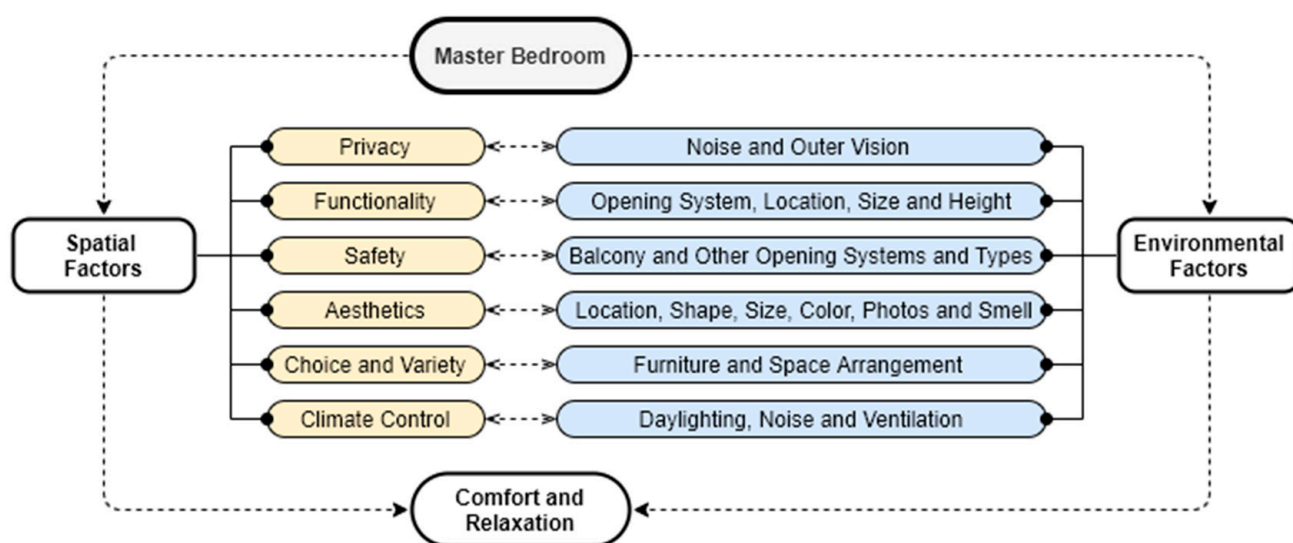


Figure 8. Relationship between spatial and environmental factors of master bedroom. (Illustration: Author, based on literature).

In contrast, men tend towards CDs, sports equipment and achievement-related items in personal spaces like bedrooms [68]. Finally, in 2015, Graham mapped occupants' desired psychological ambiance in their master bedrooms. According to the authors, romance, privacy, comfort, relaxation and love are the most prominent and frequent psychological ambiances of occupants for their master bedrooms [9]. The overall relationship between the spatial and environmental design factors of the master bedroom is illustrated in Figure 8.

Child Bedroom

According to Bao, self-cognition is an essential design element for the perfect children's space, where parents entering the room (e.g., bedroom) by knocking on the door first can promote children's positive psychological sense [12]. In that case, the visual contact formed by a sudden interruption will induce negative emotions due to privacy concerns [12]. Creating an exciting space encourages children to ask questions and learn from their living environment, such as children's bedrooms where space flexibility, a dramatic setting, natural elements and an adequate play area impact their mental wellbeing [69].

Here, the reason for space flexibility and functionality is to provide adaptability to contextual situations. Space can be utilised proportionately according to function by altering spatial aspects [69]. For example, a child's bedroom (space) can be used as a study room. This space can also be separated into different areas by using portable light dividers where other functions, such as painting, playing, reading and sleeping, can be applied. Graham et al. identified the most frequently selected ambiances, such as quiet, productivity, organisation, privacy and creativity or self-expression, for the study space, which may be recommended for the bedroom and study area for children in domestic settings [9]. Using appropriate materials and textures for children's spaces will enhance their imagination in living environments [70]. In this case, using natural materials and avoiding artificial fabrics will encourage originality and develop positive psychology [71].

Many studies found that children living in rigid spaces cannot express their creative capacities to discover new opportunities. Nevertheless, various shapes, colors and other indoor environmental factors, including furniture and visual detail, increase children's aptitude to learn, realise and cultivate inventiveness in their living spaces [69,71].

In the child's living space, color has a significant influence and a meaningful correlation with enhancing creative potential [71]. Enjoyable, colorful and stimulating pictures have been identified as the basis for human creativity and inspiration. The shape, size, layout and function of the spaces are important factors in social interactions and encourage skill enhancement in a child's room [72]. For example, using colored glass, different light spectrums, proper daylight, and play with water and natural elements may stimulate children's curiosity in their living environments [69]. The overall relationship between spatial and environmental design factors of a child's bedroom is illustrated in Figure 9.

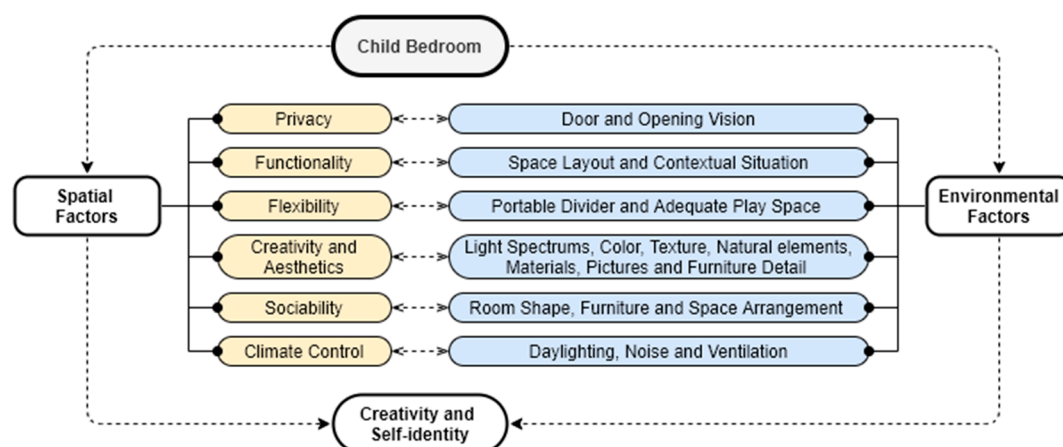


Figure 9. Relationship between spatial and environmental factors of child bedroom. (Illustration: Author, based on the literature).

Guest Bedroom

Besides the first two types of bedrooms (e.g., master bedroom and child bedroom), a guest room generally indicates a bedroom in a house for visitors or guests to stay and sleep in, attached to the domestic setting's public zone. Graham et al. also described the psychological ambiance of guest rooms. According to the authors, an inviting approach is the primary psychological ambiance of this particular space. Comfort, relaxation, attachment and convenience are other prominent and frequent psychological aspects of guest rooms [9]. According to the literature, a comfortable bed and functional furniture layout for closets and luggage are an essential part of a guest room to ensure guest comfort and privacy. Convenient power outlets, that can be reached without moving furniture around and easy access to the toilet are other significant issues in designing a guest bedroom. It is essential to have easy access to enough light in a guest bedroom during nighttime, such as bedside lighting to read and flexible space layout, especially for older guests [7,9,66]. The overall relationship between spatial and environmental design factors of the guest bedroom is illustrated in Figure 10.

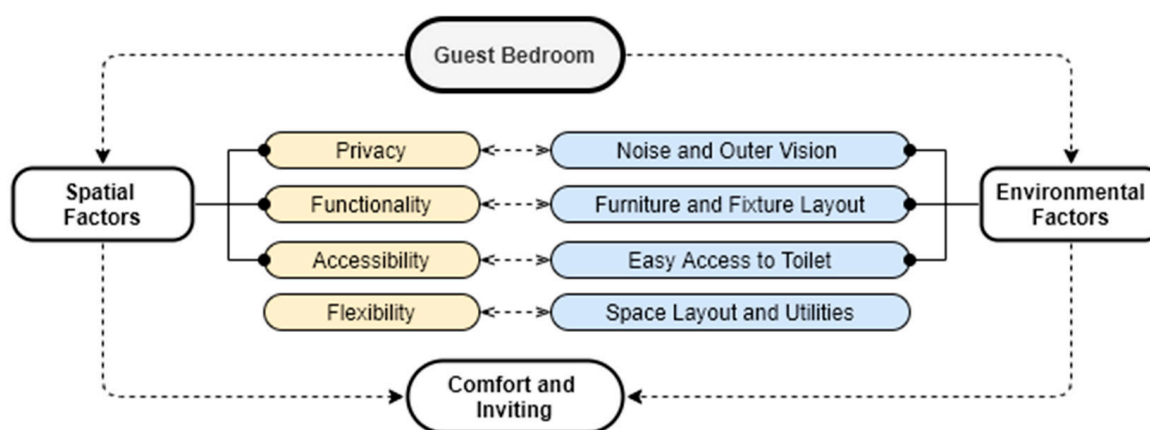


Figure 10. Relationship between spatial and environmental factors of guest bedroom. (Illustration: Author, based on the literature).

4.1.6. Bathing and Toilet

Bathing and toilet are the most private areas in a house. According to Alexander, this space is one of the most prominent functional rooms for its size and quality [34]. Amerigo et al. mentioned that an indoor toilet is the extreme design objective of residential excellence for specific cultures and socioeconomic levels [30]. In a high-density domestic setting, the quality, number and location of indoor toilets influence occupants' behavior, choice and freedom because of different situational contexts such as crowdedness, limited resources and usability [12].

Several studies found that increased privacy and cleanliness are the most vital human spatial factors for occupants' health and wellbeing in bathroom settings, where there is always a gender effect [73]. Suitable bathroom and toilet facilities are related to high levels of unhappiness and depression after changes in gender, marital status, age, engagement and migratory conditions [63]. Many studies found that occupant panic disorder increases due to a lack of proper toilet facilities in the living area [38]. According to Graham et al., privacy, relaxation and rejuvenation are the prominent psychological ambiances for bathing and toilet, whereas an inviting approach and quietness are also preferred by the inhabitants [9].

Bathrooms are essential for individual hygiene, mainly at the start and end of the day. Residents become restless if the toilet is inadequate and unhygienic. This situation creates anxiety, panic disorder and depression regarding the occupants' safety and personal privacy, especially in a crowded domestic environment [38]. According to UK GBC, avoiding moisture, pollutant and mold growth are essential issues when developing good

indoor quality for bathing and toilet [56]. Cho et al. identified a strong psychological need for window ventilation in the bathroom to enhance the occupants' indoor quality [60]. Hendrassukma emphasised that color and lighting design issues are essential to improving the comfortable atmosphere in the bathroom. According to the author, the occupants need a relaxed, comfortable and safe atmosphere in the bathroom. Color preferences in the bathroom can improve the impression of calm, freshness and cleanliness. In that case, the author suggested a white color choice for a bathroom to enhance the impression of cleanliness and purity. The combination of white with other cool colors also makes the occupant feel relaxed and peaceful after bathing.

However, a bathroom should have sufficient indoor lighting to reduce the room's moisture and prevent risk caused by a darkened room [45]. Madsen further explained that a bathroom is a place where people should have a degree of privacy. The author also emphasised insulation, floor quality and heating systems to provide a high degree of comfort in the bathroom setting. Therefore, occupants may wear slippers for safety issues [44]. Mridha mentioned that bathroom size is a dominant predictor of occupants' satisfaction at present [57]. Several studies focus on accessibility and aesthetic beauty for bathrooms, which indicates the prominent need and demand among occupants for new built and modifications or renovations, where fixtures, functional layout, usability and greening for purification and relaxation need to be considered in detail in the design process [26,74]. The overall relationship is illustrated in Figure 11.

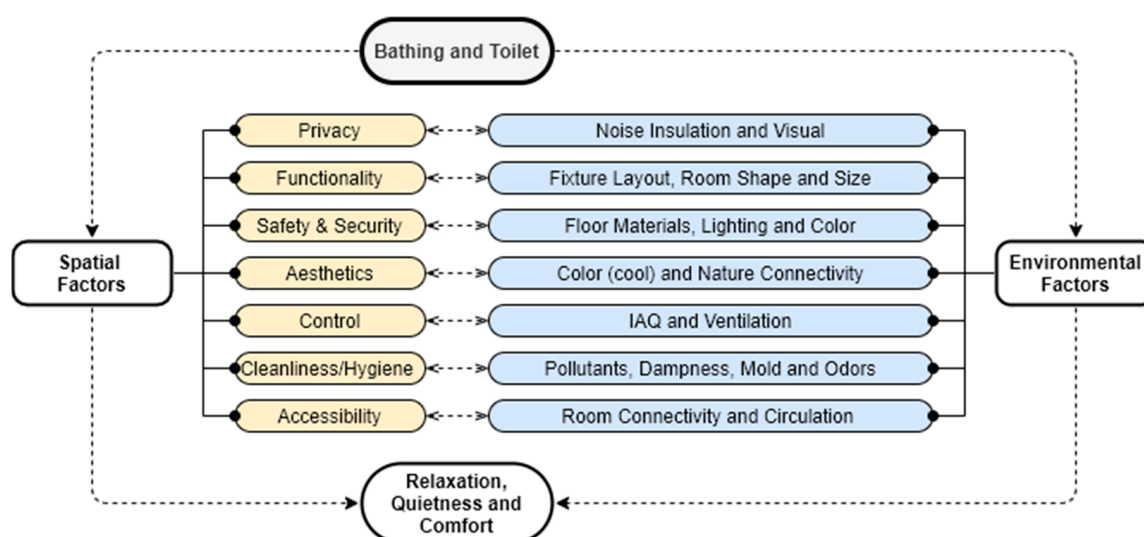


Figure 11. Relationship between spatial and environmental factors of bathing and toilet. (Illustration: Author, based on the literature).

4.1.7. Study and Work Space

The occupant needs a disturbance-free space, with self-regulating individual noise, for working, learning and reading in a domestic setting. Without such a space for study, it may generate stress reactions and negative psychological emotions may be generated in the occupants. In a high-density domestic environment, living and other rooms can be utilised for this purpose with an interval according to the occupants' preferences [12]. According to several studies, privacy, relaxation, functionality and creativity are the main human psychological ambiances for this particular space [9,56]. Consequently, numerous studies related to the home office identified that feeling comfortable when working from home is the occupants' primary concern, as is a noiseless working zone with a comfortable furniture arrangement [44]. Ceiling height has an influential role in social engagement and impacts human focus ability [75]. Research findings noticed that when occupants reside in a room or space with low ceilings, they perform better on focused works, such

as reading and studying. In contrast, high ceilings encourage imaginative thinking and influence social gatherings [8,56]. A recent study investigated ceiling height's impact on occupants' aesthetic perceptions and activity; spaces with high ceilings have higher aesthetic attractiveness scores than low height spaces [75].

Moreover, in the present pandemic (COVID-19) period, scenarios have changed. People now need to finish all office activities sitting at home. At present, the working environment inside the house and people's psychological relationship with it are critical when designing a domestic setting. Studies have shown that having an indoor green space enhances positive emotions for the occupants, particularly those who have socioeconomic constraints [76]. Insufficient indoor lighting levels, a variation in wall colors, noise and other physical environmental ambient properties stimulate mental stress by changing people's circadian rhythms and troublesome work cycles [27]. Besides these, indoor air pollution, excessive temperature and lack of ventilation also negatively impact human efficiency [1,2,77]. The overall relationship is illustrated in Figure 12.

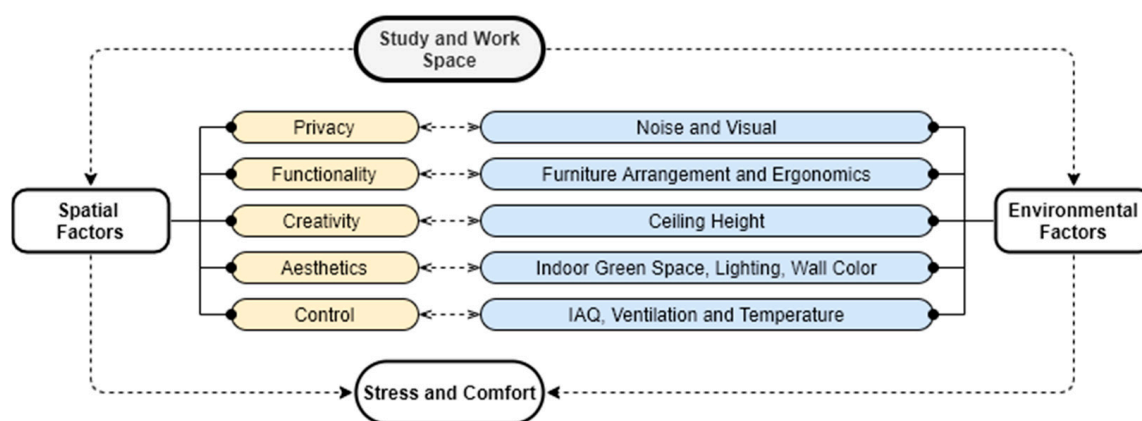


Figure 12. Relationship between spatial and environmental factors of study and working space. (Illustration: Author, based on literature).

4.1.8. Balcony

The domestic setting needs a connection to the outside through intermediate spaces (e.g., balconies) with views of a neighborhood or communal green areas [56]. A residential balcony creates a flexible space for the diverse activities of occupants. Significantly, a balcony permits a connection with the outdoor space without leaving the indoor environment. The balcony can be attached to a personal space (e.g., bedroom) and public space (e.g., living room) or semi-private spaces in a domestic setting and becomes a prominent transitional space between the outside and inside for refreshment, which affect the quality of life in a residential environment [67]. External vision plays an essential role in the indoor-outdoor relationships in a domestic setting, where balconies promote occupants' opportunity to connect with nature (e.g., during COVID-19). A balcony creates a spatial change in the dwelling plan and makes it more flexible for use as a third room [12].

According to Mridha, a balcony is a changeover space between the outdoors and indoors and a source of air and light [57]. Madsen mentioned Jacob's photograph and stated that a balcony with a proper overhang promotes a healthy balance between daylight and shadow and the natural ventilation system and indoor comfort in a house [44]. According to Kim and Kim, despite all the positive uses of sunlight, ultraviolet rays become harmful to human skin. By removing the balcony space, inhabitants' chances of being exposed to indirect sun in a residential apartment increase [78].

According to Kennedy et al., specific physical and spatial design characteristics related to occupants' everyday living functions, privacy and indoor environmental comfort are significant factors to consider in the context of adding a balcony to a domestic setting [67]. The author found that most residents described their functional utilisation of balconies

for a varied range of household activities, such as preparing foods, gardening, exterior private space and other mixed attitudes, where privacy is the common phenomenon for all the inhabitants. Residents do not want to hear and engage with the other residents or the community noise from their private balconies. In that case, the balcony's location is a prominent design factor for the occupants [67]. Drying laundry and storage are also essential purposes of the balcony. Residents typically use their balconies for changes and everyday events, such as studying, relaxing, reading, care of pets, physical exercise or just inactive sitting. Contentiously, some inhabitants smoked on their balconies, annoying inhabitants of other residences [67]. Sometimes dust and other external pollution may enter through the balconies and dirty indoor spaces and furniture [67]. Lack of fencing and bar grills on balcony, windows and doors increased occupants' weakness to outside attacks and experience of distress, particularly during the night, due to insecurity [38].

The moisture and condensation consequences due to the balcony space's poor insulation have been stated in some studies. In a questionnaire survey in Seoul, most residents complained about mold and indoor dampness problems with a changed balcony. In that study, health problems among the children and residents were identified where balconies were removed [79]. Ozaki also discusses some ritual perceptions of a balcony that may impact the inhabitants, as the domestic environment is closely related to peoples' symbolic, private, secular life. The balcony is an individual's access to open spaces for personal utility purposes. Still, this space is frequently positioned at the front side of a building and some unsightly activities traditionally connected with a backyard, for example, laundry, drying, food preparation and washing, where the occupants prefer high privacy [80]. The overall relationship between the spatial and environmental design factors of a balcony is illustrated in Figure 13.

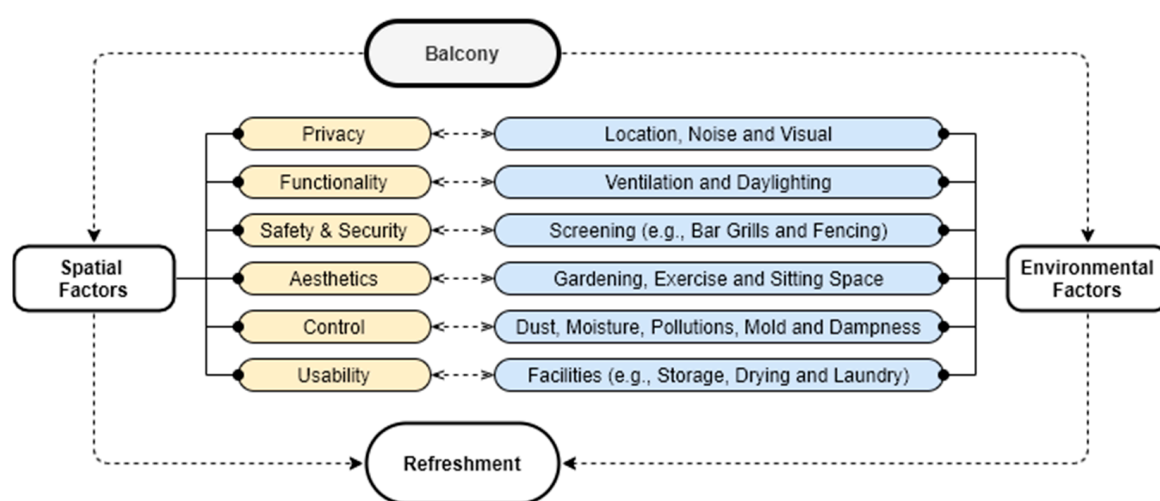


Figure 13. Relationship between spatial and environmental factors of balcony space. (Illustration: Author, based on the literature)

4.1.9. Lobby and Circulation Space

In 1986, Haber considered occupants' perceptions of a highrise housing lobby and identified that the need for communal interaction was a critical feature determining the occupants' assessment of this space [37]. It also seems that lobby design is an essential factor for occupants' communal experiences of highrise residential buildings and comprehensive research needs to be conducted to investigate influential lobby designs [37].

Consequently, circulation is vital for social interaction, where considering daylight and external views make circulation an enjoyable experience by offering spatial variation in the dwelling environment. The spatial enclosure enhances aesthetic and psychological responses to indoor environments. People generally feel secure in more open indoor spaces

with better external visual connectivity [75,81]. Confirming suitable dimensions promotes circulation, enjoyable for less physically able people with an accessibility threshold criteria [56]. The lobby and circulation space are used for social interaction and occupants can also use this space for physical exercise, particularly children and older adults, who cannot go outside frequently in highrise residential apartment buildings. This area also promotes other household activities for women to enhance stress-free living [8]. The overall relationship is illustrated in Figure 14.

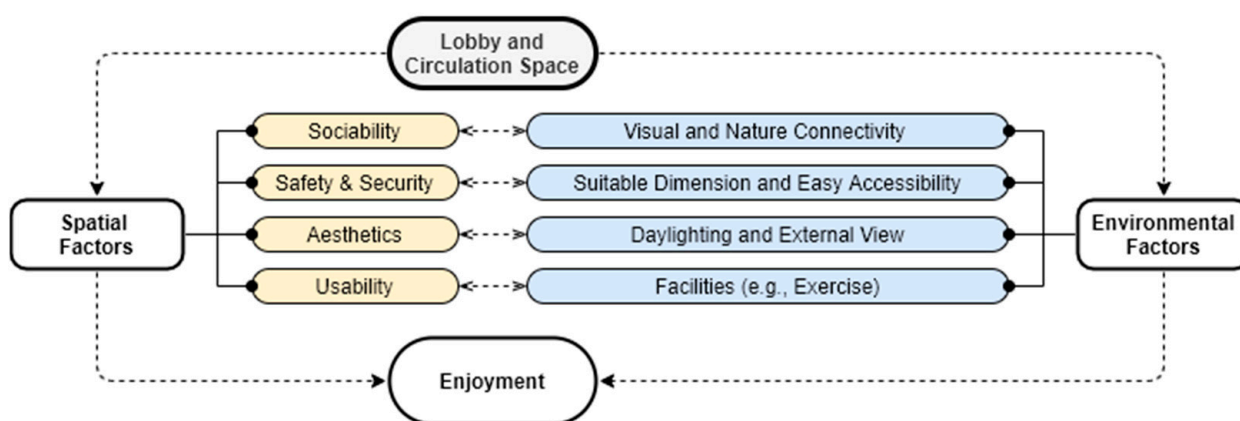


Figure 14. Relationship between spatial and environmental factors of lobby and circulation space. (Illustration: Author, based on the literature).

4.1.10. Storage and Utilities

Generally, a house's storage and utility facilities refer to a place where various household necessities are stored. This can be a separate room or an area in the domestic space. According to Alexander, storage has become critical in housing development in recent years because houses are getting smaller over time. It is challenging to allocate extra space for storage and utility facilities in a domestic area [34]. The type of storage facility employed depends on the inhabitants' needs and demands in their daily household activities. Alexander mentioned that designers identified that almost twenty-five percent of a domestic space should be dedicated to storage facilities [34]. Storage and utility provision in a domestic setting promotes stress-free functional living for the occupants. The functionality of the storage space depends on the shape, size and location of the room. In many cases, a small unoccupied area of a dwelling, such as the unused space under the stairs or the top of the kitchen or toilet, is usually used as a storage space [56].

According to various studies, humidity and ventilation inside the room are very important for such storage and utility spaces. Without the right amount of light and ventilation, storage spaces can accumulate various fungi and mold growth, which is subsequently dangerous for stored goods and technical accessories [28,44,60]. The overall relationship between the spatial and environmental design factors of storage and utilities is illustrated in Figure 15.

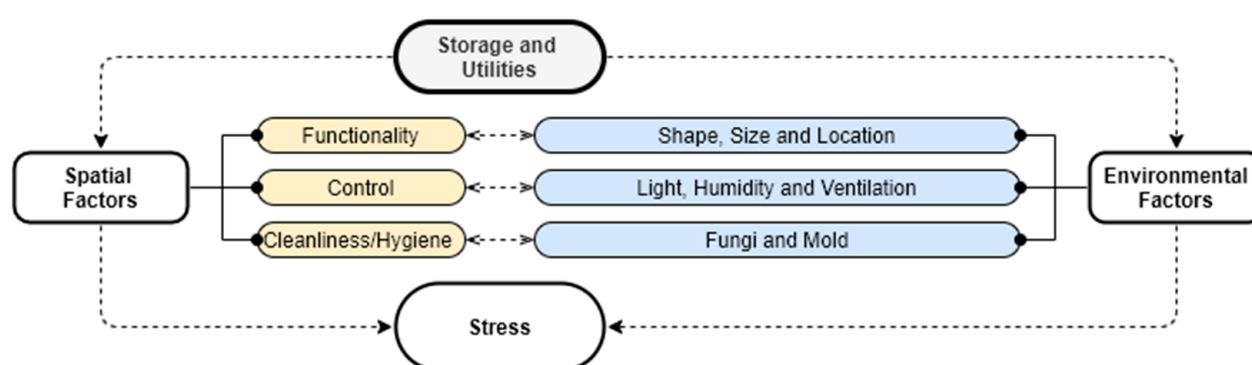


Figure 15. Relationship between spatial and environmental factors of storage and utilities. (Illustration: Author, based on the literature)

4.2. Domestic Environment and Occupants' Sociocultural Context

In this study, different domestic spaces have been conceptualised according to spatial and environmental factors, reflecting occupants' domestic experiences based on the academic literature. A domestic environment expresses a symbolic connection of occupants' contextual factors through the user's life journey [33]. Regardless of the spatial features and environmental design components, each domestic space provides its dwellers with senses that serve their individual needs and demands [35]. Therefore, a domestic environment comprises individual emotional expression, spatial requirements and contextual relationships [35,39].

Accordingly, several studies highlighted the status of macro-level features such as sociocultural factors (e.g., climate, profession, culture, education, religion, sex, age, household compositions) shaping individual perception in a domestic living environment. Hence, contextual factors affect occupant's behavior and perception due to diverse social and cultural aspects [35]. The sociocultural aspects of spatial characteristics are related to occupants' lifestyles, which indicate different environmental preferences under different domestic settings and circumstances [82,83]. Studies also showed that environmental factors are affected by the varying needs and choices of user groups. According to Lawrence, the space-use of a dwelling and morphological changes cannot be disconnected from differences in the sociocultural meaning, as well as household personalisation, which establishes changes in an occupant's relationship with the home environment [29]. Therefore, in a domestic setting, occupants' personalisation diverges concerning social and cultural factors and lifestyle behavior [29,33,35,82]. Thus, domestic living concepts synchronise users' diverse sociocultural relations, along with spatial and environmental preferences that may enhance occupants' wellbeing [6,29].

Nonetheless, social and cultural values play an essential role in defining space identity and rituals, which may affect occupants' perceptions in their domestic private spaces [26,29,31,37]. Therefore, identifying the core relationship between spatial, environmental and user contextual factors in domestic spaces is significant in architectural design to interpret occupants' experiences (Figure 16.). Several ethnographic studies illustrate that sociocultural phenomena' domestic spatial appearance is articulated in numerous ways, influenced by individual choice according to regional and social code variation. Hence, a different cluster of user activities may change domestic spaces' spatial and environmental preferences because of a complex sociocultural phenomenon [82,83]. However, this study mainly indicates the theoretical correlation between spatial and environmental factors within domestic spaces; combining users' sociocultural context with a pragmatic understanding of designing domestic space is suggested for future direction.

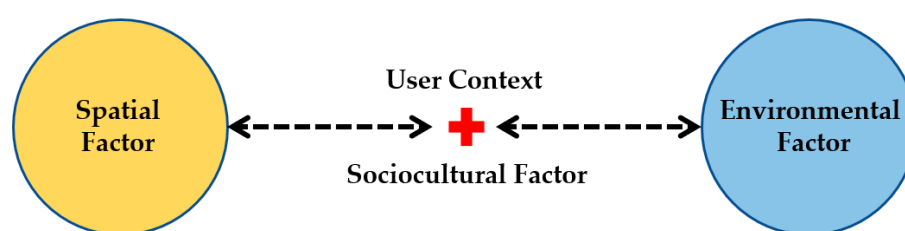


Figure 16. Relationship between spatial, environmental and sociocultural factors for a domestic setting. (Illustration: Author, based on the literature).

5. Discussion and Future Research Direction

From the above discussion, occupants living in each space in a household have different needs and preferences regarding spatial and environmental aspects related to their psychological and behavioral factors. However, sociocultural factors influence the occupants' spatial and environmental attributes, which are closely intertwined, and shape those relationships. Research into domestic environments' spatial and environmental factors usually relies on the inhabitants' behavioral and psychological attributes [42]. These factors need to be considered to understand domestic spaces' diversities to enhance occupants' feelings of satisfaction and comfort. According to several studies, adequate knowledge of spatial activities in a household environment tends to access the occupants' overall behavioral process within a domestic setting [6,9,12,42]. It is also imperative to determine the occupants' spatial and environmental experiences in different domestic settings and utilise them accordingly in the architectural design solution.

According to the literature, this review identified twelve spatial factors for the domestic environment according to occupants' needs and demands (Table 1). Consistent with different domestic spaces, attempts were made to explore the correlation of environmental factors with each spatial factor in view of occupants' experiences. From this review, it has been observed that privacy, functionality and aesthetics are the prominent spatial factors for different spaces in domestic environments that impact occupants' psychological experiences, considering their needs and demands. The overall discussion also suggests that any domestic area's privacy is related to its environmental design factors such as size, shape, location, visual connectivity to the external environment and sound, where the occupants' lifestyle has a significant impact. For functionality, ventilation, daylight and outdoor connectivity indicate essential design components, as well as the opening system, shape and location.

Additionally, space layout and ergonomics also have influential connectivity to occupants' psychological perceptions. However, in almost every domestic space, nature connectivity, natural and artificial light, interior color scheme, smell and the nature of the material used to accelerate the occupant's aesthetic perceptions. Subsequently, any place's aesthetic features profoundly affect the minds of the people living there. Most studies have identified that residents value the indoor environment's quality (e.g., daylight, noise, ventilation, artificial light spectrums) in domestic spaces, which are closely connected to the comfortable living concept. Other issues, such as indoor dust, mold, moisture, pollutants and dampness are directly related to occupants' physical and mental health. Occupants prefer to control these issues according to their choices regarding safety and hygiene. Looking at the safety–security measures in different domestic spaces, environmental design phenomena such as opening system, screening, quality of materials, accessibility, light and color generally indicate the most influential design components according to occupants' experiences.

Overall indoor environmental components such as light, color, temperature, materials, layout, shape, size, height, opening and greenery affect human interactions and emotions. Research has shown that furniture arrangement in a space significantly affects the behavior when living there. In that sense, all the elements of a room are closely related to each other.

In 1986, Pennartz mentioned that a room's spatial and environmental arrangement affects occupants' experience in a domestic environment [21].

Table 1. Occupants' spatial factors in the domestic environment.

Spatial Factors	En-trance	Living Room	Dining Room	Kitchen	Master Bed-room	Child Bed-room	Guest Bed-room	Study & Workspace	Bathing & Toilet	Bal-cony	Storage & Utilities	Lobby & Circulation
Control												
Privacy												
Functionality												
Usability												
Flexibility												
Sociability												
Accessibility												
Aesthetics												
Creativity												
Variety of Choice												
Cleanliness and Hygiene												
Safety and Security												

(Here, the color field indicates the factors' essentiality for different domestic spaces).

The above study also identified that, in a domestic environment, the public zone can be divided into subzones, separated by a movable light partition or door and allocated as the study area, guest room, prayer space or work station, etc. Besides, circulation spaces or lobbies can be used for children's play areas or for adults' physical exercise, where safety–security and psychological emotions are very important to consider. The essential aspects in the kitchen are flexibility, functionality and safety–security for users. A kitchen is a place where, usually, the family members of the house spend most of their time. As a result, occupant's emotional issues, as well as other practical and functional issues are strongly related to this place. The cooking space encourages interaction between family members. Research has also identified that cleanliness and hygiene are the most significant factors for residents, whereas adequate lighting, ventilation and layout provide peace of mind. Other design components, such as furniture, ergonomics and functionality are closely related to occupants' psychological satisfaction and comfort.

Furthermore, the relationship with the outside environment through windows, wall color, room shape and size, balcony and toilet attachments create a spiritual connection with the human mind. The occupants usually prioritise adequate ventilation systems, fixture layout, lighting and odor quality when considering bathrooms and toilets in a domestic environment. The windows of a house create a connection between the occupants' outside and inner world. Studies on highrise residential buildings have shown that large windows or window height negatively impact the occupants in many cases. This effect is especially evident in women and children who live on the top floor of highrise buildings. The balcony has recreational facilities and some ritual perceptions that may impact the occupants in their domestic environments. The overall conceptual parametric relationship between spatial and environmental design factors in different domestic spaces is illustrated, according to the literature, in Figure 17.

Moreover, during the COVID situation, working from home grew increasingly predominant. Every home needs an environment where work can be done peacefully. In that case, the bedroom, study area, dining space or living space can be utilised in a dual way considering their space usability, functionality and flexibility. Consideration of these design components depends on the occupants' contextual status. Users adjust their personal spaces according to their individual context and try to find pleasure or satisfaction in their living environments. However, consideration of different dwelling models and the pragmatic nature of spaces also influence numerous occupants' perceptions of workability because of their diverse shapes, sizes and multi-functionalities [84]. In general, residential satisfaction depends on occupants' needs and preferences, which are closely related to the spatial and environmental components in living environments. Consequently, occupants may achieve happiness by changing or modifying their living environments' physical characteristics to create more comfortable settings.

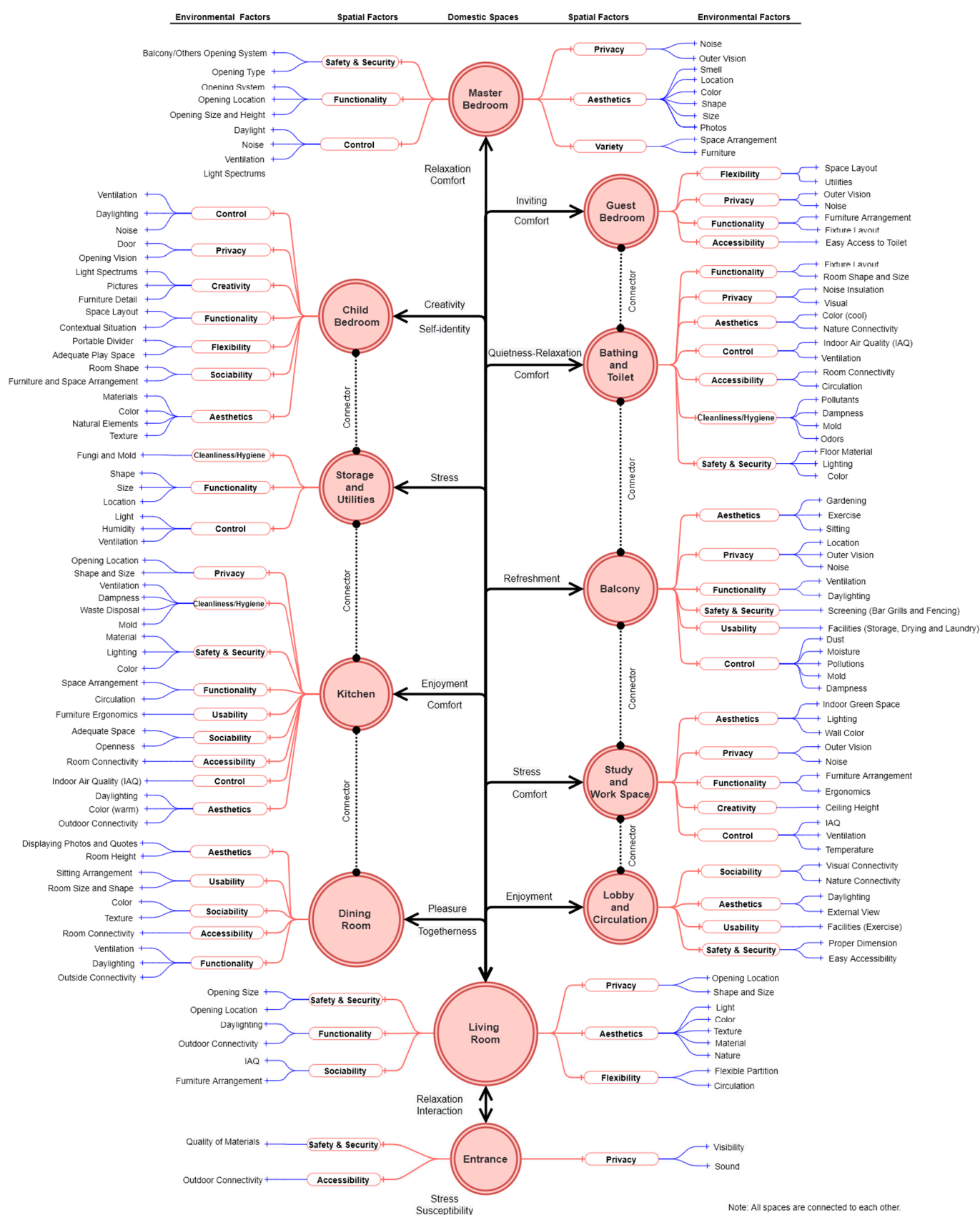


Figure 17. The overall conceptual parametric relationship of occupants' domestic environmental experiences.

After 1970, architectural psychological concepts emerged on human performance, wellbeing and control in built-environmental research [1,6]. However, these are mainly limited to evaluating institutional and health care spaces. According to studies, limited research is conducted on domestic environments and occupant experiences [6]. Nonetheless, studies of architecture and environmental psychology concerning residential settings mainly focus on indoor environmental quality related to occupants' behaviors and physical health risks [28].

From the reviews, it is clear that, in any living condition, occupants' behavior is affected not only by the spatial and environmental aspects but also the occupants' perceptions, feelings and needs, as well as the users' sociocultural context [85]. Occupants who use domestic spaces may have specific values and standards for a given area regarding meaningfulness, attachment and perceptions. Individuals' sociocultural contextual situations may impact different spaces or rooms in a domestic setting, where spatial behavior is related to various cultural and social factors and user preferences. Today's architectural design approaches do not adequately address the relationship between users' context, spatial and environmental design factors, along with occupants' psychological satisfaction and comfort [6,85].

From the literature, it has also been identified that there is a study gap between two current theories, "Environmental Deterministic" and "Social Constructivism" that drive users' experiences within the built environment [86,87]. Here, the "Environmental Deterministic" theory based on environmental psychology describes the physical environmental impacts on human behavior. The scope of explanation about user contexts is limited, to some extent, in this theory. Consequently, the "Social Constructivism" theory describes cultural and social perceptions as challenging to measure or correlate the effects of the built environment is limited [85]. However, the position of "Environmental Experience Design (EXD)" between the two spectra derives from users' physical and psychological experiences and addresses users' sociocultural, spatial and environmental design aspects (Figure 18).

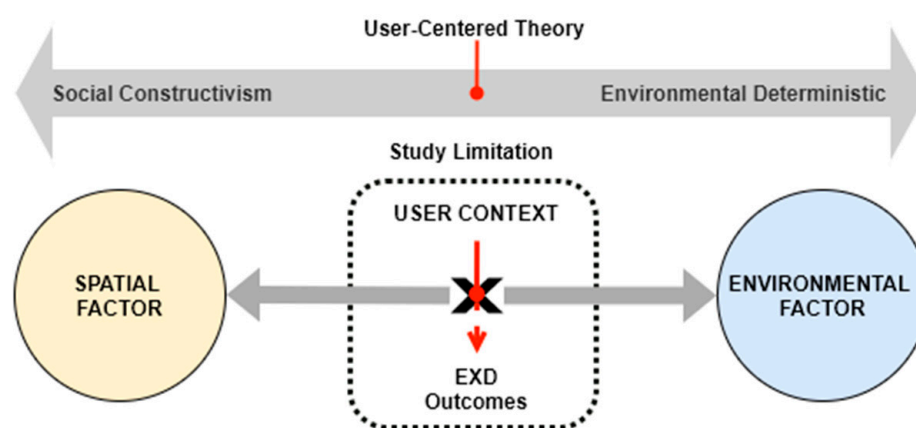


Figure 18. Research gap and future research direction.

This design approach may combine users' spatial preferences and environmental design factors, as well as users' sociocultural context, through their domestic experiences, which may improve occupants' mental wellbeing [6,7]. Therefore, this study establishes a theoretical relationship between spatial and environmental design factors based on the literature, focusing on occupants' experiences in different domestic spaces, where a users' contextual situation plays a critical role in enhancing their wellbeing in domestic settings. Therefore, combining occupants' preferences according to their sociocultural context with spatial and environmental design factors will be a future research direction to explore in the sustainable notion of "Domestic Environmental Experience Design".

6. Conclusions

This study was conducted by a comprehensive literature review based on occupants' domestic experiences and identified that numerous spatial and environmental design factors affect occupants' psychological responses in a domestic setting. This study has illustrated that the theoretical associations between spatial and environmental design factors of different domestic spaces can stimulate occupants' satisfaction and comfort in domestic living. However, occupants' contextual situations impact their domestic living environment, where diverse sociocultural factors such as age, gender, religion, income, education, occupation and lifestyle shape their household needs and demands, which are beyond this study's scope. Each living space has multidimensional uses that are tailored to the sociocultural context of the occupants. Today's environmental design approaches, in the architectural design domain, fail to cohesively address the relationship between user context and spatial and environmental design factors that may enhance occupants' mental wellbeing in a domestic setting. The scope of explanation of users' contextual situation is also limited, to some extent, in environmental design theories. Without a clear perception of occupants' context, environmental design solutions may be harder to implement to enhance wellbeing. Thus, the concept of "*Environmental Experience Design (EXD)*" may combine users' spatial preferences and environmental design factors, along with user contextual factors through their experiences to improve occupants' mental wellbeing. Therefore, a combination of occupants' contextual factors, e.g., sociocultural factors, with spatial and environmental design factors will be the future research direction to explore the notion of "*Domestic Environmental Experience Design*" for the sustainable development of high-density housing sectors.

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