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Original Research Article

Exploring Architectural Experts' Perceptual Patterns of Biophilic Factors Influencing Subjective Well-Being of Residential Complex Residents*

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Abstract

Problem statement: The scarcity of natural landscapes in contemporary residential settings and the disconnection between humans and nature in modern societies deprive residents of the tranquilizing benefits of natural environments. Consequently, enhancing subjective well-being and mental health has come to be known as a critical challenge in residential setting design.

Research objective: The present study was an attempt to identify and classify the dominant perspectives of architectural experts familiar with biophilic design principles regarding the influence of nature-based design on the subjective well-being of residents in residential complexes.

Research method: The present heuristic study is fundamental in terms of objective and falls into the category of descriptive survey studies in terms of data collection. The Delphi method was employed to identify expert perspectives, and Q factor analysis was used to classify their perceptual patterns. In the Delphi phase, 20 experts in architectural education and design were selected through purposive, non probability sampling. The sample size was justified by the inclusive recruitment of experts with distinct views and their participation in the study. A Likert scale questionnaire for Q factor analysis was then administered to the experts, and the data were analyzed with SPSS 27.

Conclusion: The findings revealed four dominant subjective patterns among architectural experts: Objective pattern (visual quality of nature) 14.635%, Functional pattern (structure of nature) – 13.027%, Semantic pattern (semantic relationship with nature) – 12.879%, and Sensory pattern (non visual physics of nature) – 9.996%. These four patterns indicate that architectural experts consider nature effective in improving residents' subjective well being from four perspectives: visual, functional, semantic, and non visual.

Keywords: *Biophilia in architecture, Residential complex, Experts' subjective patterns, Q factor analysis, Subjective well being.*

Introduction and Problem Statement

Biophilic design is a complex, multi faceted concept that is subject to varying interpretations among designers and experts. The absence of a systematic and locally adapted theoretical framework for residential complexes has resulted in the application of this approach often being limited to superficial levels, while the deeper architectural capacities for

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enhancing subjective well being remain neglected. A thorough understanding of this issue requires knowledge of the subjective patterns (subjective frameworks) of experts who are responsible for creating these environments. Therefore, the present exploratory study, employing Q methodology, seeks to answer this question: "What distinct subjective patterns do architectural experts hold regarding the influence of biophilic factors on subjective well being in residential complexes?" The ultimate goal is to move beyond theoretical generalizations and achieve a precise classification of expert perspectives, thereby providing a foundation for developing design principles aligned with residents' psychological needs.

The reduced presence of natural elements and landscapes in contemporary residential environments, coupled with the growing disconnection between humans and nature in urban societies, has raised serious concerns regarding the consequences of this condition for residents' mental health and subjective well being. Under such circumstances, attention to the role of architectural design in reconnecting humans with nature has become a major concern in environmental and architectural research. In the second half of the 20th century, the positive effects of integrating nature into design on human well being became increasingly evident, and the concept of "biophilia" – as a genetic and learnt need – inspired new design movements (Kellert, 2006; Ibrahim, 2019; Bettaieb & Alsabban, 2023). However, rapid population growth and the expansion of built environments have led to encroachment on natural habitats and a reduction in direct human contact with nature (Aghalatifi, 2019). This ecological disconnection has confined residents of modern societies within structures of steel and concrete and in soulless spaces, thereby exacerbating internal isolation. In this situation, individuals spend most of their time in enclosed environments that lack appropriate design and natural qualities, with serious consequences for their physical and mental health (Gong et al., 2023; Kujundzic et al., 2023; Mojtabavi & Tafakori, 2023). In response to the challenges of urban life and limited access to nature, biophilic architecture has been introduced as a novel, human centered approach to restore this lost connection (Hutson & Hutson, 2023). This approach, by utilizing natural patterns and integrating features such as natural ventilation and light, vernacular materials, and nature inspired elements into built environments, not only supports sustainability goals and mitigates negative environmental impacts but also improves residents' physiological and cognitive indicators (Liu & Guo, 2024; Yazdanirostam et al., 2024; Gong et al., 2023), thereby creating a bridge between humans and nature (Mirheydarian & Zarghami, 2026). Scientific evidence indicates that the presence of natural elements reduces stress levels, restores attention, and enhances cognitive performance (Sternberg, 2009; Asnani & Sharma, 2024; Shakhshir & Sheta, 2024). With the emergence of the global COVID 19 crisis and the consequent necessity of staying at home, the urgency of applying this approach has gained even greater significance. Prolonged confinement within residential spaces, while exposing the vulnerability of urban environments, has made an urgent and undeniable priority of reviewing natural environment components such as ventilation, surface area, and green space to ensure citizens' mental and physical health (González & Krarti, 2021; Tokazhanov et al., 2020; Bahador & Mahmudi Zarandi, 2024). Studies indicate that natural and built environments have a significant influence on subjective well being – a multifaceted construct shaped by the balance between life satisfaction and the predominance of positive over negative emotions (Diener et al., 1999; McCabe, 2013). Indeed, exposure to nature and green space reduces mental fatigue and enhances feelings of safety, thereby fostering positive emotions such as happiness and satisfaction (Bowler et al., 2010; Markevych et al., 2017; Richardson & McEwan, 2018; Anderson et al., 2018).

Research Questions

The present study addresses two main questions.

1. What perspectives do architectural experts hold

regarding the influence of biophilic design on the subjective well being of residents in residential complexes?

2. What is the dominant subjective pattern of experts concerning the effect of biophilic design on enhancing the subjective well being of residents in residential complexes?

Background and Theoretical Foundations

• Perceptual pattern

Patterns (paradigms), as strategic maps in the realm of science, reflect the worldviews, frameworks, and shared beliefs of a community of scholars and play a vital role in guiding scientific currents (Askari & Behzadfar, 2016). The dynamism and vitality of science depend on the development of concepts, the evolution of indicators, and the intellectual maturity of scientists who progress in step with contemporary changes. In the present era, facing the accumulation and explosion of knowledge on the one hand, and the complexity of realities on the other, has rendered the use of tools such as "typology" and "articulation of patterns" indispensable for monitoring, organizing, and classifying intellectual structures (Memarian & Tabarsa, 2012). In the field of housing studies, particularly the articulation of the relationship between biophilic design and subjective well being in residential complexes, a clear research gap is evident. Existing knowledge in this field often remains implicit, embedded in scattered intellectual currents within the minds of experts, and has not yet been systematically articulated. This is while significant differences have always existed between designers' assumptions and users' perceptual realities (Duerk, 2011) and conventional research, due to being superficial, fail to analyze deep mental layers and behavioral roots (Duenckmann, 2010). Therefore, to move beyond these superficial layers and fill the existing theoretical gap, the present study aims to conduct a comparative and contrastive analysis of experts' perspectives using Q methodology. By extracting and classifying experts' subjective patterns, this approach converts their tacit knowledge into explicit, scientific perceptual patterns – emergent patterns that, owing to their heuristic nature, lack any precedent in the existing theoretical background and offer a new avenue for improving users' subjective well being.

• The pattern language and evolution of biophilic design

Biophilia, as a profound love of life, was first introduced by Erich Fromm in 1964 as a psychological tendency to be attracted to everything alive and dynamic (Aghabahaei Khordechi & Haghlesan, 2026). Two decades later, Edward Wilson expanded this concept into an evolutionary hypothesis, rooted in humans' innate connection to natural processes (Wilson, 1984). Subsequently, Stephen Kellert identified nine fundamental values of biophilia, thereby articulating the diverse dimensions of this emotional and functional affiliation (Kellert, 1993). Over time, as the term entered the architectural literature, "biophilic design" emerged as a conscious effort to recreate human attunement with natural systems within the built environment—an approach that, far from merely adding vegetation, encompasses the full sensory, metaphorical, and spiritual dimensions of nature (Bolten & Barbiero, 2020; Beatley, 2011). Bibliometric reviews indicate that the focus of research has shifted from an initial emphasis on living organisms to deeper explorations of the human–environment relationship and the formulation of architectural strategies (Zhong et al., 2022).

In the course of this approach's evolution, a variety of theoretical frameworks have been proposed to translate biophilia into a design language. These range from the early classifications by Heerwagen and Hase (2001) and Kellert's comprehensive model (2008) with six elements and seventy attributes, to the practical fourteen-pattern framework by Terrapin Bright Green (Browning et al., 2014), as well as the categorization by Kellert and Calabrese (2015) based on three axes: direct experience of nature, indirect

experience of nature, and the nature of the space. In recent years, researchers have addressed this field with more specialized approaches, including the hybrid model by Lee and Park (2022) for residential settings and the elderly, McGee's interior design matrix (2019), and localized studies such as Afifian's model (2023) for elderly spaces, as well as research by Mousapour (2024) and Wil & Ismail (2025) across various residential scales. This evolutionary trajectory demonstrates that biophilic design has transformed from an abstract idea into a coherent set of design patterns that, by integrating physical, sensory, and digital components, seeks to enhance subjective well-being and quality of life in human settlements (Fig. 1).

- **Subjective well-being**

In recent research discourses, the focus of attention has shifted from mere physical health toward mental health and its components (MacKinlay, 2017). In this context, subjective well-being is defined as an emotional state encompassing a range from health to life satisfaction (Seligman, 1998) and is considered the ultimate goal of human beings (Siegrist, 2003). In positive psychology, Carr regards subjective well-being as synonymous with happiness – a construct characterized by high levels of life satisfaction, positive emotions, and reduced negative emotions (Carr, 2005). From a structural perspective, subjective well-being comprises two main facets: cognitive and affective. The cognitive facet refers to an individual's evaluation of life based on their own subjective standards, while the affective facet denotes the balance between positive and negative emotions (Diener, 2000). The reduction of negative emotions in this process leads to the formation of a sense of calmness and the enhancement of subjective well-being (Teilegen, 2019), and causes individuals to have a more favorable evaluation of the events around them (Ostir et al., 2000). Although numerous studies have demonstrated that variables such as economic capacity (Suh et al., 1998), employment (Csikszentmihalyi, 1975), and satisfaction of basic needs (Ghodrati et al., 2012) play a role in enhancing subjective well-being, the main focus of the present study is on those environmental factors that are directly related to architecture and nature.

Methodology

Due to the lack of articulated theoretical foundations for identifying biophilic factors that enhance subjective well-being in residential complexes, the present study is heuristic in nature. In terms of data collection method, it falls into the category of descriptive-survey studies and employs a mixed-methods research approach. In the first step, based on a review of the relevant literature, an initial list of components and items was compiled. The Delphi method was used to identify and screen the components. Specifically, in this first phase, the list was administered in the form of a semi-structured

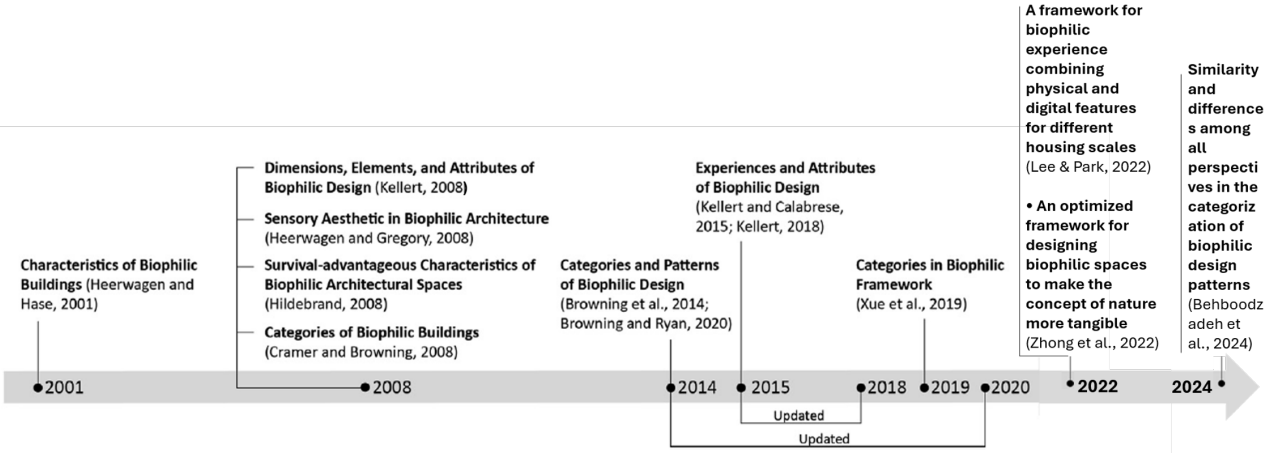

Fig. 1. Timeline of different conceptualizations of biophilic design. Source: Adapted from Zhong et al., 2022.

questionnaire based on a five-point Likert scale (ranging from "strongly disagree" to "strongly agree"). This allowed for quantitative scoring and ranking of the components while also collecting supplementary qualitative opinions from the experts (Babbie, 2007; Dunham, 1998), and enabled the addition, modification, and merging of items.

After collecting the initial data, the responses were organized, low-scoring options were removed, and similar opinions from the open-ended section of the questionnaire were merged. The revised questionnaire was then administered again for expert feedback. This process continued until a final consensus was reached. Because the results remained consistent and no significant change occurred between the second and third phases, the Delphi cycle was terminated. At the end of the Delphi cycle, items with low mean scores or very high SD were removed, and similar items were merged based on expert consensus. Thus, the final set of items that served as the basis for the Q-analysis was the product of combining the theoretical literature and iterative expert feedback.

After reaching consensus in the Delphi process, the data entered the Q-analysis phase. Q-methodology is a robust tool and a bridge between quantitative and qualitative methods, aiming not to count individuals but to discover "subjective patterns" and the "typology of perspectives" (Khoshgooyanfard, 2007). In this method, unlike conventional factor analysis, in which variables are classified, individuals (respondents) are categorized based on their subjective commonalities and differences (Beretta, 1996; Gibson, 1998). Thus, in contrast to classical factor analysis, where variables are clustered, individuals are grouped according to patterns of similarity and difference in their judgments regarding the items. Consequently, the extracted perceptual patterns (objective, functional, semantic, and sensory) are the result of Q-factor analysis and represent the "existing types of subjectivity" among experts, categorized without researcher intervention (Fig. 2). Each of these perceptual patterns highlights a

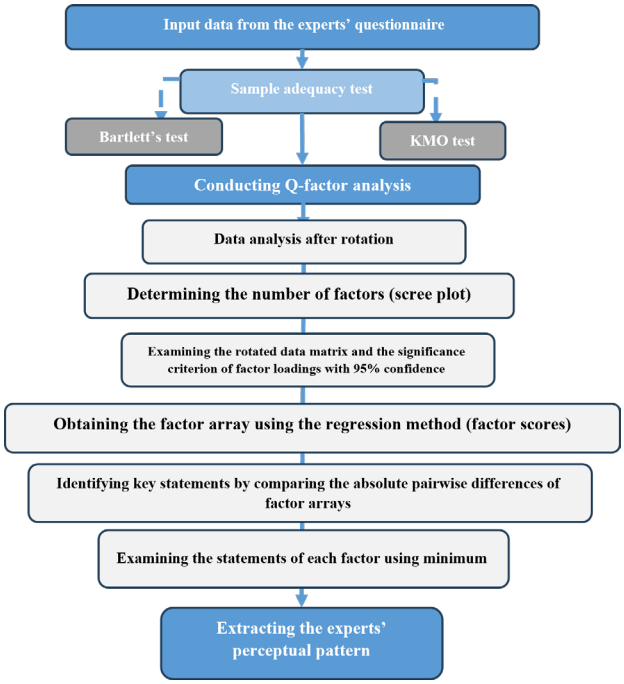

Fig. 2. Stages of Q factor analysis. Source: Authors.

set of items that, from the perspective of those holding that pattern, have relatively greater importance. This does not imply the rejection of other factors, but rather indicates a difference in their prioritization and subjective salience.

- **Population selection and sample size**

The population of this study, in its documentary phase, comprises all texts and articles related to biophilic architecture in residential settings. In the survey phase, the population consists of architectural experts. In Q methodology, the selection of the population is a process based exclusively on the purposive selection of a sample group, in which the diversity of individuals takes precedence over their number (Ahmadian & Eslami, 2014). In this method, participants are not selected through probability sampling; rather, the samples are typically chosen purposively and in small numbers. This is because Q methodology only seeks to discover different subjective patterns, and to achieve this, the presence of specific individuals with a particular subjective pattern would suffice (Khoshgooyanfard, 2007). Thus, from within the discourse space, those holding a specific view on

the topic are selected for direct participation, so as to extract the distinct subjectivity existing within the population (Van Exel & De Graaf, 2009). On the other hand, with respect to the Delphi method, studies indicate that the number of participants is typically fewer than 50 and often ranges between 10 and 20 (Landeta, 2006; Powell, 2003). Accordingly, in the present study, 20 experts were selected as the sample. These included faculty members from the Departments of Architecture at the University of Tabriz, Shahid Rajaee Teacher Training University, Islamic Azad University – Central Tehran Branch, and Farhangian University. The majority of these experts specialized in biophilic design, sustainability, subjective well being, and the relationship with nature and landscape, and were considered knowledgeable in these fields. Given the heuristic nature of Q methodology, the sample was selected not as a statistical representative of the population of architects but rather as the most informed and knowledgeable individuals with respect to the research topic. Inclusion criteria included having research or professional experience in biophilic design or sustainable architecture, familiarity with environmental psychology and subjective well being, and willingness to participate in the subjective analysis based on Q methodology. Additionally, efforts were made to ensure sufficient diversity among participants in terms of their field of activity (academic and professional) and theoretical background, so that different perceptual patterns could be detected.

• Assessment of instrument validity and reliability

To ensure the validity and reliability of the research instrument, precise quantitative evaluations were conducted. For content validity assessment, Lawshe's Content Validity Ratio (CVR) was used. To determine the CVR value, experts were asked to respond to each item based on a three point scale: "useful but not essential," "not essential," and "essential" (Jam et al., 2019). The responses were then calculated using the following formula.

$$CVR = \frac{\left(n_E - \frac{N}{2}\right)}{\left(\frac{N}{2}\right)}$$

ne: number of experts who responded: "essential."

N: total number of experts

Given that the number of participants was 20, according to the CVR table, the CVR coefficient must be greater than 0.42. After calculating this coefficient for all items, the validity of the research instrument was confirmed. Furthermore, the reliability of the instrument was examined through internal consistency measurement, and Cronbach's alpha coefficient (0.639) indicated acceptable reliability of the questionnaire. In addition, to assess the adequacy of the sample size and the appropriateness of the data structure for factor analysis, the KMO and Bartlett's tests were conducted (Table 1). The KMO value was 0.535 (greater than 0.5), and the significance level of Bartlett's test was 0. 00 (less than 0.05), both confirming the adequacy of the sample and the appropriateness of the data structure for statistical and factor analyses.

Findings

After performing factor rotation in SPSS software, the data analysis indicated the formation of four main factors with eigenvalues greater than 1.5, extracted from the perspectives of 20 experts (Table 2). Examining the contribution of each factor to the explained variance reveals that the first factor (visual quality of nature) and the second factor (structure of nature), with values of 14.635% and 13.027%, respectively, carry the greatest weight

Table 1. KMO and Bartlett's test of sphericity for sampling adequacy. Source: Authors.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.535
Bartlett's Test of Sphericity	Approx. Chi-Square	496.250
	df	190
	Sig.	.000

in explaining subjective patterns. The third factor (semantics of nature) and the fourth factor (non visual physics of nature), with 12.879% and 9.996%, occupy the subsequent ranks. The total variance explained by these four factors is 50.537%. This finding indicates that approximately half of the respondents' thinking is influenced by a common external reality and convergent perspectives, while the remaining 49.463% reflects their individual thoughts, tendencies, and preferences.

The scree plot (Fig. 3) also confirms this structure, as the slope of the plot begins to flatten after the fourth

Table 2. Total variance explained for the four factors (perceptual patterns). Source: Authors.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.631	18.157	18.157	3.631	18.157	18.157	2.927	14.635	14.635
2	2.539	12.696	30.853	2.539	12.696	30.853	2.605	13.027	27.662
3	2.096	10.478	41.331	2.096	10.478	41.331	2.576	12.879	40.541
4	1.841	9.206	50.537	1.841	9.206	50.537	1.999	9.996	50.537
5	1.522	7.608	58.145	-	-	-	-	-	-
6	1.353	6.765	64.910	-	-	-	-	-	-
7	1.272	6.360	71.270	-	-	-	-	-	-
8	1.006	5.032	76.302	-	-	-	-	-	-
9	.923	4.615	80.917	-	-	-	-	-	-
10	.691	3.456	84.373	-	-	-	-	-	-
11	.679	3.394	87.767	-	-	-	-	-	-
12	.544	2.721	90.489	-	-	-	-	-	-
13	.418	2.089	92.578	-	-	-	-	-	-
14	.376	1.881	94.459	-	-	-	-	-	-
15	.364	1.820	96.279	-	-	-	-	-	-
16	.276	1.382	97.661	-	-	-	-	-	-
17	.162	.811	98.472	-	-	-	-	-	-
18	.144	.720	99.192	-	-	-	-	-	-
19	.092	.458	99.650	-	-	-	-	-	-
20	.070	.350	100.000	-	-	-	-	-	-

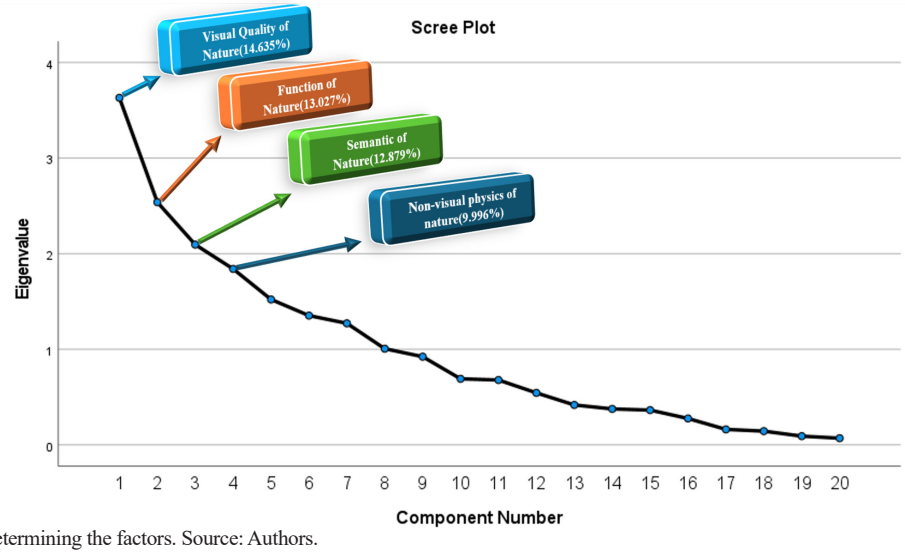

Fig. 3. Scree plot for determining the factors. Source: Authors.

factor and the eigenvalues drop below 1.5, which corroborates the significance and interpretability of the four extracted factors.

In the next step, the rotated factor matrix (Table 3) enables the identification of the constituent variables and the position of each expert within the subjective patterns. To determine the significance level, given the presence of 36 items and a 95% confidence level, factor loadings greater than $\frac{1.96}{\sqrt{36}} = 0.326$ were considered significant. This factor loading of 0.326 indicates that approximately 10% of the variance of the variable is explained by the respective factor, which is a substantial magnitude. Based on the distribution of factor loadings, the composition of experts across the factors is as follows: the first and second factors each contain 5 experts, the third factor contains 6 experts, and the fourth factor consists of 4 experts.

After extracting the factors, the critical phase of their precise interpretation begins. In Q methodology, unlike conventional factor analysis, where the researcher directly consults factor loadings, the interpretation process requires linking the factor loadings with the content of the items. This is because factor loadings only indicate the relationship of individuals to the factors, but the meaning of the factors depends on the content of the statements. Thus, factor scores are used as a bridge between the content of the Q statements and the extracted factors (Hatami Khanghahi et al., 2016). In the present study, factor scores for all 36 items were calculated with respect to the four factors (Table 4). Using the absolute value of the differences between factor arrays (with a difference greater than 2.5), distinguishing and consensus items were identified. This analytical process has enabled a precise articulation of experts' subjectivity regarding "the influence of biophilic design on enhancing residents' subjective well being," based on items with extreme scores (minimum and maximum) and distinguishing items (Table 5).

Discussion

The present study was an attempt to explore the subjective structure and perceptual patterns of

Table 3. Rotated factor matrix and respective factor loadings. Source: Authors.

	1	2	3	4
VAR00017	.802	.136	-.264	-.026
VAR00002	.703	.001	.277	-.223
VAR00004	.673	.029	-.147	.064
VAR00014	.671	.270	.299	.307
VAR00007	.365	.047	.120	-.361
VAR00011	.039	.738	.092	.128
VAR00003	.120	.721	-.112	-.322
VAR00009	-.071	.718	.331	.064
VAR00015	.256	.538	-.209	.419
VAR00001	.456	.529	-.018	-.042
VAR00013	.118	.354	.656	-.116
VAR00008	.279	-.029	-.642	-.112
VAR00010	-.008	.090	.606	-.226
VAR00019	.183	-.197	.573	.299
VAR00006	-.337	.079	-.566	-.006
VAR00012	.052	-.028	-.358	-.130
VAR00020	.215	-.056	.069	-.685
VAR00018	.314	-.339	.239	.653
VAR00005	.253	.251	.083	.463
VAR00016	-.095	-.008	.272	.353

Table 4. Absolute difference of factor arrays and factor score for each item. Source: Authors.

Nmumber	Item	Factor array				Absolute difference of each statement's factor array					
		for Factor 1	for Factor 2	for Factor 3	for Factor 4	between Factor 1 and Factor 2	between Factor 1 and Factor 3	between Factor 1 and Factor 4	between Factor 2 and Factor 3	between Factor 2 and Factor 4	between Factor 3 and Factor 4
1	Living plants	29	26	13	5	3	16	24	13	21	8
2	Natural outdoor landscapes	30	16	7	25	14	23	5	9	9	18
3	Variable natural light	31	2	2	13	29	29	18	0	11	11
4	Small ecosystems	23	36	25	31	13	2	8	11	5	6
5	Native and traditional materials	7	8	17	9	1	10	2	9	1	8
6	Rich sensory information with a nature-like hierarchy	5	14	9	26	9	4	21	5	12	17
7	Layers of view – visual corridors	1	11	30	4	10	29	3	19	7	26
8	Distant and close – accessibility	2	35	6	18	33	4	16	29	17	12
9	Natural elements	18	6	32	17	12	14	1	26	11	15
10	Sounds of nature – auditory	12	15	24	29	3	12	17	9	14	5
11	Natural scents – olfactory	11	17	4	34	6	7	23	13	17	30
12	Multi-sensory engagement	33	19	16	20	14	17	13	3	1	4
13	Natural ventilation	16	32	5	3	16	11	13	27	29	2
14	Daily and seasonal temperature control and variation	24	25	3	15	1	21	9	22	10	12
15	Natural airflow	8	29	8	27	21	0	19	21	2	19
16	Natural cooling and humidity systems	26	20	23	22	6	3	4	3	2	1
17	Dynamic water with movement and flow	34	21	29	30	13	5	4	8	9	1
18	Touching water	20	13	33	36	7	13	16	20	23	3
19	Experiencing water elements	32	23	28	24	9	4	8	5	1	4
20	Dynamic shading	17	1	11	19	16	6	2	10	18	8
21	Seasonal and temporal changes	25	4	1	35	21	24	10	3	31	34
22	Natural wood	19	22	22	23	3	3	4	0	1	1
23	Natural colors	10	9	18	6	1	8	4	9	3	12
24	Symmetry and complexity	6	5	19	28	1	13	22	14	23	9
25	Expansive views	36	34	10	11	2	26	25	24	23	1
26	Horizontal landscapes – horizon lines	14	31	14	1	17	0	13	17	30	13
27	Open spaces	21	3	26	2	18	5	19	23	1	24
28	Protected/refuge corners	3	7	27	12	4	24	9	20	5	15
29	Natural canopies	4	27	34	33	23	30	29	7	6	1
30	Vast natural vistas	35	12	35	21	23	0	14	23	9	14

Rest of Table 4.

NWmumber	Item	Factor array				Absolute difference of each statement's factor array					
		for Factor 1	for Factor 2	for Factor 3	for Factor 4	between Factor 1 and Factor 2	between Factor 1 and Factor 3	between Factor 1 and Factor 4	between Factor 2 and Factor 3	between Factor 2 and Factor 4	between Factor 3 and Factor 4
32	Awe-inspiring elements	27	10	36	16	17	9	11	26	6	20
33	Intensity of presence of elements	13	30	31	10	17	18	3	1	20	21
34	Diversity of elements	15	33	21	14	18	6	1	12	19	7
35	Scale and dimensions	28	28	12	8	0	16	20	16	20	4
36	Arrangement/layout	22	18	20	7	4	2	15	2	11	13

Table 5. Experts' subjective patterns regarding biophilic factors influencing subjective well being. Source: Authors.

Perceptual Pattern	Item number receiving the maximum score	Item number receiving the minimum score	Number of participants	Viewpoint
Objective Pattern – Visual qualities of nature	25 - Expansive views 30 - Vast natural vistas 17 - Dynamic water with movement and flow	7 - Layers of view – visual corridors 8 - Distant and close – accessibility 28 -Protected/refuge corners	7,14,4,2,17	Viewpoint 1
Functional Pattern – Structure and behavior of nature	4 - Small ecosystems 8 - Distant and close – accessibility 25 - Expansive views	20 - Dynamic shading 3 - Variable natural light 27 - Open spaces	11,8,10,19,6,12	Viewpoint 2
Semantic/Symbolic Pattern – Meaning of nature	32 - Awe-inspiring elements 30 - Vast natural vistas 29 - Natural canopies	21 - Seasonal and temporal changes 3 - Variable natural light 14 - Daily and seasonal temperature control and variation	13,8,10,19,6,12	Viewpoint 3
Sensory Pattern – Non-visual physics of nature	18 - Touching water 21 - Seasonal and temporal changes 11 - Natural scents – olfactory	26 - Horizontal landscapes – horizon lines 27 - Open spaces 13 - Natural ventilation	20,18,5,16	Viewpoint 4

architectural experts regarding the influence of biophilic design on the subjective well being of residents in residential complexes. Based on the findings of the Q analysis, the answers to the research questions can be summarized as follows.

Research question 1: Architectural experts, when confronted with the concept of biophilic design and its role in residents' subjective well being, follow four distinct perceptual patterns.

- Objective pattern (emphasis on visual qualities and natural landscape);
- Functional pattern (emphasis on the structure, function, and ecological logic of nature);
- Semantic pattern (attending to the symbolic, identity related, and inspirational facets of nature);
- Sensory pattern (Highlighting the non visual and multisensory experience of nature's presence).

Research question 2: Among these patterns, the objective pattern explains the largest share of the variance in perspectives and can therefore be introduced as the "dominant subjective pattern" in the studied population. However, the existence of the

other three patterns indicates that experts' perception is not uniform or limited solely to this visual facet, but rather a multifaceted spectrum of perspectives exists among them.

The use of Q methodology in the present study made it possible to move beyond common generalizations and achieve a precise classification of the tacit perspectives of experts. The findings revealed that experts' perception of the concept of "nature based design" is not uniform, but can be recognized in the form of four distinct subjective patterns: the objective (visual) pattern, the functional (structural) pattern, the semantic (perceptual) pattern, and the sensory (non visual) pattern (Figs. 4 & 5). Architectural experts do not hold a single, uniform perception of biophilic design; rather, their mindset is shaped through four distinct pathways: a pathway that sometimes relies on the aesthetics and visual presence of nature, sometimes on its functional logic, and in other cases leans toward the deeper layers of meaning and multisensory experience. This diversity indicates that the concept of "nature" in residential settings is a multifaceted matter for designers and cannot be limited solely to the presence of plants or landscapes.

The diversity of these patterns indicates the multifaceted and complex nature of the human–nature relationship in the built environment. The first (objective) pattern, which explained the largest share of variance, suggests that a considerable portion of the expert community still interprets nature primarily through the lens of "visual aesthetics" and elements such as expansive landscapes and the presence of water. However, the dominance of this pattern does not imply the negation or trivialization of other facets; rather, it merely indicates that for this group of experts, the objective facet is more prominent, while the other patterns also exist alongside it as distinct subjective variants.

Although this approach is necessary, reducing biophilia to merely a visual experience may limit its effectiveness in deeply enhancing subjective well being. In contrast, the emergence of the second (functional) pattern signals a shift among a fraction of the professional community toward an ecological and systemic understanding of nature, where ecosystem sustainability and accessibility take precedence over formal appearance.

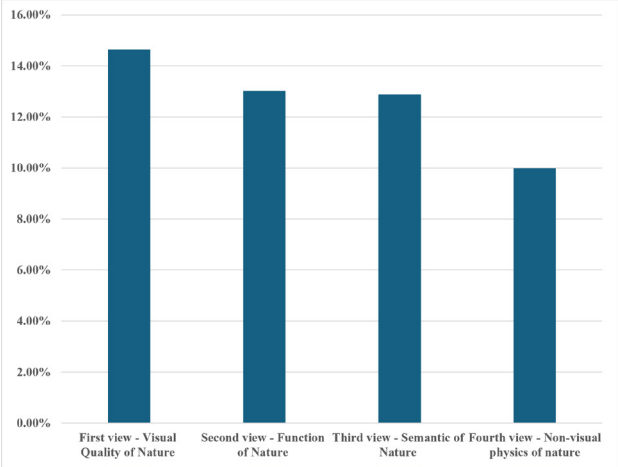

Fig. 4. Bar chart showing the frequency of the most important biophilic design factors in residential complexes for enhancing subjective well being. Source: Authors.

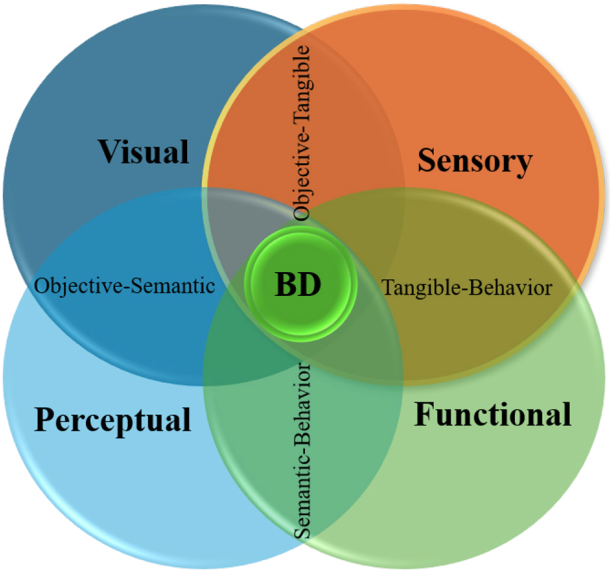

Fig. 5. Conceptual model of biophilic design factors in residential complexes for enhancing subjective well being. Source: Authors.

A noteworthy point in the present study is the identification of the third (semantic) and fourth (sensory) patterns, which reveal deeper layers of lived experience. The semantic pattern, by emphasizing elements such as awe and inspiration, points to the spiritual and symbolic facets of nature—recognized in environmental psychology literature as a key factor in attention restoration and reduction of mental fatigue. On the other hand, the sensory pattern, by highlighting olfactory and tactile experiences as well as seasonal changes, acknowledges that subjective well being in residential settings is not achieved merely by watching, but requires "sensory immersion" in the space. The presence of diverse patterns indicates that the authentic experience of nature can lead to a sustainable enhancement of subjective well being only when the visual, functional, semantic, and sensory facets are brought together. This finding goes beyond merely classifying experts' subjective frameworks; as it demonstrates that the main risk in applying biophilia is reducing it to superficial beautification, while subjective well being requires a deeper, more intertwined, and multi layered engagement with nature.

Conclusion

The results of the present study, derived from synthesizing these patterns at the level of theoretical interpretation, have important implications for the design of future residential complexes. Although Q methodology is founded upon the detection of differences and distinctions among subjective patterns, relying solely on any one of these patterns cannot address the sophisticated needs of modern humans. The totality of the four extracted patterns presents a multifaceted and complementary picture of the human–nature relationship in residential environments. In other words, each pattern highlights a part of the experts' subjective reality, and none alone is capable of covering all facets of the biophilic experience. From this perspective, a successful biophilic design that leads to the sustainable enhancement of subjective well being requires adopting a "holistic and hybrid" approach – that is, it is recommended that in practice, designers simultaneously attend to the visual, functional, semantic, and sensory facets of nature, rather than merely settling for one of these patterns (e.g., the objective pattern). Within this framework, biophilic design is regarded as an approach in which nature is simultaneously integrated into the spatial organization of residential complexes as a physical (objective) element, a sustainable (functional) system, a source of meaning (perceptual), and a multisensory stimulus (non visual). The literature on biophilic design indicates that the experience of contact with nature in the built environment is not limited merely to the presence of green elements or vegetation, but rather encompasses a spectrum of physical, sensory, metaphorical, and material facets that, in interaction with one another, shape environmental experience (Zhong et al., 2022). Therefore, failing to attend to the synergy of these facets can result in the formation of spaces that, despite being visually "green," do not necessarily create a restorative experience or enhance residents' subjective well being.

Limitations and Suggestions

One of the limitations of this study is its exclusive focus on the experts' perspectives. Since the lived experience of end users may differ from designers' subjectivities, it is suggested that future research investigate actual residential complexes using Q methodology to explore the subjective patterns of residents and to assess the degree of consistency or gap between designers' and users' viewpoints. Furthermore, developing locally adapted design guidelines based on these four perceptual patterns could represent an effective step toward improving the quality of life in dense metropolitan areas.

Conflict of Interest Disclosure

The authors hereby declare that there was no conflict of interest in conducting this research.

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