KASU ENVIRONMENTAL SCIENCE JOURNAL (KESJ)
KASU Environmental Science Journal (KESJ) e-ISSN: 3156-2914
Volume 6, Issue 2, December 2026

SYMBOLIC BIOPHILIC DESIGN AND RESTORATIVE EXPERIENCE IN NIGERIAN RESORT ARCHITECTURE: THE MEDIATING ROLE OF BEING AWAY

Ahmed T. KASIM[1] and Abubakar D. ISAH[2]
[1&2]Department of Architecture, Federal University of Technology Minna, Niger State, Nigeria
Corresponding author email: kasimxahmed@gmail.com

ABSTRACT

Purpose*: Research on restorative environments has predominantly emphasized direct nature exposure while underexploring the role of symbolic biophilic design in built environments. This study advances restorative environment theory by examining how symbolic biophilic design influences restorative experience and the mediating role of "Being Away" within Nigerian resort contexts.*

Design/methodology/approach: *Grounded in Attention Restoration Theory (ART), a quantitative cross-sectional explanatory survey of 259 resort users was analysed using exploratory factor analysis, multiple linear regression, and Hayes' PROCESS macro (Model 4) for mediation analysis with 5,000 bootstrap resamples.*

Findings*: Reliability and construct validity were acceptable. Symbolic biophilic design had a stronger effect on restorative experience ($\beta = 0.39$, $p < 0.001$) than direct nature exposure ($\beta = 0.26$, $p < 0.001$), explaining 36.6% of the variance ($R^2 = 0.366$). Mediation results indicate that "Being Away" partially mediated this relationship (indirect effect = 0.249, 95% CI [0.155, 0.350]), demonstrating that symbolic environmental cues significantly enhance psychological detachment and restoration.*

Research limitations/implications*: The cross-sectional design limits causal inference. Additionally, the sample's specific socio-economic profile within urban Nigerian hospitality contexts restricts generalizability. Symbolic biophilia was examined as an aggregated construct; future research should disaggregate individual features to identify specific restorative cues.*

Practical implications: *Hospitality architects should integrate vernacular materials, biomorphic forms, and nature-inspired textures as core architectural elements rather than relying solely on landscape interventions. Furthermore, designers should create spatial sequences and transition zones that strengthen occupants' sense of "Being Away" from everyday routines, and improve perceived "Extent" through enhanced spatial continuity and visual connectivity.*

Originality/value: *This study provides empirical support for the role of cognitively mediated environmental meaning within ART, demonstrating that nature-inspired architecture offers significant restorative benefits beyond direct nature exposure in developing-country contexts.*

Keywords: Hospitality, environments, biophilic-design, Vernacular architecture.

[1] Email: kesj@kasu.edu.ng

1.0 INTRODUCTION

Rapid urbanization, escalating work demands, and information-intensive lifestyles have heightened global concerns regarding cognitive fatigue and psychological well-being, thereby stimulating significant interest in restorative environments. In densely populated urban centers, particularly in developing nations like Nigeria, the built environment often exacerbates attentional depletion due to high sensory loads and limited access to natural settings. Attention Restoration Theory (ART) provides a foundational framework for understanding how environmental experiences facilitate recovery from attentional depletion through cognitive restoration processes (Berto, 2014; Corazon et al., 2019). According to ART, environments that possess specific restorative characteristics—such as being away, fascination, extent, and compatibility—can effectively replenish directed attention and mitigate psychological stress (Kaplan, 1995). Consequently, designing built environments that support cognitive recovery has become a critical priority for contemporary architecture and environmental psychology.

Biophilic design has emerged as a vital architectural approach to promote restoration by integrating natural elements into the built environment. Traditionally, this has been operationalized through Direct Nature Experience (DN), which includes the incorporation of vegetation, daylight, water features, and natural views. Extensive empirical evidence associates these direct interventions with reduced stress, enhanced mood, and improved cognitive functioning (Bratman et al., 2019; Yildirim et al., 2023). However, restorative research has predominantly emphasized physical nature exposure, largely assuming that restoration depends on direct interaction with living natural systems. This assumption limits the applicability of biophilic design in dense urban, resource-constrained, or highly controlled hospitality settings where direct access to living ecosystems is not always feasible. Consequently, there is a growing recognition of Symbolic Biophilic Design (SV)—nature-based architectural elements such as timber and terracotta finishes, leaf- or branching-inspired forms, earth-derived textures, locally derived motifs, and patterns referencing vegetation or geological formations. These symbolic cues may evoke deep connections with nature and place identity without requiring direct interaction with living ecosystems (Ryan et al., 2014; Coburn et al., 2020).

Despite the theoretical recognition of symbolic biophilic design, its restorative potential remains insufficiently understood, particularly within hospitality environments such as resorts. Resorts are specifically designed as retreats for psychological recovery and leisure, making them ideal contexts for studying restorative experiences. While direct nature exposure is commonly utilized in resort design, the cognitive mechanisms through which symbolic, culturally mediated architectural cues contribute to psychological restoration remain largely underexplored. Furthermore, existing literature on restorative environments is heavily skewed towards Western contexts, with a notable scarcity of empirical evidence examining how culturally responsive and symbolic architectural elements influence restoration in developing-country contexts, such as Nigeria. The integration of vernacular and symbolic biophilic elements in Nigerian resort architecture presents a unique opportunity to evaluate how environmental meaning and cultural familiarity contribute to occupant well-being.

To address these gaps, this study examines the influence of symbolic biophilic design on restorative experience in Nigerian resort environments. Specifically, the study aims to: (1) evaluate the comparative effects of symbolic biophilic design and direct nature experience on restorative outcomes; (2) examine the mediating role of "Being Away"—a cognitive state of psychological detachment from routine demands, in linking symbolic biophilic design to restorative experience; and (3) provide empirical evidence for the integration of symbolic, nature-referencing architectural elements in hospitality design. By proposing Being Away as a mediating mechanism, this research advances restorative environment theory beyond conventional pathways based solely on direct nature exposure, offering critical insights for the design of psychologically restorative resort architecture.

2.0 LITERATURE REVIEW

2.1 Restorative Environments and Psychological Restoration

Restorative environments are settings that facilitate recovery from psychological stress and cognitive fatigue, particularly the depletion of directed attention caused by demanding urban lifestyles. Attention Restoration Theory (ART) serves as the foundational theoretical framework for this study, positing that exposure to environments possessing specific restorative characteristics can effectively replenish cognitive resources (Kaplan, 1995). According to ART, restoration occurs when an environment facilitates effortless attention through four key components: Being Away, fascination, extent, and compatibility. These components are commonly measured using the Perceived Restorativeness Scale (PRS) (Hartig et al., 1997; Stragà et al., 2023). Empirical evidence consistently associates restorative environments with improved cognitive functioning, emotional regulation, and overall psychological well-being (Song et al., 2022; Yildirim et al., 2023; Gaekwad et al., 2023). However, a critical review of the literature reveals a significant geographical and contextual bias: restorative research has predominantly emphasized direct exposure to natural settings, giving limited attention to symbolic or representational environmental cues. This gap is particularly pronounced in built environments where physical access to nature is constrained, such as dense urban centers in developing nations (Zhong et al., 2022; Ma et al., 2024).

2.2 Biophilic Design and Direct Nature Experience

Biophilic design is an architectural approach grounded in the biophilia hypothesis, which promotes human well-being through the integration of natural elements into the built environment (Beatley & Newman, 2013; Kellert, 2018). Its most prevalent application is Direct Nature Experience (DN), encompassing the incorporation of daylight, vegetation, water features, natural ventilation, and visual or physical access to living ecosystems (Ryan et al., 2014; Elf et al., 2020). Numerous studies have robustly associated DN interventions with reduced physiological stress, improved affect, enhanced cognitive performance, and higher perceived restorativeness (Hartig et al., 2014; Stevenson et al., 2018; Bratman et al., 2019). Despite this substantial evidence base, DN-centric research largely operates on the assumption that restoration is contingent upon direct interaction with living natural systems. This assumption limits the practical applicability of biophilic design in dense urban, highly controlled, or resource-constrained settings where maintaining living ecosystems is economically or spatially unfeasible. Consequently, symbolic and culturally mediated representations of nature remain comparatively underexplored as viable alternative mechanisms for cognitive restoration. This study therefore treats Direct Nature Experience as a baseline restorative pathway against which the unique contribution of symbolic biophilic design can be rigorously evaluated.

2.3 Symbolic Biophilic Design in Built Environments

Symbolic biophilic design extends the restorative design paradigm beyond direct nature exposure by incorporating nature-referencing architectural elements. These include biomorphic forms, natural materials (such as timber and terracotta), organic textures, and vernacular motifs that evoke environmental meaning without requiring living natural systems (Goldhagen, 2017; Sussman & Hollander, 2021). Unlike direct biophilic interventions, the restorative potential of symbolic design is not inherent in the physical elements themselves but depends on how occupants cognitively interpret and associate these symbolic cues with nature and place identity (Coburn et al., 2017; Coburn et al., 2020). Despite growing theoretical recognition of neuroarchitecture and cognitive responses to built forms, empirical evidence on the restorative effectiveness of symbolic biophilic design remains limited. This gap is particularly evident in hospitality architecture, where nature-inspired forms and vernacular materials are widely utilized for aesthetic and cultural expression but are rarely evaluated

as active mechanisms of psychological restoration (Tabassum & Park, 2024; Ifebi et al., 2024). By examining these elements within Nigerian resort contexts, this study addresses the critical need to understand how culturally responsive, representational architecture contributes to occupant well-being.

2.4 Being Away as a Mediator of Restorative Experience

Within the framework of Attention Restoration Theory (ART), "Being Away" describes a cognitive state of psychological detachment from routine demands and familiar environments, which is essential for attentional recovery. Crucially, this state may arise through perceptual disengagement from familiar cognitive contexts rather than requiring physical relocation to a remote natural setting. This conceptualization makes Being Away highly relevant to built environments, where restoration depends heavily on environmental meaning and immersive design rather than mere nature exposure (Ohly et al., 2016; Menardo et al., 2021). While the Perceived Restorativeness Scale (PRS) comprises Being Away alongside fascination, extent, and compatibility (Scopelliti et al., 2016), ART conceptually identifies Being Away as the principal cognitive trigger that initiates the restorative process. Methodologically, to avoid conceptual overlap and tautology, this study models Being Away as an independent mediating construct, while operationalizing the dependent variable, Restorative Experience, using the remaining PRS dimensions (fascination, extent, and compatibility). Existing restorative environment research has focused primarily on direct biophilic interventions, giving limited attention to the specific cognitive mechanisms through which symbolic architectural cues promote psychological detachment, particularly in developing-country contexts (Kellert, 2018; Tabassum & Park, 2024). This study addresses this gap by explicitly examining Being Away as the mediating pathway linking symbolic biophilic design to restorative experience.

3.0 AREA OF THE STUDY

This study was conducted in selected resort and hospitality environments within Lagos State, Nigeria. As Nigeria's primary economic hub, Lagos is characterized by rapid urbanization, intense commercial activity, and high population density, which frequently expose urban dwellers to sensory overload and cognitive fatigue (Akindejoye, 2021). Consequently, the dense built environment and limited access to expansive natural settings necessitate alternative restorative strategies.

Despite these spatial constraints and the high economic cost of maintaining living ecosystems, Lagos hosts numerous resort facilities designed as psychological retreats. To promote guest well-being within these constrained urban contexts, many facilities increasingly rely on *symbolic biophilic design* (or "natural analogues")—such as indigenous materials, biomorphic forms, and nature-inspired textures, rather than direct nature exposure (Ryan et al., 2014; Coburn et al., 2020). This unique architectural context makes Lagos State an ideal setting for investigating how symbolic environmental cues can facilitate psychological detachment (Being Away) and cognitive restoration in developing-country hospitality environments where direct access to nature is limited.

4.0 METHODOLOGY

4.1 Research Design and Data Collection

This study employed a cross-sectional explanatory survey design to examine the relationships among Symbolic Biophilic Design (SV), Direct Nature Experience (DN), Being Away (BA), and Restorative Experience (RPE) in selected resort environments in Lagos State, Nigeria. Grounded in Attention Restoration Theory (ART), the study tested a mediation model in which Being Away links symbolic biophilic design to restorative outcomes. Data were collected using a structured online questionnaire administered to adults (≥18 years) who had recently visited the selected resort facilities. A total of 284 responses were initially received, of which 25 were excluded during the screening process: 14 were

incomplete or showed patterns of unengaged responding, while 11 did not meet the inclusion criteria. Consequently, 259 valid responses were retained for analysis. The questionnaire comprised demographic items, the Perceived Restorativeness Scale (PRS), and biophilic design measures. Convenience sampling was employed because the study focused on examining theoretical relationships among variables rather than estimating population characteristics. Participation was voluntary, anonymous, and based on informed consent.

4.2 Measures

All constructs were measured on a five-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). Symbolic Biophilic Design (SV) was measured using six indicators representing vernacular materials, biomorphic forms, organic textures, indigenous motifs, nature-inspired colour palettes, and natural materials. Direct Nature Experience (DN) assessed perceptions of daylight, vegetation, and water features. Being Away (BA) was measured as a separate latent construct using three items adapted from the Perceived Restorativeness Scale (PRS). To avoid conceptual overlap and tautology with the proposed mediator, Restorative Experience (RPE) was operationalized using the remaining PRS dimensions: fascination, extent, and compatibility.

4.3 Statistical Analysis

Data were analysed using IBM SPSS Statistics. Descriptive statistics were used to summarize respondent characteristics and construct scores. Reliability and construct validity were evaluated using Cronbach's alpha and Exploratory Factor Analysis (Principal Component Analysis with Direct Oblimin rotation). EFA was adopted because the study integrated measurement items from established instruments and applied them within a new contextual setting (Nigerian resort environments), making construct exploration appropriate prior to confirmatory validation. Pearson correlation analysis examined bivariate relationships among the study variables, while multiple linear regression evaluated the independent effects of Symbolic Biophilic Design (SV) and Direct Nature Experience (DN) on Restorative Experience (RPE). Mediation analysis was performed using Hayes' PROCESS macro (Model 4) with 5,000 bootstrap resamples and 95% confidence intervals. Statistical significance was set at $p < 0.05$.

4.4 Regression and Mediation Models

Two complementary analytical models were specified. First, a multiple linear regression model compared the independent contributions of Symbolic Biophilic Design (SV) and Direct Nature Experience (DN) to Restorative Experience (RPE):

$RPE = \beta0 + \beta1(SV) + \beta2(DN) + \varepsilon$

Second, the mediating role of Being Away (BA) was examined using Hayes' PROCESS Model 4. The mediation model estimated the following pathways:

$BA = \beta0 + \beta1(SV) + \varepsilon$ (Path a)

$RPE = \beta0 + \beta1(BA) + \beta2(SV) + \varepsilon$ (Paths b and c')

Together with the total-effect model:

$RPE = \beta0 + \beta1(SV) + \varepsilon$ (Path c)

These equations represent paths **a, b, c′, and c,** respectively. The total effect (c) reflects the bivariate relationship between Symbolic Biophilic Design and Restorative Experience prior to accounting for the mediator, whereas the direct effect (c′) represents the remaining effect after controlling for Being Away. Indirect effects were estimated using 5,000 bootstrap resamples and were considered statistically significant when the 95% confidence interval excluded zero.

5.0 PRESENTATION AND DISCUSSION OF RESULTS

5.1 Sample Characteristics and Descriptive Statistics

Data from 259 valid questionnaires were analysed. Table 1 summarizes the respondents' characteristics and the descriptive statistics for the study variables.

Table 1: Descriptive Statistics for Study Variables

Construct	Mean	Standard Deviation
Symbolic/Vernacular Experience	3.84	0.92
Being Away	3.76	0.88
Compatibility	3.65	0.95
Restorative Experience (Fascination, Extent & Compatibility)	3.61	0.82
Direct Nature Experience	3.52	1.04
Fascination	3.42	1.10
Extent	3.28	1.08

The findings indicate that Symbolic/Vernacular Experience achieved the highest mean score (M = 3.84), exceeding Direct Nature Experience (M = 3.52). This suggests that respondents perceived vernacular materials, indigenous motifs, and organic textures as prominent contributors to their resort experience. Restorative Experience, operationalized as the composite of fascination, extent, and compatibility, recorded a mean score of 3.61. Extent recorded the lowest mean score (M = 3.28), indicating comparatively weaker perceptions of environmental immersion.

5.2 Reliability and Construct Validity

Reliability and construct validity were examined prior to hypothesis testing.

Table 2: Reliability Coefficients

Construct	Cronbach's Alpha (α)
Symbolic/Vernacular	0.78
Direct Nature	0.74
Being Away	0.72
Compatibility	0.75
Fascination	0.69
Extent	0.66

Cronbach's alpha coefficients ranged from 0.66 to 0.78. Although Extent ($\alpha = 0.66$) and Fascination ($\alpha = 0.69$) were marginally below the conventional 0.70 threshold, values above 0.60 are considered acceptable for exploratory research, particularly during the early stages of scale development (Hair et al., 2019). Exploratory Factor Analysis (Principal Component Analysis with Direct Oblimin rotation) supported construct validity (KMO = 0.768; Bartlett's $\chi^2 = 1452.18$, $p < 0.001$), with six factors explaining 54.2% of the total variance.

5.3 Correlation Analysis

Pearson correlation analysis was conducted to examine bivariate associations. Table 3 presents the correlation coefficients among the study variables.

Table 3: Pearson Correlation Coefficients among Study Variables

Variable	DN	SV	BA	FAS	EXT	COM	RPE
Direct Nature (Experience) [DN]	1						
Symbolic/Vernacular [SV]	0.38**	1					
Being Away [BA]	0.41**	0.48**	1				
Fascination [FAS]	0.45**	0.36**	0.42**	1			
Extent [EXT]	0.31**	0.44**	0.35**	0.28*	1		
Compatibility [COM]	0.35**	0.49**	0.51**	0.33**	0.42**	1	
Restorative Perceived Experience [RPE]	0.44**	0.52**	0.62**	0.55**	0.48**	0.58**	1

*Significant at $p < 0.05$; **Significant at $p < 0.01$.

Symbolic/Vernacular Experience was moderately associated with Direct Nature Experience ($r = 0.38$, $p < 0.01$). Restorative Experience was positively associated with Symbolic/Vernacular Experience ($r = 0.52$), Direct Nature Experience ($r = 0.44$), and Being Away ($r = 0.62$), with the strongest relationship observed for Being Away (all $p < 0.01$), supporting its proposed mediating role.

5.4 Multiple Regression Analysis

Multiple regression analysis determined the relative influence of Direct Nature Experience and Symbolic/Vernacular Experience on restorative outcomes. The overall model was statistically significant ($F(2, 256) = 74.05$, $p < 0.001$), with an R^2 of 0.366, indicating that the environmental variables explained 36.6% of the variance in restorative experience.

Table 4: Multiple Regression Results (Predicting RPE)

Predictor	Unstandardized B	Std. Error	Standardized β	t	p-value
(Constant)	1.42	0.24	—	5.91	< 0.001
Direct Nature (DN)	0.22	0.05	0.26	4.40	< 0.001
Symbolic/Vernacular (SV)	0.35	0.06	0.39	5.83	< 0.001

Both predictors were significant positive predictors of restorative experience, with Symbolic/Vernacular Experience demonstrating a stronger standardized effect.

5.5 Mediation Analysis

Being Away was modelled as the mediating construct linking symbolic biophilic design to restorative experience using Hayes' PROCESS macro (Model 4).

Table 5: Mediation Model Results

Path	Standardized β	p-value
a: SV → BA	0.48	< 0.001
b: BA → RPE	0.52	< 0.001

c: SV → RPE (Total Effect)	0.52	< 0.001
c': SV → RPE (Direct Effect)	0.29	< 0.001

The mediation analysis indicated a significant total effect of symbolic biophilic design on restorative experience ($\beta = 0.52$, $p < 0.001$). After accounting for Being Away, the direct effect remained significant but decreased ($\beta = 0.29$, $p < 0.001$), indicating partial mediation. The indirect effect was significant ($\beta = 0.249$, 95% bootstrap CI [0.155, 0.350]), demonstrating that symbolic biophilic design enhances restorative experience partly by promoting psychological detachment from everyday demands.

5.6 Discussion of Findings

The findings indicate that Symbolic Biophilic Design (SV) exerted a stronger influence on restorative experience ($\beta = 0.39$) than Direct Nature Experience (DN) ($\beta = 0.26$). This aligns with the theoretical propositions of Coburn et al. (2020) and Goldhagen (2017), who argued that the brain's cognitive response to built environments is deeply influenced by nature-referencing architectural elements, even in the absence of living ecosystems. A plausible explanation is that vernacular materials, biomorphic forms, and indigenous motifs evoke environmental familiarity and place identity, allowing occupants to derive restorative meaning beyond direct contact with nature. Unlike vegetation or water features, which may require significant spatial and economic resources to maintain in dense urban contexts (Ryan et al., 2014), symbolic cues remain embedded within the built environment, providing a consistent and accessible source of environmental meaning.

Furthermore, the significant mediating role of Being Away (indirect effect = 0.249) supports the conceptualization of this construct within Attention Restoration Theory (ART) as the principal cognitive trigger for restoration (Kaplan, 1995; Ohly et al., 2016). The results demonstrate that symbolic biophilic design facilitates psychological detachment from routine demands, thereby enabling the cognitive recovery necessary for restorative experience. This finding extends the work of Menardo et al. (2021) and Stragà et al. (2023) by confirming that psychological detachment can be achieved through perceptual disengagement in built environments, not solely through physical relocation to natural settings.

Finally, the relatively low mean scores for Extent ($M = 3.28$) indicate that while symbolic elements successfully promote fascination and compatibility, the perceived spatial continuity and environmental immersion in the studied resorts could be improved. This suggests that future resort architecture should not only incorporate symbolic biophilic elements but also design spatial sequences that enhance the perceived "Extent" of the environment, thereby maximizing the overall restorative potential of the space.

6.0 CONCLUSION AND RECOMMENDATIONS

This study investigated the relationship between symbolic biophilic design and restorative experiences in Nigerian resort environments. The findings indicate that symbolic biophilic design ($\beta = 0.39$) is a stronger environmental predictor of restorative experience than direct nature exposure ($\beta = 0.26$). Furthermore, the study demonstrates that the psychological state of "Being Away" partially mediates this relationship, functioning as a cognitive mechanism linking physical architecture to occupant recovery. These results are consistent with Attention Restoration Theory (ART) and suggest that representational, nature-referencing elements in the built environment provide significant psychological value alongside conventional direct nature pathways.

Based on these findings, the following integrated recommendations are proposed for hospitality architecture:

1) Integrate vernacular materials, biomorphic forms, and nature-inspired textures as core architectural elements rather than relying solely on landscape interventions.
2) Design spatial sequences and transition zones that strengthen occupants' sense of "Being Away" from everyday routines.
3) Improve perceived "Extent" by enhancing spatial continuity, visual connectivity, and opportunities for environmental immersion within resort layouts.

7.0 LIMITATION OF THE STUDY

Several limitations contextualize these findings. First, the cross-sectional survey design restricts the establishment of absolute causal relationships among symbolic biophilic design, Being Away, and restorative experience; current findings should be interpreted as robust associations rather than definitive causal pathways. Second, the sample reflects a specific socio-economic profile, with 93.4% of respondents possessing tertiary or postgraduate education. This educational bias, combined with the focus on urban-based hospitality contexts in Nigeria, limits the generalizability of the findings to broader populations or alternative geographic zones. Finally, examining symbolic biophilia as an aggregated construct prevents the isolation of individual features. Future research should disaggregate variables, such as testing vernacular materials against biomorphic forms independently, to determine which specific architectural cues most strongly correlate with psychological restoration.

REFERENCES

Akindejoye, F., Ezedinma, U., & Ike, N. (2021). A case study of urban design for wellbeing and mental health in Lagos, Nigeria. *Journal of urban design and mental health*, *7*(10).

Beatley, T., & Newman, P. (2013). Biophilic cities are sustainable, resilient cities. Sustainability, 5(8), 3328–3345. https://doi.org/10.3390/su5083328

Berto, R. (2014). The role of nature in coping with psycho-physiological stress: A literature review on restorativeness. Behavioral Sciences, 4(4), 394–409. https://doi.org/10.3390/bs4040394

Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., De Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Jr., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., ... Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. Science Advances, 5(7), eaax0903. https://doi.org/10.1126/sciadv.aax0903

Coburn, A., Vartanian, O., & Chatterjee, A. (2017). Buildings, beauty, and the brain: A neuroscience of architectural experience. Journal of Cognitive Neuroscience, 29(9), 1521–1531. https://doi.org/10.1162/jocn_a_01146

Coburn, A., Vartanian, O., Kenett, Y. N., Nadal, M., Hartung, F., Hayn-Leichsenring, G., ... & Chatterjee, A. (2020). Psychological and neural responses to architectural interiors. Cortex, 126, 217–241.

Corazon, S. S., Sidenius, U., Poulsen, D. V., Gramkow, M. C., & Stigsdotter, U. K. (2019). Psycho-physiological stress recovery in outdoor nature-based interventions: A systematic review of the past eight years of research. International Journal of Environmental Research and Public Health, 16(10), 1711. https://doi.org/10.3390/ijerph16101711

Elf, M., Anåker, A., Marcheschi, E., Sigurjónsson, Á., & Ulrich, R. S. (2020). The built environment and its impact on health outcomes and experiences of patients, significant others and staff—A protocol for a systematic review. Nursing Open, 7(3), 895–899.

Gaekwad, J. S., Moslehian, A. S., & Roös, P. B. (2023). A meta-analysis of physiological stress responses to natural environments: Biophilia and stress recovery theory perspectives. Journal of Environmental Psychology, 90, 102085. https://doi.org/10.1016/j.jenvp.2023.102085

Goldhagen, S. W. (2017). Welcome to your world: How the built environment shapes our lives. HarperCollins.

Hartig, T., Korpela, K., Evans, G. W., & Gärling, T. (1997). A measure of restorative quality in environments. Scandinavian Housing and Planning Research, 14(4), 175–194. https://doi.org/10.1080/02815739708730435

Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. Annual Review of Public Health, 35, 207–228. https://doi.org/10.1146/annurev-publhealth-032013-182443

Ifebi, O. C., Obi-George, L. C., Maduka, N. M., Nzewi, N. U., & Ochonogor, H. (2024). Integration of biophilic design elements in hotel building environment towards enhancing users wellbeing in Abuja, Nigeria. International Journal of Innovative Environmental Studies Research, 12(4), 134–151.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. Journal of Environmental Psychology, 15(3), 169–182. https://doi.org/10.1016/0272-4944(95)90001-2

Kellert, S. R. (2018). Nature by design: The practice of biophilic design. Yale University Press.

Ma, H., Zhang, Y., Liu, P., Zhang, F., & Zhu, P. (2024). How does spatial structure affect psychological restoration? A method based on graph neural networks and street view imagery. Landscape and Urban Planning, 251, 105171. https://doi.org/10.1016/j.landurbplan.2024.105171

Menardo, E., Brondino, M., Hall, R., & Pasini, M. (2021). Restorativeness in natural and urban environments: A meta-analysis. Psychological Reports, 124(2), 417–437. https://doi.org/10.1177/0033294120914697

Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., & Garside, R. (2016). Attention Restoration Theory: A systematic review of the attention restoration potential of exposure to natural environments. Journal of Toxicology and Environmental Health, Part B, 19(7), 305–343. https://doi.org/10.1080/10937404.2016.1196155

Ryan, C. O., Browning, W. D., Clancy, J. O., Andrews, S. L., & Kallianpurkar, N. B. (2014). Biophilic design patterns: Emerging nature-based parameters for health and well-being in the built environment. Archnet-IJAR: International Journal of Architectural Research, 8(2), 62–76. https://doi.org/10.26687/archnet-ijar.v8i2.436

Scopelliti, M., Carrus, G., Adinolfi, C., Suarez, G., Colangelo, G., Lafortezza, R., Panno, A., & Sanesi, G. (2016). Staying in touch with nature and well-being in different income groups: The experience of urban parks in Bogotá. Landscape and Urban Planning, 148, 139–148. https://doi.org/10.1016/j.landurbplan.2015.11.002

Song, C., Ali, F., Cobanoglu, C., Nanu, L., & Lee, S. H. J. (2022). The effect of biophilic design on customer's subjective well-being in the hotel lobbies. Journal of Hospitality and Tourism Management, 52, 264–274.

Stevenson, M. P., Schilhab, T., & Bentsen, P. (2018). Attention Restoration Theory II: A systematic review to clarify attention processes affected by exposure to natural environments. Journal of Toxicology and Environmental Health, Part B, 21(4), 227–268. https://doi.org/10.1080/10937404.2018.1505571

Stragà, M., Miani, C., Mäntylä, T., de Bruin, W. B., Mottica, M., & Del Missier, F. (2023). Into the wild or into the library? Perceived restorativeness of natural and built environments. Journal of Environmental Psychology, 91, 102131. https://doi.org/10.1016/j.jenvp.2023.102131

Sussman, A., & Hollander, J. B. (2021). Cognitive architecture: Designing for how we respond to the built environment. Routledge.

Tabassum, R. R., & Park, J. (2024). Development of a building evaluation framework for biophilic design in architecture. Buildings, 14(10), 3254. https://doi.org/10.3390/buildings14103254

Yildirim, M., Gocer, O., Globa, A., & Brambilla, A. (2023). Investigating restorative effects of biophilic design in workplaces: A systematic review. Intelligent Buildings International, 15(5), 205–247. https://doi.org/10.1080/17508975.2024.2306273

Zhong, W., Schröder, T., & Bekkering, J. (2022). Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review. Frontiers of Architectural Research, 11(1), 114–141. https://doi.org/10.1016/j.foar.2021.07.006