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The Impact of Work Environment Type on Perceived Stress and Wellbeing: A Comparative Study of Closed and Biophilic Settings

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ABSTRACT

This study investigated the psychological effects of contrasting workplace environments on employee stress and wellbeing. Building upon theories suggesting human connection to nature benefits psychological health, we hypothesized that biophilic office settings would be associated with lower perceived stress and higher overall wellbeing compared to conventional closed offices. A quantitative, cross-sectional design was employed with 100 office workers (19 in biophilic environments, 81 in closed environments). Perceived stress was measured using the Perceived Stress Scale (PSS-10), and wellbeing was assessed with the WHO-5 Wellbeing Index. Statistical analyses revealed significant differences between groups: employees in biophilic settings reported significantly lower perceived stress (Mann-Whitney U = 0.00, Z = -6.78, $p < .001$, r = 0.68) and significantly higher total wellbeing ($t(98) = 4.79$, $p < .001$, $d = 1.22$). These large effect sizes suggest practical significance for workplace design. While limited by its cross-sectional nature and sampling, the study provides comparative evidence using validated measures, indicating biophilic design holds promise for mitigating stress and enhancing wellbeing in the workplace.

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Introduction

The design and characteristics of the physical workplace have long been acknowledged as factors influencing employee experience, impacting everything from task performance to comfort and satisfaction (Veitch, Charles, Newsham, Geerts, & Marquardt, 2007). In recent decades, significant attention has been given to the profound influence of the built environment on fundamental aspects of human health and psychological well-being, including stress levels (Sternberg, 2009; Ulrich, 1984). Given that a substantial portion of time is spent in office settings, understanding how different physical environments affect employee health outcomes is crucial not only for academic interest but also for organizations aiming to foster productivity, retention, and a thriving workforce (World Health Organization, 2010).

Contemporary work demands, rapid technological advancement, and the blurring lines between professional and personal life have contributed to a rising prevalence of workplace stress (American Psychological Association, 2020). Chronic stress is linked to numerous negative consequences for individuals, including impaired physical health, burnout, reduced job satisfaction, and diminished cognitive function (Lazarus & Folkman, 1984; Maslach, Schaufeli, & Leiter, 2001; Segerstrom & Miller, 2004). For organizations, elevated employee stress can result in decreased productivity, increased absenteeism and presenteeism, higher healthcare costs, and greater turnover (Goh, Pfeffer, & Zenios, 2016; Leka, Griffiths, & Cox, 2004). Consequently, promoting employee wellbeing has become a strategic priority, recognized as interconnected with individual flourishing and organizational success (Ryan & Deci, 2001; Seligman, 2011). Wellbeing is a multifaceted construct encompassing positive psychological functioning, life satisfaction, and a sense of purpose (Diener, 1984; Ryff, 1989), and interventions aimed at enhancing it within the workplace are increasingly sought.

Traditionally, office design has often prioritized efficiency and density, leading to environments with limited access to natural light, views, and natural elements (Heerwagen, 2000; Kellert, Heerwagen, & Mador, 2008). These conventional layouts, often featuring cubicles or enclosed offices with artificial lighting and minimal connection to the outdoors, constitute a significant portion of current built environments. While functional for tasks, they raise concerns regarding potential contributions to sedentary behavior, social isolation, and psychological distress (Kim & de Dear, 2013).

In contrast, biophilic design, an approach to architecture and interior design, seeks to integrate elements of nature into the built environment (Kellert et al., 2008). Rooted in the Biophilia Hypothesis (Wilson, 1984), which posits an innate human need to connect with nature, biophilic design translates this need

into tangible patterns including direct connections (e.g., natural light, views, plants) and indirect connections (e.g., natural materials, patterns) (Browning, Ryan, & Ulrich, 2014). Proponents argue that reconnecting occupants with nature leverages evolutionary relationships to confer psychological and physiological benefits, such as reduced stress and enhanced wellbeing (Hartig, Evans, Jamner, Davis, & Gärling, 2003; Ulrich, 1984).

Research in various settings has supported the health impacts of nature exposure (Hartig, Mitchell, de Vries, & Frumkin, 2014; Ulrich, 1984). Within workplaces, studies have investigated the impact of factors like natural lighting (Aries, Veitch, & Newsham, 2010), views of nature (Kaplan, R., 1993; Bringslimark, Hartig, & Patil, 2007), and indoor plants (Bringslimark, Hartig, & Patil, 2011) on psychological outcomes. While these studies provide valuable insights into individual biophilic elements, a comprehensive comparison of *overall* work environment *types* – specifically, a conventional "Closed" office versus a workplace intentionally designed with multiple, integrated biophilic principles – using standardized and widely validated measures of perceived stress and wellbeing, remains less explored in certain populations.

This study aims to address this gap by directly comparing these two distinct work environment types on employees' self-reported perceived stress (Cohen, Kamarck, & Mermelstein, 1983) and overall sense of wellbeing (Tennant et al., 2007). Understanding the differential impact of these environments is crucial for informing workplace design decisions beneficial to both employees and organizations.

The investigation is underpinned by theoretical perspectives from environmental psychology. The Biophilia Hypothesis (Wilson, 1984; Kellert, 1997) posits an innate drive for humans to affiliate with nature, suggesting deprivation in built environments can lead to distress, while connection can support wellbeing. Attention Restoration Theory (ART; Kaplan, S., 1995) proposes that exposure to natural environments facilitates cognitive restoration by engaging involuntary attention, reducing mental fatigue and improving cognitive function, which contributes to wellbeing. Stress Reduction Theory (SRT; Ulrich, 1983) focuses on the affective and physiological benefits, arguing that natural stimuli elicit rapid, positive emotional responses and physiological de-arousal, aiding recovery from stress. Applied to the workplace, these theories collectively suggest that integrating nature can mitigate stress and enhance wellbeing.

Despite increasing interest in biophilic design, several research gaps persist. Much existing work is correlational or focuses on single elements rather than the holistic impact of environment type.

Consistency in using standardized psychological measures for direct comparison across distinct environment types is also lacking. Furthermore, more research is needed specifically focusing on general office workers. This study aims to fill these gaps by directly comparing perceived stress and total wellbeing, measured using validated scales, between employees in conventional Closed and Biophilic office environments within this population.

Based on the theoretical framework and literature review, the following hypotheses were tested:
H1: Employees in biophilic work environments will report significantly lower perceived stress scores than employees in closed work environments.
H2: Employees in biophilic work environments will report significantly higher total wellbeing scores than employees in closed work environments.

Method

Participants

The sample consisted of 100 general office workers. Participant demographics are presented in Table 1 (as presented in dissertation Chapter 4, pp. 42-43). The mean age was 22.79 years (SD = 4.09), with a range of 18 to 45 years. Participants reported varying approximate weekly work hours: Less than 20 hours (36%), 20-40 hours (31%), 41-60 hours (17%), and More than 60 hours (16%). Participants were drawn from two distinct work locations classified as either a Closed Environment (N = 81) or a Biophilic Environment (N = 19).

Design

This study employed a quantitative, comparative, cross-sectional research design. This design was selected as appropriate for comparing quantitative outcomes (perceived stress and total wellbeing) between two distinct groups (employees in Closed vs. Biophilic environments) at a single point in time, allowing for the examination of group differences. While precluding causal inference, it effectively identifies associations and differences aligned with the study's objectives.

Materials

- **Perceived Stress Scale (PSS-10):** The PSS-10 (Cohen, Kamarck, & Mermelstein, 1983) is a widely used 10-item self-report measure of subjective perceived stress over the past month. Items are rated on a 5-point Likert scale (0 = never, 4 = very often). Total scores range from 0-

40, with higher scores indicating greater stress. The scale has demonstrated strong validity and reliability across diverse populations (Cronbach's alpha typically .70-.85).

- **WHO-5 Wellbeing Index:** The WHO-5 (World Health Organization, 1998) is a 5-item self-report questionnaire assessing subjective psychological wellbeing over the past two weeks. Items are rated on a 6-point Likert scale (0 = at no time, 5 = all of the time). Raw scores range from 0-25, which can be multiplied by 4 for a percentage score (0-100%). Higher scores indicate greater wellbeing. The WHO-5 has strong psychometric properties and sensitivity to wellbeing changes (Topp et al., 2015; Topp, Østergaard, Søndergaard, Bech, & WHO-ADABH Group, 2015).

Procedure

Suitable Closed and Biophilic work environments were identified, and necessary permissions were obtained. Participants were recruited via invitations distributed within these locations, explaining the study's nature, voluntary participation, and confidentiality. Data were collected using an anonymous online survey platform. Upon accessing the survey link, participants received an information sheet detailing objectives, procedures, risks, benefits, confidentiality, and contact information. Informed consent was obtained electronically. The survey included sections for demographic data and the PSS-10 and WHO-5 scales. Participants completed the questionnaire anonymously, with the online platform ensuring data security and anonymity. The estimated completion time was 10-15 minutes.

Operationalization of Environment Type

Participants were categorized into the "Closed" or "Biophilic" group based on the pre-determined classification of their regular work location.

- *Closed Environment:* Defined as a conventional office setting characterized by a predominance of enclosed offices or cubicles, reliance on artificial lighting, limited or no views of nature, and minimal incorporation of natural elements.
- *Biophilic Environment:* Defined as an office setting intentionally designed to incorporate multiple biophilic principles, including significant access to natural light, views of nature, presence of indoor vegetation, and/or the use of natural materials and patterns, aimed at fostering a connection with nature.

Data Analysis

Data were downloaded from the online platform and imported into SPSS Statistics Version 27 for analysis.

- **Preliminary Analysis:** Data were screened for errors and missing values. Descriptive statistics (means, medians, standard deviations, ranges, frequencies, percentages) summarized participant demographics and scores on dependent variables overall and by group.
- **Assumption Checks:** Normality for STRESS TOTAL and TOTAL WELLBEING within each group was assessed using the Shapiro-Wilk test and visual inspection (histograms, Q-Q plots). Homogeneity of variances for variables considered for parametric tests was assessed using Levene's test.
- **Inferential Analysis:** An Independent Samples t-test compared mean Total Wellbeing scores between groups, as normality was met in both groups and Levene's test was non-significant ($F(1, 98) = 0.42$, $p = .520$). A Mann-Whitney U test, a non-parametric alternative, compared Perceived Stress scores due to violation of the normality assumption for STRESS TOTAL in the Biophilic group. Statistical significance was set at $\alpha = .05$. Effect sizes (Cohen's *d* for t-test, rank-biserial *r* for Mann-Whitney U) were calculated for significant results.

Results

The results are presented in the following order: participant demographics, descriptive statistics for the dependent variables, assessment of statistical assumptions, and inferential statistical analyses.

Participant Demographics

A total of 100 participants completed the study. The mean age of the participants was 22.79 years ($SD = 4.09$), with ages ranging from 18 to 45 years. The median age was 22.00 years. The distribution of participants by approximate hours of work per week and by work environment type is presented in Table 1.

Approximately one-third of participants reported working less than 20 hours per week (36.0%), while a similar proportion reported working 20-40 hours per week (31.0%). Smaller percentages reported working 41-60 hours (17.0%) or more than 60 hours (16.0%). The sample included 19 participants in the Biophilic environment (19.0%) and 81 participants in the Closed environment (81.0%).

Table 1

Participant Demographics (N = 100)

Characteristic	Frequency (n)	Percent (%)
Age (Years)		
M	22.79	
SD	4.09	
Approximate Hours of Work		
Less than 20 hours	36	36.0
20-40 hours	31	31.0
41-60 hours	17	17.0
More than 60 hours	16	16.0
Work Environment Type		
Biophilic	19	19.0
Closed	81	81.

Figure 1.

Showing Bar Chart of Age Distribution (N=100)

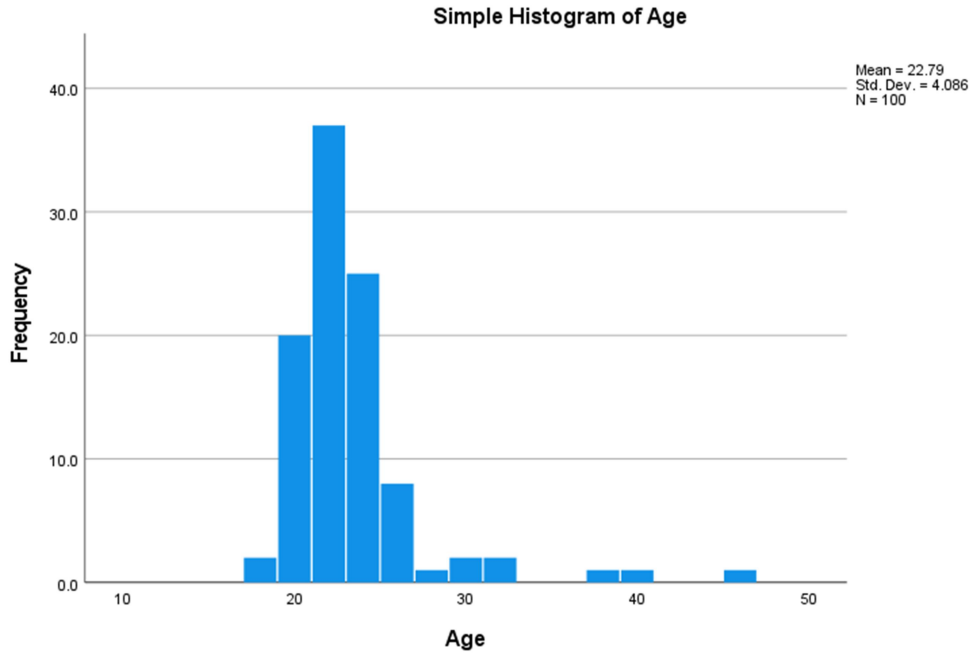


Figure 1 displays a histogram showing the frequency distribution of ages. The distribution is unimodal and skewed to the right, indicating that the majority of the 100 individuals in the sample are clustered around the early twenties, with fewer individuals in older age groups. The mean age is 22.79 years, and the standard deviation is 4.086 years, suggesting a moderate spread of ages around the mean.

Figure 2

Histogram Showing the estimate of weekly work hours.

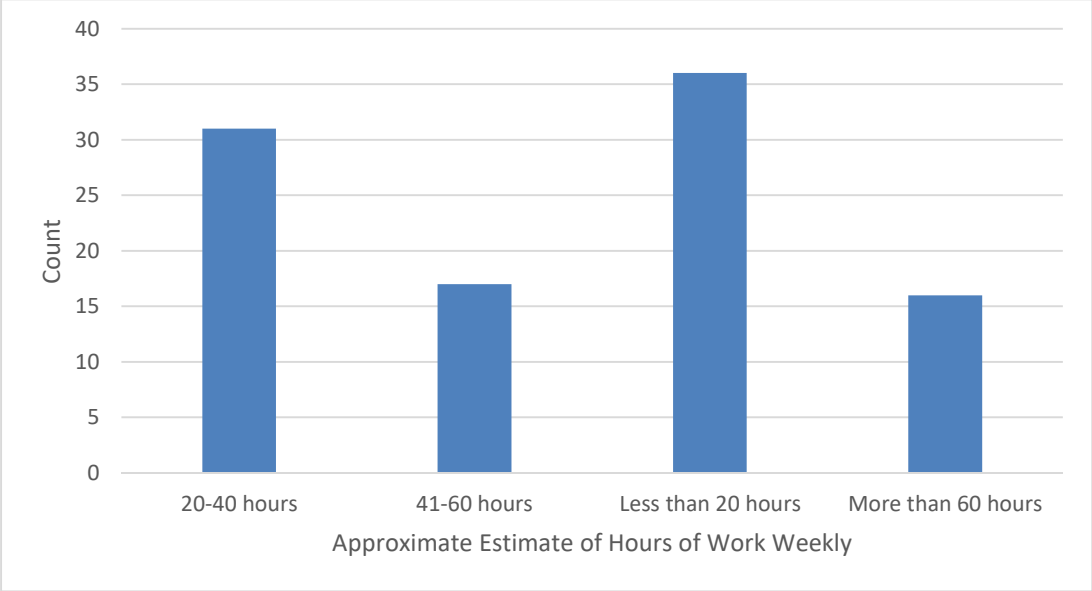
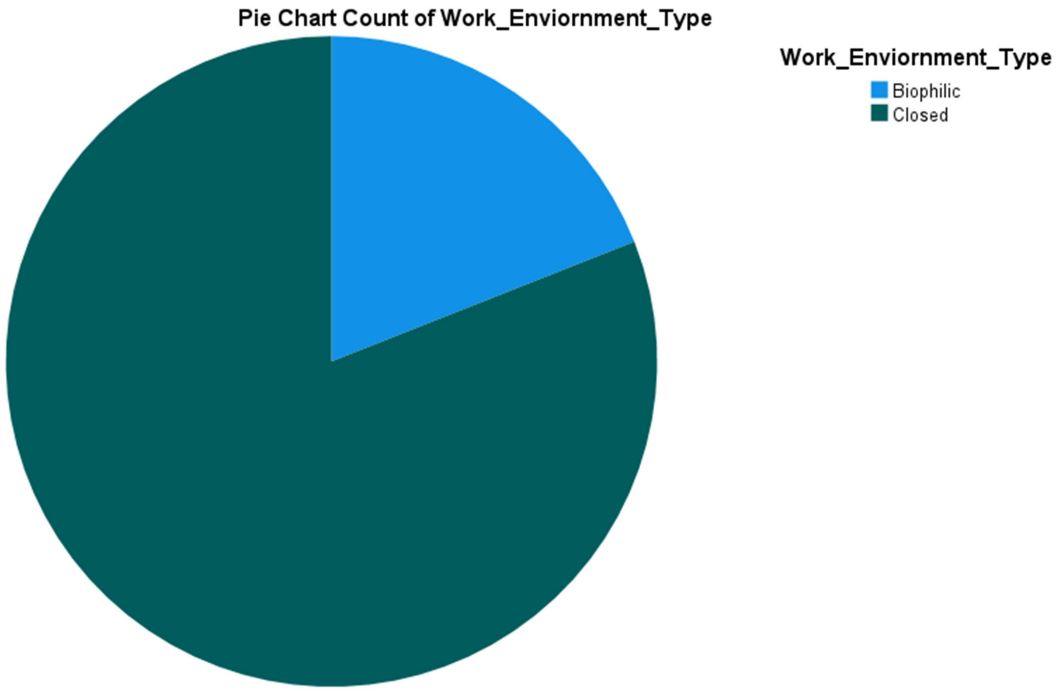


Figure 2 is a histogram illustrating the count of individuals based on their approximate estimate of weekly work hours, categorized into four groups. The "Less than 20 hours" category has the highest count, followed by "20-40 hours". The "41-60 hours" and "More than 60 hours" categories have relatively lower counts.

Figure 3 is a pie chart showing the distribution of work environment types. The chart indicates that the majority of the work environments are "Closed" (represented by the larger, darker segment), while a smaller proportion are "Biophilic" (represented by the smaller, lighter segment).

Figure 3



Pie Chart Showing the distribution of work environment types.

Descriptive Statistics for Dependent Variables

Descriptive statistics for the continuous measures of perceived stress and total wellbeing are presented for the overall sample and separately for each work environment group in Table 2.

Overall, participants reported a mean perceived stress score of 32.18 (*SD* = 6.64) and a mean total wellbeing score of 29.80 (*SD* = 8.41). As hypothesized, participants in the Biophilic environment reported a notably lower mean stress score (*M* = 21.53, *SD* = 3.78, Median = 23.00) compared to those in the Closed environment (*M* = 34.68, *SD* = 4.24, Median = 34.00). Participants in the Biophilic environment also reported a considerably higher mean wellbeing score (*M* = 37.32, *SD* = 6.25, Median = 37.00) than those in the Closed environment (*M* = 28.04, *SD* = 7.88, Median = 28.00). These observed differences suggest that environment type may be associated with both stress and wellbeing outcomes.

Visual inspection of box plots revealed a narrower range of scores for both variables in the Biophilic group compared to the Closed group. Two outlier scores (3 and 18) were observed in the Total

Wellbeing data for the Closed environment group, indicating a few participants in this group reported very low levels of wellbeing.

Table 2

Descriptive Statistics for Stress and Wellbeing Scores by Work Environment Type

Variable	Work Environment	N	Mean	Median	SD	IQR	Min	Max
Stress	Biophilic	19	21.53	23.00	3.78	7	16	26
	Closed	81	34.68	34.00	4.24	7	27	48
Well-being	Biophilic	19	37.32	37.00	6.25	14	26	25
	Closed	81	28.04	28.00	7.88	10	3	25

The bar chart illustrates a clear trend: individuals in closed work environments predominantly experience high stress, whereas those in biophilic environments mostly report moderate stress. This suggests that biophilic design may be associated with lower stress levels in the workplace.

Assessment of Assumptions

Prior to conducting inferential tests, assumptions of normality and homogeneity of variances were assessed for the dependent variables within each work environment group. Normality was evaluated using the Shapiro-Wilk test and visual inspection of histograms and Q-Q plots. Table 3 presents the results of the Shapiro-Wilk tests.

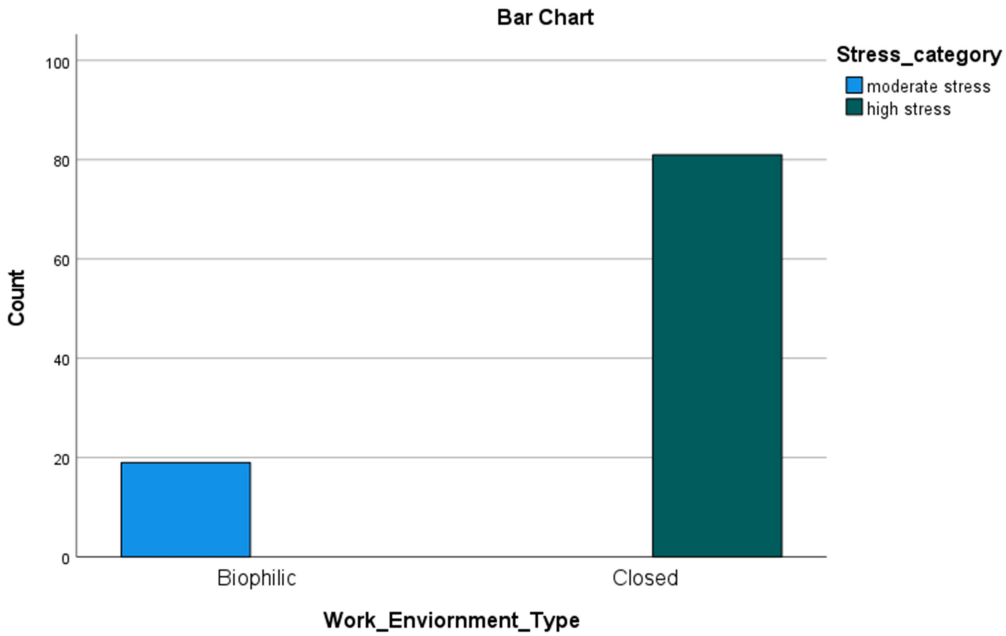


Figure 4. *Bar Chart Showing Impact of Work Environment Type on Reported Stress Levels.*

For TOTAL WELLBEING, the Shapiro-Wilk test indicated that scores were normally distributed within both the Biophilic group (p = .121) and the Closed group (p = .471), as both p-values were greater than the significance level of .05. For STRESS TOTAL, scores were normally distributed within the larger Closed group (p = .126), but significantly deviated from normality within the smaller Biophilic group (p = .021).

Given the violation of the normality assumption for STRESS TOTAL in the Biophilic group, a non-parametric test was deemed appropriate for comparing stress levels between the two environments. For TOTAL WELLBEING, the assumption of normality was met, allowing for the use of a parametric test. The assumption of homogeneity of variances for TOTAL WELLBEING was assessed using Levene's test, which was non-significant ($F(1, 98) = 0.42, p = .520$), indicating that the variances were equal between the two groups.

Table 3

Results of Assumption Tests for Stress and Wellbeing Scores by Work Environment Type

Variable	Work Environment	N	Shapiro-W	p	Levene's F	Levene's p

Variable	Work Environment	N	Shapiro-W	p	Levene's F	Levene's p
Stress	Biophilic	19	0.880	.021		
	Closed	81	0.976	.126		
Wellbeing	Biophilic	19	0.922	.121	0.42	.520
	Closed	81	0.985	.471		

Inferential Statistics

To test the hypotheses regarding the impact of work environment on perceived stress and total wellbeing, inferential statistical analyses were conducted. An Independent Samples t-test was used to compare mean Total Wellbeing scores, as assumptions for this test were met. A Mann-Whitney U test, a non-parametric alternative, was used to compare Perceived Stress scores due to the violation of the normality assumption for this variable. The results of these tests are presented in Table 4.

Comparison of Total Wellbeing

An Independent Samples t-test was conducted to compare the mean Total Wellbeing scores between employees in Biophilic and Closed work environments. Levene's test indicated that equal variances could be assumed ($p = .520$). The analysis revealed a statistically significant difference in mean Total Wellbeing scores, $t(98) = 4.79$, $p < .001$. Employees in Biophilic environments reported significantly higher mean Total Wellbeing ($M = 37.32$, $SD = 6.25$) compared to those in Closed environments ($M = 28.04$, $SD = 7.88$). The mean difference was 9.28 (95% CI [5.43, 13.13]). The magnitude of this difference was very large, as indicated by a Cohen's d of 1.22. These results support the hypothesis that employees in biophilic work environments experience higher total wellbeing.

Comparison of Stress Total

A Mann-Whitney U test was conducted to compare the distribution of Perceived Stress scores between employees in Biophilic and Closed work environments. This non-parametric test was appropriate given the violation of the normality assumption for stress scores in the Biophilic group. The test revealed a statistically significant difference in Perceived Stress scores between the two groups, $U = 0.00$, $Z = -6.78$, $p < .001$. Employees in Biophilic environments (Median = 23.00, Mean Rank = 10.00) reported significantly lower perceived stress compared to employees in Closed environments (Median = 34.00, Mean Rank = 60.00). The effect size of this difference was large ($r = 0.68$). These results support the hypothesis that employees in biophilic work environments experience lower perceived stress.

Table 4. *Comparison of Stress and Wellbeing Scores Between Work Environment Types*

Variable	Test	Statistic	df	p	Mean Diff.	95% CI Lower	95% CI Upper	Effect Size
Wellbeing	Independent *t*-test	4.79	98	< .001	9.28	5.43	13.13	$d = 1.22$
Stress	Mann-Whitney *U*	0.00	—	< .001	—	—	—	$r = 0.68$

For the Mann-Whitney U test, the Z statistic was -6.78. Negative Z / lower mean rank indicates lower scores in the first listed group (Biophilic). CI = Confidence Interval. df = degrees of freedom. Statistical significance determined at α = .05. Effect sizes are Cohen's *d* for the t-test and rank-biserial correlation (*r*) for Mann-Whitney U.

Discussion

This study aimed to investigate the comparative impact of conventional Closed versus Biophilic work environments on employees' perceived stress and total wellbeing. Consistent with our hypotheses and the theoretical frameworks of Biophilia, ART, and SRT, the quantitative analyses revealed statistically

significant differences: employees in Biophilic settings reported both significantly lower perceived stress and significantly higher total wellbeing compared to their counterparts in Closed settings.

The finding of reduced perceived stress in biophilic environments aligns with the Stress Reduction Theory (Ulrich, 1983, 1984), which posits that exposure to natural stimuli aids physiological and emotional recovery from stress. Features such as natural light, views of greenery, or indoor plants present in the biophilic settings likely provided employees with opportunities for 'micro-restoration' throughout the workday, buffering against stressors. Conversely, conventional closed environments, often lacking these elements, appear to offer fewer stress-buffering opportunities, contributing to higher perceived stress. The large effect size ($r = 0.68$) observed for stress suggests this environmental difference results in a substantial difference in the subjective experience of stress.

The significantly higher total wellbeing reported in the biophilic environment is consistent with the Biophilia Hypothesis (Wilson, 1984) and Attention Restoration Theory (Kaplan, S., 1995). The integration of natural elements in biophilic workplaces may satisfy the innate human need for nature connection, fostering positive psychological functioning. ART suggests that engaging with natural stimuli provides effortless attention (fascination), allowing directed attention to rest and recover, leading to cognitive restoration, improved mood, and a greater sense of energy – all components of wellbeing. The very large effect size for wellbeing ($d = 1.22$) highlights the potentially profound impact that work environment type can have on employees' overall sense of flourishing.

These findings build upon existing literature demonstrating the positive effects of specific nature-related interventions (e.g., Bringslimark et al., 2007, 2011; Figueiro et al., 2014; Han, 2017; Kaplan, R., 1993; Raanaas et al., 2011; Ulrich, 1984). By directly comparing overall environment types using standardized, validated measures in a general office worker population, this study adds robust comparative evidence regarding the combined, holistic impact of biophilic design principles versus conventional approaches. The notably large effect sizes observed, potentially larger than some reported for single interventions, suggest that the cumulative effect of multiple integrated biophilic elements may be particularly impactful.

Theoretically, this study reinforces the applicability of environmental psychology theories within modern built contexts, demonstrating that physical surroundings are active participants in influencing psychological states, not merely passive containers.

Practically, these results have substantial implications for stakeholders involved in creating and managing workplaces. The compelling empirical evidence that biophilic environments are associated with lower stress and higher wellbeing provides a strong rationale for organizations to view investment in biophilic features not just as aesthetic enhancements but as strategic investments in human capital. For architects and designers, the findings offer justification for prioritizing biophilic design patterns, supporting choices that maximize natural light, views of nature, and integration of natural elements. HR and occupational health professionals can leverage these findings to advocate for healthier workspaces, recognizing the physical environment as a modifiable factor influencing employee health.

Despite the study's strong findings, several limitations should be acknowledged. The cross-sectional design prevents causal conclusions; observed differences might be influenced by unmeasured factors or self-selection into environments. Numerous potential confounding variables (job type, workload, organizational culture, etc.) were not measured or controlled. The purposive sampling method and unequal sample sizes limit the generalizability of findings. Dependent variables relied on subjective self-report measures, susceptible to bias. The classification of environments as purely "Closed" or "Biophilic" was based on criteria which might encompass internal variability in the degree of biophilic integration. Finally, the study did not account for the duration of time participants had worked in their respective environments, which could influence adaptation effects.

Future research should employ longitudinal or experimental designs to investigate causality more rigorously. Incorporating objective measures (e.g., physiological indicators, performance metrics) alongside self-reports would provide a more comprehensive picture. Future studies could also statistically control for key demographic and job-related confounding variables. Research exploring the relative contribution and interaction of specific biophilic patterns could refine design recommendations. Mixed-methods approaches, incorporating qualitative data (e.g., interviews), could offer deeper insights into employee experiences. Replicating this study across diverse industries, locations, and populations would enhance generalizability and provide a more nuanced understanding of how different levels of biophilic integration impact outcomes.

Conclusion

In conclusion, this study provides compelling empirical evidence demonstrating a significant association between work environment type and employees' perceived stress and total wellbeing. Employees working in intentionally designed biophilic settings reported significantly lower stress and significantly

higher wellbeing compared to those in conventional closed environments, with large to very large effect sizes. These findings align with established theories on human-environment relationships and underscore the critical role of the physical workspace in fostering psychological health. While limited by its design and sampling, the study addresses a key gap by providing a direct comparison of distinct environment types using validated psychological measures in a relevant population. The results offer valuable, evidence-based insights for organizations, designers, and policymakers seeking to create workplaces that support employee wellbeing and mitigate workplace stress, contributing to healthier individuals and more productive organizations.

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