**Conference topic:**

# Biophilic design for offices – A scoping Study

Tatsuya Matsuoka[1], Derek Clements-Croome[1,2] and Yangang Xing[1]

[1] Nottingham Trent University, The School of Architecture, Design and the Built Environment
[2] Reading University, School of Built Environment

[*]*Corresponding email:* matsuoka2024@my.ntu.ac.uk

## ABSTRACT

Biophilic design can improve health and wellbeing by bringing freshness and aesthetics to indoor environments. There is a growing body of research that highlights the positive effects of incorporating biophilic design into office spaces. This approach focuses on human physiology and psychology and has been shown to enhance employee productivity and creativity. Furthermore, the evidence-based integration of greenery into actual office environments has been implemented. Previous studies evaluating the effects of biophilic design have utilized various indicators. In this paper, we conducted a keyword search for indicators such as those mentioned above, specifically in real and hypothetical office settings. Our goal was to explore these evaluation methods and their quantitative effects on biophilic design. We systematically organized the results and identified issues related to measurement. We also explored several examples of biophilic design and interviewed landscaping companies to gather insights on recent efforts and key characteristics of this design approach. The results demonstrated the effectiveness of incorporating greenery into office environments. However, previous studies highlighted certain limitations related to the experimental conditions, such as test duration, room environment, design of the greenery, and individual differences among participants. To apply the insights gained from previous research to actual office settings, this paper emphasizes the need to address these issues by developing a more robust methodology for evaluating the effects of biophilic design in office spaces. In this paper, we organized and summarize this information while identifying issues related to the implementation of research findings.

**KEYWORDS** *Biophilic design, Office, Greenery, Assessment of technology, Werable sensors*

## 1. INTRODUCTION

### 1.1 Research in Biophilic design in offices

Due to urbanization and modern lifestyles, people spend most of their time indoors and in artificial urban settings, leading to a decline in human connections with nature (Kellert, 1997). In particular, employees spend about one-third of their day in the workplace. They are expected to be productive (Feige et al., 2013), surrounded by artificial structures and minimal contact with nature (Cooper and Browning, 2015). Biophilia is the innate human instinct to connect with nature and other living beings (Wilson, 1984). Biophilic design attempts to translate an understanding of the inherent human affinity to affiliate with natural systems and processes into the design of the built environment (Kellert, 1997). Previous studies also reported evidence that biophilic designs are preferred over built environments (van den Berg et al., 2003) and biophilic environments can increase the wellbeing of the general population (Clements-Croome, 2020). Regarding biophilic design in the workplace, it was reported that occupants who work in environments with natural elements, such as greenery, natural materials, and sunlight, reported a 15% higher level of wellbeing, 6% higher level of productivity, and 15% of higher level of creativity, rather than the case with no connection with natural elements in the workplace (Cooper and Browning, 2015).

Previous studies clarified the evidence for stress reduction, attention restoration, and inspiration related to experiencing real nature and seeing images of nature (Kahn et al.,2008, Xing et al, 2024a, Xing, et al., 2025). Many recent studies conducted the experiments using biophilia assuming the workspaces. These studies evaluated physiologically and psychologically. The common measurements for evaluating the effects of biophilia are listed in Table 1. In terms of physiological aspects, heart rate (HR), heart rate variability (HRV), RMSD: Root Mean Square of Successive Differences Between Normal Heartbeats, skin conductance signal (SCL), electrodermal activity (EDA) (Seoane-Collazo, et al., 2015) and electrical activity of the brain (e.g. electroencephalogram; EEG) (Ancora, et al., 2022), Blood pressure (BP) (Yin, et al. 2018). Each evaluation item was measured using equipment attached to participants' bodies, such as their arms and heads, and was adapted based on the goals of previous studies. Regarding the psychological aspects, questionnaires were also developed to evaluate the effects of biophilic design (Schubert et al., 2001), and emotional states of participants has been measured by using questionnaire which are consists of some scales to measure each affect type, and each item is rated on a several point like “Not at all” to 5 “Very much”. There are some scales such as Positive and Negative Affect Schedule (PANAS), Perceived restrictiveness scale (PRS) and State-Trait Anxiety Inventory (STAI) (Clements-Croome 2020).

### 1.2 Technical aspects and application of research findings of biophilic design in offices

When introducing biophilic design in practice, several key issues need to be considered. These include the selection of plant types based on their intended purpose (e.g. the choice of species, the amount of vegetation, and the type of substrate), the associated costs (e.g. the costs and efforts involved in installing and maintaining the plants), and the assessment of the desired impacts (Hähn and Essah 2020). Maintenance such as watering and replacing wilted plants is required in offices for biophilic design. Reducing staff costs in the operational phase can contribute to higher investments in other maintenance, such as energy efficiency, innovative technologies, and wellbeing (Feige et al., 2013). In recent cases, rating systems for buildings (e.g., WELL) also evaluate sustainability, the degree of cost and resources, and the initiatives related to wellbeing (Hasebe and Harada, 2025). Therefore, there is a requirement to cultivate plants without frequent maintenance due to the limitation of space and the structures of modules in some cases.

### 1.3 The objective of this study

Previous studies have demonstrated the effectiveness of biophilic design in office environments. However, some findings indicate that the introduction of biophilia into office spaces may not always have a positive impact on human psychology and physiology (Hähn and Essah 2020). This discrepancy may be attributed to the experimental conditions, which include the measurement methods, the equipment used, the approach to integrating biophilia, and the duration of indoor exposure. Currently, the organization of experimental conditions that validate the effectiveness of biophilic design in offices has not been fully developed. Furthermore, when applying insights from previous studies to actual office environments, it is essential to address various issues from the perspectives of landscaping and construction. particularly, it is important to outline collaborative methods based on technical approaches within the industry, informed by research findings. Organizing this information from the standpoint of industry-academia collaboration is deemed beneficial. Therefore, this study has established the following two objectives:

1. To review research findings related to office spaces, organize the experimental conditions that confirm the effects and effectiveness of biophilic design on human physiology and psychology, and identify future research topics.
2. To select case studies of biophilic design initiatives in the industrial sector and explore the potential for collaboration between industry and academia in research.

## 2. METHOD

### 2.1 Methodology for Selecting Literature

There are four phases in the literature review process: Identification, Screening, Eligibility, and Inclusion. During the identification phase, a systematic literature search was conducted using databases. The search was carried out on "ScienceDirect" and "Web of Science" in May 2025, following the PRISMA 2020 checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Khalil 2025). To focus on the effects of biophilia in office environments on physiological and psychological well-being, the current study gathered articles that introduced biophilia in spaces simulating offices. In this research, "biophilia" is defined as the presence of greenery in rooms, including both natural plants and virtual reality representations of nature. To ensure a comprehensive search of related research published in English, there were no limitations on the publication year for this study (Rizzo, et al. 2023). The following keywords were used during the literature search to target relevant articles: "biophilic design" AND "office" AND "skin conductance" OR "electrodermal activity" OR "heart rate" OR "EEG" OR "brain" OR "sensor" OR "questionnaire." This study identified a total of 768 articles that addressed the physiological and psychological effects of biophilic design in offices.

During the screening phase, papers with duplication were removed, and papers were excluded if they were review articles, conference proceedings, book chapters, or non-English literature.

During the eligibility phase, the study aimed to identify papers that had the highest potential for achieving the objectives of the current review. First, the titles and abstracts of the papers were examined, and those that met any of the following criteria were excluded: studies that did not focus on the effects of biophilic design intended to promote biophilia in office environments; studies that did not examine either physiological or psychological effects and lacked numerical data in their results; and studies that did not specifically address biophilia, particularly in relation to greenery, including natural plants and virtual reality.

In the inclusion phase, the papers were evaluated in full text based on the criteria mentioned earlier.

### 2.2 Interview on Biophilic Design Initiatives in Industry

The interview was conducted with representatives from three companies that utilize biophilic design: Benholm Group (an interior landscaping company based in the United Kingdom), Oasis Landscape & Design (a landscaping company also located in the United Kingdom), and Shimizu Corporation (a construction company based in Japan). The interview with Oasis Landscape & Design took place during the Workspace Design Show, which was held in London, United Kingdom, on February 26th and 27th, 2025.

## 3. RESULTS

### 3.1 Results of the Literature Review

We extracted 15 papers based on the PRISMA 2020 checklist. These papers varied in several aspects, including the measurement items used, the types of biophilia explored, and whether the introduction of biophilic design resulted in significant differences in outcomes (Table 1). Notably, the duration spent in the biophilic space during the experiment varied significantly, ranging from as short as five minutes to continuous measurement throughout the entire day (Table 1). Most experiments were conducted in lecture rooms or university laboratories that were designed to mimic office settings except for Pavlova et al. 2023. Relevant findings were published between 2018 and 2025, with no applicable studies identified prior to this period. At least one relevant paper was published each year during this timeframe, with a peak of three papers published in

2021, 2024, and 2025. In the context of biophilia, there are two main types: greenery and natural elements. For greenery, seven studies focused on the use of natural plants, one study examined artificial plants, and seven studies utilized virtual reality (VR). Additionally, there are three studies that explored natural elements, which include materials like stone, wooden desks, and other interiors made from organic materials (Table 1). As illustrated, a consistent number of experimental studies focusing on biophilic design in office spaces have emerged annually in recent years. In terms of geographical distribution, the USA had the highest share of publications, with five papers, followed by China and Japan with three each.

In terms of skin conductance level (SCL) and electrodermal activity (EDA), Yin et al. (2018) found that SCL was significantly lower in both natural planting and virtual reality (VR) environments compared to non-biophilic environments. However, four prior studies reported no significant differences in SCL when comparing environments with and without biophilic design (Yin et al., 2019; Yin et al., 2020; Aristizabal et al., 2021; Let et al., 2021). There was a consistent decrease in heart rate (HR) with the introduction of biophilic design after virtual reality (VR) viewing (Hasebe and Harada, 2025). Conversely, four other studies indicated no significant differences in HR when comparing environments with and without biophilic design (Yin et al., 2018; Yin et al., 2020; Fukumoto et al., 2024; Latini et al., 2024; Tashiro et al., 2025). All three papers reviewed in this study found significant differences in electroencephalogram (EEG) readings due to the introduction of biophilic spaces (Lei et al., 2021; Fukumoto et al., 2024; Shao et al., 2024). Notably, EEG readings increased substantially under non-green conditions (Lei et al., 2021). In our review, we found that all four papers confirmed significant differences in blood pressure (BP) due to the introduction of biophilic spaces (Yin et al., 2018; Yin et al., 2019; Yin et al., 2020; Jiang et al., 2022) (Table 1).

In studies evaluating psychological effects through questionnaires, the introduction of biophilic design has been associated with improvements in the Positive and Negative Affect Schedule (PANAS) scores. Interestingly, while there were no significant differences in positive affect, some studies reported an increase in negative affect scores. A notable decrease in negative affect was observed when biophilic design was combined with auditory conditions (Aristizabal et al. 2021). However, in a 5-day experiment involving stressor conditions, no significant differences in PANAS scores were found between conditions with or without biophilic design (Hasebe and Harada 2025). In regards to the other index, positive effects on the Perceived Restorative State (PRS) were reported in both studies included in this research. The average PRS decreased from after entering a recharge room designed with biophilic elements. This represents an average reduction in self-reported stress levels (Putrino et al., 2020). In this study, positive effects on the Psychological Relaxation Score (PRS) were reported in both studies analyzed. The average PRS decreased after participants entered a recharge room designed with biophilic elements. This represents an average reduction in self-reported stress levels (Putrino et al., 2020). However, there were no significant differences observed in the results of the two studies that focused on the State-Trait Anxiety Inventory (STAI) (Yin et al., 2020; Aristizabal et al., 2021) (Table 1).

*Table 1. Summary of included research*

| References | Physiological measurements | Psychological measurements | Exposure time in biophilia |
|---|---|---|---|
| Yin et al. 2018 | SCL, HR, BP | - | 5 min |
| Yin et al. 2019 | SCL, HR, RMSSD | - | 13 min |
| Yin et al. 2020 | SCL, HR, LF/HF, RMSSD, BP | STAI | 6 min |
| Putrino et al. 2020 | | PRS | 15 min |
| Aristizabal et al. 2021 | SCL, SCR, RMSSD | PANAS, STAI | Daily |
| Lei et al. 2021 | SCL, EDA. RMSSD, RRG | PRS | 20 min |
| McSweenery et al. 2021 | LF/HF | | 50 min |
| Jiang et al. 2022 | RMSSD, BP | | 110 min |
| Pavlova et al. 2023 | | PRS | - |
| Fukumoto et al. 2024 | HR, LF/HF, EEG | PANAS | 15 min |
| Latini et al. 2024 | EDA, HR | | 35 min |
| Shao et al. 2024 | RMSSD, EEG | | 9 min |
| Budaniya et al. 2025 | | Subjective perception | 55 min |
| Hasebe et al. 2025 | HR, LF/HF, RMSSD | PANAS | 6 min |
| Tashiro et al. 2025 | HR, LF/HF, RMSSD | | 10 min |

### 3.2 Results of the Interviews in Industry

We interviewed Benholm Group at their head office in Falkirk to learn more about their expert approach to plant design, installation, and maintenance. With over 30 years of experience delivering standout interior plantscapes across the UK, Benholm is a leading force in biophilic design — translating creative vision into living, breathing spaces that elevate well-being and performance. Their planting schemes are tailored to complement each environment, blending spatial awareness with a deep understanding of plant behaviour. From vibrant tropicals to sculptural mosses and ferns, Benholm curates a diverse mix of species suited to both high- and low-light interiors. Every project begins with smart planning: bespoke containers are fitted with discreet water reservoirs, while peat-free substrates promote sustainability without compromising plant health. Beyond installation, Benholm provides ongoing care and environmental monitoring to ensure plants thrive — integrating seamlessly into the architecture and rhythm of the space. Unlike trend-driven approaches, Benholm's work is grounded in function, design integrity, and results. Their projects exemplify how thoughtful plantscaping can transform workplaces into healthier, more inspiring places to be.

An interview with OASIS provided insights into various biophilic design concepts set by one company. Considering the social context and the demand for spatial environments, this company has identified three planting trends for 2025: "Slow Life," "Cosmic Future," and "Unique Utopia and Radiant Energy." This company aims to create spaces that stimulate creativity and enhance perceived value through the use of appealing plants. Given the scarcity of landscape gardening examples proposing biophilic design concepts, this case serves as a noteworthy example of a company that manages everything from planting design to implementation and maintenance.

Shimizu Corporation, one of the largest general contractors in Japan, provides consulting services to help clients integrate biophilia in order to achieve the international WELL certification. With a focus on promoting healthy environments in offices and enhancing employee motivation, Shimizu Corporation supports both new and existing buildings. This involves on-site inspections and ongoing assistance until recertification is completed three years later. While the company is making progress in proposing biophilic design and working towards certification, it has not yet reached a point at the business level where it fully considers the physiological and psychological effects on the employees who work there.

## 4. DISCUSSION

### 4.1 Key Observations from the Literature Review

In this study, we organized previous findings on the effectiveness of biophilic design in office environments and analyzed the differences in effects observed in each finding, along with the physiological and psychological indicators utilized. Although we identified some studies that employed partially identical indicators, none used exactly the same set of indicators. Additionally, we could not identify any trends indicating common changes based on factors such as the country where the study was conducted, the year of publication, or the duration of time that subjects spent in the biophilic space (Table 1). Regarding the types of biophilia, significant effects were observed when introducing biophilic design into environments with both VR and real plants. This was confirmed through various physiological measurements, including electrodermal signals, heart rate indicators, EEG, and blood pressure. Similar trends were also found in psychological measurements concerning perceived restoration scale PRS (Table 1). VR effectively creates a visual connection to nature in biophilic design. Previous studies have provided evidence that both experiencing real nature and viewing images of nature can reduce stress (Kahn et al., 2008). Experimental research showed that participants with high stress levels preferred natural environments over urban ones (van den Berg et al. 2003). Additionally, observing scenes of nature activated more pleasure receptors in the brain and stimulated a larger portion of the visual cortex compared to non-nature scenes (Biederman and Vessel, 2006). Therefore, utilizing VR in research to assess the effects of biophilic design would be also effective in studies focused on office environments.

In this review, the findings consistently showed significant differences in multiple EEG bands when biophilic design was applied. Additionally, regarding the relationship between blood pressure and heart rate-related indices (such as HR and RMSSD), the study indicated that BP decreased with the introduction of biophilic design (Table 1). However, the heart rate-related indices that changed alongside this varied from one finding to another. Previous studies have reported that blood pressure tends to increase with heart rate; however, this relationship can vary based on factors such as age, body composition, the presence of disease, and the conditions at the time of measurement (Christofaro et al. 2017). As a result, it is challenging to establish a consistent correlation between heart rate-related indices, blood pressure, and EEG findings. Therefore, systematic data collection is believed to be essential for gaining a more detailed understanding of the effects of biophilic design. Research on heart rate-related indices has been conducted over various time spans, with more recent studies focusing on shorter experiments lasting less than two hours (Table 1). In terms of the effects of biophilic design over time, long-term stress analysis may reveal different dynamics (Attar et al., 2021). Long-term stress is a more reliable predictor of mental illness compared to short-term stress. Future research should prioritize long-term experiments to effectively monitor continuous and linear changes over time.

### 4.2 Potentials for collaboration between industry and academia in research

A case study examining the industry's efforts in biophilic design highlighted several key points. While the industry is ready to incorporate plants and promote specific designs, it has not yet fully integrated research findings into practice. One reason for this is that much of the existing research is based on fundamental studies. There are discrepancies when comparing research conditions to actual office environments, including the number of participants, the frequency of experiments, and the lack of experimental examples that reflect real working hours. Although these studies have significantly clarified the effects of introducing biophilic design, further demonstration experiments based on these findings are needed. In particular, future studies should focus on the physiological and psychological effects of different plant species, designs, and concepts, behavioral change (Xing, et al,, 2024b), while also clarifying their long-term impacts in actual biophilic office designs.

## 5. CONCLUSION

This study reviews research on the physiological and psychological effects of biophilic design in office environments, analyzing relevant papers. All studies showed positive outcomes from biophilic design, though the indicators varied due to differences in conditions, measurement methods, and plant types. The industrial sector is increasingly adopting biophilic design, developing technologies to integrate plants indoors, and promoting its use. We recommend creating tailored knowledge for specific conditions through systematic classification of office spaces, demonstration experiments in architectural projects, and continuous evaluation methods.

## ACKNOWLEDGEMENT

This research project is supported by the Benholm Group and funded by Shimizu Corporation.

## REFERENCES

Ancora, L.A., Blanco-Mora, D.A., Alves, I., Bonifácio, A., Morgado, P. and Miranda, B. (2022) Cities and neuroscience research: A systematic literature review. Front Psychiatry.13:983352.

Aristizabal, S., Byun, K., Porter, P., Clements, N., Campanella, C., Li, L., Mullan, A., Ly, S., Senerat, A. and Nenadic, I.Z. (2021) Biophilic office design: Exploring the impact of a multisensory approach on human well-being. Journal of Environmental Psychology 77, 101682.

Attar, E.T., Balasubramanian, V., Subasi, E. and Kaya, M. (2021) Stress Analysis Based on Simultaneous Heart Rate Variability and EEG Monitoring. IEEE J Transl Eng Health Med 9: 2700607.

Biederman, I., and Vessel, E. (2006) Perceptual Pleasure and the Brain. American Scientist, 94, 248-255.

Budaniya, M., Mishra, A.K., Rai, A.C. and Dasgupta, M.C. (2025) Indoor plants' effect on occupants' performance, perceived comfort, and affect in an open-plan space in composite climatic regions, India. Building and Environment 274: 112785.

Christofaro, D.G.D., Casonatto, J., Vanderlei, L.C.M., Cucato, G.G. and Dias, R.M.R. (2017) Relationship between Resting Heart Rate, Blood Pressure and Pulse Pressure in Adolescents. Arq Bras Cardiol. 108(5):405-410.

Clements-Croome, D. (2020) Designing Buildings for People: Sustainable liveable architecture. Chapter 3 "Lessons from nature – biomimetic and biophilic architencture", The Crowood Press Ltd.

Cooper, C. and Browning, B. (2015) The Global Impact of Biophilic Design in the Workplace reference. Human Spaces Report.

Feige, A., Wallbaum, H., Janser, M. and Windlinger, L. (2013) Impact of sustainable office buildings on occupant's comfort and productivity. Journal of Corporate Real Estate 15(1): 7-34.

Fukumoto, H., Shimoda, M. and Hoshino, S. (2024) The effects of different designs of indoor biophilic greening on psychological and physiological responses and cognitive performance of office workers. PLoS ONE 19(7): e0307934.

Hähn, N. and Essah, E. (2020) Biophilic design and office planting: a case study of effects on perceived health, well-being and performance metrics in the workplace. Intelligent Buildings International, 13 (4) 241-260.

Hasebe, T. and Harada, Y. (2025) Repeated restoration effects of viewing a WELL-certified biophilic office environment—A pilot study using psychological, physiological, and eye-tracking indicators. Building and Environment 271: 112637.

Jiang, Y., Li, N. Yongga, A. and Yan, W. (2022) Short-term effects of natural view and daylight from windows on thermal perception, health, and energy-saving potential. Building and Environment 208: 108575.

Kahn, P. H., Jr., Severson, R. L., & Ruckert J. H. (2009). The Human Relation with Nature and Technological Nature. Current Directions In Psychological Science, 18(1): 37-42.

Kellert, S. (1997) Kinship to Mastery: Biophilia in Human Evolution and Development.Washington, DC: Island Press.

Khalil, M.H. (2025) Green Environments for Sustainable Brains: Parameters Shaping Adaptive Neuroplasticity and Lifespan Neurosustainability—A Systematic Review and Future Directions. Int. J. Environ. Res. Public Health 22(5), 690.

Latini, A. Torresin, S., Oberman, Tin., Giuseppe, E.D., Aletta, F., Kang, J. and D'Orazio, M. (2024) Virtual reality application to explore indoor soundscape and physiological responses to audio-visual biophilic design interventions: An experimental study in an office environment. Journal of Building Engineering 87: 108947.

Lei, Q., Yuan, C. and Lau, S.S.Y. (2021) A quantitative study for indoor workplace biophilic design to improve health and productivity performance. Journal of Cleaner Production 324: 129168.

McSweeney, J., Johnson, S., Sherry, S., Singleton, J. and Rainham, D. (2021) Indoor nature exposure and influence on physiological stress markers. International Journal Of Environmental Health Research 31 (6): 636–650.

Pavlova, M.V., Reznichenko, S.I. and Nartova-Bochaver, S.K. (2023) A new instrument to measure healthy workplace qualities: the People in the Office Scale. Front. Psychol. 14: 124155.

Putrino, D., Ripp, J., Herrera, J.E., Cortes, M., Kellner, C., Rizk, D., and O'Connor, K.D. (2020) Multisensory, Nature-Inspired Recharge Rooms Yield Short-Term Reductions in Perceived Stress Among Frontline Healthcare Workers. Front Psychol. 11:560833.

Rizzo, G., Cirrincione, L., Gennusa, M.L., Peri, G. and Scaccianoce, G. (2023) Green Roofs' End of Life: A Literature Review. Energies 16(2), 596.

Schubert, T., Regenbrecht, H. and Friedmann, F. (2001) The experience of presence: Factor analytic insights Presence: Teleoperators and Virtual Environments, Presence: Teleoperators and Virtual Environments, 10: 266-281.

Seoane-Collazo, P., Fernø, J., Gonzalez, F., Diéguez, C., Leis, R., Nogueiras, R. and López, M. (2015) Hypothalamic-autonomic control of energy homeostasis. Endocrine 50, 276–291.

Shao, Y., Zhou, Z., Ding, D., Cui, Y. and Wu, X. (2024) Psychological Effects of a Living Wall System on Office Occupants: A Comparative Study Based on Physiological Responses. Buildings 14(7): 1981.

Tashiro, S. and Harada, Y. (2025) Psychological and physiological thermal effects of biophilic built environment using virtual reality: A pilot study for certified green building. Building and Environment 270: 112534.

van den Berg, A. E., Koole, S. L., van der Wulp, N. Y. (2003) Environmental preference and restoration: how are they related? J. Environ. Psychol., 23, 135–146.

Wilson, E.O. (1984) Biophilia. Cambridge, MA: Harvard University Press.

Xing, Y., Kar, P., Bird, J.J., Sumich, A., Knight, A., Lotfi, A. and van Barthold, B.C. (2024a) Developing an AI-Based Digital Biophilic Art Curation to Enhance Mental Health in Intelligent Buildings. Sustainability 16: 9790.

Xing, Y., Williams, A. and Knight, A. (2024b) Developing a biophilic behavioural change design framework - a scoping study. Urban Forestry and Urban Greening, 94: 128278.

Xing, Y., Stevenson, N., Thomas, C., Hardy, A., Knight, A., Heym, N. and Sumich A. (2025) Exploring biophilic building designs to promote wellbeing and stimulate inspiration. PLoS One. 20(3): e0317372.

Yin, J., Arfaei, N., Macnaughton, P., Allen, J. G., and Spengler, J. D. (2019) Effects of biophilic interventions in office on stress reaction and cognitive function: A randomized crossover study in virtual reality. Indoor Air 29(6):1028-1039.

Yin, J., Yuan, J., Arfaei, N., Catalano, P.J., Allen, J. G., and Spengler, J. D. (2020) Effects of biophilic indoor environment on stress and anxiety recovery: A between-subjects experiment in virtual reality. Environment International 136:105427.

Yin, J., Zhu, S. H., Macnaughton, P., Allen, J. G., and Spengler, J. D. (2018) Physiological and Cognitive Performance of Exposure to Biophilic Indoor Environment. Building and Environment, 132, 255-262.