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Biomimetic Design for Academic Workspaces: Enhancing Staff Well-Being and Productivity in UK University Offices

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Abstract

Academic office environments profoundly shape the intellectual, emotional, and professional lives of university staff, yet many remain standardised, inflexible, and ecologically disconnected from the natural systems that support human well-being. This study investigates how biomimetic design principles can address the lived workspace challenges of UK academic staff and translates user-identified needs into evidence-based design strategies. Employing a qualitative, interpretive methodology, semi-structured interviews were conducted with thirty academic staff from six disciplinary departments across multiple UK universities. Reflexive thematic analysis identified five cross-cutting barriers to well-being and productivity: inadequate acoustic privacy, environmental discomfort, spatial inflexibility, limited personal control, and the absence of natural or restorative elements. These findings are synthesised into a Biomimetic Design Translation Framework — the primary contribution of this paper — which maps empirically derived user challenges onto

nature-inspired design strategies operating at the form, process, and ecosystem levels of biomimetic application. Reframed through a responsible design lens, these findings suggest that access to acoustically private, thermally comfortable, and restorative working conditions is unevenly distributed across academic roles and institutions, positioning staff well-being as a matter of institutional responsibility and equity rather than design optimisation alone. The study contributes empirical grounding for subsequent design framework development in academic settings and offers practical implications for institutional workspace planning that supports dignity and equitable access to restorative space.

Keywords: ***biomimicry, biophilic design, interior design, academic workspace, well-being, qualitative research, UK universities, thematic analysis, responsible design, institutional equity***

Introduction

Academic office environments are pivotal sites of intellectual labour. They host a dense and shifting repertoire of activities focused research, teaching preparation, student meetings, and interdisciplinary collaboration, which impose competing spatial and sensory demands. Despite their centrality to academic life, many contemporary university offices are shaped by standardised, efficiency-driven design models that prioritise spatial economy over human well-being, contributing to heightened stress, reduced concentration, and diminished long-term productivity (Kim and de Dear 2013; De Croon et al. 2005; Haapakangas et al. 2011).

Understood in this way, the design of academic office space is not simply a matter of spatial economy or aesthetic preference; it is a question of institutional responsibility. Who is afforded a quiet, comfortable, and restorative place to work, and who is not, is shaped by decisions over which individual staff have little influence, including capital budgets, estates standards, and space allocation policies, which determine whose working conditions support dignity, sustained attention, and professional well-being, and whose do not. Reframing academic workspace design as a responsible design problem foregrounds these questions of access and equity alongside questions of performance and comfort, situating the present study within a broader concern for designing physical environments that support social connection, dignity, and belonging in institutional life.

Responses to this problem have largely proceeded along two parallel tracks. The first, activity-based working (ABW), reconfigures office space into functionally differentiated zones to support varied work modes (Appel-Meulenbroek, Groenen, and Janssen 2011). The second, biophilic design, introduces natural sensory stimuli, plants, daylight, natural materials, and outdoor views based on an evolved human affinity with nature (Kellert, Heerwagen, and Mador 2008; Wilson 1984). Neither framework, however, provides the integrated, systems-level logic needed to address multiple, interrelated workspace challenges simultaneously, that is, a design approach capable of treating acoustic performance, thermal comfort, spatial adaptability, and restorative quality as interdependent properties of a whole environment rather than isolated problems to be solved separately (Pedersen Zari 2018; Pawlyn 2011). It is here that biomimicry (or biomimetic design) offers a distinctive contribution.

Biomimicry refers to design that emulates the functional processes and systemic relationships of natural systems, not merely their visual forms (Benyus 1997; Vincent et al. 2006). Pedersen Zari (2018) proposes a hierarchical model of biomimetic application operating at three levels: form (the emulation of natural structures and materials), process (the emulation of natural functions such as thermoregulation, sound attenuation, and light distribution), and ecosystem (the emulation of systemic, adaptive, and self-regulating relationships among components). This conceptual architecture distinguishes biomimicry from biophilic design, which foregrounds sensory and experiential contact with nature (Browning, Ryan, and Clancy 2014; Kellert et al. 2008), and from ABW, which foregrounds spatial reconfiguration. This paper uses 'biomimicry' and 'biomimetic design' consistently to refer to design that emulates natural processes and systems, not merely natural forms. Where biophilic design is discussed, this distinction is maintained.

Academic workspaces have received comparatively minimal direct attention in the built environment literature. Most empirical work on workplace design focuses on generic commercial or open-plan office settings (Kim and de Dear 2013; Bernstein and Turban 2018), and studies of educational environments typically examine learning spaces such as lecture theatres, studios, and libraries rather than the offices occupied by academic staff (Heerwagen 2000). The academic workspace thus represents a distinct and underexplored typology, one in which the demands of solitary research, student-facing interaction, and confidential professional exchange create spatial and environmental requirements that generic office design models poorly serve.

This paper addresses that gap, guided by two research questions: (1) What are the primary spatial and environmental challenges experienced by UK academic staff in their office environments? (2) How can biomimetic design principles be systematically mapped onto these empirically identified challenges to inform future workspace redesign? The paper makes its primary contribution through a Biomimetic Design Translation Framework (Table 3), an empirically grounded instrument that links user-identified needs to nature-inspired design strategies across Pedersen Zari's (2018) three levels of biomimetic application. This framework constitutes the evidential and conceptual foundation for subsequent design framework and guideline development, and for institutional efforts to distribute the conditions for dignified, restorative work more equitably across academic roles and spaces.

The paper proceeds as follows: Background establishes the theoretical context; Methodology describes the research design and framework development process; Findings presents the five thematic patterns; Discussion presents the framework, situates findings in the literature, and appraises the study; and the Conclusion summarises contributions, limitations, and future directions.

Background

The relationship between built environments and human well-being has been theorised through complementary frameworks: Ulrich's (1983) stress recovery theory and Kaplan and Kaplan's (1989) attention restoration theory, which together hold that natural environments support psychological and physiological recovery from cognitive and emotional stress. These frameworks underpin biophilic design interventions and the demand for natural elements

consistently reported in workplace studies (Browning et al. 2014; Kellert et al. 2008).

Empirical research on open-plan offices documents persistent trade-offs between collaborative affordances and the cognitive and privacy costs of shared space (Kim and de Dear 2013). Bernstein and Turban (2018) found open office configurations reduced face-to-face interaction while increasing digital communication, complicating the institutional rationale for open-plan academic workspaces. Appel-Meulenbroek et al. (2011) show activity-based working can mitigate some of these costs, though effective implementation requires genuine user involvement (Sanders and Stappers 2008).

Within biomimetic design scholarship, Pawlyn (2011) and Pedersen Zari (2018) established the theoretical architecture for applying natural system principles to buildings at multiple scales. Pedersen Zari's three-level model of form, process, and ecosystem provides the framework against which this paper's findings are mapped. Prior applications have concentrated on building skins, ventilation systems, and urban-scale ecology, with interior workspace design in educational settings remaining unexplored — the gap this study occupies.

The application of biomimetic principles to interior design specifically is an emerging area. Kellert et al. (2008) and Browning et al. (2014) provide extensive biophilic interior frameworks addressing sensory responses to natural stimuli, distinct from biomimetic application's focus on functional emulation. More directly relevant are Gruber (2011), who treats biomimetics as a design methodology grounded in biological principles, and Hwang, Kim, and Kim (2017), who demonstrate biomimetic surface strategies for interior acoustic and thermal performance; Pedersen Zari (2012) applies the ecosystem-

services model to buildings as a whole. Applications to date include honeycomb-patterned partitions for acoustic attenuation (Vincent et al. 2006), termite-inspired passive ventilation (Turner and Soar 2008), and canopy-inspired ceiling panels (Pawlyn 2011), confirming technical feasibility at the interior scale though systematic application to academic workspaces remains underexplored.

The distinction between biomimicry and biophilic design matters for practice. Biophilic design, per Kellert et al. (2008) and Browning et al.'s (2014) fourteen patterns, addresses psychological and sensory responses to natural stimuli, whereas biomimicry addresses functional performance by emulating how natural systems solve problems such as thermoregulation and structural adaptation. The two overlap in practice: a living wall is simultaneously biophilic, offering sensory contact with nature, and biomimetic, contributing to evapotranspiration cooling. This study argues that academic workspace design requires both dimensions, though the process and ecosystem levels of biomimetic application, currently underrepresented in workspace practice, are particularly well suited to its functional complexity.

Methodology

This study adopted a qualitative, interpretive research design appropriate to its focus on the situated, subjective experiences of academic staff with their office environments. Qualitative approaches are suited to investigations that seek depth of understanding over breadth, and to contexts where phenomena of interest are embedded in lived practice and institutional culture (Creswell 2013; Mason 2002). An interpretivist epistemological stance was adopted, acknowledging that participants' accounts of their workspaces are

shaped by disciplinary norms, professional identities, and personal experiences of the built environment factors that are analytically significant rather than sources of bias to be controlled.

Interview Design and Conduct

Data were collected through semi-structured interviews, a format that enables systematic coverage of predetermined topics while preserving flexibility to probe emergent lines of inquiry (Gray 2014). The interview guide addressed five thematic areas: (1) spatial configuration and privacy; (2) environmental quality, including lighting, ventilation, and acoustics; (3) the integration of natural elements and biomimetic features; (4) flexibility and personalisation of the workspace; and (5) sustainability and institutional responsibility in design decisions. The full interview guide is included as Appendix A.

Interviews were conducted in 2025, either face-to-face in office or meeting room settings at participants' institutions, or via Microsoft Teams, according to participant preference. All sessions were audio-recorded with informed written consent and subsequently transcribed verbatim by the lead researcher.

Participant Recruitment and Sample

Thirty academic staff members were recruited across six departments, Design, Business, Arts and Humanities, Engineering, Law, and Psychology from multiple UK universities. Purposive sampling was used to achieve disciplinary diversity; initial contacts were established by direct email, and a small number of additional participants were recruited through professional referrals. Five participants per department provided sufficient within-department depth while enabling structured cross-departmental comparison.

Table 1 summarises participants by title, expertise area, and recruitment method.

A sample of thirty is consistent with established thematic saturation benchmarks in qualitative interview research (Guest, Bunce, and Johnson 2006; Braun and Clarke 2021). Saturation was assessed iteratively: analytical memos documented when new interviews ceased to generate substantively new codes. Ethical approval for the study was granted by Brunel University of London ethics committee (Ref. 4631-A-Mar/2025-53976-1). Participation was voluntary, participants provided informed written consent, and all data were anonymised using alphanumeric codes (AS1–AS30). Recordings and transcripts were stored securely in compliance with institutional data protection requirements.

Reflexive Thematic Analysis

Interview transcripts were analysed using reflexive thematic analysis (Braun and Clarke 2006, 2019), a method that treats themes as actively constructed by the researcher through systematic engagement with data, rather than as pre-existing entities to be discovered. Analysis proceeded through six stages: familiarisation with data through repeated reading and note-taking; generation of initial codes across the full dataset; construction of candidate themes; review and refinement of themes against the coded data and the dataset as a whole; definition and naming of themes; and write-up (Braun and Clarke 2006). Figure 1 presents the analysis process schematically.

Initial coding generated codes relating to spatial conditions, environmental factors, institutional structures, and individual coping strategies. Codes were iteratively clustered and refined into five

overarching themes (see Figure 2 for a sample theme identification diagram). The final five themes were selected because they represented the broadest and most conceptually distinct patterns across the dataset, each encompassing several related codes while remaining sufficiently distinct from one another. Together, they captured the principal spatial and environmental challenges described consistently across participants and provided the analytical foundation for the subsequent interpretation and development of the Biomimetic Design Translation Framework. Reflexive memos were maintained throughout analysis to record interpretive decisions and interrogate potential researcher assumptions. These trustworthiness strategies, such as multiple-coder checking, an audit trail, and a reflexive memo, are aligned with established criteria for rigour in qualitative research (Lincoln and Guba 1985; Liamputtong 2011). Table 2 provides a sample coding example illustrating the pathway from raw data to theme.

Following the completion of thematic analysis, the five themes were used as the empirical foundation for developing the Biomimetic Design Translation Framework presented in the Discussion section. The framework development process involved three steps. First, each empirically derived theme was translated into a corresponding user need or design challenge, drawing directly on the coded data and participants' own articulations of their workspace problems. Second, relevant biomimetic design precedents were identified from the existing literature, selecting strategies with documented evidence of addressing the specific functional problems — acoustic attenuation, thermal regulation, daylight distribution, adaptive zoning — identified within each theme. This selection was guided by Pedersen Zari's (2018) three-level taxonomy (form, process, ecosystem), and

prioritised process- and ecosystem-level strategies on the basis that these address functional complexity more substantively than form-level referencing alone. Third, each pairing of user need and biomimetic strategy was evaluated for conceptual coherence and cross-referenced against the interview data to ensure that the strategy was responsive to the specific conditions participants described. The resulting framework is an interpretive instrument grounded in empirical evidence and biomimetic theory, not validated by an expert panel or post-occupancy evaluation, and presented as a staging document for subsequent applied research rather than a prescriptive design guide.

Table 1. Academic staff interviewed (n = 30).

ID	Title	Expertise Area	Recruitment
Design Department			
AS 1	**Professor**	**Engineering, product design**	**Direct email**
AS 2	**Reader**	**Design strategy, management**	**Direct email**
AS 3	**Professor**	**Design, branding**	**Direct email**
AS 4	**Senior Lecturer**	**Engineering, sustainability**	**Direct email**
AS 5	**Senior Lecturer**	**Product design**	**Direct email**
Business Department			
AS 6	**Senior Lecturer**	**Management**	**Referral (AS 11)**

AS 7	**Honorary Senior Lecturer**	**Finance strategy**	**Direct email**
AS 8	**Senior Lecturer**	**Marketing**	**Direct email**
AS 9	**Senior Lecturer**	**Strategic management**	**Direct email**
AS 10	**Senior Lecturer**	**Business communications**	**Direct email**
Arts & Humanities Department			
AS 11	**Reader**	**Education**	**Direct email**
AS 12	**Senior Lecturer**	**Creative computing**	**Direct email**
AS 13	**Research Development Advisor**	**Education**	**Referral (AS 11)**
AS 14	**Senior Lecturer**	**Education, leadership**	**Referral (AS 6)**
AS 15	**Teaching Fellow**	**Social sciences**	**Referral (AS 13)**
Engineering Department			
AS 16	**Senior Lecturer**	**Space science instrumentation**	**Direct email**
AS 17	**Reader**	**Sustainable construction**	**Direct email**
AS 18	**Lecturer**	**Additive manufacturing**	**Direct email**
AS 19	**Professor**	**Geotechnical engineering**	**Direct email**
AS 20	**Reader**	**Civil engineering**	**Referral (AS 19)**
Law Department			

AS 21	**Senior Lecturer**	**Commercial law**	**Direct email**
AS 22	**Lecturer**	**Private law**	**Direct email**
AS 23	**Assistant Professor**	**Corporate law**	**Referral (AS 21)**
AS 24	**Teaching Fellow**	**Intellectual property law**	**Direct email**
AS 25	**Lecturer**	**Commercial law**	**Direct email**
Psychology Department			
AS 26	**Senior Lecturer**	**Psychology, cultural identity**	**Direct email**
AS 27	**Senior Lecturer**	**Psychology**	**Direct email**
AS 28	**Assistant Professor**	**Relationships**	**Direct email**
AS 29	**Reader**	**Child health**	**Direct email**
AS 30	**Lecturer**	**Health, behaviour**	**Referral (AS 27)**

Table 2. Sample coding excerpt illustrating pathway from data to theme.

Data Extract (representative)	Initial Code	Subtheme	Theme
'I can hear everything through these walls — it completely destroys concentrated work' [AS16]	**Noise intrusion from adjacent spaces**	**Inadequate sound insulation**	**Lack of acoustic privacy**

'There is no way to open a window … by mid-afternoon my concentration falls off a cliff' [AS4]	Sealed building / no ventilation control	Poor air quality, thermal autonomy	Environmental discomfort
'I'm doing five different types of work in a day, but the space doesn't support any of them' [AS11]	Fixed layout incompatible with work variety	Spatial rigidity, functional undifferentiation	Spatial inflexibility
'We're not allowed to move the furniture without filling in a form' [AS21]	Institutional restriction on workspace adaptation	Limited agency, lack of ownership	Limited personal control
'After a few hours with no windows, no plants, nothing — it feels suffocating' [AS26]	Sterile environment, absence of nature cues	Ecological disconnection, sensory depletion	Absence of natural elements

Findings

The thematic analysis identified five cross-cutting themes that recurred across all six disciplinary groups. While disciplinary emphases varied, these five themes constituted a consistent pattern of concern across the dataset. Each theme is presented below with representative participant quotations. Quotations are selected to illustrate thematic patterns across departments and are identified by participant code and department; they are representative of broader patterns within each theme rather than exceptional cases.

Participants occupied a range of office configurations. Approximately half described working in nominally private single or shared offices

(occupied by two to four staff), while the remainder worked in open-plan or semi-open arrangements, including shared departmental suites and hot-desking environments. Several participants occupied hybrid spaces — rooms formally designated as private offices but separated from adjacent areas by thin partition walls or shared doors offering limited acoustic separation. This variety of setting types is relevant to interpretation: while acoustic privacy and lack of control emerged as cross-cutting concerns, their precise character varied with the degree of enclosure. Where office type is especially salient to a theme, it is noted in the analysis below.

Theme 1: Lack of Acoustic Privacy

Acoustic privacy emerged as the most pervasive barrier to productivity. Participants across all departments described disruption from neighbouring conversations, corridor traffic, and digital meetings conducted in proximity to focused work. Even academics occupying nominally private offices reported that inadequate sound insulation permitted intrusive noise from adjacent rooms.

> ***'The problem is that I can hear everything through these walls — phone calls, meetings, even individual conversations. It completely destroys any attempt at concentrated work. [AS16, Engineering]'***

The challenge was particularly acute for activities requiring confidentiality such as student advising, marking, peer review, which are central to academic professional practice. Multiple participants described displacing productive work to libraries and cafés as a direct response to unmanageable office acoustics, a pattern consistent with Kim and de Dear's (2013) finding that the privacy costs of open-plan

offices frequently outweigh their collaborative benefits, and with Bernstein and Turban's (2018) evidence that open workspaces may paradoxically reduce genuine interaction.

> ***'I've given up trying to have private conversations in my office. I take my laptop to a coffee shop when I need to actually think. [AS8, Business]'***

Theme 2: Environmental Discomfort and Sensory Stress

Environmental discomfort, encompassing lighting quality, thermal regulation, air quality, and ventilation was raised across all departments. Central concerns included over-reliance on artificial lighting, inability to access fresh air in sealed buildings, and the unresponsiveness of centralised HVAC systems to individual and seasonal variation.

> ***'The air in here is genuinely stagnant for most of the day. There's no way to open a window, the ventilation system makes a constant noise, and by mid-afternoon my concentration just falls off a cliff. [AS4, Design]'***

Limited access to natural daylight was framed consistently as a physiological and psychological concern. This aligns with established evidence linking daylight exposure to circadian regulation, mood, and cognitive performance (Heerwagen 2000; Allen et al. 2016). Psychology faculty were particularly articulate about the cognitive implications of artificial lighting, while several Engineering and Design participants described deliberately positioning workstations to maximise window access, a behavioural adaptation that underscores both the perceived importance of daylight and the inadequacy of current spatial provision.

Theme 3: Spatial Inflexibility and Physical Strain

Spatial inflexibility emerged as a structural barrier to the diverse, rapidly shifting character of academic work. Participants described existing layouts as fixed and functionally undifferentiated, unable to support transitions between solitary research, collaborative work, student advising, and administrative tasks within a single working day.

> ***'My office is set up for one thing — sitting at a desk in front of a screen. But in reality, I'm doing five completely different types of work in a day, and the space just doesn't support any of the others. [AS11, Arts and Humanities]'***

Ergonomic inadequacy compounded spatial inflexibility. Participants described furniture as outdated and insufficiently adjustable. Arts and Humanities academics reported that ergonomic equipment required formal medical justification placing the burden of provision on individuals rather than reflecting an institutional baseline. A shared aspiration across departments was for modular or reconfigurable arrangements: moveable seating, acoustically separable zones, and small-group breakout areas that would support multiple work modes without requiring staff to leave the building. This desire maps closely onto the activity-based working principles documented by Appel-Meulenbroek et al. (2011), suggesting that participants had intuited ABW logic from lived experience rather than from design knowledge.

Theme 4: Limited Personal Control and Customisation

A persistent thread across interviews was the desire for greater autonomy over workplace conditions. Participants described minimal ability to adjust lighting, temperature, or acoustic environments, and

faced institutional restrictions on personalising offices through plants, artwork, or furniture rearrangement.

> ***'We're not even allowed to move the furniture without filling in a form. It feels infantilising — as if we can't be trusted to know what we need to work effectively. [AS21, Law]'***

This limited agency carried both practical and symbolic weight. Practically, it forced informal workarounds personal fans, headphones, remote working, which are disruptive or sub-optimal. Symbolically, it communicated institutional indifference to staff well-being. Elsbach and Pratt (2007) document that workspace personalisation, what they term 'workspace marking' functions as a mechanism for asserting professional identity and managing cognitive boundaries. Institutional restrictions on this marking may therefore carry costs beyond physical comfort, undermining the sense of ownership and professional recognition that sustains motivated academic engagement.

Theme 5: Absence of Natural and Restorative Elements

Participants across all departments associated natural elements, plants, natural materials, outdoor views, and organic textures with psychological restoration, reduced stress, and enhanced creativity. Their absence was linked to perceptions of environmental sterility and cognitive depletion. This finding is consistent with stress recovery theory (Ulrich 1983) and attention restoration theory (Kaplan and Kaplan 1989), both of which predict that contact with natural environments supports recovery from cognitively demanding work.

> ***'Even just looking outside at trees makes a difference to how I feel. When I'm in a room with no windows, no plants, nothing — after a few hours it just feels oppressive. [AS26, Psychology]'***

Crucially, participants drew a consistent distinction between authentic and cosmetic nature integration. Graphic wallpaper, artificial plants, and nature-themed imagery were dismissed as inadequate, a finding with direct implications for design practice. The operative mechanism is not visual representation per se but functional or experiential contact with genuine ecological qualities: living organisms, dynamic daylight, natural material variation, and outdoor connection. This distinction reinforces the argument that process- and ecosystem-level biomimetic strategies, rather than form-level nature referencing, are required to deliver the environmental qualities participants found credible and restorative (Pedersen Zari 2018).

The absence of informal or restorative zones within academic buildings was a closely related concern. Without designated areas for reflective breaks, creative conversation, or cognitive recovery, staff displaced these activities externally, to cafés and green spaces, reinforcing uninterrupted work cultures that are incompatible with sustained intellectual performance.

Cross-Departmental Comparison

Table 3 provides a structured cross-departmental comparison of thematic emphasis. While all five themes recurred across disciplines, their relative salience varied in ways that reflect disciplinary work cultures and workspace types. Engineering academics placed highest

emphasis on acoustic privacy and environmental control, consistent with the sustained, solitary concentration that research-intensive scientific work demands. Psychology faculty foregrounded environmental discomfort and the absence of natural elements, reflecting their professional engagement with the links between environment and mental health. Design academics emphasised aesthetic quality and creative stimulation. Business faculty prioritised confidentiality and task efficiency. Arts and Humanities academics focused on sensory authenticity and emotional comfort. Law faculty expressed the strongest frustration with limited personal control, unsurprising given the confidential nature of much legal academic work and the associated demand for private, controllable space. These disciplinary variations do not undermine the cross-cutting nature of the five themes; rather, they indicate that the same structural failures manifest differently depending on the work demands of each discipline.

Table 3. Cross-departmental thematic salience.

Theme	Design	Business	Arts & Hum.	Engineering	Law	Psych
Acoustic privacy	High	High	High	Very high	High	High
Environmental discomfort	High	High	High	High	Moderate	Very h
Spatial inflexibility	High	High	High	High	High	High
Limited personal control	High	High	Moderate	Moderate	Very high	High

Absence of natural / restorative elements	**High**	**Moderate**	**High**	**Moderate**	**Moderate**	**Very h**
Disciplinary emphasis	**Creative stimulation, aesthetic quality**	**Confidentiality, task efficiency**	**Sensory authenticity, emotional comfort**	**Focus, thermal control, autonomy**	**Personal agency, private space**	**Psycho regula multi- senson design**
Note: Salience ratings reflect the frequency and intensity of theme expression within each departmental g assessed through coded transcript data. 'High' indicates the theme appeared in most interviews wi department and was articulated with consistent concern. 'Very high' indicates the theme was the most pr cross-cutting concern within that departmental group, appearing in all interviews and frequently foregrou participants as the primary barrier to well-being or productivity. 'Moderate' indicates the theme was pres less frequently or less emphatically expressed. Ratings are interpretive summaries derived from coded tr data and cross-checked by a second coder; they are not quantitative frequency counts.						

Discussion

Biomimetic Design Translation Framework

The five empirical themes provide the evidential basis for the Biomimetic Design Translation Framework presented in Table 4, the paper's primary contribution: a diagnostic instrument mapping user-identified needs to nature-inspired design strategies, organised by

Pedersen Zari's (2018) three levels of biomimetic application (form, process, ecosystem).

Collectively, these five empirical themes demonstrate that the quality of academic workspaces is determined primarily not by individual preferences or behaviours but by institutional decisions regarding space allocation, environmental provision, and workplace management, supporting the interpretation of workspace design as a matter of institutional responsibility and equity.

The framework functions as a conceptual staging instrument rather than a prescriptive design guide: a structured, contestable starting point that makes explicit which biomimetic strategies are plausibly suited to which user needs, and at which level of the Pedersen Zari hierarchy each operates. This distinguishes evidence-based design implication from speculative prescription (Heerwagen 2000); questions of implementation, feasibility, cost, and contextual fit are left to subsequent applied research.

Strategies operating at the process and ecosystem levels are prioritised because they address the functional complexity of academic work — thermoregulation, acoustic performance, spatial adaptability, user control — more substantively than form-level nature referencing, which addresses sensory experience but not function. Participatory design processes appear at the ecosystem level because staff desired co-production of their workspaces, connecting to the established co-design literature (Sanders and Stappers 2008).

Table 4. Biomimetic Design Translation Framework: empirically grounded mapping of user needs to nature-inspired design strategies.

User Need / Challenge	Biomimicry Level (Pedersen Zari 2018)	Biomimetic Design Strategy	Intended Impact and Supporting Evidence
Acoustic disruption and lack of privacy	Form / Process	Honeycomb-inspired partition structures; dense natural-fibre acoustic panels; acoustic moss walls [illustrative, not exhaustive]	Attenuates auditory distraction; supports confidential work and sustained cognitive focus
Spatial inflexibility and fixed layouts	Ecosystem	Modular zones inspired by branching network growth patterns (coral, mycelium); reconfigurable microhabitat clusters (Pedersen Zari 2018)	Enables diverse work modes; increases user autonomy; reduces spatial fragmentation
Poor ventilation and thermal discomfort	Process	Passive ventilation modelled on termite mound convection (Turner and Soar 2008); evapotranspiration cooling via planted walls	Improves air quality; reduces reliance on mechanical systems; enhances thermal comfort
Inadequate natural daylight	Form / Process	Canopy-inspired ceiling diffusion panels; light-shelf systems drawing	Supports circadian regulation

		on leaf canopy geometry (Pawlyn 2011)	(Heerwagen 2000); reduces eye strain; improves mood and energy
Limited user control over environment	Ecosystem	Responsive climate zones modelled on self-regulating ecosystems; user-controlled adaptive shading (Pedersen Zari 2018)	Empowers users; accommodates individual variation; reduces stress from environmental helplessness (Elsbach and Pratt 2007)
Absence of natural and restorative elements	Form / Ecosystem	Living green walls; water features; fractal-patterned surfaces; natural material palettes — wood, stone, clay (Kellert et al. 2008; Browning et al. 2014)	Reduces physiological stress (Ulrich 1983); replenishes directed attention (Kaplan and Kaplan 1989); enhances creativity
Non-ergonomic and inflexible furniture	Form	Ergonomic forms derived from skeletal and exoskeletal biomechanics; adjustable structures	Reduces physical discomfort; supports extended working periods;

		modelled on adaptive plant morphology	**improves posture and musculoskeletal health**
Absence of informal and restorative zones	**Ecosystem**	**Spatial zoning modelled on ecological microhabitats (Pedersen Zari 2018); nested areas differentiated by activity type — focus, collaboration, recovery**	**Facilitates cognitive recovery; supports informal interaction; reduces attentional fatigue**
Visual monotony and sensory depletion	**Form**	**Natural material textures; colour palettes derived from natural ecosystem chromatics; dynamic lighting simulating diurnal variation**	**Enhances sensory engagement; creates psychological comfort; counters cognitive fatigue**
Poor adaptability to seasonal change	**Process**	**Climate-responsive shading modelled on hygroscopic plant mechanisms (pinecone, Banksia seedpod); phase-change thermal materials (Vincent et al. 2006)**	**Maintains indoor comfort year-round; reduces energy demand; responds dynamically to external conditions**
Limited staff involvement in design decisions	**Ecosystem**	**Participatory co-design processes conceptualised through**	**Improves spatial relevance; strengthens user**

		ecological mutualism — iterative, mutually adaptive engagement between occupants and design professionals (Sanders and Stappers 2008)	**ownership; translates institutional commitment to staff well-being into design practice**

Note: Biomimetic strategies listed in each row are illustrative examples drawn from the existing literature, not exhaustive inventories of all possible approaches. Precedents were selected based on: (a) documented relevance to the functional need identified in that row (e.g. acoustic attenuation, thermal regulation); (b) explicit grounding in biological principles rather than mere aesthetic reference; and (c) alignment with Pedersen Zari's (2018) taxonomy, with preference given to process- and ecosystem-level strategies where available. Each strategy listed in the Biomimetic Precedent column is primarily biomimetic in character — that is, it operates by emulating a natural function or system — though some strategies (e.g. living green walls, daylighting systems) may simultaneously deliver biophilic benefits through sensory contact with natural stimuli; these overlaps are intentional and reflect the complementary relationship between the two approaches.

Discussion

The convergence of concerns across six disciplines and multiple institutional settings is analytically significant. It suggests that the spatial and environmental challenges documented here are not artefacts of individual preference or departmental characteristics but reflect systemic misalignments between institutional design logic and the functional requirements of academic labour. This finding has implications beyond workspace design: it points to a broader institutional pattern in which standardisation of space, of environmental systems (lighting, heating, ventilation), and of service provision (what is supplied and at what level) is pursued at the expense of responsiveness to the diverse, knowledge-intensive work that universities are designed to support. Understood through a

responsible design lens, this is not solely a design-performance problem but an equity problem: the staff most exposed to substandard acoustic, thermal, and spatial conditions are frequently those with the least institutional power to change them, including early career, part-time, and non-permanent staff sharing peripheral or provisional office space, so standardised provision functions as a matter of institutional fairness as much as efficiency.

The study's findings both confirm and extend existing literature, while also introducing productive tensions into it. The open-plan challenge is well established (Kim and de Dear 2013; Bernstein and Turban 2018), but the present study extends it into a context where the costs of acoustic disruption are professionally and ethically specific, thereby affecting not only individual productivity but the quality and confidentiality of student-facing interactions. Academic staff are not merely knowledge workers; they are also educators, advisors, and examiners whose professional responsibilities require spatial conditions that generic office design models do not routinely provide.

The finding that participants rejected superficial nature simulation while responding positively to authentic ecological integration importantly advances the biophilia literature. Wilson's (1984) biophilia hypothesis and the Kaplan and Kaplan (1989) attention restoration theory predict benefits from nature contact, but they do not specify the degree of ecological authenticity — that is, the extent to which a nature-derived element functions according to genuine ecological principles rather than merely resembling nature in appearance — above which these benefits are reliably activated. This study suggests that this threshold is not trivial: form-level nature referencing (artificial plants, nature imagery) may fail to deliver the restorative benefits associated with genuine ecological engagement.

This has practical implications for how biophilic design is implemented and evaluated and provides an empirical argument for process and ecosystem-level biomimetic strategies over decorative nature referencing.

The theme of limited personal control surfaces a dimension of the workspace problem that remains undertheorized in the design literature. Elsbach and Pratt (2007) establish the significance of workspace marking for professional identity, but the institutional mechanisms that restrict this marking, facilities management protocols, estates procurement structures, and standardised fit-out policies, have not been examined empirically in academic settings. This study provides evidence that these mechanisms are experienced not merely as inconveniences but as institutional signals of indifference. Read through a responsible design lens, the capacity to exercise control over one's immediate working environment is not incidental to well-being but constitutive of dignity at work, and its uneven distribution across staff groups is itself a matter of institutional equity. If participatory design processes (Sanders and Stappers 2008) are to deliver the sense of psychological ownership, the felt sense that one has agency over and investment in a space — that the literature predicts will support well-being and motivated engagement- they must address not only the design brief but the institutional culture that governs ongoing workspace use.

A rigorous assessment of the Biomimetic Design Translation Framework requires acknowledging its limitations. The mapping from empirical need to biomimetic strategy necessarily involves interpretive judgement: the claim that termite mound ventilation logic applies to academic offices, for example, is plausible but not proven. The framework does not establish causal pathways; it proposes

design hypotheses grounded in user evidence and biomimetic precedent. Evaluation of these hypotheses requires post-occupancy studies in which biomimetically redesigned spaces are assessed against the needs identified in this study. Additionally, the framework does not account for the political economy of institutional design decisions: heritage building constraints, capital budget cycles, estates procurement frameworks, and sustainability commitments (such as BREEAM certification) all shape what is achievable, and future work should examine how biomimetic strategies can be pursued within these constraints rather than assumed to be unconstrained choices.

Several limitations of the study must be acknowledged directly. First, the sample is drawn exclusively from UK universities; findings may not transfer to academic workspace cultures in other national contexts, which vary significantly in building stock, institutional cultures, and space standards. Second, the study relies entirely on self-reported data. Participants' accounts of their workspaces reflect perceived experience rather than objectively measured environmental conditions; acoustic levels, thermal performance, and daylight access were not independently measured. Third, participant distribution across departments was structured for disciplinary diversity but not stratified by gender, career stage, institutional type, or building age, variables that may influence workspace experience and that future studies should systematically examine. Fourth, the reflexive thematic analysis, while conducted with multiple-coder checking and an audit trail, reflects interpretive choices that other researchers might make differently; the framework presented in Table 4 is one defensible mapping, not a uniquely correct one.

Conclusion

This study makes three contributions. Empirically, it provides a detailed, cross-disciplinary account of the spatial and environmental challenges experienced by academic staff in UK university offices, grounded in thirty qualitative interviews and organised through rigorous thematic analysis. Conceptually, it advances the distinction between biomimetic design operating at the levels of natural process and ecosystem emulation and surface-level biophilic treatment, arguing that the functional complexity of academic work requires the former. Practically, it proposes the Biomimetic Design Translation Framework, mapping empirically identified user needs onto nature-inspired design strategies as an evidential foundation for subsequent design development.

The findings confirm that the challenges facing academic workspaces are structural: they reflect persistent misalignments between institutional design logic and the demands of academic labour that neither incremental refurbishment nor surface-level greening will resolve. Framed as a matter of responsible design, these are not only questions of comfort and performance but of who within the institution is afforded dignified, restorative working conditions and who is not, making their resolution a question of institutional equity as much as design quality. Addressing them requires both better design and different design processes ones that treat academic staff as co-producers of spatial knowledge rather than passive occupants of standardised environments.

Future research should proceed in three directions. First, post-occupancy evaluation of spaces redesigned according to biomimetic principles measuring acoustic performance, thermal comfort, daylight

access, and self-reported well-being would provide the outcome evidence currently absent from the literature. Second, the framework should be tested and refined through participatory design workshops with academic staff and estates professionals, examining its practical applicability within real institutional constraints. Third, the study should be extended to non-UK contexts and to under-represented staff demographics early career researchers, professional services staff, and those with disability-related workspace requirements to examine the generalisability and equity implications of biomimetic, responsible workspace design.

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