

Research



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A mindful body approach to creating architecture: movement, models and spatial experiences

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If architecture is an expression of human creativity through multi-sensory embodiment, then learning, creating and experiencing architecture should also be multi-sensory and embodied. In this article, we challenge the separation of mind and body through Sheets-Johnstone’s mindful bodies concept. We define a mindful body in architecture as one that documents, analyses and memory maps the moving body in different qualities of movement to create diverse spatial experiences. A mindful body approach to creating architecture involves: (i) engaging in meaningful movement and documenting the body, (ii) documenting embodied interactions with dynamic, animate elements in the built environment, (iii) connecting our body’s movements with emotions and memories, (iv) designing spaces that produce diverse movements and atmospheres, and (v) designing architecture based on these spaces. We hypothesize that if designers engage in a mindful body approach to design, they can create spatial experiences that help us make sense of ourselves, others and the world. A mindful body approach to design can result in architectural spaces that activate our attentional switches, connect haptic experiences and memories and reveal wonders.

This article is part of the theme issue ‘Minds in movement: embodied cognition in the age of artificial intelligence’.

1. Introduction

The aim of this article is to demonstrate the potential for architectural design when we privilege embodied experiences and interactions as devices in the design process. Using three architectural elements as provocations and interlocutors—staircase, door and window—we explore the mindful body’s action possibilities and affordances and present three explorations in embodied architectural interaction. Our development of understanding combines visual documentation, analytic drawings, reflection and study of our experiences and design proposals.

In the sixteenth century, architect Leon Battista Alberti differentiated architects from builders. He positioned architects as those who externalize ideas onto paper through sketches and materialize buildings through representations and instructions of the mind, i.e. drawings [1]. Builders, on the other hand, he positioned as those who physically engage with materials in acts of labour and construction. One materializes through representations of materials in the mind, while the other materializes through physical engagement with materials and the body. In the nineteenth century, there was an additional development with foundational architectural training and education comprising the representation of three-dimensional (3D) shapes and spaces in two dimensions [2]. Not the physical construction of buildings, but abstract construction through geometry. The separation of architects from

physical materials and construction and the abstraction of materials and space through geometrical drawings aligned the profession with the mental through vision, erasing embodied experiences of tactility, sensoriality and materiality [1,3].

In some countries, architectural education involves engaging in building crafts and construction to tie those realities with the abstraction of the same in the profession [3]. Twentieth-century architectural education involved the externalization of ideas and instructions through embodied acts such as hand-sketching, drawing with T-squares and rules on horizontal boards and building physical models by cutting, forming and assembling materials. Research tells us that sketching and diagramming serve as cognitive tools that can visually augment information processing and convey spatial ideas [4–6]. Today, however, computers and other digital technologies are part and parcel of technologically focused architectural pedagogy and practice. Computers and software are used to produce two-dimensional (2D) and 3D drawings, build digital 3D models, render design ideas and—more recently with generative AI tools—to imagine design possibilities and impossibilities. When it comes to acts of making, digital tools like 3D printers can materialize 3D digital models and laser cutters can cut 2D materials, which are then assembled to bring the architect's ideas into 3D scaled form. The unquestioned proliferation of digital tools and methods in the architecture studio can modify our embodied experiences in the design process. These 'technological extensions of the eye' further distance students and designers from tactile and sensuous understandings of materials and the environment by privileging vision over other senses [7].

In this article, we challenge the separation of mind and body through Maxine Sheets-Johnstone's mindful bodies concept with mind as a function of body [8]. We also address overreliance on visual engagement in the architectural design process, which occurs at the expense of other bodily senses. We argue that architecture is an expression of human creativity through multi-sensory embodiment and that learning, creating and experiencing architecture should also be multi-sensory and embodied. We hypothesize that if designers engage in, document and analyse their moving bodies in meaningful interactions with the built environment during design, then they can create rich spatial experiences.

2. Background

(a) Mindful bodies and movement

Scholars increasingly challenge the mind–body separation of cognition to argue for and empirically support an embodied cognition perspective grounded in the body and its movement. Philosopher, scholar and former dancer Maxine Sheets-Johnstone has written extensively on bodily movement, meaning and experience. She has long theorized that animate beings learn about themselves and the world by moving in it and engaging in meaningful movement [9]. Sheets-Johnstone calls a body that is thinking in movement a 'mindful body', and she shows how meaning motivates and informs our movement [8]. She points out that movement ought not to be thought of as a change in position, but instead an 'experientially anchored dynamic', unfolding moment by moment [9]. In addition to establishing that movement—not vision—enables perception, Sheets-Johnstone defines four primary qualities apparent in movement: tensional, she defines as the intensity of our movement; linear as the overall direction of our movement; areal pertaining to movement size or area; and projectional, that is, how movement is made evident [9,10]. She also describes some spatial qualities created by movement: resistant, angular, yielding and circular [11]. Her conceptualizations of mindful bodies, qualities of movement and spatial qualities are very much connected to architecture. First, as animate beings, not only do architects move to learn, but we also draw to learn about the world, understand it and manipulate it [12,13]. Architects think and engage in meaningful movement in drawing. Second, if we (architects) engage in meaningful experiences and understanding of movement qualities, then we can design (analysis and synthesis) with these in mind. Third, architects design spaces that we inhabit and move through; therefore, experiencing, learning and designing with spatial qualities are important in architectural education.

(b) Architecture and cognition

Scholarly investigations concerning the relationship between architecture, cognition and psychology have been published in the social and cognitive sciences and architecture. Most have focused on the effects of and the relationship between existing buildings and humans. Little has been written on the relationship between bodies and cognition when it comes to designing architecture, that is, regarding its creation through abstraction.

Finnish architect and theorist Juhani Pallasmaa has long argued for a return to multi-sensory, embodied approaches to designing, experiencing and engaging with architecture and the world [3]. In 'eyes of the skin', Pallasmaa [7] bemoans the 'suppression' and 'flattening' of the sensory capacities of architectural designers because of reliance on computer imaging. He argues that the act of design involves haptic contact and experience through drawing and making physical models by hand. Pallasmaa contends that our senses can measure architecture through touch, sound and movement and that our perceptions and understanding of the world are strengthened through them. Pallasmaa, American architect Steven Holl and Mexican-born architectural historian and theorist Alberto Pérez-Gómez ascribe the 'wisdom of the body [as being] stored in [its] haptic memory' [14]. Wisdom and memory can be created through the sound of spaces, the feel of materials, an awakening of consciousness through movement and our attempts to understand how architecture was constructed [14,15]. We endorse these arguments and further assert that architecture ought to emerge from haptic, sensual experiences with elements of architecture and the built environment.

Columbian-born architect and computational design scholar, Daniel Cardoso-Llach, traces histories of computing and notes the social and material distance of architects from the world [1]. He posits that computer-aided design (CAD) systems have

increased social and material distances by privileging vision as a means of acquiring knowledge from and about the world [1]. Both Pallasmaa and Cardoso-Llach note the passive engagement of the architect with the material world, their imagination of materials as ‘passive recipients’ of design [1] and the view of the design process as ‘passive visual manipulation’ [7]. We add that these imaginations of the design process distance us from embodied ways of knowing through multi-sensory experiences and prevent us from situating ourselves as socially, materially and corporeally conscious participants. In other words, these imaginations increase our corporeal distance from the physical world.

The interdisciplinary team of Jelić *et al.* [16] in their enactive approach to studying architectural experience discusses ‘activating the attentional switch’ of the body for conscious experiences of settings and self. They remind us that one’s engagement with architecture and the built environment depends on the kind of body one inhabits. Different bodies and identities might involve age, gender, ailments, race and disability, to name a few [17]. Recent scholarship in design and computation has been reconnecting bodies with design to decrease the social, material and corporeal distance between the architect and the real world. By exploring questions of design and technology through embodied practices in craft, culture and society, the work includes generating architectural form from dancing sculptures; creating research frameworks that facilitate sensory, perceptual and material interactions; and centring embodied knowledge in pedagogy [18–20]. We argue that without an awareness of our bodies, how we manoeuvre them and their affordances, architectural designers risk creating spaces that are desensitized and uninformed about bodily movements, perceptions and experiences.

Pérez-Gómez [2] in his work on perception, emotional and meaningful spaces offers the term ‘poetic disclosures’ to describe the potential of architecture when we search for wonders to reveal. We also understand it to mean prospects for spatial experiences of architecture that reveal or reawaken our social, sensual and material perceptions and experiences of the world. One example is the Bruder Klaus Field Chapel in Mechernich, Germany, which was constructed by local farmers. The chapel’s thick, highly textured concrete interior of charred walls tapers as they go up, revealing and framing times of day and seasons through an opening in the roof that lets light and the climate in. Another example is the Thermal Baths in Haldenstein, Switzerland, with its thick, smooth stone walls and floors, interplays of light and shadow, rippling reflections and sounds of water and atmospheres of colour, light and steam. Both projects were designed by Swiss architect, Peter Zumthor. These poetic disclosures, we reason, can be awakened by activating our ‘attentional switches’ in the design process through self-produced movement with physical elements of architecture [16].

Pérez-Gómez [21] argues that the legibility and understanding of architecture depend on ‘acknowledging habits and framing them in new settings’. We would add that if we are unconscious of the habits, actions, rituals, movements and haptic experiences of bodies (ourselves and others), then our understanding of architecture and the world cannot be reframed for explorations in new settings and experiences. Pérez-Gómez also asserts that meanings in architecture are communicated through sound, silence, tactility, materiality, atmosphere and all our multimodal senses. We extend this position and suggest that during the design process, when architecture has not yet been physically materialized, meaning is found and conveyed in acts of sketching and drawing, and through interactions with materials, building digital and physical models, creating collages, atmospheric explorations with models, renderings and more. These actions inform rituals and meanings in the creation of architecture [22].

(c) Movement and cognition

Richard Held & Alan Hein [23] conducted an experiment to test the relationship between development, movement and visual stimulation. In the experiment, newborn kittens moved about in ‘an illuminated and patterned environment’ while attached to a carousel. One set of kittens (set A) could walk and move on their own in different directions as determined by the carousel. When set A moved, they would pull another set of kittens (set B) that were restrained from moving on their own by being held in a case that allowed them to only move their heads. Visual developments of set A, actively moving, were compared with that of set B, passively moving and interacting with their environment only through vision. The results showed inadequate visual development of set B, demonstrating that active movement and engagement with the environment are required for perceptual development [23]. This and many other studies show that our tools, skills and environment modify perception [2,24]. We surmise that passive engagement with architecture that privileges vision and screen-based interactions with images risk architectural, corporeal and spatial blindness, resulting in deficient perceptual and spatial skills that are essential for poetic discoveries and disclosures in the design process.

Ireland & Garnier [25] describe architecture as a ‘product of behaviours’. If perception and cognition depend on interactions, if architecture provides the ground for perception and understanding of the world and is a product of behaviours and actions, then interactions and behaviours with the built environment are also precursors to architecture and ought to be engaged with for its creation [7,25,26]. Understanding embodied cognition is important for how we learn, the environments we create and live in, our health and our well-being. With increasingly disembodied ways of engaging with the world through 2D screens and 3D digital worlds that privilege vision while squelching other senses, this work contributes to our understanding of knowledge acquisition with and through architecture, design and our built environment. This article also contributes to interdisciplinary research investigating the relationship between architecture, cognition and psychology. In the following section, we describe the studio setting and the project.

(d) The architectural design studio

Our setting is a School of Architecture in a technologically focused university without a visual or performing arts programme in the United States of America. Students here have access to computers with the latest CAD software and digital fabrication

machines such as 3D printers and laser cutters. Design studios are central to architectural education it is here that students usually spend most of their time. Studios are social learning environments where students learn through drawing, physical and digital modelling, one-on-one discussions with instructors, chats with fellow classmates, curation and presentation of their work for feedback from instructors, peers and guests [27–29]. Students are usually given a design problem or prompt and creatively explore a proposal that responds to it. In §2e below we describe the prompt for the ‘Mindful Bodies’ studio.

(e) The Mindful Bodies studio

The ‘Mindful Bodies’ studio project challenged the erasure of bodies and separation of mind from body. The studio brief in part stated, ‘People’s cultures, histories, communities, creativity, and knowledges have been erased, devalued, and framed as less valuable than the mind. Movement is part of many cultures’ expression, resistance, creativity, and joy. [...] In this studio, we will be designing from our bodies, for bodies, such that our mindful bodies are seeds from which our architecture emerges [...] as a powerful tool and vessel to shape others, shape histories, and shape society. Bodies are essential, yet strategically denied, hidden, and erased. [...] How can our body’s movement, action, and perception lead to new realms of architecture and architectural experiences? How might consciously engaging with, confronting, and analyzing bodily movements with the built environment yield spatial experiences that help us make sense of ourselves, other humans, and the world? In this studio, you must move to analyze design, you must move to represent your interactions, you must move to perceive and experience architecture and space, you must move to know your affordances’. Students had to design architecture based on meaningful interactions and bodily engagements with a staircase, a door or a window. Three of the authors participated in this studio.

3. A mindful bodies approach

We sought to find answers to our questions about the connection between moving bodies and meaningful interactions in the design process and their link to spatial experiences by creating a series of exercises. The term ‘choreographic objects,’ first defined by dancer and choreographer William Forsythe and colleagues, was a main conceptual underpinning for the studio [30]. Forsythe *et al.* define choreographic objects as ‘objects that produce distinct classes of action and behaviors in the visitor’. The Mindful Bodies studio riffed on and framed exercises around this concept.

(a) Exploration: movement + drawing

The first exercise asked students to engage in some form of movement and document their bodies. They were encouraged to have fun, be reflective, athletic, to push their bodies to unexplored limits, be at rest, be relaxed, get to know their body’s capabilities, what it sees, how it is seen and how they see it. They were to document their bodies in plan and elevation using photos and drawings, and if possible, where they were looking. The goal was to practise documentation, diagramming, representation and analysis of their bodies and movements with images, videos and drawings from a third-person perspective [11]. Drawing is a memory aid that allows perceptual experiences to be recalled [31,32]. In this exercise, they would learn and practise different ways of depicting the body and its motion and begin to understand the complexity of the problem that informs their next steps. By analysing their body’s movements through drawings—a third-person perspective—they could become aware of its dynamics and understand it [9].

In the first example, the participant took photos of their body in different poses and explored several ranges of motion. They then diagrammed the spaces between their arms and legs (figure 1). In the second example, the participants video recorded themselves painting with both hands and feet (figure 2). Black paint marked moving feet, while white paint marked moving hands. They moved their body randomly until the canvas was filled with paint strokes. They then exported frames of the video as images into CAD software (Rhino 3D, <https://rhino3d.com/>) and traced abstract representations of their body onto the images. The drawings contain arrows indicating movements of the head, hands and feet from previous to new positions. In the third example, the participant first recorded their body in yoga poses, then recorded it moving from one yoga position to another (figure 3). Frames from the video were exported as images into Adobe Photoshop, and movements of the right leg and right hand were traced as their body moved from one position to the next.

(b) Choreographic spatial elements

The second exercise involved measuring, parametrizing and interacting with an architectural element—a staircase, door or window. These elements were chosen because of their physicality and their ability to create dynamic actions and behaviours. Students would document and diagram their bodily movements, gestures and perspectives while engaging with one of the three elements. They were instructed to contort their bodies to interact with and perceive the element and space in new ways and perspectives outside the norm. This included varying the parameters (height, width, thickness, location, etc.) of their element and then envisioning how their bodies might interact with it. Again, they were to document the elements and their movements with them from multiple views with images and drawings. These drawings, created with CAD tools (Rhino 3D) for

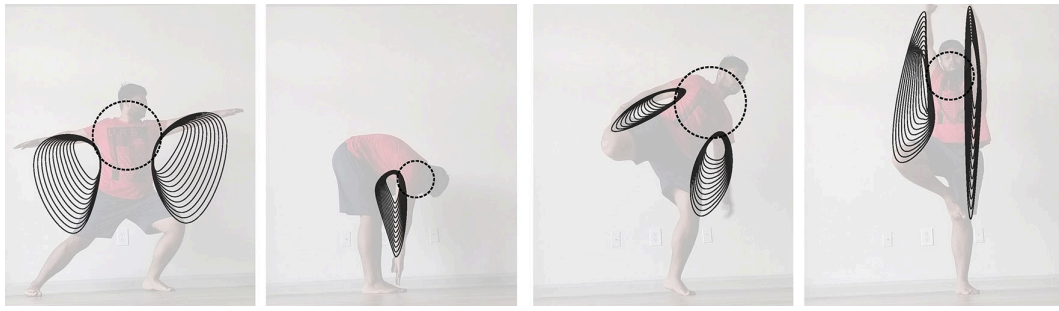


Figure 1. Photos of self-moving and posing body, with drawings marking the spaces between arms and legs.

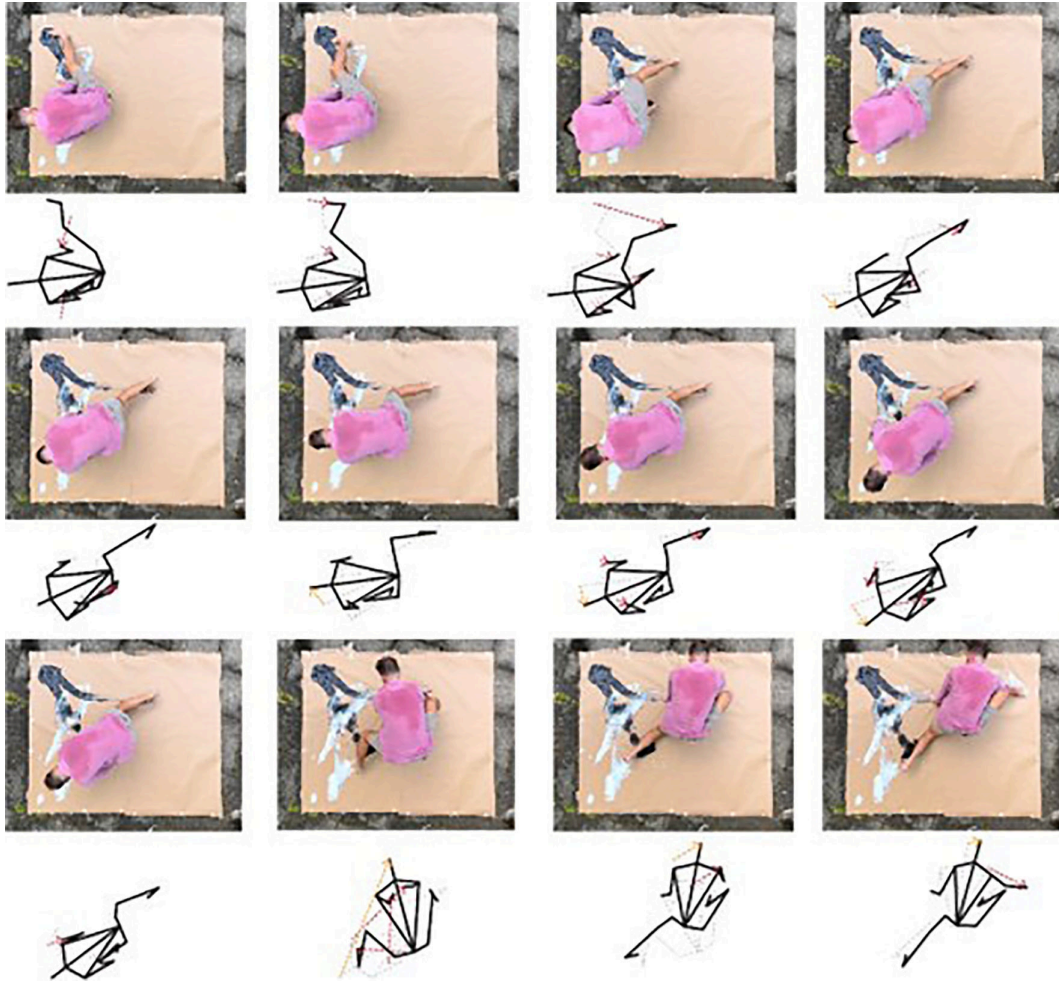


Figure 2. Creating painting with hands and feet, then drawing the body and its transitions between movements.

consistency, would serve as models for examination, evaluation and exploration. Students would engage in abstraction, active scrutiny and interpretation by developing these drawings, simulating and conducting experiments with the precision offered by CAD software. These drawings (models) allow understanding, experimentation and insight into the body's processes and the complexity of the problem [12,33,34]. By varying the parameters of the elements, students could engage with them as animate things to be manipulated in relation to the body's movements [35]. These drawings would encourage experimental thinking with body and moving architecture, transforming the static into a dynamic, animate one [35].

(i) Staircase

The participant interacting with the staircase video recorded their movements walking up and down the stairs. After walking up and down normally, they decided to walk backwards down the stairs (figure 4). By doing this, they activated their 'attentional switches', allowing a conscious experience of the staircase and their body [16]. They constantly turned their head left and right to remain aware of their surroundings. They also reached for the stair railings for support after almost tumbling. Because they were navigating the stairs backwards, they constantly recalculated their movements, thinking consciously and differently about the stairs.

To produce analytical drawings of the movements, they first drew a side view of the staircase with Rhino 3D and then exported multiple image frames of the movement. They selected all frames where their feet touched the stair tread and traced

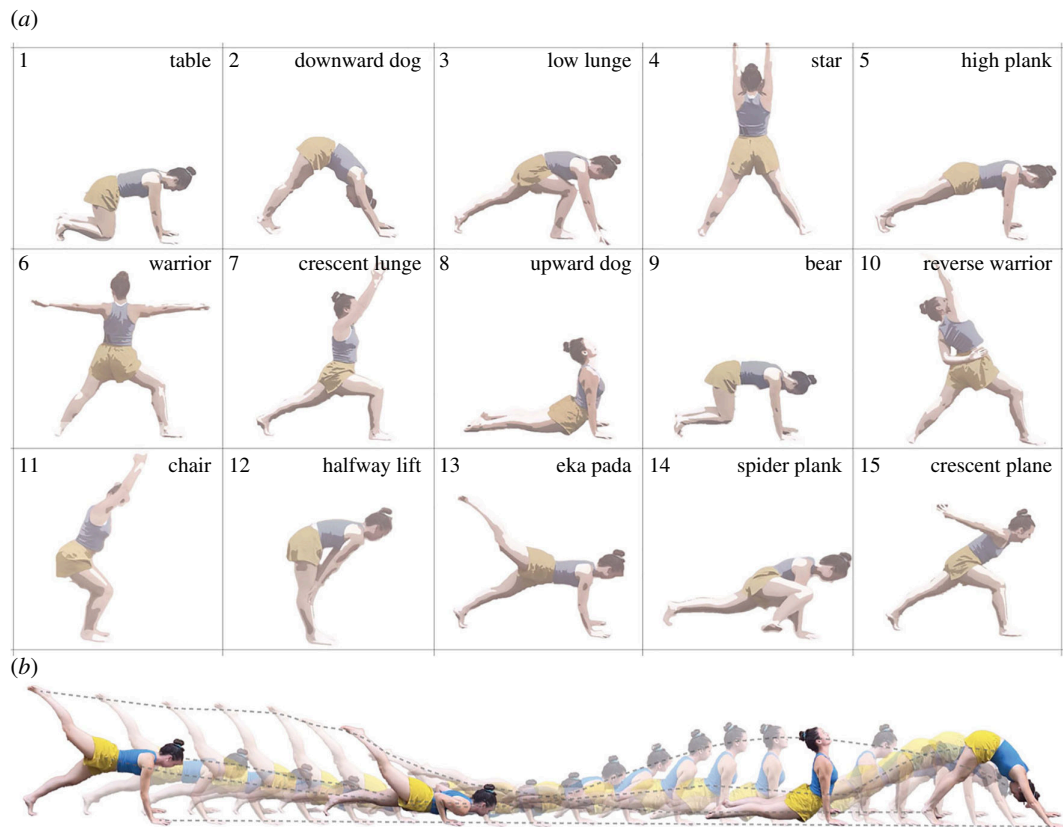


Figure 3. (a) Photo documentation of participant's body in yoga poses. (b) Diagram tracing right leg and hand as they move from one yoga pose to another.

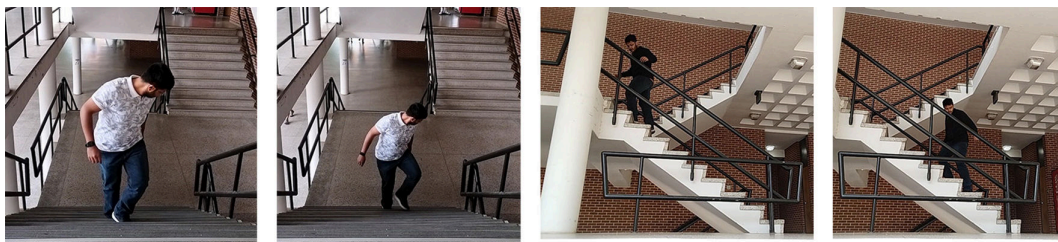


Figure 4. Participant walking backwards down the staircase.

their body's profile (figure 5). They chose to trace the body's silhouette rather than its skeleton to make visible its size. Then, using the navel of the body as an approximate datum, they translated these outlines to a horizontal plane to examine positional changes in the head, hands, legs and centre of gravity (figure 6). In zone 1, their body was in a relaxed state leaning forward to maintain balance going down the stairs. In zone 2, their hand opened and reached out to the railing for support. In zone 3, they were relaxed, while in zone 4, they were constantly looking behind to avoid falls or collisions. In zone 5, their body was again in a relaxed state. Their actions and interactions included leaning, twisting, climbing, slipping, reaching and balancing.

(ii) Door

In this second case, the participant selected a bi-fold door that forms the entry to a small phone booth (figure 7). They measured their body, the door, the phone booth and its furniture, then digitally modelled them all in Rhino 3D. Their movement with the door was video recorded in both plan and elevation. The participant first built a 3D drawing (model) of the booth with their body standing in front of the closed door (figure 8). Each subsequent drawing—a total of 25—was made by copying the drawing before, then drawing the new position of the door and manipulating the body's joints and limbs to match their locations in the videos (figures 8–10).

Figures 8 and 10 are analytical diagrams (models) of the body interacting with the bi-fold door and the booth in axonometric, plan and elevation views. While these figures hint at an elongated linear movement quality of the body as it interacts with the door, in reality, it is a small areal one.

Given the small size of the phone booth, the locations and heights of its bench and desk, when the participant stepped forward into the booth, they had to turn their body to prevent their knees from getting in the way of the door. Actions and interactions included turning, pushing, folding, sliding, twisting, lowering, spinning, leaning, pulling, shifting, balancing and extending. The participant experienced the booth as a space of constraint.

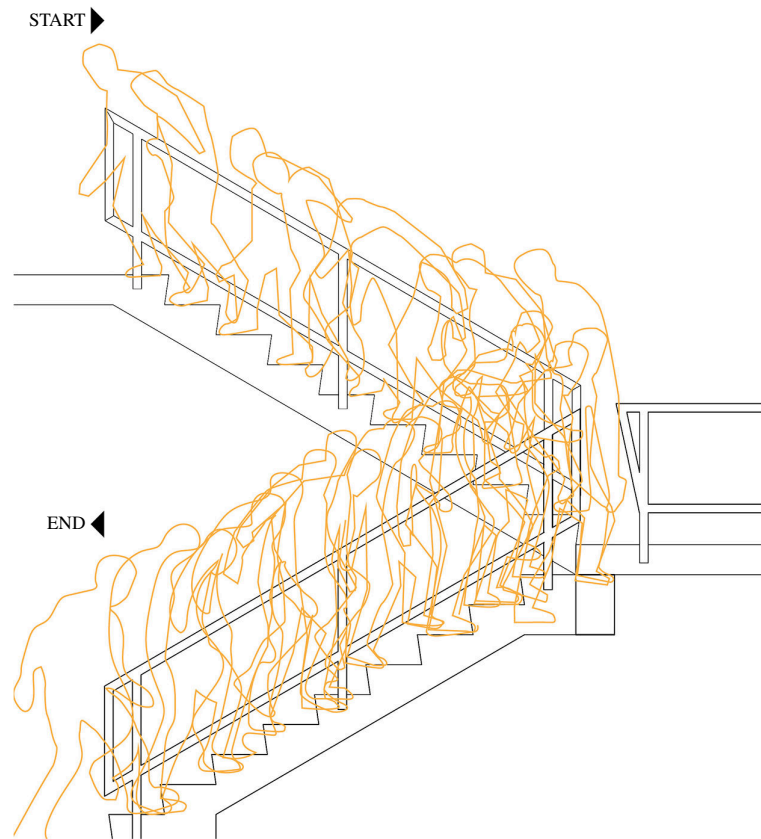


Figure 5. Drawing documenting the body's movement and positions while walking backwards down a staircase.

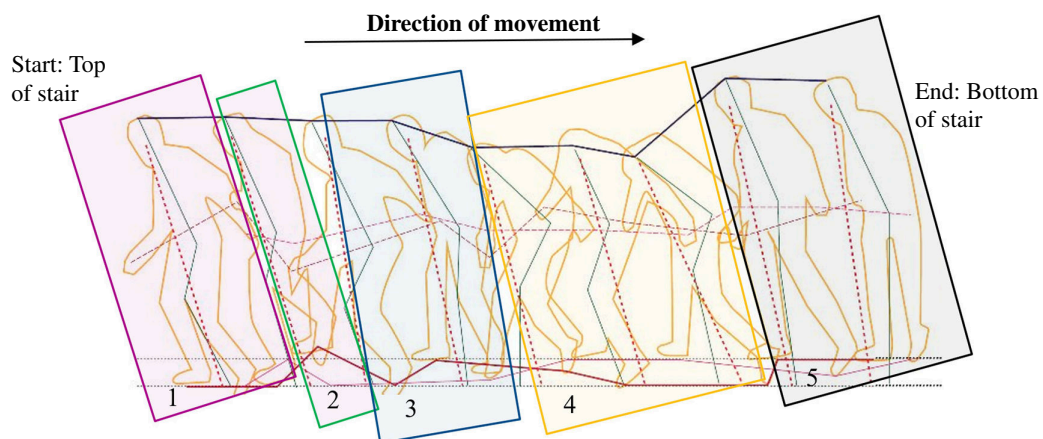


Figure 6. Analytic drawing of body movements while walking backwards down a staircase.



Figure 7. Images of interaction with bi-fold door and phone booth.

(iii) Window

In the third case, the participant interacted with an operable window. They photographed their body's movements from the side with each photo approximately 1 s apart. Rather than merely opening the window with their hands, they also opened it with their knees, head, elbows and feet (figure 11). They moved in a slow, deliberate manner to be mindful of their experience and to think in the moment as they interacted with the window in these new ways. After photographing their movements, they imported the images into Rhino 3D and traced the window and their body. Then, using the digital models, they experimented with moving the window to different heights and locations in the wall. They enacted how their body would move and interact

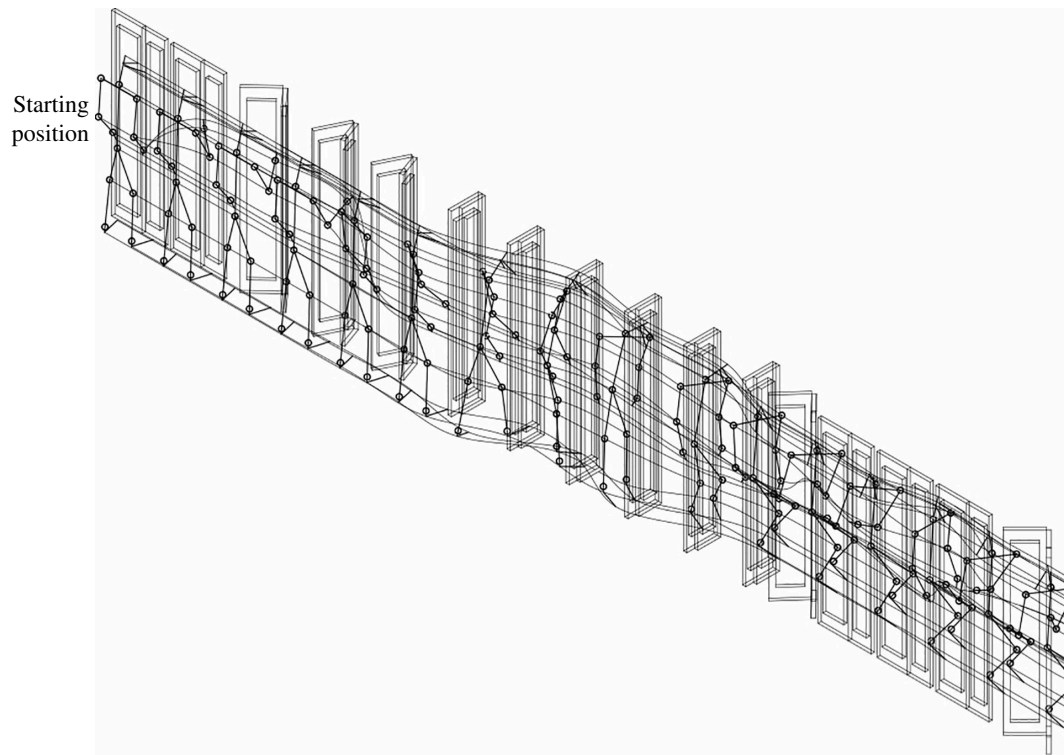


Figure 8. Axonometric drawing of participant's body and hands pushing bi-fold door to enter a phone booth.

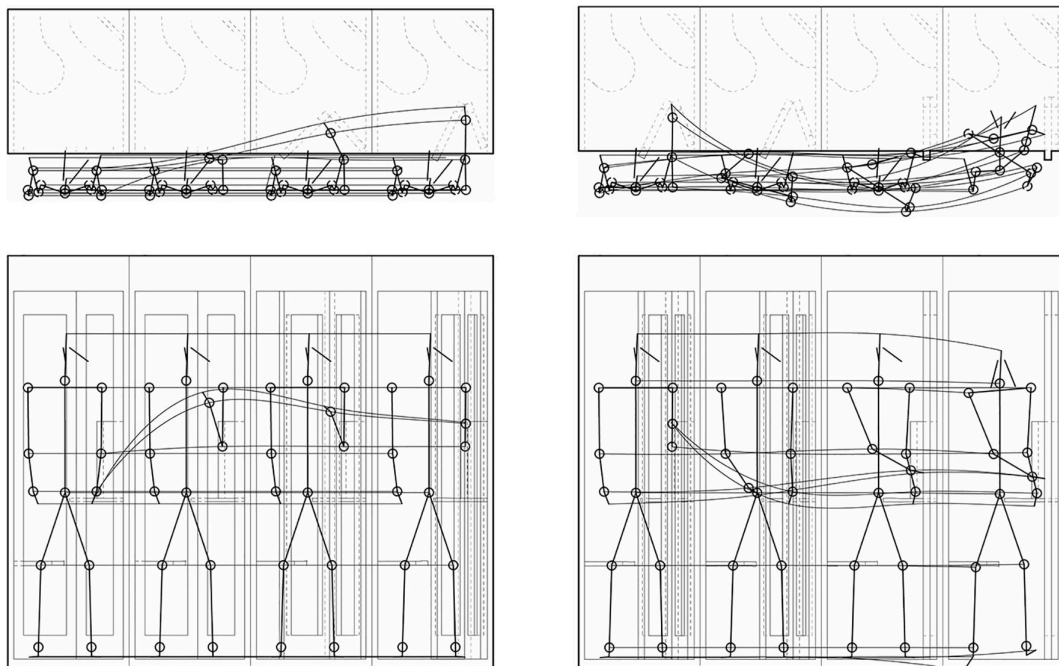


Figure 9. Plan and elevation views of interactions between body and bi-fold door to the phone booth. Lines connect the movements of joints and the head in the process.

with the window in these new positions and then diagrammed their speculations of these movements (figure 12). By doing this, they treated the building as animate, able to be manipulated through their imagination [35]. Actions and interactions with the animate window included leaning, reclining, pushing, climbing, reaching, bending backwards, balancing, crouching and laying.

(c) Embodied memory mapping

In the third exercise, students participated in a movement workshop led by a dance artist, scholar and embodied memory mapping expert from another university [36]. Dr. Johnson's work is grounded in four premises: that memories live and move in our bodies; that our bodies draw on sense perception to access embodied memory; that we more deeply understand ourselves and each other by mapping and sharing embodied stories; and that emphatic connections result from these understandings. The

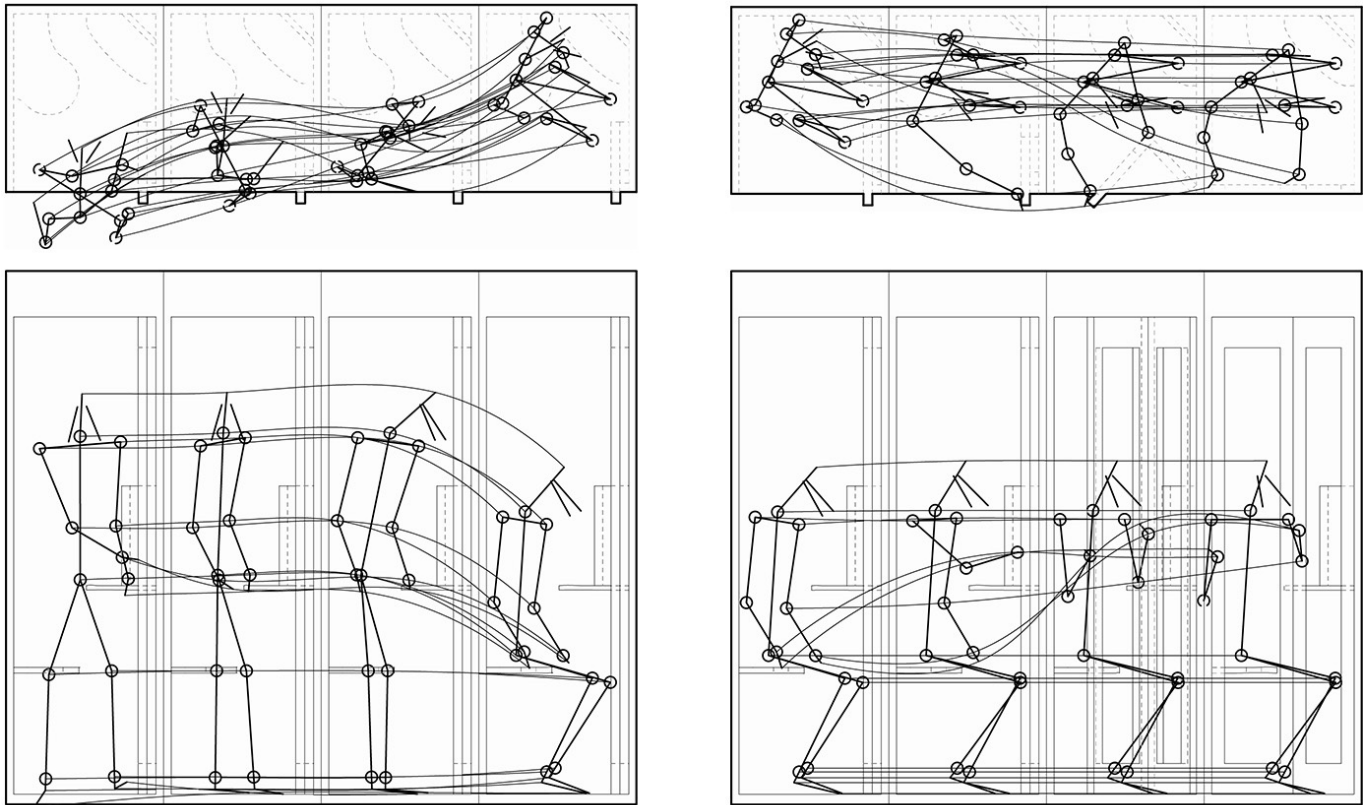


Figure 10. Plan and elevation views of engagement with the door while moving to sit. Lines connect the movement of joints and the head in the process.



Figure 11. Participant sitting on a chair and opening the window with their feet.

expert taught students how to connect with, describe and share their emotions and memories through improvisation, memory exercises and movement [37–39].

For the participant connecting emotions and memory through a staircase, memories of them hiking to the summit of the Himalayan mountain range came to mind. They crouched to convey exhaustion and opened their eyes wide to communicate feelings of joy, thrill and physical pain upon reaching the top. Emotions and memories with the bi-fold door to the phone booth involved feelings of confinement and claustrophobia for the participant owing to the compact, dark and somewhat uncomfortable space. They also felt joy from memories of phone calls with loved ones. The exercise also made them aware of how difficult it would be for certain different bodies to interact with the door and the phone booth. Entering, sitting in and exiting the booth through the door required certain abilities and privileges of movement not accessible to everyone. For the participant moving with the window, memories and emotions involved seeing snow for the first time, the warmth of blankets, coldness, voices, smells of cooking and excitement.

(d) Choreographic rooms

In the fourth exercise, students had to create rooms of various sizes from and for rituals, movements and behaviours [30]. The goal was to use their body's movements, positions, experiences and interactions as spatial design devices to create rooms for the collection and exhibition of objects of their fascination. The room as a scale was chosen so that students could focus on their bodies, their movements and interactions with their objects at multiple scales of intimacy before designing buildings with increased programmatic, material, structural, scalar and tectonic complexities. The resulting spatial and movement qualities and embodied experiences would then be used to inform their final architectural designs.

(i) The staircase, cubes and making sense of ourselves

In this exploration, the participant was fascinated with cubes. They 'collected' hollow cubic volumes of multiple sizes that could be inhabited, traversed and hold tangible and intangible elements. They started by creating a series of squares (cubic voids) and placed their body positions from the analytical stair drawings (figure 6) into these spaces to communicate experiences of inclination, disorientation, uncertainty and mystery (figure 13).

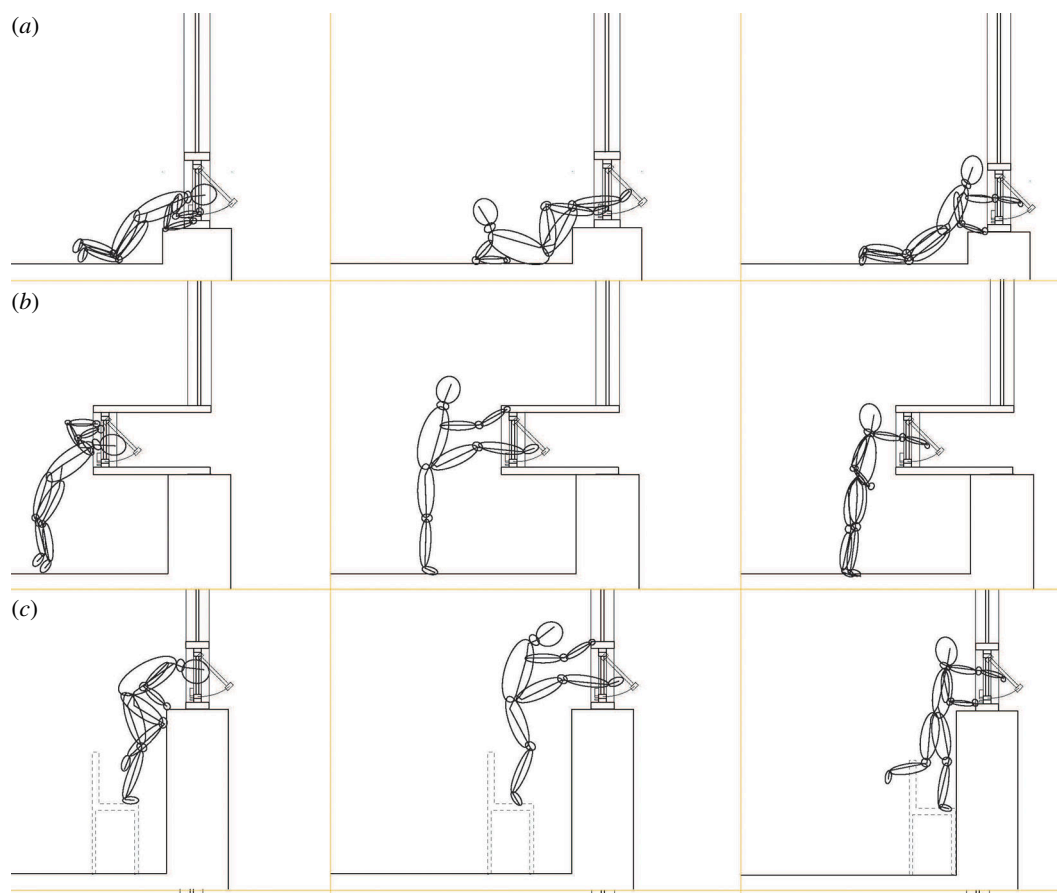


Figure 12. Speculative drawings of how the body's head, legs and hands might open a window (a) when it is a short distance off the ground, (b) when it is a standard distance off the ground but protruding into a space and (c) when it is higher off the ground than usual, such that one needs a chair to help (c).

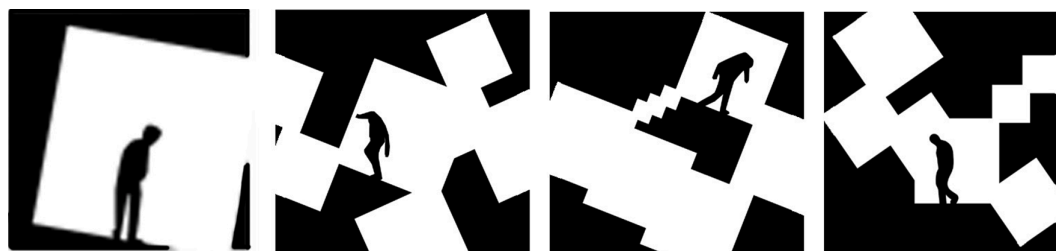


Figure 13. Collection of cubic voids and spatial explorations of mystery, disorientation and imbalance.

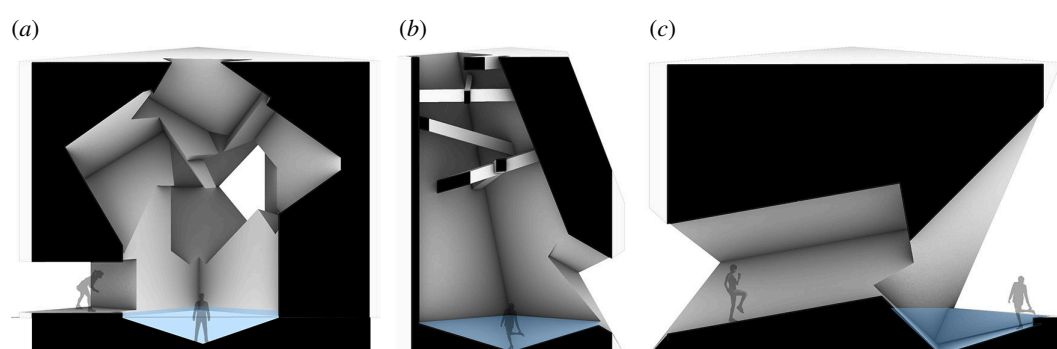


Figure 14. Choreographic rooms based on embodied engagements and interactions with a staircase.

The participant further developed these ideas by digitally modelling a series of carved spaces and proto-atmospheres (figure 14) with affective characteristics of light, shade and shadow [40]. Movement qualities are tensional, linear, areal and projectional. In one experience, the body crouches to enter a low space that leads to another with sloping floors filled with water (figure 14a). Bodily experiences associated with that sequence include crouching, standing, sliding and surprise. To grasp the experience of light and shadow, depth and reflections of the water rippling on the ceiling above, the person must step into the water or crouch at the edge of the tunnel. The areal design of the movement to enter is contractive. One space is compressive, while the other is expansive. In a second imagined space, the ground plane is again sloping below water with light

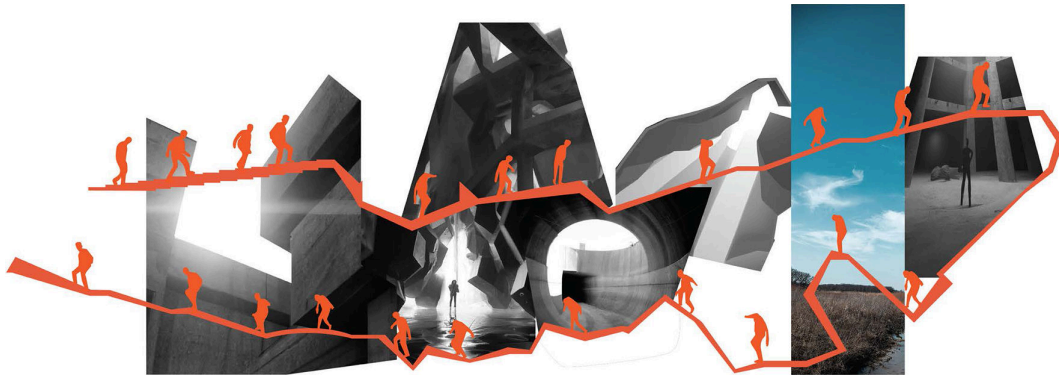


Figure 15. A collage of imagined experiences and atmospheres as the body moves through choreographic rooms based on experience with a staircase.

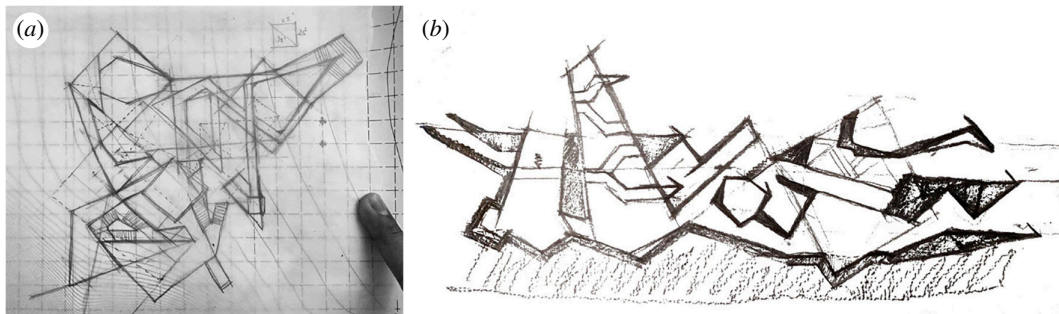


Figure 16. Sketches and drawings by a participant in plan (a) and section (b) to work through ideas.

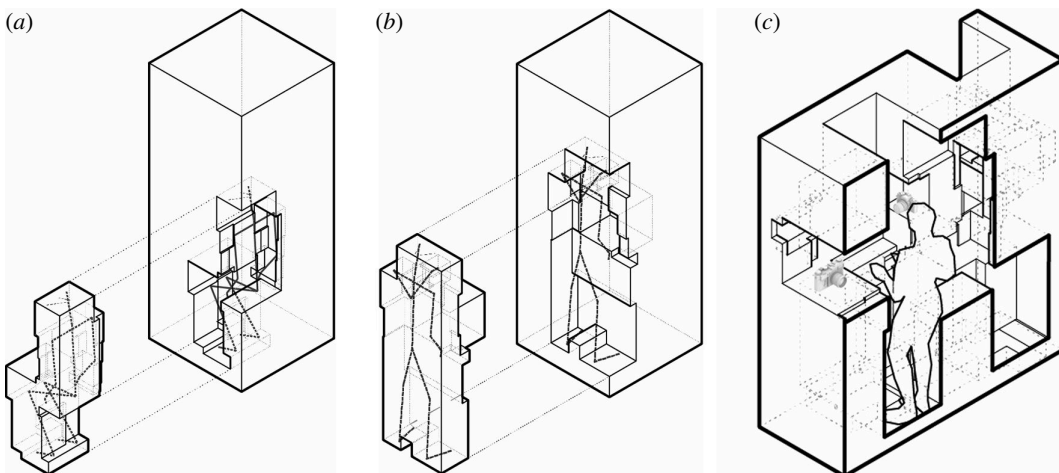


Figure 17. (a,b) Orthogonal masses surrounding body positions in the phone booth then carving out these small volumes from larger ones. (c) Section through choreographic room created by subtracting smaller volumes from a larger one.

entering from above via a tall column of space with beams that create sharp shadows and shapes (figure 14b). In a third space, one ascends an inclined tunnel—linear quality—then abruptly slides down into a pool with sloping floors (figure 14c). This movement has a tensional quality based on the effort and experience of trudging upward, then goes into a projectional one as sliding into the pool may be abrupt [9]. One space has an inclining quality and the other a reclining one. These spaces and their qualities enable different actions, behaviours and qualities of movement. A collage weaving these experiences, atmospheres and choreographic spaces together to arouse muscular and haptic experiences is shown in figure 15 [7]. In figure 16, the participant thinks through their ideas and experiences by sketching and drawing in plan and section.

(ii) The door, cameras and making sense of others

In this second example, the participant was fascinated with antique cameras and created rooms to collect and exhibit them. Their approach involved carving rooms based on the dimensions and movements of the body entering and exiting the phone booth (figure 17). The choreographic room is tightly coupled to positions of the body and small areal movements (figure 17c). While there were tensional qualities of movement experienced by pushing the door open and closed, the proposed space lacks force and dynamism, aligning more closely with the booth rather than the door. We can imagine the body moving in a contractive manner with little if any tensional or linear qualities in this space.

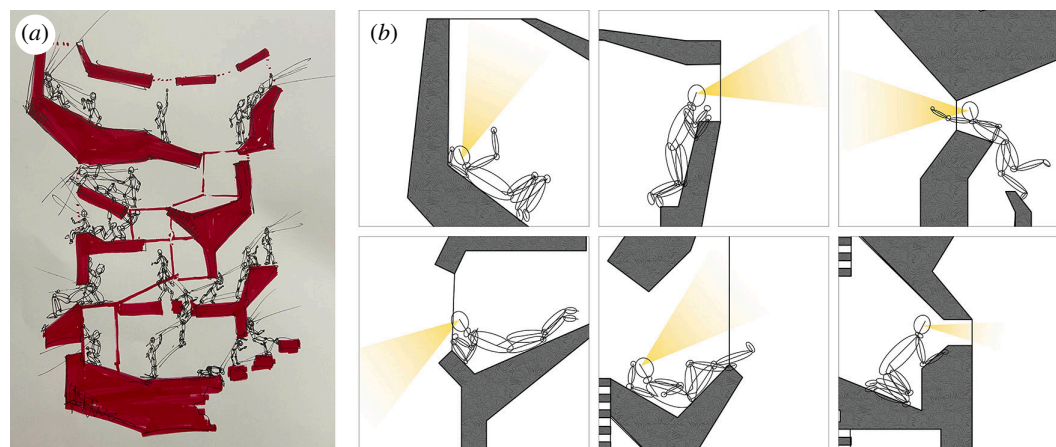


Figure 18. (a) Hand drawing of bodily interactions with a window as the body moves from one position to another to create rooms and interactions with openings. (b) Close-up drawings of the body in rooms and its interactions with openings.



Figure 19. Choreographic rooms based on dynamic body movement, positions and interactions with window.

(iii) The window, rocks and making sense of the world

In this third example with the window, the participant was fascinated with volcanic rocks. They designed rooms to exhibit volcanic rocks by tracing the positions of their body as they moved from one position to the next when opening the window. This included the body at rest, leaning forward and back, looking up and extending (figure 18). To create a dynamic journey, they placed openings based on these positions, allowing architecture to be shaped by moments of rest, reach, contemplation, pivoting and leaning. Sketches in figure 18 hint at tensional and areal movement qualities—tensional from the forces exerted from different parts of the body in opening the window, and areal qualities that are contractual, expansive and intensive, depending on the body part.

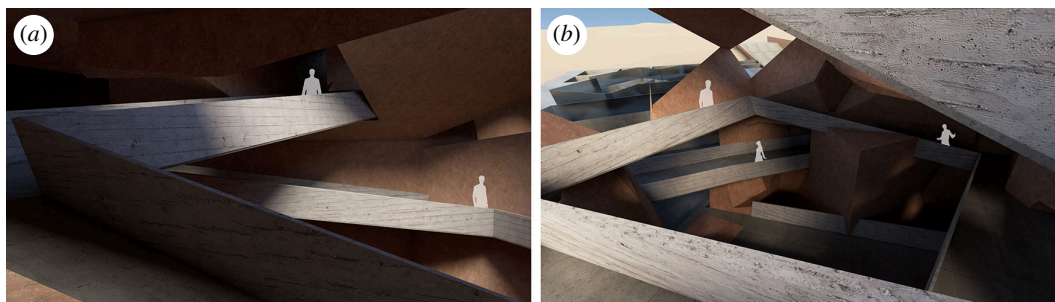


Figure 20. Renderings communicating the atmosphere of the spaces and materials based on the participant's engagement with a staircase.



Figure 21. Renderings communicating the atmosphere of spaces and materials based on the participant's engagement with a door entering a phone booth.



Figure 22. Renderings communicating the atmosphere of spaces and materials based on the participant's engagement with a window.

In the choreographic rooms, the body interacts with different openings in different spatial orientations and directions (figure 19). Rooms are carved around these interactions that draw from the window, with different wall thicknesses, heights and other parameters that respond to the body. These experiences can direct attention to different cycles, seasons of the year and hours of the day. Spatial qualities readable in this section include crouching, extending, ascending and lunging. The relationships between the body and window can activate attentional switches, what people see, hear, smell and feel. In the following section, we present final interior renderings of the architectural projects and their spaces.

4. Final spaces and atmospheres

Meaning in architecture is conveyed through materials, atmospheres, sound and how we experience them. Swiss architect, Peter Zumthor, describes 12 matters of his concern when creating atmospheres [15]. They include the tectonics of different materials and loads coming together, how materials react with one another, sounds, temperature, choreography through the architecture, tensions between inside and outside, intimacy and scale, light and form. Figures 20–22 are renderings—imagined atmospheres—developed by the participants of spaces in their final architecture. Renderings communicate meaning and evoke intended atmospheres through what Nunes de Vasconcelos & Rolla call proto-atmosphere [40]. They carry emotions and moods and can activate architectural engagement [41]. Through these lenses, we analyse spaces and their atmospheres but admit that finding words to describe them proved difficult. Final floor plans, sections and exterior views of entire buildings are not included in this paper since our focus is on the scale of the body and interior spaces.

(a) The stair and serenity

The final spaces rendered in figure 20 are built on experiences of mystery and disorientation, twisting and reaching; tensional, linear, areal and projectional movement qualities; and spatial qualities of compression, expansion and incline. The participant

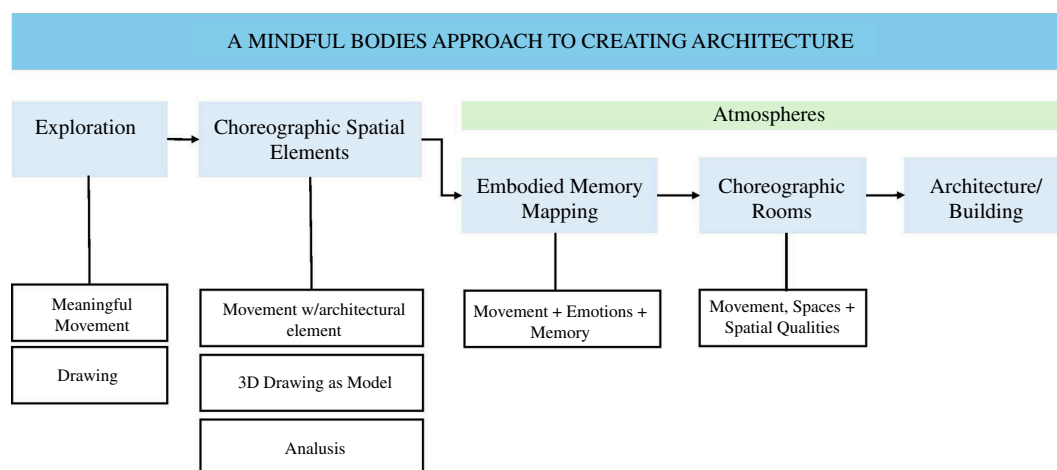


Figure 23. Steps and elements of a mindful bodies approach to architectural design.

constructed these atmospheres with Vray (<https://vray.us/>), a photorealistic and real-time rendering software in SketchUp (<https://www.sketchup.com/>). Within these renderings, there are moments of darkness and light where people can see others circulating a central core with natural light entering from above, but we are unable to see the bottom of the space, implying that the space is deep in the earth. Materials include thick-cut stone for walls that lean and concrete for long inclined walkways that puncture and straddle these stone walls. There are few people in the renderings, with heavy materials of stone and concrete, moments of darkness, floating walkways that twist and climb and natural light from above. These evoke an atmosphere of solitude, serenity and quiet.

(b) The door and confinement

Figure 21 renders spaces and atmospheres that evoke feelings of constraint, confinement, intimacy and restricted movement. The participant created these atmospheres with Lumion (<https://lumion.com/>), a real-time 3D rendering software that works with Rhino 3D models. The atmospheres evoke compression and narrowness, with little space for stretching and expansion. The wavy walls in figure 21a were developed using the lines connecting the joints of the body in figures 8 and 10. Natural light enters from crevices above, eliciting feelings of being buried and squeezed. The circulation is linear and horizontal in this canyon-like space. Upon reflection, it seems that the experience of being in the phone booth was more powerful than the experience of opening the bi-fold door, resulting in constrained atmospheres and spatial qualities.

(c) The window and light

For the final design exploring the window, the participant rendered spaces and atmospheres based on experiences of reclining and climbing, memories of warmth and the weather outside. The space is constructed from materials including concrete, mass timber and large rocks, with openings above and from the sides through which bright sunlight enters (figure 22). Renderings show bodies climbing the rock masses—tensional qualities of movement. The atmosphere evokes warmth, brightness and a closeness to nature. Upon reflection, spatial qualities of compression, extension and ascension using architectural elements—walls, circulation, structure, volume, etc.—are absent. These qualities are visible in the rendering of the body, rather than in the architectural spaces and tectonics.

5. Discussion

In this paper, we challenge the separation of mind and body through Maxine Sheets-Johnstone's mindful bodies concept, with mind as a function of body. We argue that if architecture is an expression of human creativity through multi-sensory embodiment, then learning, creating and experiencing architecture should also be multi-sensory and embodied. A mindful body in the architectural design process is one that documents, analyses and memory maps the moving body in different qualities of movement to create diverse spatial experiences. A mindful bodies approach to creating architecture (figure 23; [41]) involves the following:

- Exploration: Engaging in meaningful movement and exploring ways of documenting the body with images and drawings. This reduces the social, material and corporeal distance of the physical world from the designer and activates their attentional switches.
- Choreographic spatial elements: Moving with dynamic elements in the built environment, drawing and parametrizing these elements and our moving bodies in 3D and animating both. This helps designers gain insight into movement

qualities, reduces corporeal distance from the world and activates attentional switches. Designers can also find poetic disclosures, reveal wonders and reduce spatial blindness.

- Embodied memory mapping: This connects the wisdom of those engaging in design with their bodies, its with emotions and memories through movement and further activates attentional switches. It also reduces corporeal blindness and shares embodied stories through movement. Ideas for atmospheres begin at this stage and continue to develop until the final architecture has materials, structure, etc., in mind.
- Choreographic rooms: Designing rooms with diverse spatial qualities and atmospheres that employ the wisdom of the body activates attentional switches, reduces blindness and facilitates poetic disclosures that engage multiple senses.
- Architecture: Designing complete architectures involves engaging with complex concerns about site, materials, circulation, tectonics, structure, programme and more. In this step, the more complex elements of the architectural project would contain and be informed by spaces and qualities developed in the previous steps.

Without a mindful body approach to design, architects risk creating desensitized spaces that do not engage bodily movements, perceptions and experiences. Owing to the field's current overreliance on visual engagement and manipulation in the design process, we recommend that studio pedagogy implement this mindful body approach and collaborate with creatives in dance, theatre and other performing arts. We also recommend that there be a balance between screen-based visual engagement and material engagement through sketching, drawing and building some physical models by hand. With a mindful body approach, we can create meaningful spatial experiences that help us make sense of ourselves, other humans and the world; reduce architectural, corporeal and spatial blindness; and work towards reducing the social and material distance of architects from the world.

Ethics. This work did not require ethical approval from a human subject or animal welfare committee.

Data accessibility. This article has no additional data.

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