

***Hurry Up and Wait:***  
*Spatial Strategies for Urban Stress Relief*

by  
Maighdlyn J. Hadley

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thesis requirement for the degree of  
**Master of Architecture**



*This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions as accepted by my examiners.*

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## STATEMENT OF CONTRIBUTIONS

Maighdlyn Hadley was the main author of all chapters in this thesis under the supervision of assistant professor Jonathan Enns. Chapters 1, 2, 3 and 5 were not written for publication. Chapter 4 was written for publication in *Conscious Cities Anthology 2019*.

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## **ABSTRACT**

In the midst of rising urban density and its projected impacts on infrastructures and city dwellers alike, the importance of understanding the effects of built space on our biology and mental well-being is becoming essential to responsible spatial design. This thesis casts the designer as a practitioner focused on human impacts and synthesizes the lessons of current environmental psychology theory and mixed-methods biometric research into an analytical design framework to promote stress recovery and restoration. Architectural factors of scale, lighting, social organization, materiality, visual complexity, and enclosure are used as lenses through which to analyse an existing transit terminal and propose a reimagined space for waiting.

An identification of waiting rooms as high-opportunity areas within existing urban infrastructures led to the choice of Toronto Coach Terminal as a theoretical site in which to test the framework and to assess the value of restorative waiting environments. The subsequent design exploration takes the form of an open-ended kit of parts which creates seating areas and enclosures through a system of frames, connectors and panels to promote psycho-physiological restoration for a variety of users.

Topics of framework development and user testing methodologies are addressed in an attempt to make disciplinary boundaries more porous and to co-solve questions with spatial implications using all available resources. Since both waiting and stress impact city dwellers more severely and the world is becoming increasingly urbanized, better access to and more seamless integration of restorative environments in the incidental spaces of the public realm would play a role in the management of stress at a population level.



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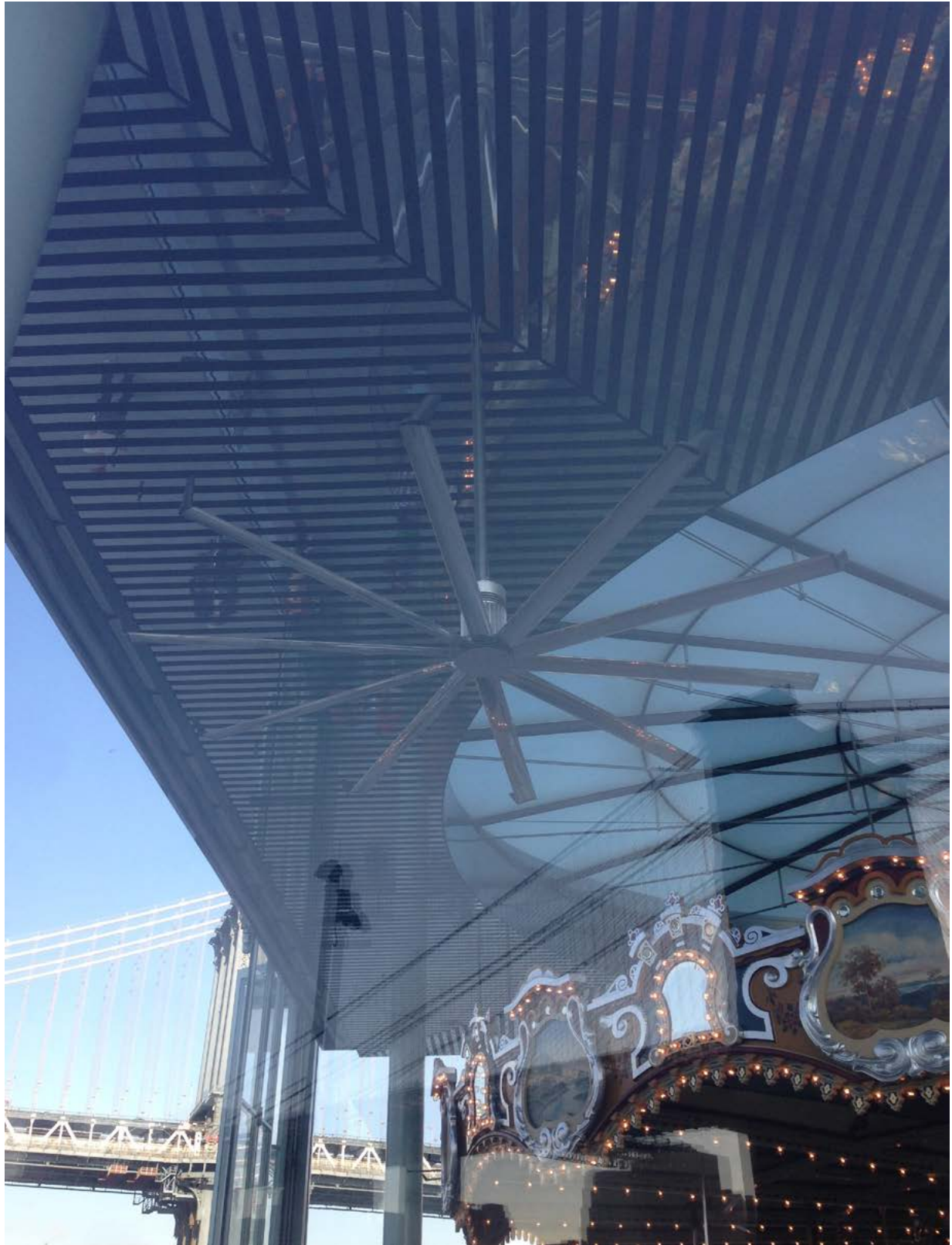
## **LIST OF ABBREVIATIONS**

<b>ART</b>	Attention Restoration Theory
<b>EEG</b>	Electroencephalogram
<b>HRM</b>	Heart Rate Monitor
<b>PSRT</b>	Psychosocial Restoration Theory
<b>QEW</b>	Queen Elizabeth Way; a 400-series highway in Ontario
<b>TSST</b>	Trier Social Stress Test
<b>UN DESA</b>	United Nations Department of Economic and Social Affairs
<b>VR</b>	Virtual Reality









## Introduction

As a kid growing up on the outskirts of a small city just beyond the Greenbelt of southwestern Ontario, trips to Toronto—a city of six million people—were an event. When the Highway 403 gave way to the QEW and the hazy skyline grew in height and density, so too increased the giddy energy in my stomach. Toronto wasn't a yet full-fledged city in my mind, rather a shorthand for a few neighbourhoods stitched together by the backseat of a minivan. Together they laid the backdrop for concerts in elegant buildings, food that you couldn't find in restaurants at home, and people who dressed like celebrities and moved purposefully through the streets, perennially unperturbed. As a child, these urban adventures were exercises in patience: waiting for my mother to finish poring over each artefact in a museum exhibit, waiting until intermission to peer into the orchestra pit at the ballet, waiting for dumpling soup to cool down enough that it wouldn't scald my mouth. Despite my impatience, city life had captivated me. I would go on to intern at architecture studios in a number of cities as an undergraduate student – Innsbruck, New York, Berlin, London – and by the time I returned to Toronto in my early twenties I had a more holistic picture of urban living. The freedom to navigate the streets had introduced a wider variety of experiences and a complex matrix of information to decode, information which allowed me to use transit systems, find shortcuts, develop routines predicated on a combination of safety, practicality and flights of fancy. I felt myself shift from tourist to local.

However, relationships are rarely one-sided. As I adapted to urban life, I felt my interactions with my environment become more

*fig. 0\_1 (PRIOR PAGE)*

*The Empire State Plaza in Albany, New York is a civic space which operates on a symbolic level but not at a human scale.*

*fig. 0\_2 (OPPOSITE PAGE)*

*Reflections on Jane's Carousel, housed by Jean Nouvel. Brooklyn, New York.*

unpredictable under the constant barrage of stimuli vying for my attention. A lifelong cyclist, I generally preferred taking my bike to relying on public transit, but I suddenly found myself too nervous to get on a bike for days at a time. The baseline stress of navigating independent work in an open-plan office, the nuanced, unwritten rules governing the space I shared with two roommates, and the herd of commuters which shadowed me daily, seemed to elicit outsized panic responses and my nervous system often screeched into high gear after an encounter as innocent as the opening door of a parked car or a loud siren. Crowds operated as flows rather than collections of individuals and my mind whirred as I subconsciously charted the least-resistant path to navigate the currents. I was finally a part of the fast-paced life I had craved as a child, but my ability to enjoy it felt compromised.

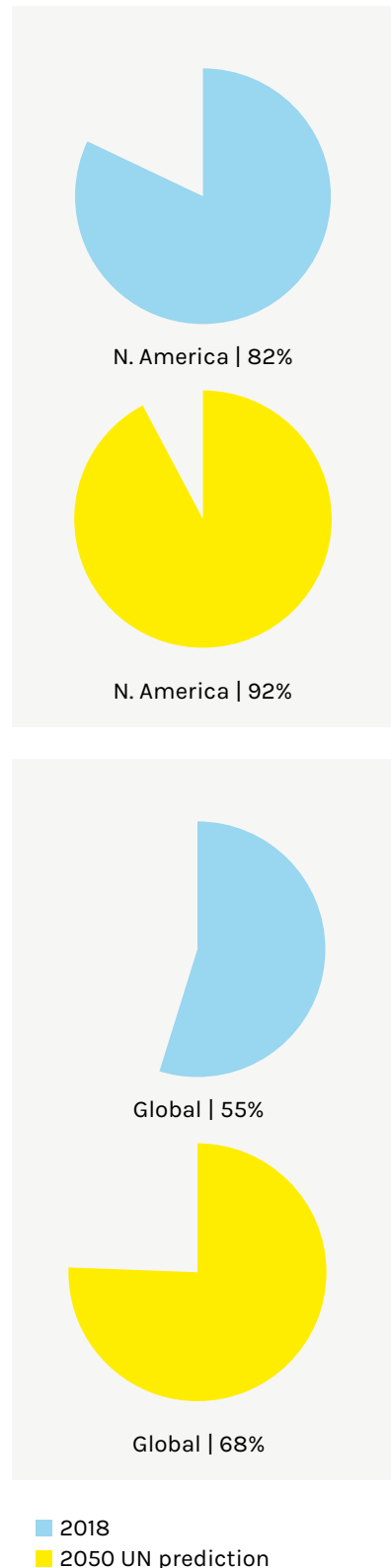
It would be irresponsible to conflate one personal anecdote with a larger phenomenon—to suggest that contemporary urban life causes panic attacks—but my experience was the start of an interest in researching how our bodies and brains process stress, and why stress becomes chronic. As I gained coping strategies and improved self-monitoring of my states of heightened stress, my inherent spatial sensibilities motivated me to turn this investigation to the role of the built urban environment in causing and mitigating stress. In 2016, 82% of North Americans were, like me, living in urban centres. Two years later, the United Nations Urban Populations report predicted that by 2050, two out of every three people in the world will live in a city or other urban centre (UN DESA 2018). This flooding of new populations into already-dense communities is a fertile breeding ground for widespread social instability—increased competition for resources, a loss of identity for both newcomers and long-time residents, and feelings of isolation— all of which are catalysts for widespread chronic stress (McKenzie 2008: 360-362). People from urban centres have developed different connections between some regions of their brain than those who grew up in suburban or rural settings

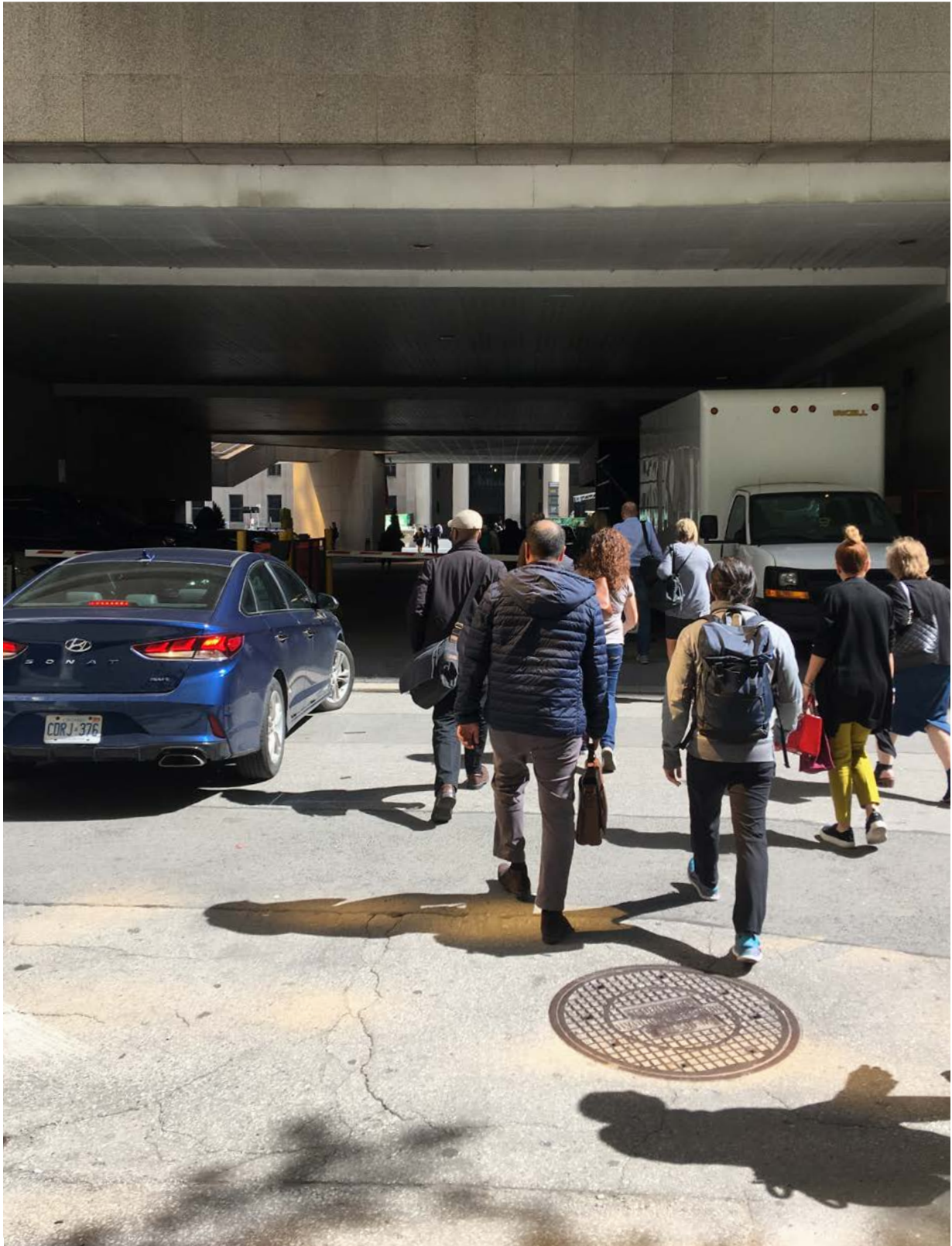
*fig. 0\_3 Urbanizing Populations  
Urbanicity is on the  
rise globally, with North  
American urban land use  
already near 100%.*



(Lederbogen et al., 2011). Urbanites have a weaker connection between their amygdala, which is responsible for sending emotions and distress responses to the body, and their anterior cingulate cortex, which regulates the amygdala's sensitivity. This is concerning, given that multiple studies have correlated urban life with increased rates of mental illnesses all over the world (Lederbogen et al. 2011; Srivastava 2009; Trivedi et al. 2008; Duncan et al. 2013; Gong et al. 2016). The urban condition comes with a constant undercurrent of stress and modern life is fraught with environmental and social stressors. The buildings we inhabit can either exacerbate or mitigate the long-term effect of the urban stressors that are beyond our control. How can we foster a sense of self-assurance and security within our environment and the way we relate with our community? What does architectural stress relief look like and how can designers participate? The first chapter of this thesis addresses extant design case studies, environmental psychology theories and studies which inform our understanding of the impacts of the built environment. Chapter Two is a survey of state-of-the-art design methodologies for findings-informed design. Chapter Three takes lessons from existing architectural frameworks to organize the findings from a literature review focused on identifying the "Big Six" spatial factors of restorative design. This chapter also proposes a method of user testing with which to examine the six hypotheses made in this framework proposal. In Chapter 4, I discuss the important role of site selection on the efficacy of any design for human impact, and delve into the history and potentials of public waiting areas. Chapter 5 gathers the themes of the prior four sections to outline a design proposal for the main coach bus terminal in downtown Toronto.

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## **Chapter 1 | Human Impacts of Urbanization**

To find solutions for mitigating urban stressors, it is necessary to establish a clear picture of what stress looks like in people, and what causes it in the environment. Just as not all factors for stress are urban, not all factors for urban stress are spatial. So, what makes urban stress a challenge which architects are well-positioned to tackle? The fields of environmental psychology and neuroscience have begun to probe the ways in which architecture affects our mind and body, but this research has yet to be comprehensively translated into guidelines for design. Studies on the health and happiness of urbanites suggest that the needs of city dwellers are not being met by their architecture (Galea et al. 2005). People feel dissatisfied with their dwellings to the point that a quarter of Americans don't consider their place of residence to be 'home' (Ellard 2015). New Urbanists champion a community-driven approach to protecting and nourishing vital urban fabric amid a gentrifying popular North American culture, but what of the spaces which lack a community? Many of us spend over 90% of our time in manmade environments, and many spend a portion of that far from their home community or in transit. Placemaking in the transitional public spaces of daily lives could foster a greater sense of wellbeing.

In architectural discourse, these interstitial urban spaces are often positioned as a generic "non-places," a concept which architectural theorist Hans Ibelings borrows from philosopher Marc Augé in his book *Supermodernism*, which observes the evolution of the international city toward increasingly generic and dematerialized forms. The airport, the subway station, the lobby: these places are largely unclaimed by a community and designed as 'Teflon

*fig. 1\_1 (OPPOSITE PAGE)*

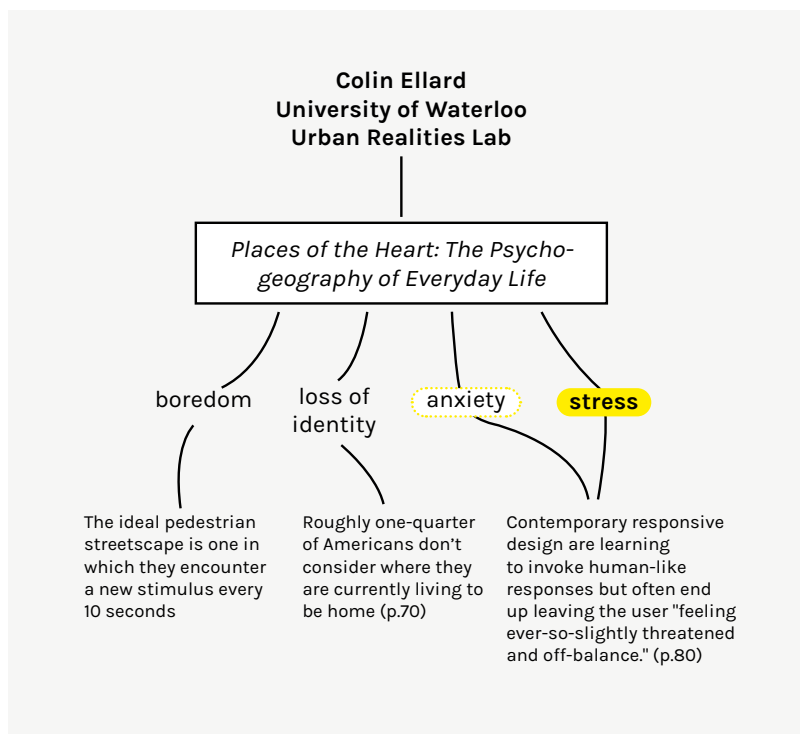
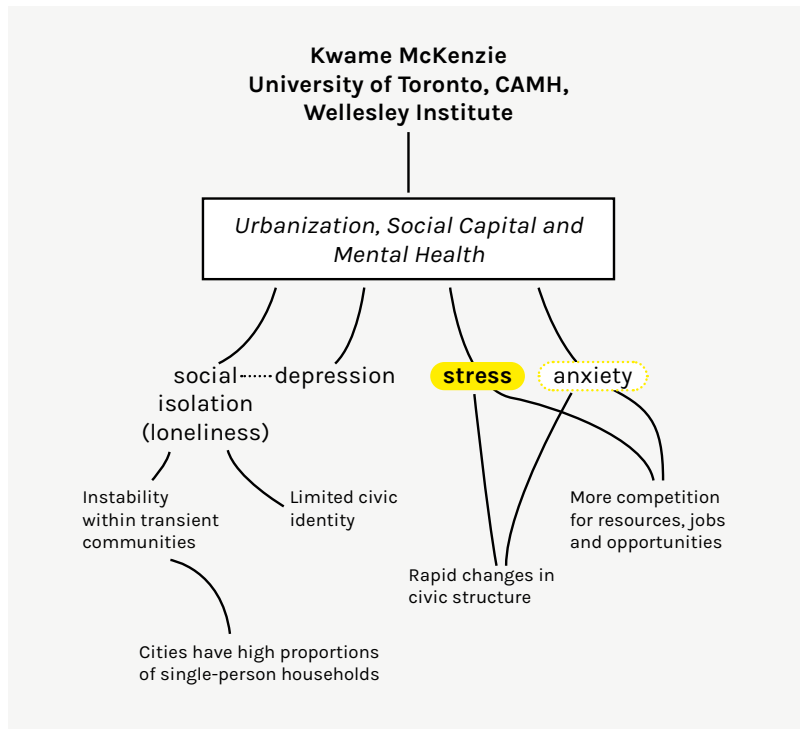
Commuters in Toronto's Financial District create informal routes to get to their train, choosing to cut through valet parking lots and loading docks en masse.



fig. 1\_2 *Mat Urbanism: Aerial view of Marrakech (1956).*

fig. 1\_3 (OPPOSITE) *Human Impacts of City Life Stress, anxiety and loneliness are some of the top psychological impacts of urban living.*

architecture” (Ibelings 1998: 65-66), an amorphous ‘non-stick’ spatial condition which encourages efficient passage between destinations and discourages lingering by making attachments between the users sharing the space or even between user and place itself undesirable and even untenable. In decades prior, this unclaimed urban fabric was cast as a space of pure potential. Alison Smithson advocated for Mat Urbanism, a type of urban plan expressed through “clusters” rather than streetscapes. The interstitial spaces between buildings are expressed as shared space belonging to local residents and pedestrians, and any mode of urban occupation is accommodated. The Smithsons held up the Islamic a city plan which would accommodate generative growth (Forés 2013: 79-80) like a trellis. However, due to increasing privatization of public space, the potential of the urban public remained unrealized. Tactical urbanism, or the use of informal ‘hacks’ to adapt public spaces to suit the needs of a particular community without significant permanent modification, is a compelling model of spatial production for designers to consider. How best to work with the cities we have inherited and find opportunities to integrate architectural interventions and additions into existing urban fabric? The field of architecture is, to quote Juhani Pallasmaa, an ‘impure discipline’ (Pallasmaa 2013: 5), and it is natural and valuable to draw inspiration from other disciplines. Industrial designers have already generated myriad examples of tools which engage an individual’s focus through one or more senses, allowing the overstimulated mind to return to a relaxed state: think of weighted blankets, noise cancelling headphones, aromatherapy, patterned lights. Architecture is different from product design in timescale, budget, and the reliance on a client willing to invest in innovative design, so this surge of findings-based design has yet to fully infiltrate the field. However, it stands to reason that these barriers could be surpassed if spatial tactics could be effective at a slightly smaller scale than new-build architecture, as a hack, a retrofit or intervention. By using design tools to control haptic,





acoustic, olfactory and visual input, a typology of architecture-modifiers could emerge. Imagine a mode of design which would invigorate these interstitial urban public places while helping with the management of stress for the populations who inhabit them. Public architecture is more accessible to the average citizen than therapy by financial, physical and cultural measures. This work aims to translate findings from other fields of study into a toolkit of spatial and material tactics which put research into reality; a guide to a more collaborative, interdisciplinary design approach. The design of the toolkit must be flexible enough to be integrated into existing urban spaces yet specific enough to serve as a strong framework for future city-building. This research culminates in a developed understanding of the ways in which urbanization leads to stress, a catalogue of the spatial qualities which are shown to alleviate stress through user engagement, and a series of small-scale architectural experiments designed and built to alleviate stress, and a method of user testing for efficacy. The proposition imagines a world in which urbanites are bolstered by the opportunities for respite afforded to them by their built environment, leading to resilience and eager engagement with the myriad benefits brought by urban living.

The way humans interpret environmental stimuli has been a field of study for only the past few decades (see figure 1\_4), stemming from great advances in the understanding of perception in the field of psychology. It was not until the nineteen-fifties that experimental psychology developed a stimulus-response model which recognizes the role of the brain to directly perceive stimuli in the environment without conditioning (a rejection of behaviourism, the prevalent theory of the day to explain our responses). American psychologist James Gibson was renowned in his field for taking subjects out of the laboratory and into the dynamic complexity of 'real-world' environments. His model of "perceptual systems" serves as a foundation for people-environment studies. Gibson described the

three components of the environment as the medium, the surface and “substances” (Lucas 2016:114-123). The medium is the space, a qualitative atmospheric territory which defies definition through a Cartesian model; substances are elements which exert resistance on the occupant; and the surface is the mediator between the territory and the forces. The challenge of the designer is to parse a collection of discrete techniques into spatial form—surface—with qualities inherent to an interior enclosure.

Good architects can intuitively understand how to design elements of a calming environment without findings-based design guidelines—spas and abbeys are sure proof of that—but these programs often rely on material and spatial luxuries which are not available to the average public space. By teasing apart the elements of spaces which appeal to us on a human level, we can design more considered environments which introduce or enhance spatial qualities to encourage stress recovery. The term ‘restoration’ comes from the world of psychology and has to do with the activation of the parasympathetic nervous system, also known as ‘rest and digest’ process. The idea that certain environments can improved our ability to restore cognitive functions is the focus of Rachel and Stephen Kaplan, experimental psychologists from the University of Michigan.

Kaplan and Kaplan’s Attention Restoration Theory (ART) understands psychosocial restoration as a process which happens over time: the first stage of restoration is the clearing of ‘cognitive clutter’, or the worries and anxieties of daily life; the next step is a sensation of renewed ‘directed attention’ capacity; lastly, reflection on matters of personal importance. These stages, while not reliant on a particular environment, inevitably occur within an environment. The process can be hindered by stressful surroundings or supported by a space which promotes restoration through the following qualities: the sensation of ‘being away’, meaning that the environment harbours no reminders of external stressors; extent, or enough physical space to encourage exploration and ‘gentle

### Timeline of (Western) Environmental Psychology Theory



fig. 1\_4 Timeline: Environmental Psychology Theory

fascination' ; and 'compatibility', the fidelity of the space with the users' demands of, and desires for, that environment (Hartig 2004). The Kaplans believed nature was the best example of a restorative environment, though they later profiled museums and religious buildings as restorative environments, if only for those already comfortable in them (Kaplan, Bardwell, and Slakter 1993; Ouellette, Kaplan, and Kaplan 2004). The Ulrich model of restoration was established in response to a study which found that patients with a view to trees outside their hospital room experienced accelerated post-surgery healing and better pain management with less drugs (Hartig 2004; Ulrich 1991). Though Ulrich focuses more on visual responses to naturalistic aesthetic experiences rather than the spatial qualities of the environment, it shares common foundations with ART in the high value placed on nature as a restorative environment. University of Waterloo psychology researchers found that the calming effects of nature cited by the Kaplans and Ulrich held true even in virtual reality environments (Valtchanov, Barton, and Ellard 2010). Their findings reiterated that nature is restorative, but also that urban environments are neutral in the absence of stressors such as traffic. Ellard (2015) has since expanded on the urban environment in finer grain, using consumer-grade biometric devices to explore the differences in physiological stress and perceived stress of urban pedestrians depending on the urban condition they were navigating e.g. walking near a park, crossing a busy intersection or passing a reflective glass tower façade. Even when urbanite pedestrians self-reported lower levels of stress, citing immunity through exposure, their skin conductance and heart rate levels indicated spikes of physiological stress when navigating busy traffic crosswalks.

These findings from researchers in the human sciences prove hunches that designers have long held about the way humans process our spatial environment and its impacts on our mental health and wellbeing. We intuitively know that people prefer access to green spaces, natural light, fresh air, engaging visuals,





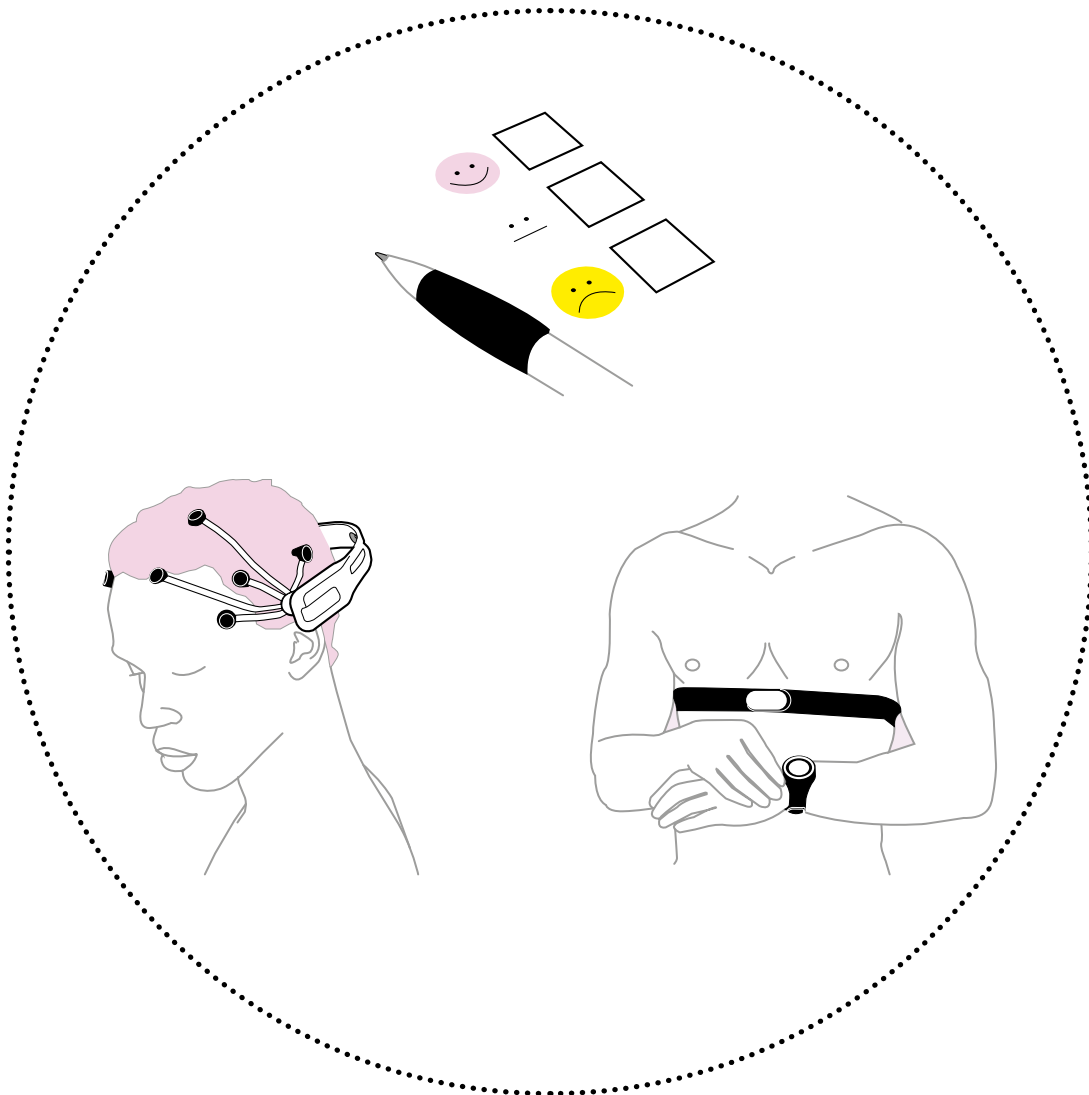
fig. 1\_5 Biodata journey map along urban path in Ellard and Montgomery's study of urban pedestrians



fig. 1\_6 Test participants logging reactions to a treelined residential area along the journey.

and spaces which facilitate social interaction, but the weight of scientific inquiry can help to strengthen the case when justifying these design decisions in the face of energy and financial efficiency directives. Urban stress affects everyone, but our built environment does not have to be a contributing factor. The work pursued in this thesis questions how architects might use insights from psychology and neuroscience about the innate perceptions and responses of humans to build in a way which serves our bodies and minds.

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## **Chapter 2 | Findings-Informed Design: From Theory To Practice**

A growing understanding in academia of the potentials for spatial design to make an impact on wellbeing has led to more partnerships between human science researchers and architecture practitioners, and integration of research both pre-design and post-occupancy. Large architecture firms are creating research and development wings or in-house consultancy practices within their offices, to analyse the needs of the user groups and set impact priorities to guide the design. The projects which follow blend the worlds of aesthetic practice and scientific inquiry to create architecture for impact.

HKS designed and built a Sensory Well-Being Hub as a response to the differing needs of the neurodiverse student body at Lane Tech College Prep High School in Chicago. Comprised of a demountable framing structure which is somewhat reminiscent of a playset made from industrial K'nex, it provides “hubs” for activities ranging from quiet to stimulating. The hub offers a unique, modular solution which allows students to refocus and calm down on their own terms. Through their research, the HKS team learned that diverse learners each have particular needs and desires from a respite environment, so the hub empowers each student to create an experience that works for them in order to find balance. Audio, visual, kinaesthetic and tactile features in the hub help students reset from a state of either hyper- or hypo-stimulation (Park et al. 2019). The design process involved breaking down the work into three phases: define, design and deliver. Defining the problem meant completing a literature review and a research plan, and meeting with users and expert consultants. This resulted in

*fig. 2\_1 (OPPOSITE) User data in human-centred design is primarily collected via questionnaires or interviews, wearable biometric sensors like the EEG headset and heart rate monitors shown, or a combination thereof.*

a set of principles which informed the design. Iterating through sketching, mock-up prototypes, scenario testing and analytical simulations led to a design package which was submitted for research proposals and approvals. To deliver the informed design product, the team installed the Hub's design prototype, recruited participants to interact with the hub, and used data collected from those participants to analyse and draw conclusions, leading them to a "design refresh." The result of this iterative synthesis was called Cocoon 2.0. The team wanted to make their design findings accessible to all, publishing an open-source instruction guide to anyone who wishes to build their own Sensory Hub. A rigorous research process and design thinking approach led this team of designers to a product which served the sensory needs of the students at the school in which it was implemented.

The school environment is important, but young students in half-day programs benefit from access to enriched design in other areas of their life. Shifting the focus from the school environment to education through play, Hume Architects and Temple University psychologists and educators fostered a pilot project called Urban Thinkscapes in Philadelphia. It was a community urban design to encourage learning through play at bus stops and street corners in an underserved area of the city in an attempt to bridge the learning gap between children who were given additional learning opportunities outside of school, and those who were not. Community members were trained in data collection and observation to take note of how parents and children engaged with the design in the months after installation. The team found that parents and caregivers engaged with their children in areas where the Thinkscapes were deployed more than unaltered public spaces in the same neighbourhoods. On-site signage and a website connect caregivers to additional information and resources about the links between play and learning. The project was effective in creating education opportunities for the community for both young children and adult learners by providing enriched situated



**Active Zone**

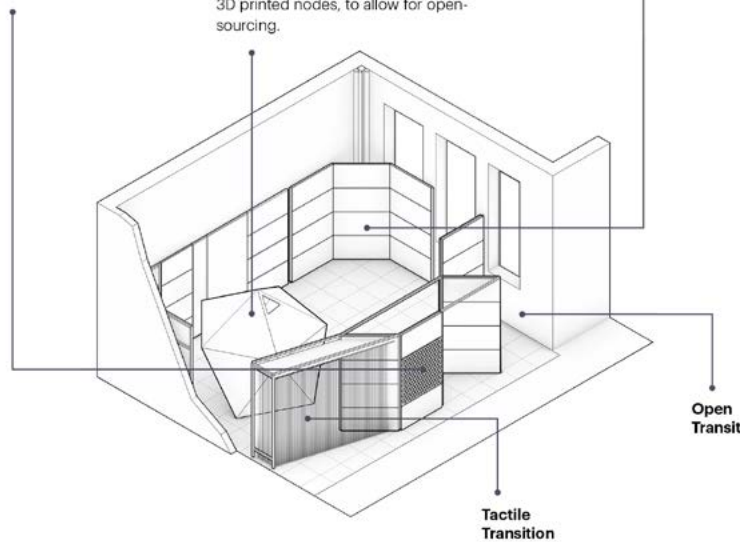
An energizing space, includes a textured wall, a sound wall and rolling pins. The goal of the elements is to stimulate a case-effect response.

**Cocoon**

A semi-enclosed microenvironment structure, equipped with tensile fabric seating, and lined with double-layered acoustic panels. It was designed computationally with 3D printed nodes, to allow for open-sourcing.

**Respite Zone**

A calming space, includes projected nature images, a Lite Brite wall, vibrating bean bag and a weighted blanket.



learning opportunities for children, and by deepening the existing role of mature members of the community as neighbourhood watch by providing the training to run aspects of a psychology experiment.

A Space for Being was an installation for the Milan Design Week 2019. Reddymade Architecture and Muuto Interiors designed and built a series of evocative interior spaces informed by neuroaesthetics guidelines put forward by the Johns Hopkins Arts + Mind Lab. Guests were outfitted with a wristband by Google

fig. 2\_2 The Active, Cocoon and Respite Zones of the HKS Sensory Wellness Hub in use and in context.



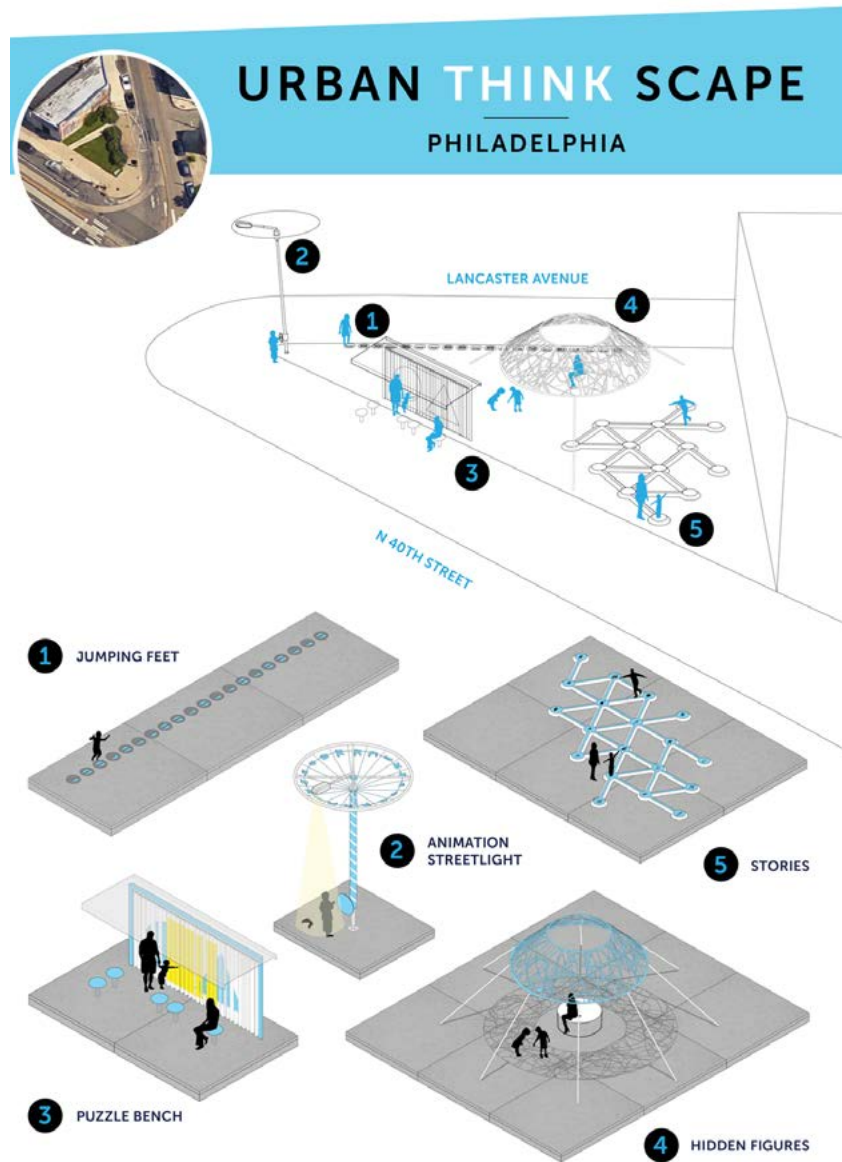


fig. 2\_3 (ABOVE) Urban Thinkscape in use.

fig. 2\_4 (RIGHT) Urban Thinkscape design components in context.



which measured heart rate, breath rate, and skin temperature. Walking through the exhibition, the wristband measured the responses of each guests to create a customized, individual report, suggesting the space in which each guest felt “most comfortable or at ease” based on his or her real-time physiological responses. The biometric data was compared with the visitor’s perceptions of which room they preferred by asking them to rank their favourite. Though the project data was not collected for analysis, the installation revealed the testing pitfall of incongruous biometric and reported data: in conversation with Such Reddy, the architect who headed up the project at Reddymade, it was revealed that a number of guests were surprised by the room that their report suggested was the most enjoyable to them. If the user group did not predominantly consist of Milan Design Week guests from the design industry—people with strongly held opinions and an intellectualized way of experiencing built space— it would be curious to see how the fidelity of data congruency might chance. A major benefit of design stakeholder analysis is to understand the perspective of users who are unaffected by the aesthetic biases which are inherent to an architectural education. This ensures the success of a building at serving its community without alienating them. A Space for Being is a prototype for a model of experiential design testing using full-scale architecture models to workshop ideas.

These projects share a common interest in bettering the experience of all people who occupy built spaces by learning from their responses. Pairing up with research labs in the life sciences gives designers access to verified findings and a framework for better understanding user impacts where there is no consistent format of recording and sharing findings within architecture.

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*fig. 2\_5 (TOP) Google wristband to measure biometric data and position in exhibition for A Space for Being.*

*fig. 2\_6 Three neuro-aesthetic designed interiors exhibited at Milan Design Week 2019.*



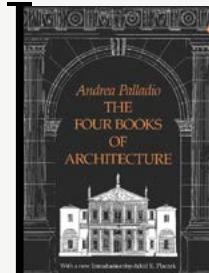


### **Chapter 3 | Designing a Framework for Restorative Design**

Frameworks have long been a way to impose order and spread movements and insights among architects. They have taken the format of codes and rulebooks, stories and infographics, and built artefacts. The first recorded architecture framework is responsible for Classical Architecture: the Ten Books on Architecture by Vitruvius. Written around 27 BC, the ten books are structured somewhat similarly to the contemporary building code, though they use allegories more than to isolate and describe the best practices for discrete components of building design. The most famous takeaway from the Ten Books is the assertion that buildings should exhibit stability, utility or “commodity”, and beauty, and that these qualities can be successfully integrated in a building by following Vitruvius’ prescriptions regarding urban design, building materials and finishing, water, sundials and clocks, and machines. His book on proportion centres the human man as the measure of all things: ratios of “perfect” numbers are reinforced by their supposed mapping in the ratios of a person’s—well, a man’s—fingers, palms, forearms and feet.

Centuries later, in 1570, Palladio reintroduced the Vitruvian proportions in his iconic villa layouts. Palladian architecture was governed by a “three-part solution”: dramatic exterior motifs, economical structural materials, and internal harmony and balance. Systematic rules of thumb inform the design and construction of the distinctive Palladian villas, replicated across Europe and even in America by the end of the 18th century. The first book of the four defines nine rule sets to determine parametric ‘identities’, all based on Vitruvian and harmonic proportions.

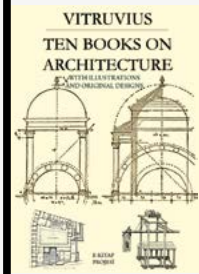
ARCHITECTURAL FRAMEWORKS 27 B.C. –PRESENT



**Palladio's** *Four Books on Architecture*  
published 1570

HUMAN BODY

**Vitruvius'** *Ten Books on Architecture*  
published ~27 B C



**Le C...**  
pub...





fig. 3\_1 A timeline of architecture frameworks throughout Western history.

The way in which architectural frameworks relate to the human always reflects the state of sciences at the time. The focus on the human body was one of proportions and aesthetics, reflected by the anatomy and mathematics study of Vitruvius in Ancient Rome. Human health became a focus as physiology brought ergonomics to the forefront. As human mind becomes better understood, a more informed focus on designing for perception and neurobiology is following.

In the 20th century the focus of frameworks shifted from merely mirroring the human body to considering its comfort and health. Le Corbusier took the measure of man into the twenty-first century with his Modulor Scale. Likely inspired by the German Neufert's Architect's Data book published the decade before, this scale informed proportions for Corbusian interior design. Based on a man with one arm outstretched, the first set of ratios were based on a 5'9" man, but was updated to 6'0" in its second iteration to relate more to the taller "ideal" man of crime novels and cinema than the height of the average Frenchman.

By the late nineties there was enough scientific consensus on the environmental impact of the building industry to compile the LEED Standard, Leadership in Energy and Environmental Design. With goals to "evaluate the environmental performance of a building & encourage market transformation towards sustainable design", it operates on a system of points or credits rating energy usage, water management, construction materials, indoor air quality, and waste control. LEED's aim is to establish a uniform measuring system recognizing sustainable building practices. Its main goal is to take a holistic look at how a building impacts the environment.

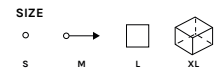
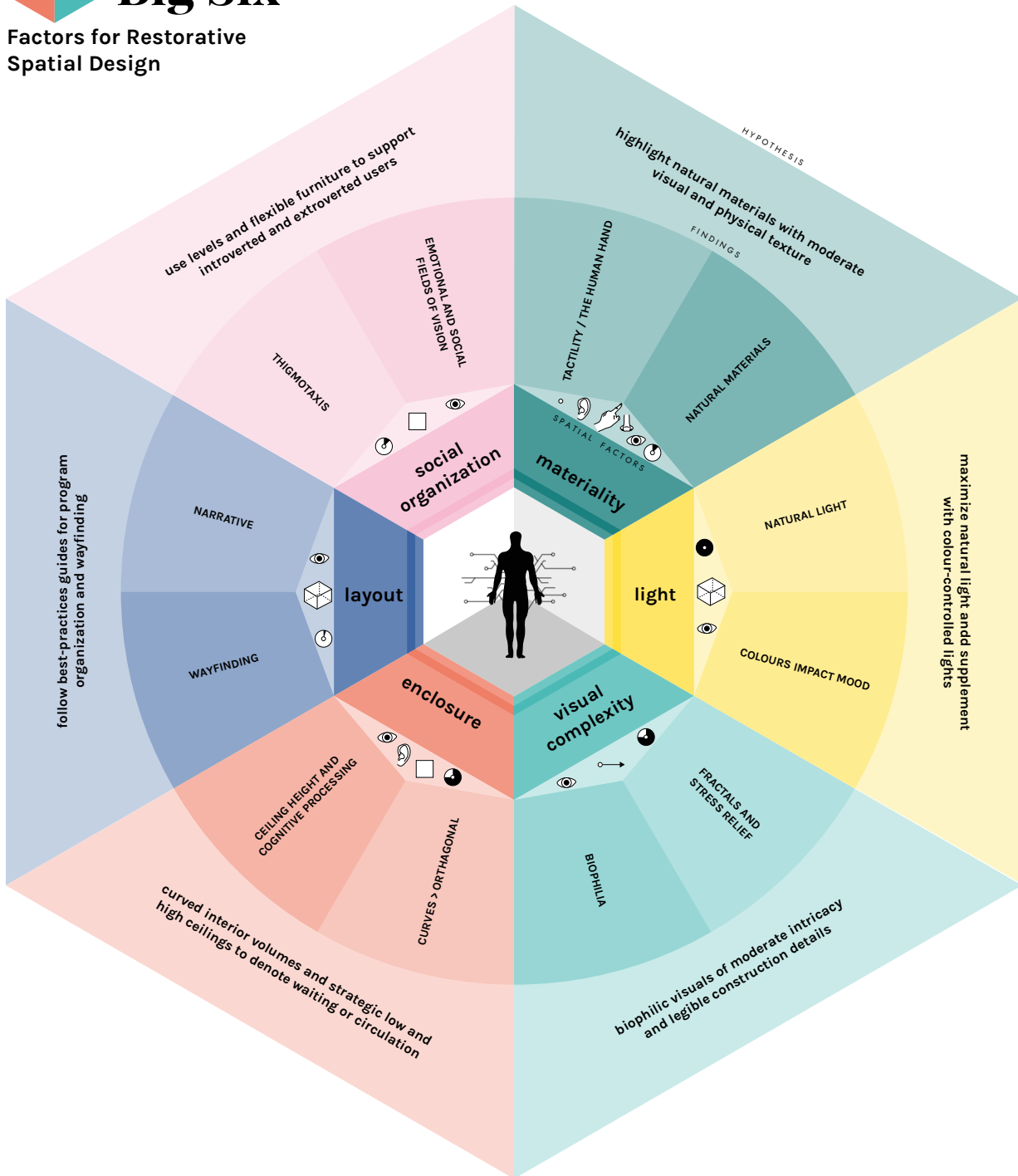
The WELL Standard, similar in implementation to LEED but different in focus, is a reflection of the interest and increasing ability to codify user comfort and health by the early twenty-tens. An offshoot of the LEED indoor air quality standard as a starting point, WELL is only focused on the health and comfort of occupants. As well as air quality, WELL rates buildings on such factors as natural light, access to windows and nutrition, and more. Rather than being concerned with how a building is sustainable, WELL starts to measure the impact a building has on human beings. Since 2014, a partnership initiative between their respective administrative bodies has led to the LEED and WELL standards being offered in tandem.

The benefits of each of these frameworks are consistent standards of quality between projects, and increased legitimacy of the values represented by each framework. Architecture is inherently patron- or client-driven and good design which comes out above the minimum standards needs to be incentivized to the client. Frameworks infer value upon their constituent parts and make it easier for architects to win the fight for good design.

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# The Big Six

Factors for Restorative Spatial Design



### **3.1 | The Big Six: Factors for Restorative Design**

As design frameworks have developed from aesthetic guides to safeguards of social and environmental health and comfort, they account for more and more human impacts. To some degree, each framework has used the previous model as a foundation. A psychophysiological impact framework for restorative architecture would complement the existing foundation of environmental stewardship and user health laid by LEED and WELL, and act as a next step to creating environments which are mindful of the perceptual and cognitive impacts of spatial design. The foundation for this framework was laid by sources native to the discipline, including Juhani Pallasmaa's reader on neuroscience and architecture (2013) and Sussman and Hollander's *Cognitive Architecture*, as well as popular science books linking the built environment and its impacts of cognition by Colin Ellard (2015) and Sarah Williams-Goldhagen (2017). A literature review across psychology databases followed, homing in on experimental findings which focused on perceptual or physiological human impacts of material or spatial aspects. I present below my efforts to synthesize the findings of these sources into a useful guide for designers who want to incorporate restorative qualities into their design, *The Big Six: Factors for Restorative Design*. The name is a riff on the OCEAN Big 5 Inventory used in psychology to quantify a subject's extraversion, agreeableness, conscientiousness, neuroticism and openness, the measure of which provides a rudimentary summary of a human personality. The value of *The Big Six* is to translate findings into spatial tactics. These findings are grouped into six slightly overlapping categories: Social Organization, Materiality, Lighting, Visual Complexity, Enclosure, and Layout. Overlaid on each sextant is the timeframe and scale at which the category is most impactful, and the senses which are engaged.

*fig. 3\_2 (OPPOSITE) The Big Six Factors for Restorative Spatial Design*



### **Social Organization: Designing a flexible perimeter to support introverts and extroverts**

Anyone who has ever entered a crowded cafeteria or cinema and not been sure where to sit will understand the importance of perimeter areas in public space. Architect Ann Sussman and urban planning researcher Justin B. Hollander (2015) cite Christopher Alexander, who describes a phenomenon common from middle school dances to the animal kingdom: “The life of a public square forms naturally around its edge. If the edge fails, the space never becomes lively.” (A Pattern Language, 1977) The borders of spaces appeal to our inherent tendency to ‘hug’ walls, a behavioural trait also called thigmotaxis. Thigmotactic behavior increases with anxiety levels and unfamiliar surroundings and decreases with comfort and confidence in an environment. Designers can appeal to our wallflower tendencies by creating opportunities for the stressed and uncertain to find refuge around the perimeter of more public spaces, as well as more extroverted programming toward the center of the space for those who are comfortable in their setting and eager to engage. Accommodation of extroverted and introverted users can be manifested at the interior scale with seating configurations which allows for more prospect or more privacy, defined respectively by psychologist Humphrey Osmond as ‘sociopetal’ or ‘sociofugal’ social organization. In a study of environmental preferences of the socially ostracised, it was found that stressed or vulnerable people seek out sociofugal settings, whereas well-adjusted people exhibit more varied preferences (Meagher 2017). Field of vision is also important to social organization. Our brain prioritizes vision over all other senses, and prioritizes faces over other visuals, so design should consider the spatial factors which impact pro-social behaviour. The extent of our ‘social field of vision’ ends at ~100m, and our ‘emotional’ field of vision at ~22m. To create a prosocial environment, a designer should layer views through space by designing a route which permits a slower engagement with surroundings. This





fig. 3\_3 (ABOVE) thigmotaxis in practice - people seek edges even when provided with other seating options. In the Piazza del Campo in Siena, pedestrian clusters favour the perimeter shops before venturing into the centre of the public space.

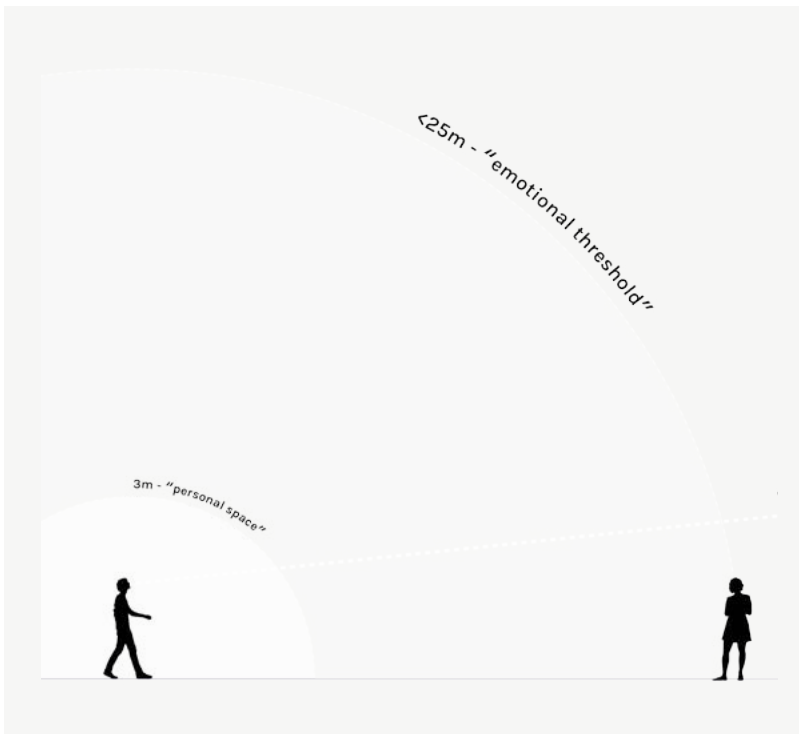


fig. 3\_4 (LEFT) spatial social and emotional thresholds.

allows users to gain a more complete understanding of the space they are entering and the potential social interactions to approach or retreat from through where they choose to linger.



**Materiality: Promote contact with natural materials and texture, control acoustics and prioritize.**

Materials are often our first point of contact with the built environment, and the most impactful environments are those which use materials which consider all of the senses. The visual impact of spatial design is often considered first, and it has been found that we find more interest in materials which bear the marks of their fabrication. This is best expressed by using materials which retain their ‘natural’ texture or grain and appeal to our innate biophilic tendencies (Kellert 2005). Floor, ceiling and wall finishes impact the acoustical resonance of a space. Less reverberant is best in a restorative environment, as introverts and neurotic personality types have a markedly worse time focussing in loud environments (Oseland 2017). The decision to specify low-VOC paint or operable windows to let in fresh air shape the olfactory experience, and generally, the more neutral the better scent sensitivities can exclude neurodivergent users and those with allergies to perfume. Stone or metal surfaces and fixtures feel colder than those made from wood, fabric or plastic, so care should be taken that these interactions are considered. The potential of touch in flexible materials can even be used for therapeutic effect: Temple Grandin (1993), Lucy McRae (2015), Sean Ahlquist (2017) have all experimented with materials which, using mechanical systems, vacuum pressure and inherent tensile properties respectively, create soothing sensory pressure which works much like a weighted blanket or a hug to promote the release of endorphins (Ahlquist 2017).

Lois Weinthal’s introduction in *Toward a New Interior* (2011) cites philosopher Michel Serres’ conception of the house as a living thing with a series of ‘skins’ that radiate from the body to the structure of a building, becoming less and less flexible with distance from

the user of the space: soft clothing, thick tapestry, flexible veneer, rough concrete structure. Considering the potential sensory impact of each layer in relation to its proximity to the user is a helpful rule of thumb when making specifications.

**Light: Maximize natural light and provide modifiable artificial light options.**

The role of natural light in human wellness is immense: it suppresses melatonin production which impacts our circadian rhythms and provides information which makes navigating buildings easier: which walls are exterior walls, what time of day it is, what cardinal direction you are facing. Daylight, particularly diffuse daylight, is proven to improve mood and support meditative states better than artificial lighting alone (Wardono and Wibisono 2018). In spaces where a window is not possible or practical, good quality full-spectrum diffuse artificial lighting can serve as a viable replacement for daylighting. There is mounting data suggesting that different colours of light can support different physiological states (Elliot 2015:368), so providing the option to tune colour temperature to individual preference can enhance a relaxing experience. Naz et al. (2017) found that different colour temperatures and brightness levels could create very different user perceptions of otherwise identical environments in a CAVE-type display. By focusing on qualities of brightness, colour and surface texture, the study arrived at design principles for different desired spatial qualities: To make spaces feel warmer, more intimate and calmer, decrease brightness of lights; Increased brightness will result in a more cool, spacious and exciting affect; Blues, green and purples make a space feel more cool and calm, whereas reds, oranges and yellows make a space feel more warm and exciting. A traditionally restorative environment might focus on providing intimate areas with dimmable artificial lighting controls and contrast that with larger main areas featuring bright, natural light.





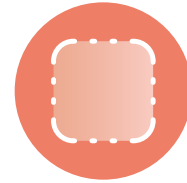
### **Visual Complexity: Highlight natural geometries and exposed construction details.**

Visual complexity is a factor of architecture which can be considered and effectively implemented in structure, ornament, materiality, and décor. It has been found that fractal or ‘self-similar’ geometries between a ratio of 1.3 and 1.5 can improve the rate of physiological recovery from stress by around sixty percent (Taylor 2011). Fractals in this range are seen in nature and some artwork. The appropriation of fractal geometries into architecture has largely manifested in surface applications, which are effective in waiting areas but potentially dizzying in large doses, and in floorplans, where the fractal quality is hardly perceived by the user. It has proven more difficult to perform a holistic translation of geometry into built space (Joye 2007; Salingaros 2013) but Gothic and Hindu architecture provide examples of effective use of fractal forms, and some structural systems of Calatrava and Nervi may be said to do the same.

Visual complexity can also be engaged by designing connections which are legible. Legible construction means a layperson could understand how it is put together, causing their canonical neurons to fire as if they were actually performing the task themselves. We spend more time looking at and feel a greater connection to works that bear the mark of human craft (Williams Goldhagen 2017: 160-161). A restorative environment could integrate these principles by exposing architectural connections of a structural system or choosing a few high-impact areas to install fractal or biomimetic visual elements such as patterned window screens or privacy dividers.

**Enclosure: Use ceiling height and curved elements to create areas of prospect and refuge.**

Enclosure is a multivalent factor, as different people prefer different levels of enclosure, but there is some experimental consensus in people finding more open rooms and curving forms more beautiful than orthogonal ones (Vartanian et al. 2015; Banaei et al. 2017). Louis Kahn, whose work harnessed the power of dramatic proportions, admired the grand scale of the Baths of Caracalla, quipping that “there’s something about a 150-foot ceiling that makes a man a different kind of man.” (Williams-Goldhagen, 2017: xxxii) There is no doubt that those grand vaults would make anyone feel like an elevated version of themselves: but why might that be? Multiple studies focusing on the affective impact of geometry make connections to how the findings might for architectural space the form of interior spaces conclude that people prefer curved visual objects, but as architecture is much more complex than simple didactic adjectives like ‘rectilinear / curving’, ‘open / enclosed,’ it is important to take into account context. Ceiling height has measurable impacts on cognitive processing, priming our brains for different types of work. Whereas low ceilings improve our abilities to do focused tasks, higher ceilings support ideation (Meyers-Levy and Zhu 2007). Since restoration is a process of self-reflection and best achieved with a wandering mind, high ceilings and interior curves are optimal.





**Narrative: Exceed organizational and wayfinding best practices.**

To design a building which is code-compliant is to design the worst building you can legally build. When considering how one might navigate the layout of a public space, be sure to exceed the standards of program-specific and Barrier-free design serves all members of an ageing society, as well as parents and caretakers with strollers or service workers pushing a cart. Layout comprises of narrative and intuitive way-finding, which engage us and help us navigate a space without much mental energy. Narrative plays into our collective desire to understand events as a continuous, sensical progression; to tell a story. This is expressed spatially by designing clear wayfinding and providing points of interest along the way to motivate people along their intended route. The psychology of queueing has been well-funded in the service industry, from hour-long lines in theme parks to the elevator lobbies of corporate towers. Maintain a single-file queue where reasonable, as this layout minimizes anxiety for the people in line who fear missing out on the faster option. Installation of mildly stimulating distractions such as mirrors and eye-catching finishes are proven to minimize complaints regarding wait times and have the added benefit of adding aesthetic value to a space (Maister 1985). It has been found that our brain activity is highest at the fork of paths, even if it is a familiar path, so creating dedicated routes with fewer options can be beneficial to restoration where appropriate for certain activities or programs. Clear, intuitive and consistent wayfinding throughout the space will further serve to minimize cognitive load at decision-making points and make navigation less stressful (MTO 2012; Karandinou and Turner 2017). Thinking beyond code requirements and considering different needs will result in a coherent spatial narrative which is useful and calming to all users.

## **Conclusion**

These factors are not a silver bullet to immediately initiate a state of restoration and recovery from stress: they are dependent on the time, scale and senses which are spent or used in a particular program. Not all of them will be applicable all of the time, and none of them exist in isolation from the others, but they provide a designer with a toolkit of strategies to bring calm and comfort into their design proposals. The application of this framework first in research, then in practice, could be part of a solution for stress in urban centres. I created a test design which could be used by an interdisciplinary team of researchers in architecture and beyond to further test the efficacy of this framework proposal, and a design exercise applying the principles to a retrofit of the Toronto Coach Terminal, an unfortunate entry point to the city used by many.

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## 3.2 | Interrogating a Framework Through User Testing

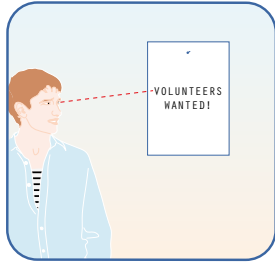
The Big Six Framework is the result of close interpretation of findings from a number of disparate sources, all of which the result of data from experimental testing. Designing a testing protocol which is airtight enough to account for inherent participant bias, perceptual priming from outside factors is essential to good data. Despite assuring the quality of the findings collected by using peer-reviewed sources and works by reputable publishers, the framework is untested. A next step to proving its efficacy would be to test its recommendation on actual spatial design options in a controlled setting. The design of this test required a close reading of the methodology portion of the papers in the literature review, and a consultation with Colin Ellard. The study is designed as a mixed-methods experiment, which means a combination of qualitative and quantitative data collection. A quasi-experimental biometric approach to pre- and post- test designs is paired with a pair of questionnaires for participants. The exploratory research methods include biometric data collection, immersive environment prototype building, and a verbal questionnaire to collect qualitative and quantitative data on user experience. The experiment consists of an interview in one of two test environments and collection of basic biometric data using heart rate monitors.

fig. 3\_5 (OPPOSITE)  
Illustrated protocol for  
isolating and testing  
discrete aspects of the  
Big Six framework

1. Test participants will be recruited for a study advertised to focus on 'emotional responses to VR architecture.
2. Upon arrival, a participant will be greeted and outfitted with a heart rate monitor in a primary space.
3. The participant will be asked to sit while the investigator leaves



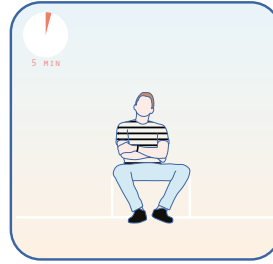
Hurry Up and Wait: Spatial Strategies for Urban Stress Relief



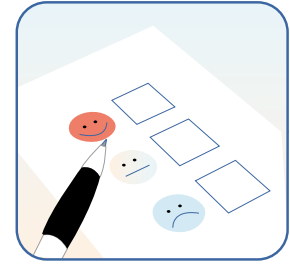
1. Participants are recruited for a study on "emotional responses of VR".



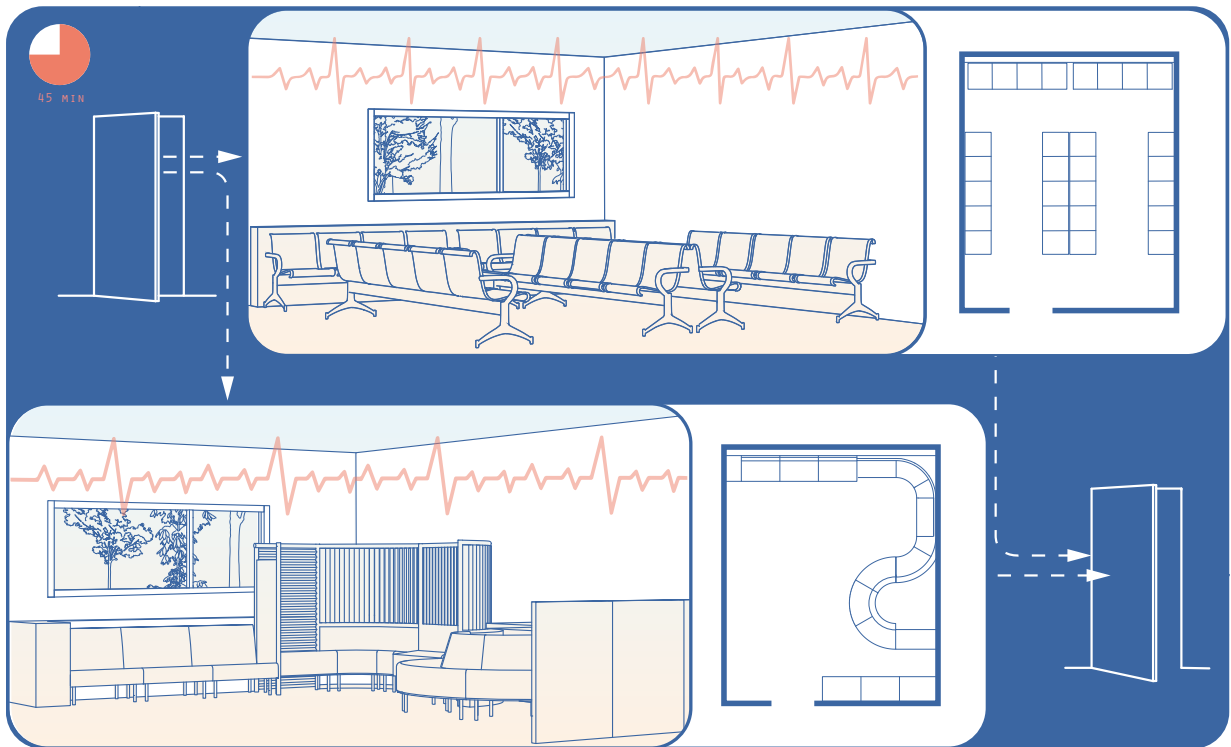
2. Outfit participant with a heart rate monitor in a primary space.



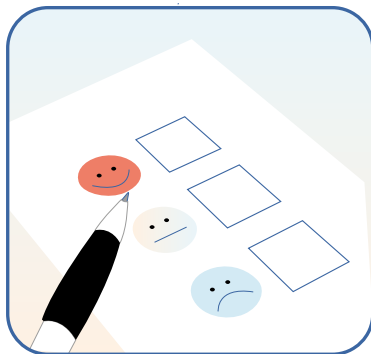
3. The participant will be asked to sit for 5 minutes (to establish HRM baseline).



4. Establish the participant's baseline emotional state with questionnaire.



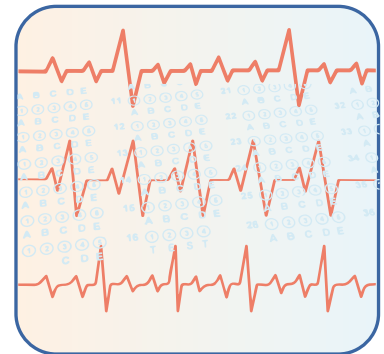
5. Lead the volunteer to one of two secondary waiting rooms<sup>2</sup>.



6. After 30 minutes complete a secondary measure of emotional resonance (ie. adjective sort).



7. Disclose the actual nature of the study to the volunteer and thank them for their participation.



8. Clean and compare the biometric and qualitative data for the two rooms to determine impact on stress relief.

the room to “prepare the VR set-up” for 12 minutes. This time will be used to establish a heart rate baseline. (according to TSST protocol).

4. The investigator will return to the room and explain that they are running late but can begin the first questionnaire to determine the volunteer’s emotional baseline while they wait. They will administer a questionnaire to establish the participant’s baseline emotional state. The investigator will administer then test.

5. Next, the volunteer will be led to one of two secondary waiting rooms\*, telling them they can expect to be ready for testing in 45 minutes. The waiting rooms are two dimensionally identical rooms: one arranged to reflect current best practices for waiting room design, the other featuring an introvert and extravert configuration of the restorative design system.

6. After 30 minutes, the investigator will return and ask the volunteer to complete a second measure of emotional resonance.

7. The investigator will then disclose the actual nature of the study to the volunteer - that the testing was actually happening while they waited - and thank them for their participation. It might be a good idea to include a VR game area for the volunteers to enjoy afterward, to manage disappointment if they were really keen on the advertised premise of the testing.

8. The biometric and qualitative data for the two waiting spaces will be cleaned and compared to determine which room had more of a psychological and physiological impact on stress relief.

A large sample and collecting both biometric and self-reported measures of situational resilience or implicit emotion pre- and post-testing should ensure that each room is at an equal baseline and allow for clearer comparison of the effect of the specific built environment modifications. The direct benefits to study participants are an opportunity to enjoy a relaxing break in their day, and the knowledge that their participation and input will offer researchers the chance to develop opportunity insights for future design innovation. The scientific and educational benefits to

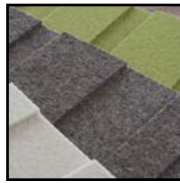
## **MATERIAL PALETTE**



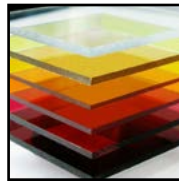
*canvas*



*wood veneer*



*felt*



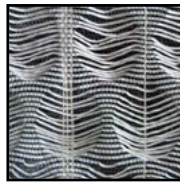
*plexiglas*



*wooden screen*



*mesh*



*woven textile*



*paper*

this research would include insights on the way people interpret the architectural interior, which will inform the development of methods to educate designers how to promote calmness in the spaces they design.

Using a simple frame-connector and panel system which could accommodate curves and a few different ceiling heights, I developed a kit of parts to create various testing environments, which can be configured to hone in on one discrete aspect like visual complexity, or social organization, or focus on the integration of the elements by using more normative furnishings to increase the level of fidelity with an actual waiting space. The testing protocol we just saw would help verify the hypotheses I made in my framework, but I was interested in working through the framework like an architect, and that required a site.

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## ASSEMBLY AND COMPONENTS

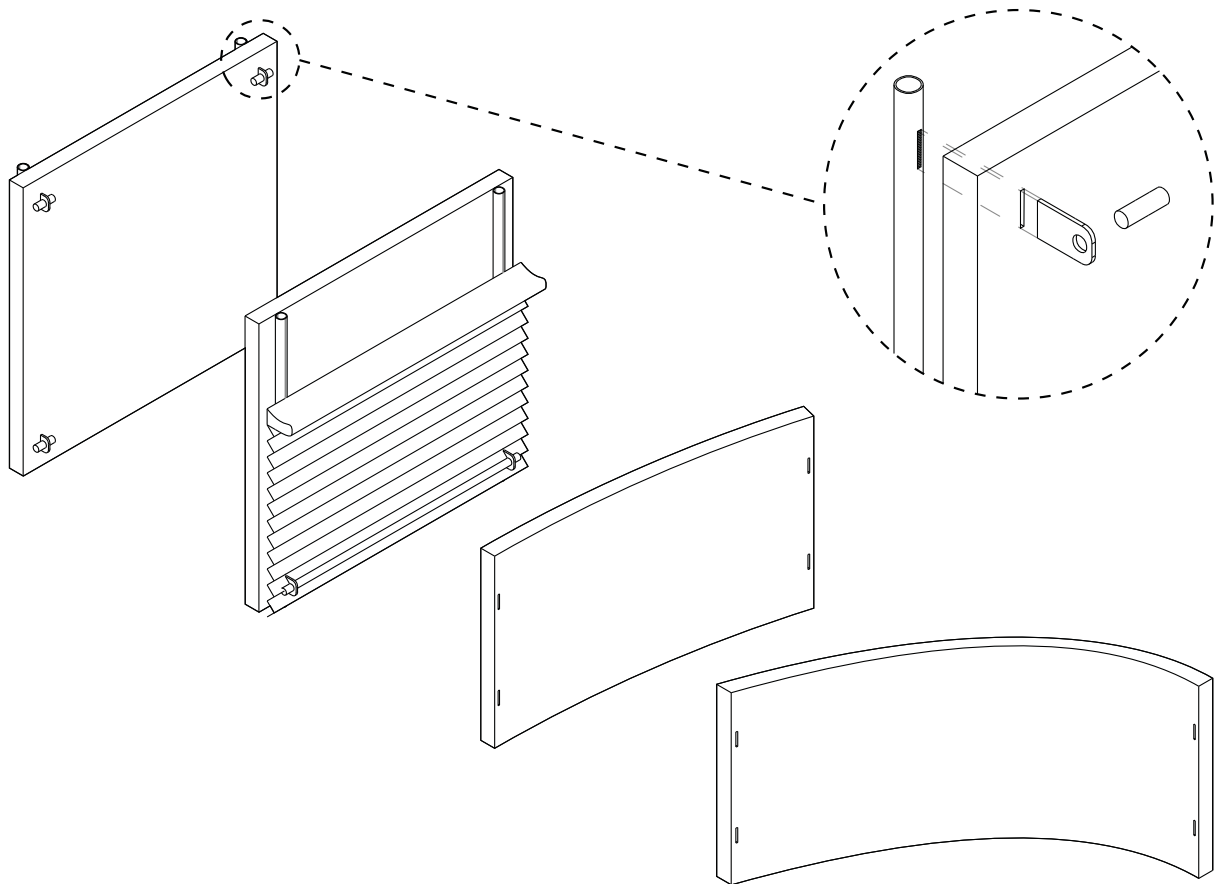


fig. 3\_6 Module Assembly  
Peg-and-slot fastener detail and  
application in mobile screen  
module

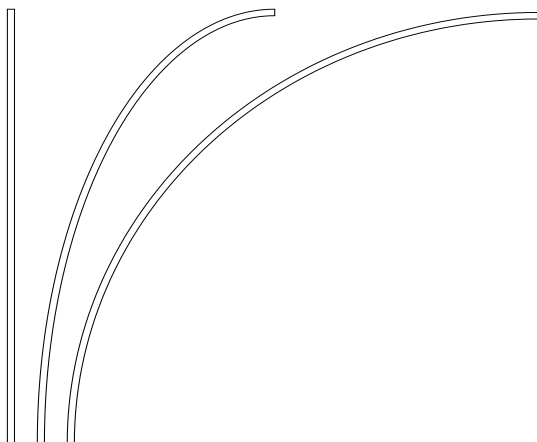
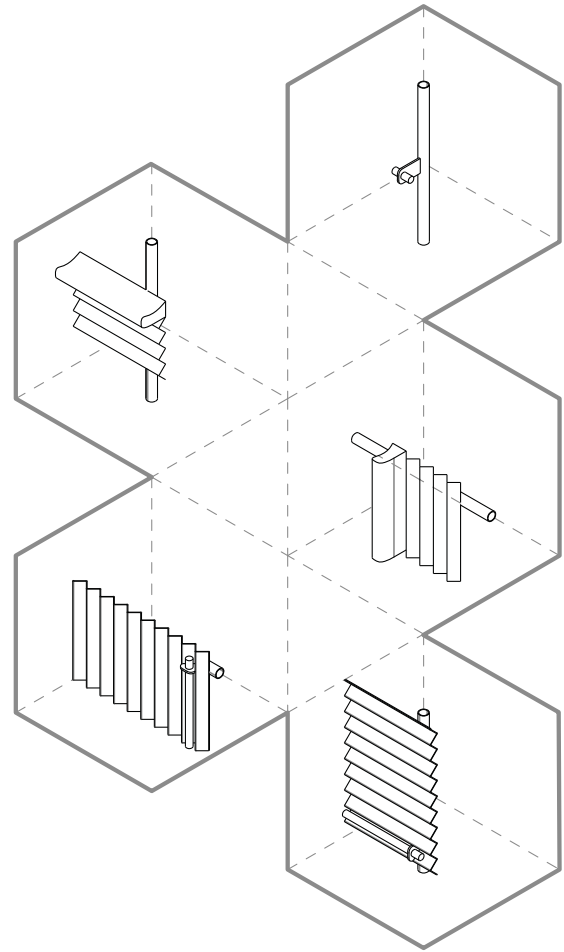
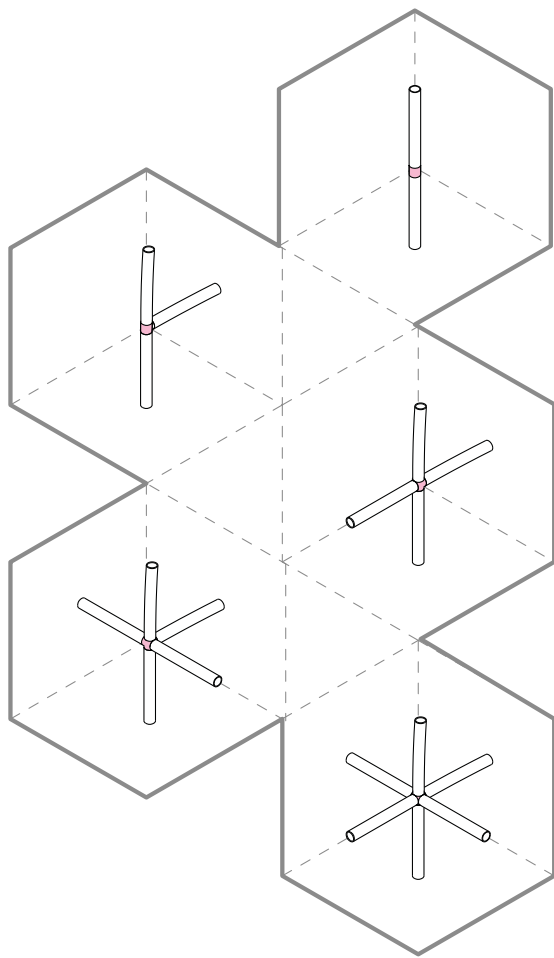


fig. 3\_7

(TOP LEFT) Connectors  
Rubberized connectors  
serve as flexible node to  
affix up to 6 frame ends

fig. 3\_8

(TOP RIGHT) Fasteners  
1. Tab & Slot  
2. Vertical/horizontal slider  
4. Vertical/horizontal bar

fig. 3\_9

(LEFT) Framing  
300mm diameter rods in  
three different profiles to  
create modules of 300,  
600, and 900mm

POSSIBLE CONFIGURATIONS

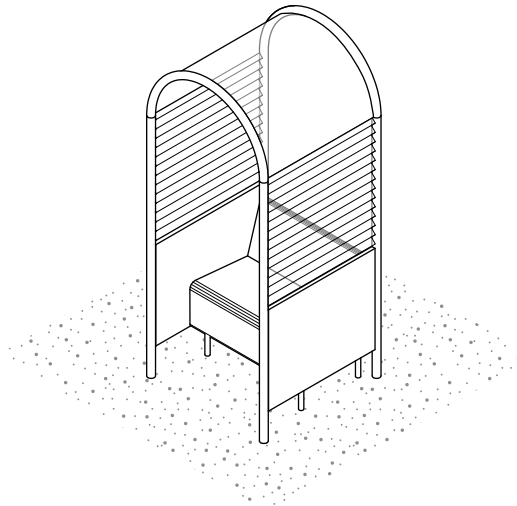


fig. 3\_10

Sociofugal individual seating for privacy and introversion; can be aggregated to form spatial dividers. LED insets allow for light colour control.

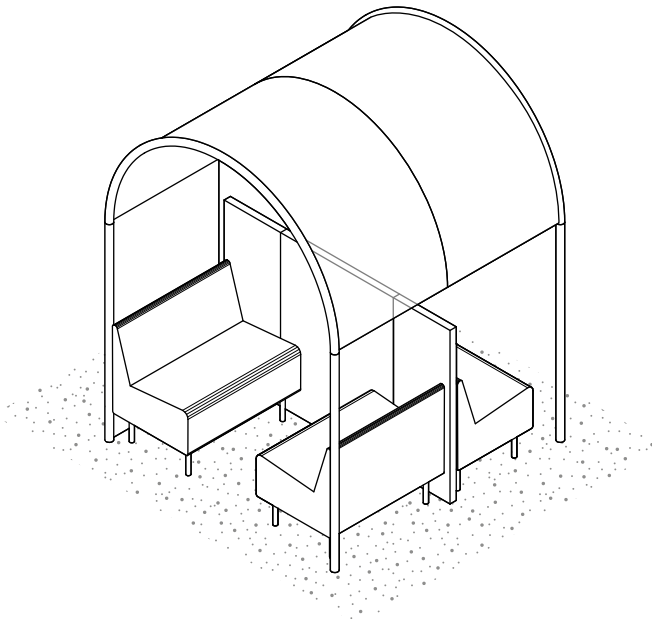
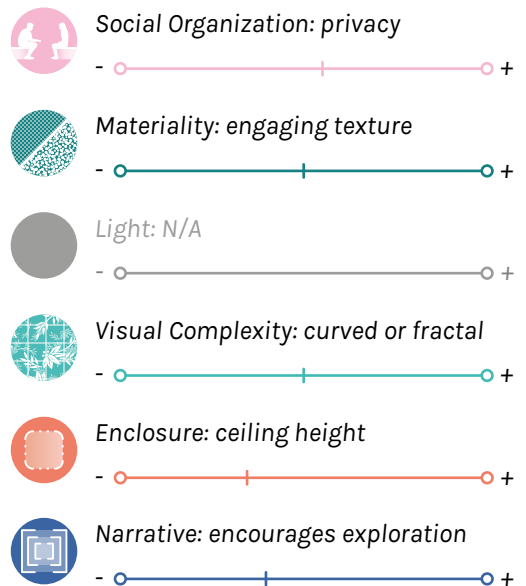


fig. 3\_11

Sociopetal/sociofugal seating for focus and socializing. Lowered ceiling improves detail-oriented thinking and creates a sense of refuge.



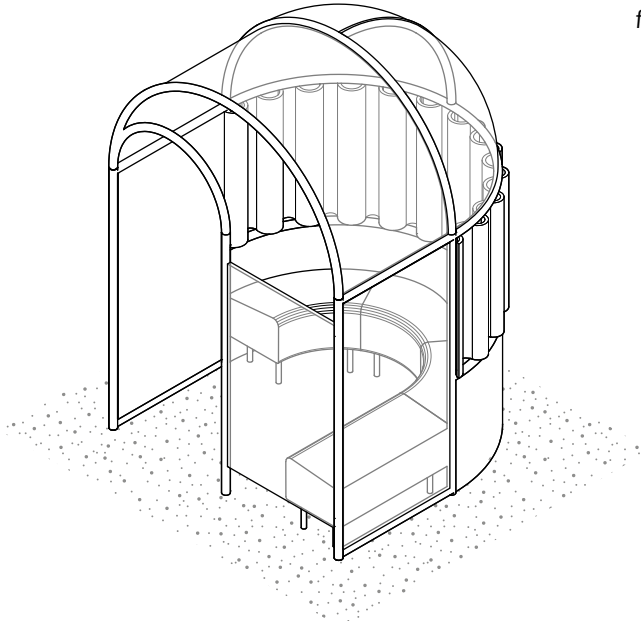
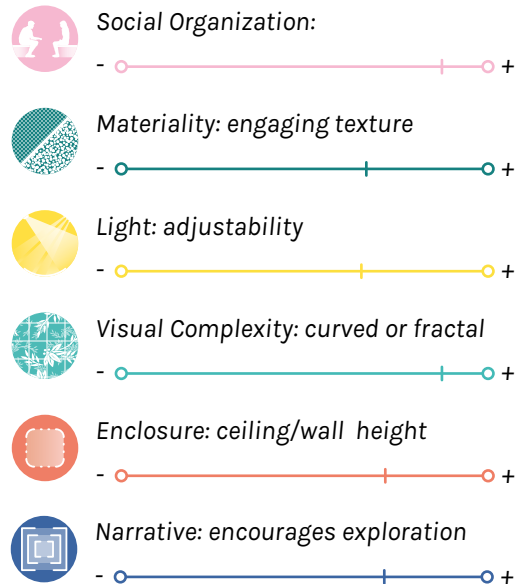
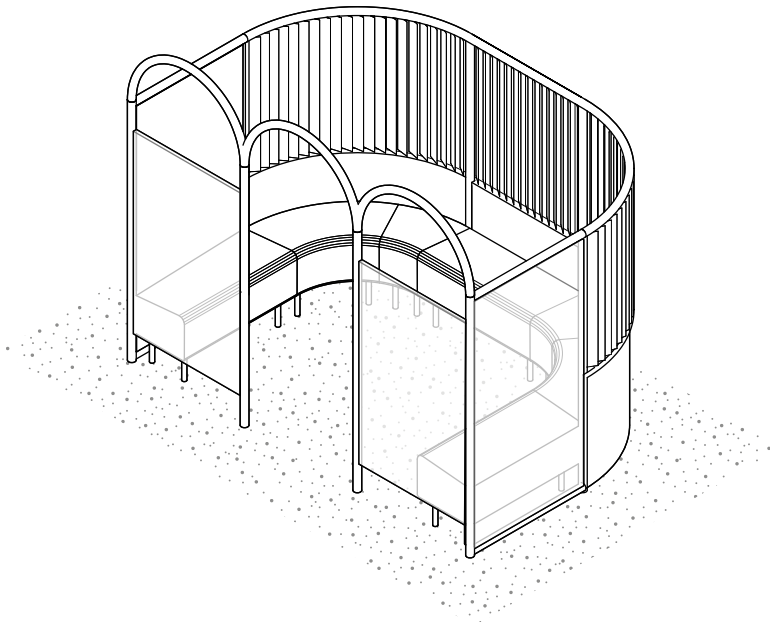


fig. 3\_12

Sociopetal enclosed seating provide privacy and intimacy for a small group. Curtain for acoustic dampening and material engagement.



fig. 3\_13



POSSIBLE CONFIGURATIONS, CONTINUED

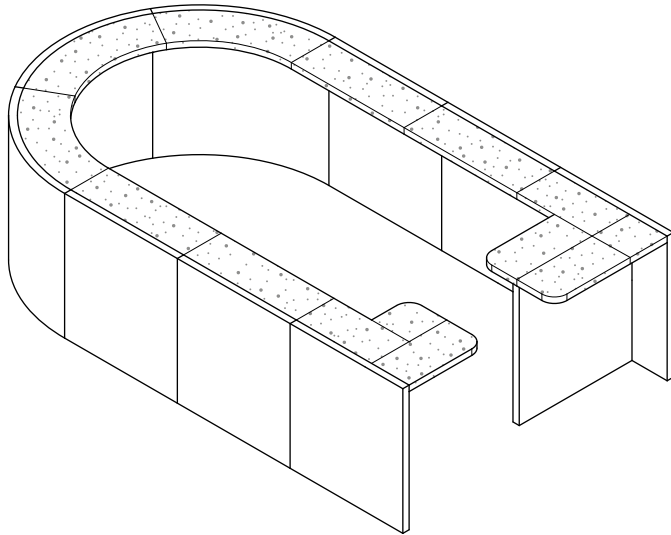


fig. 3\_14

Concession counters can be used as meeting points and social areas, and as anchors in floorplan narratives.

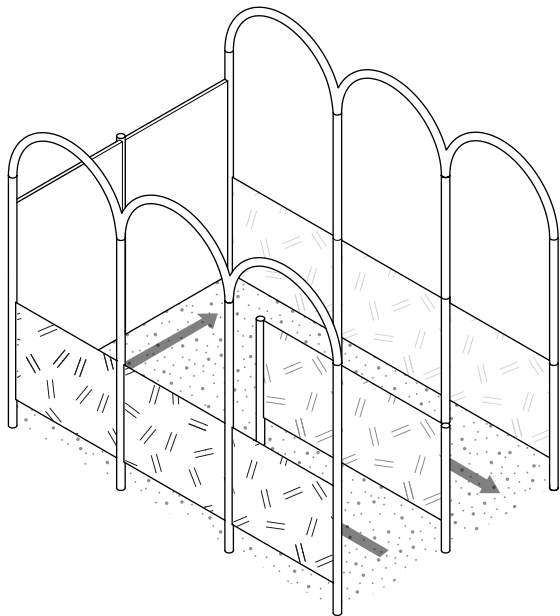
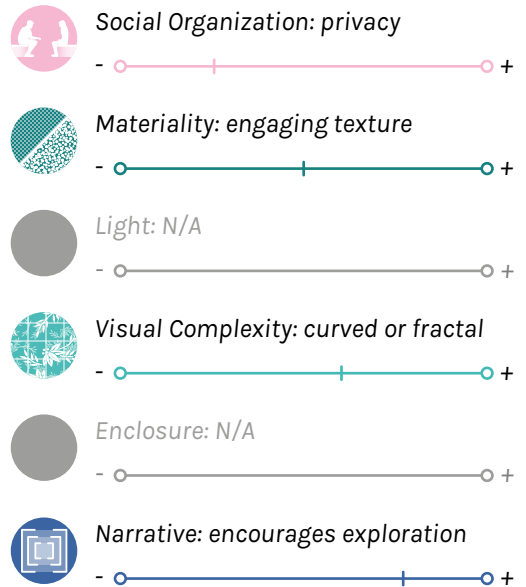
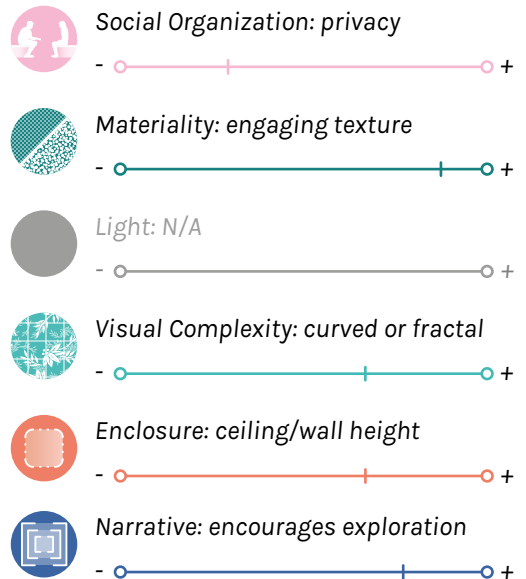


fig. 3\_15

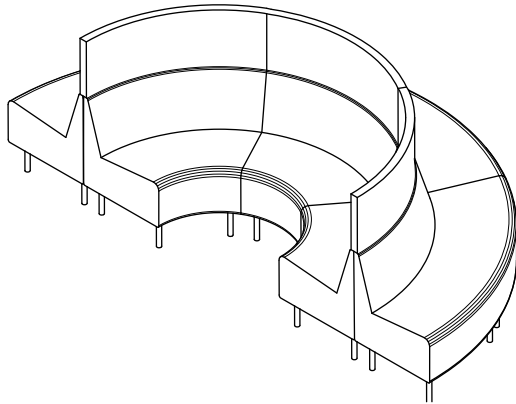
Queue structure featuring novel material choices create opportunity for mild engagement during the wait.





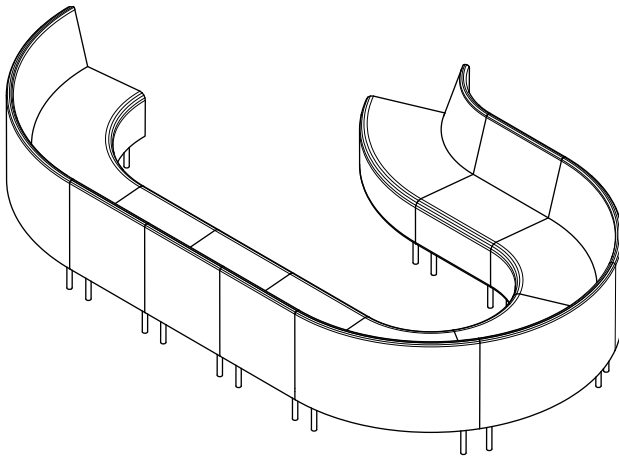
## COMPLEMENTARY FURNITURE

fig. 3\_16



Double-loaded curved sofas provide a person the option of dual opportunities: the interior arrangement is sociopetal and offers high sociability, enclosure and refuge; the exterior seats are sociofugal, offering a respite from social engagement and prospective views of surroundings.

fig. 3\_17



Modular single-loaded sofas can be arranged into a variety of configurations to modulate enclosure and intimacy, while lending structure to a space without interior renovations.



fig. 4\_1 The then-new waiting hall at New York City's Grand Central Terminal in 1904.

## **Chapter 4 | On Waiting: Site Analysis for Spatial Impact**

After completing a survey of public urban programs that seemed well-suited to tactical intervention, transit waiting areas emerged as high-opportunity sites. They are large and accessible to the masses, they provide a longer time frame for both static and dynamic engagement within the environment, and they consist of a relatively consistent formula of programmatic components and associated shortcomings.

Public transport plays an extensive role in the urban experience and has contributed to the shape and function of city development, even paradigm development. Steam engine technology ushered in trains with the Age of Enlightenment, but North American public transport began in earnest with a system of horse carts and ferries in the early 17th century. The rise of suburbs and the middle class led to the implementation of a subway system in Boston in 1887.<sup>22</sup> This high-speed transit option informed other east coast American urban hubs and developed into a benchmark for contemporary urban design. For train, bus, and subway transit, the shape of waiting rooms was roughly divided into two categories: grand waiting halls in terminal stations and small semi-enclosed shelters at stations along the way. Both models were populated with linear benches for seating. This model did not change significantly for much of their lifespan and reflects the majority of current Western examples of public transportation on land.

Flight, however, changed the way in which the spaces surrounding travel were conceived. At the birth of plane travel, airport design drew heavily from train terminals, as shown in the imperious regionalist styles of the Croydon Aerodrome in South London and

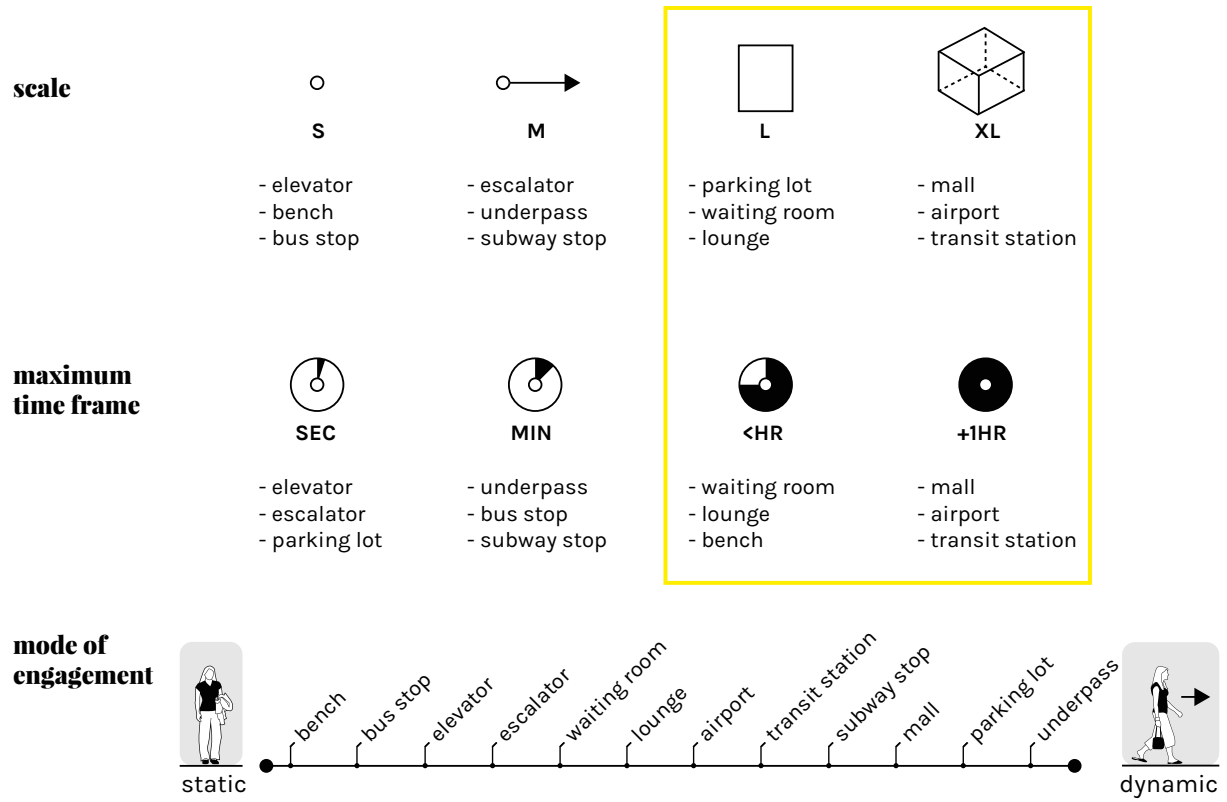


fig. 4\_2 Major factors considered in identifying good fit for restorative environment site.

Burbank United Airport in California, which resembled an English manor and a Spanish mission respectively. However, as Charles Lindbergh's transatlantic flight in 1927 redefined the concept of 'arrival', sprawling and radical designs such as the sci-fi vision of the urban airport city by Italian Futurist Antonio Sant'Elia began to make more sense for a rapidly globalizing present. The customer-facing spaces of travel mushroomed from ticket queues, washrooms and waiting rooms into self-sufficient cities, where commuters and jetsetters alike could spend an entire day between places, in relative comfort. The extended timeframe and public momentum for public transit positioned airports as a playground in which to flesh out the idea of the 'airport city,' a transit hub which was as much defined by its unrelated amenities as by its role in transportation infrastructure.

This new economic model and the increased accessibility of air travel led to numerous expansions, additions, and renovations as early as the 1970s, continuing to the present day. Successful additions to the oeuvre of transit stations incorporated familiar elements of traditional waiting halls such as ample seating, sufficient lighting, clear communication of departures and arrivals, but with added modern comforts of superior acoustic and spatial insulation from the world outside, additional programs such as cafes, shops and even spas, and more opportunity for customization. This increasingly privatized way of designing spread to other forms of transportation architecture, and the station-as-mall compartmentalized the amenities of travel, leaving fewer resources focused toward the basic public user. Contemporary lounges are a notable addition to the roster of airport programming. Programmatically akin to waiting rooms, but with special amenities for relaxation and focus available to a select group of members or otherwise privileged travelers, lounges use interior architecture to provide spatial comfort which emerged as a respite from the reflective, scale-less fields of airports and the crush of the crowds. Intended to "bring back

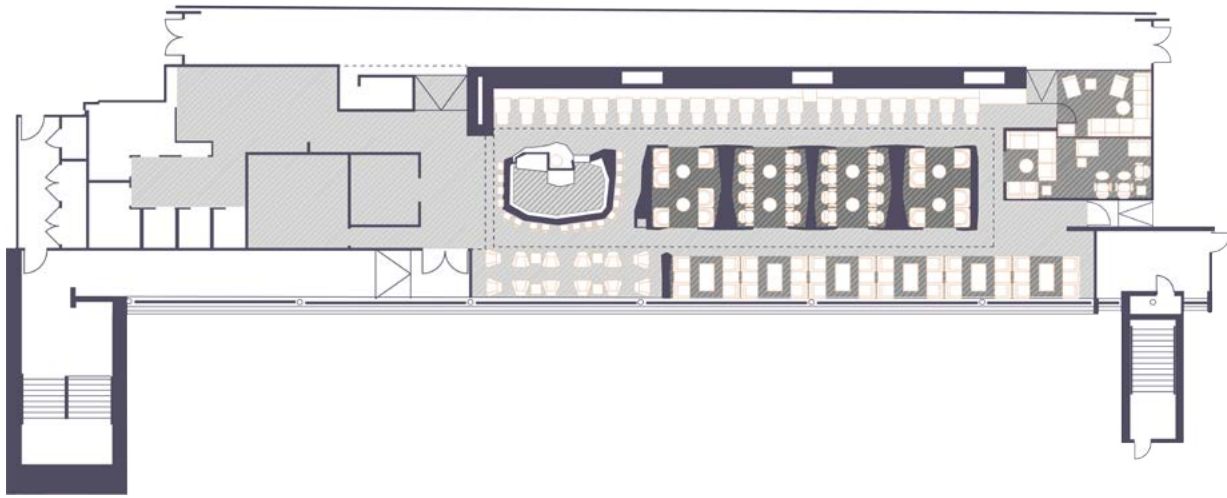


fig. 4\_3 Floorplan of Upper-Class Virgin Atlantic lounge in New York City's JFK Airport. SHoP Architects.

the lost romance of air travel," the Upper-Class Virgin Atlantic lounge (figure 4\_3) in New York City's JFK Airport is an interesting representative of contemporary lounge design, classist title aside. SHoP Architects designed complex digitally fabricated screens to create intimate scaling and enclosures while maintaining open sightlines to the terminal beyond. The seating is arranged in a mix of configurations suitable to different activities and groups of different sizes: linear bench seating, four-top tables, bar seating, workstations, armchairs, sectional sofas. The creation of different naturalistic groupings allows different types of travelers to feel equally at home in the lounge. A water feature and moat provide spatial and acoustic separation from the rest of the terminal while maintaining sightlines to the gates. This allows users to enjoy the amenities of the lounge without the anxiety of missing a flight. While lounges are a luxury not available for all, if spatial design moves are separated from the lavish amenities there are principles which can be applied more broadly to create a comfortable waiting environment for all.

A compelling way to disseminate this environment of calm escape to a larger audience is through modular design. From napping



to flexible interior architecture, the advent of pods is upon us. Taking cues from references as diverse as Japanese capsule hotels and Gundam pods, the ephemeral architecture of 1960's Co-op Himmelblau and Drop City, and the mass-manufactured self-containment of transportation design, pods can be seen as a response to the modern traveler's desire for privacy, enclosure and personalization in a generic environment. The nap pod was introduced in airports as a modern solution for the professional on the go. To the cynic, these pods are a symbol of a society in which people pay for the temporary space to fulfil a basic human need, to compensate for a lifestyle which doesn't permit the free time to rest and recharge on their own terms. However, the potentials for pods to carve out spaces for other purposes, such as MIT Self-Assembly Lab's wood-and-fibreglass transformable meeting spaces for Google (figure 4\_4) and others, allow for diversity of quality of space within an open environment. The potential for the user to aggregate or reposition elements of their environment to customize their level of privacy and enclosure, opens up a world of possibility in open program spaces.

*fig. 4\_4 Transformable Meeting Room by MIT Self-Assembly Lab, Google and Michelle Kaufmann.*



### the queue

- 0-15 mins.
- Standing (active)
- Moderate stakes: could miss bus if line is too slow
- Ropes to delineate queue
- Information required:
  - view of open kiosks
  - departure schedule
  - direction to amenities



### the lounge

- 10-60 mins.
- Seated or leaning (static)
- Low stakes: as safe as surroundings
- Configuration determined by seating
- Chairs determine posture
- Information required:
  - view of ETA/ETD board
  - view of bus yard



### the platform

- 5-15 mins.
- Standing or leaning (active)
- High stakes: big vehicles
- Curb and railing determine queue boundaries
- Information required:
  - proximity of bus
  - layers required for thermal comfort

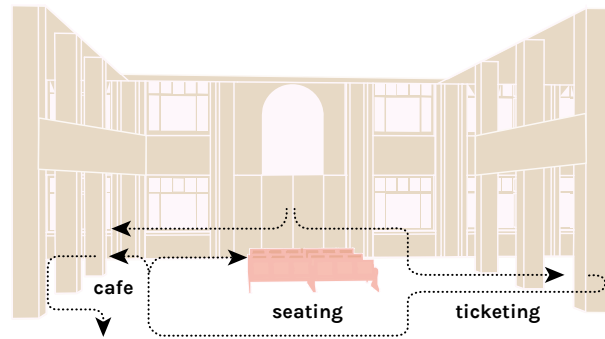
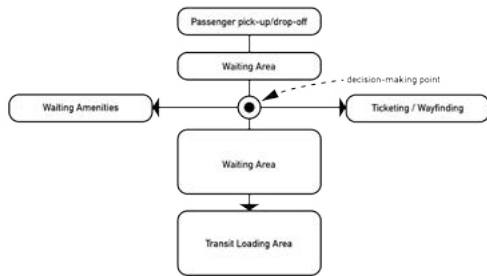


## **Chapter 5 | Design Exercise at Toronto Coach Terminal**

When introducing design as a public health measure, it is essential to focus on the areas of highest opportunity. How many people have access, who receives the benefits, what ‘dosage’ is required, how much of an improvement in stress levels is enough to consider an intervention effective? Taking cues from Kaplan and Kaplan’s rules of narrative and extent, I focused on public spaces where people spent a moderate amount of time and had room to roam. Waiting rooms and transportation hubs were at the top of the list. My application of the framework manifested in a design exercise at the Toronto Coach Terminal. Upon comparing the three different stages of waiting housed in the terminal—the queue, the lounge and the platform—it seemed most tactical to focus the proposal for the seating area of the bus terminal as it has the potential for the highest ‘dosage’ of environmental restoration benefits. While the terminal provides limited amenities and adequate seating, it does not flow in an intuitive way and is not compliant with up-to-date transit standards. The lighting is, at turns, harsh or insufficient. The acoustics are overly vibrant, and conversation carries in an uncomfortable way, so people rarely have conversations while they wait.

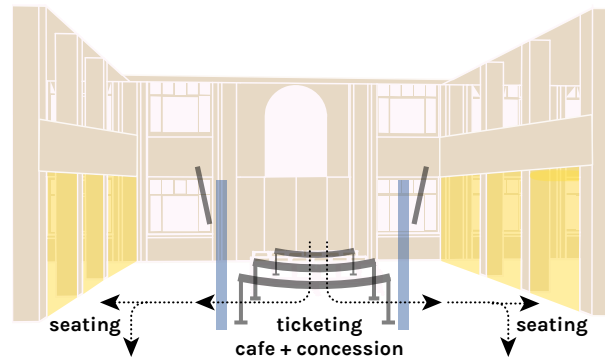
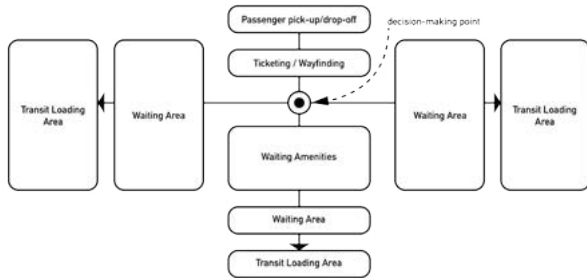
Central banks of linear track seating put those waiting on display while blocking sight-lines to the bus yard. Joining the ticket queue requires navigation past aisles of seating to a low-ceilinged area adjacent to the atrium space. To create restorative modular interventions for the patrons of the Toronto Coach Terminal, cues from the pedagogy outlined previously provide a starting point for the design, which could ideally be adapted by the full range of users

*fig. 5\_1 (OPPOSITE) Three stages of waiting: analysis of highest opportunity area.*



**Currently** Central banks of linear track seating put those waiting on display while blocking sightlines to the bus yard. Ticket queues are decentralized and bleed into the waiting space, creating a confused narrative for users.

MTQ Transit-Supportive Guidelines Layout



**Proposed** Appeal to people’s desire to stick to the edges of the room. Using lighting and structure, draw activity through the centre of the room while making the alcoves occupiable.

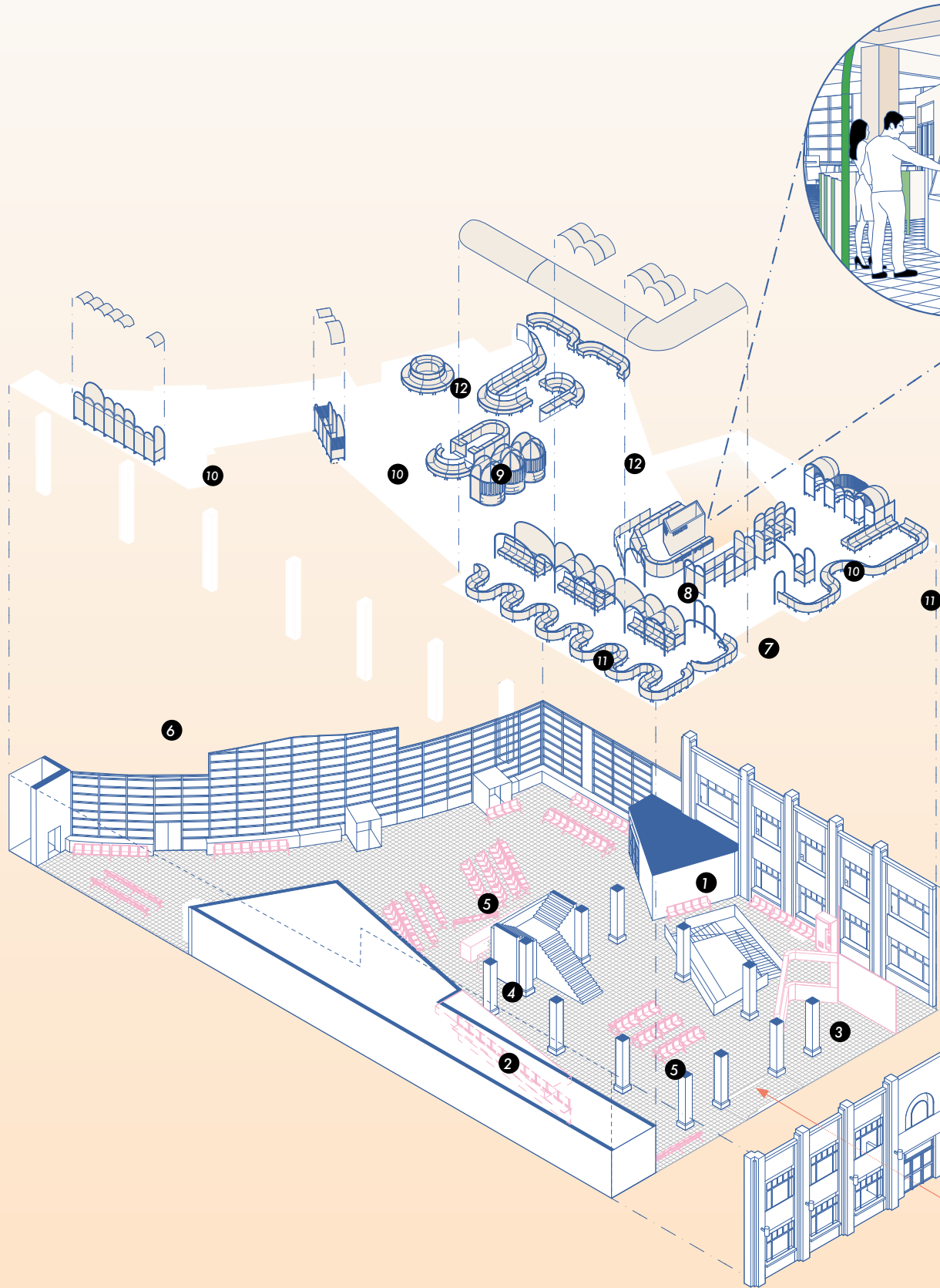
fig. 5\_2 Existing and proposed layout of Toronto Coach Terminal

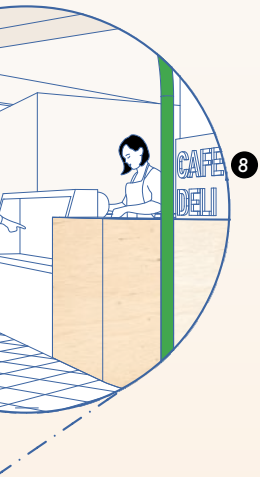
to suit. The overlapping cues from traditional and contemporary literature support a particular experience of space but leave the designer to use their intuition in designing each and selecting materials which will further the restorative journey.

The goal of the layout is to, through a modular approach, design an inhabitable perimeter which offers sociopetal clearings for socializing and sociofugal coves for privacy or work. Some of the screen elements are operable allowing for adjustment and staggering, which can exaggerate the pod effect and create an insular cell, or inversely, create a better vantage point for people watching. The potential for users to aggregate or reposition elements to customize their level of privacy and enclosure, opens up additional possibilities in spaces which are currently underutilized in the terminal.

To make waiting in the queue for tickets less stressful, the new queue is located centrally and has a view of both the buses and the seating areas. Engaging use of textured and reflective materials provide gentle distractions during the wait. Introverted or overstimulated users may choose to select the seating configurations with dividers for Individuals or small groups, creating a calm environment to be alone or catch up with friends. Adjustable LED light canopies provide further environmental customization. Those looking to sit in groups for a more communal experience may instead choose to wait in a new seating area that occupies the former queue. It hosts both curved and bench-style seating to allow users to choose from sociopetal and sociofugal configurations and focus-friendly options with lower ceilings to promote concentration (Banaei et al. 2017).

Open or 'extroverted' seating describes over 70% of the existing waiting area, and closer 50% of the proposed. The curved seating configurations allow for people-watching and clear views to the bus yard. By working to address more subtle parameters of biophilic design championed by restorative environment theory—borders, proportion, quality of light, self-similar patterns, narrative and





extent—and pairing them with a flexible model of enclosure and social organization, it is possible to provide an environment which prioritizes the experience of the user and performs within and beyond its programmatic function. The intention is to promote a clearer mind, renewed capacity for attention, reflection, and resilience in city life.

§

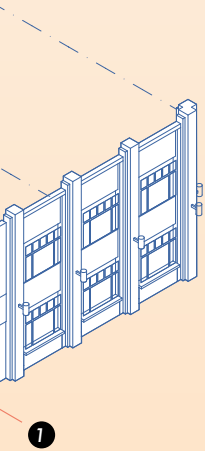
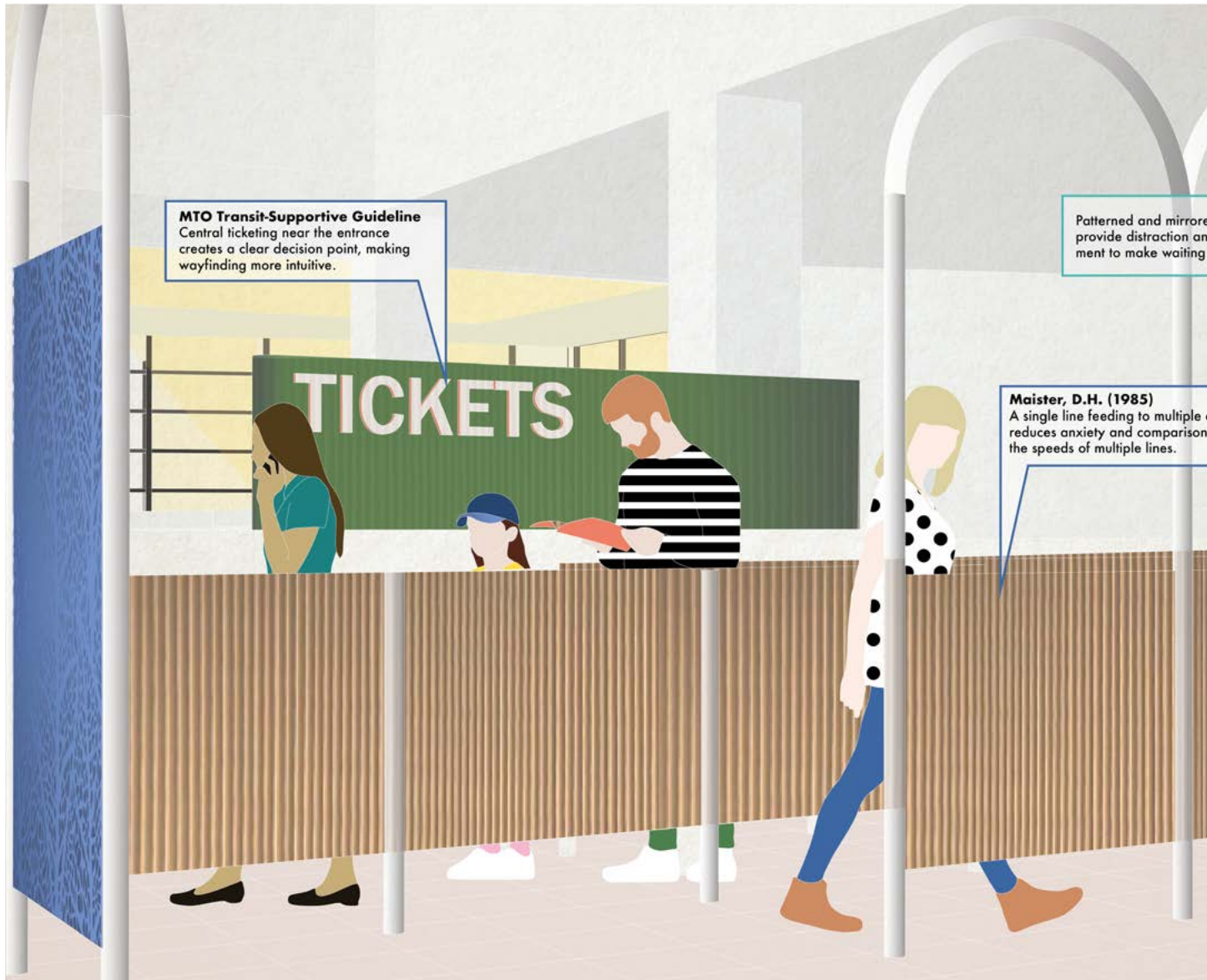


fig 5\_3 Existing and Proposed Plan for Toronto Coach Terminal

1. Bay Street Entrance	7. Proposed Ticket Queue
2. Existing Ticket Queue	8. Proposed Café
3. Existing Café	9. Proposed Concession
4. Existing Concession	10. Proposed Seating 1
5. Existing Waiting Area	11. Proposed Seating 2
6. Bus Yard	12. Proposed Seating 3



**MTO Transit-Supportive Guideline**  
Central ticketing near the entrance creates a clear decision point, making wayfinding more intuitive.

Patterned and mirrored walls provide distraction and a sense of movement to make waiting more pleasant.

**Maister, D.H. (1985)**  
A single line feeding to multiple lines reduces anxiety and comparison of the speeds of multiple lines.

**THE QUEUE: SINGLE-FILE LINE**



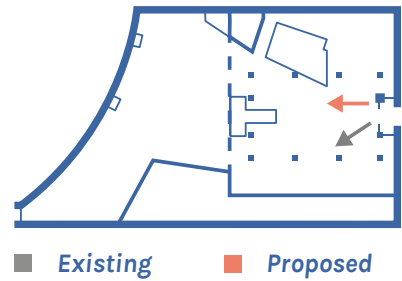


To make the queue for tickets less stressful, the new queue is located centrally and has a view of both the buses and the seating areas. Engaging use of textured and reflective materials provide gentle distractions during the wait.

fig. 5\_4 (LEFT) Proposed kit-of-parts system configuration to implement Big Six guidelines

fig. 5\_5 (ABOVE) View of existing queue

fig. 5\_6 (RIGHT) Key plan locating proposed and existing views







**Naz, Kopper et al. (2017)**  
Coloured light impacts mood, and cool blue, green, and purple shades are associated with calmness.

**Grandin (1992); Ahlquist (2015)**  
Deep touch pressure has a calming effect, which can be self-administered through the use of stretch textiles.

**SEATING AREA 1: INTROVERTED PERIMETER SEATING**



**Introverted seating configurations use dividers to customize spaces to individuals or small groups. This create a calm environment to be alone or catch up with friends. Adjustable LED light canopies provide further environmental customization.**

fig. 5\_7 (LEFT) Proposed kit-of-parts system configuration to implement Big Six guidelines.

fig. 5\_8 (ABOVE) View of existing open row seating.

fig. 5\_9 (RIGHT) Key plan locating proposed and existing views.

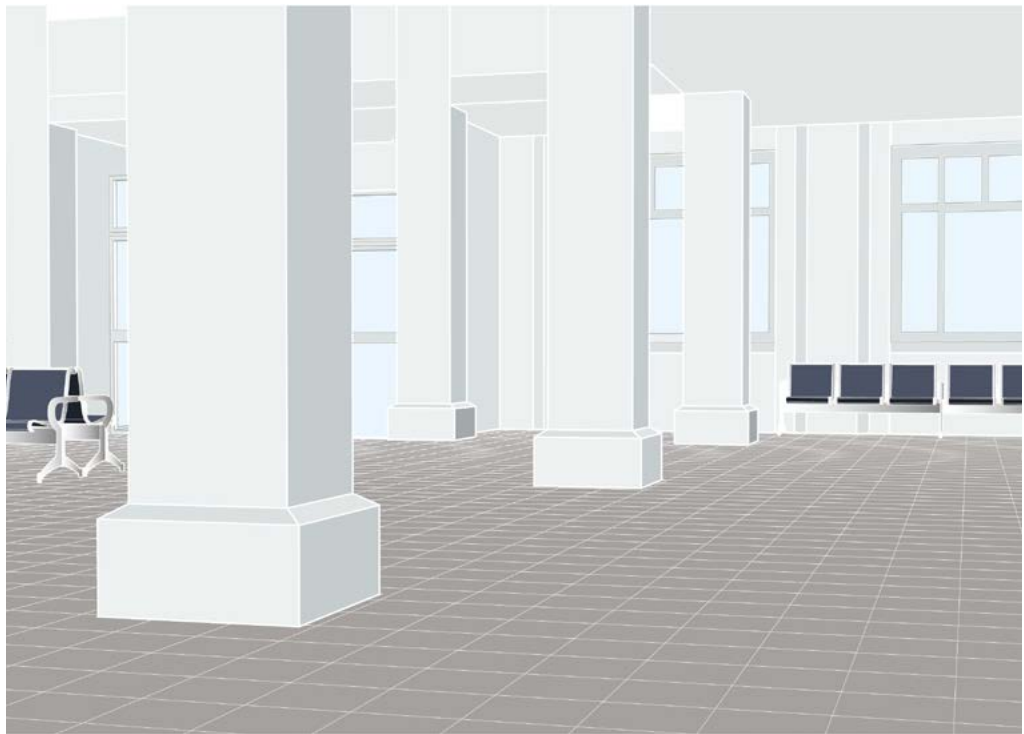




**Sussman and Hollander (2015)**  
Thigmotaxis, or 'wall-hugging', is a biological trait which we use for safety and comfort in unfamiliar or stressful situations.

**Banaei, Hatami et al. (2017)**  
Curved interior forms are more stimulating and pleasant to the brain.

**SEATING AREA 2: MIXED COMMUNAL SEATING**



**A new seating area occupies the former queue. It hosts both curved and bench-style seating to allow users to choose from sociopetal and sociofugal configurations and focus-friendly options with lower ceilings to promote concentration.**

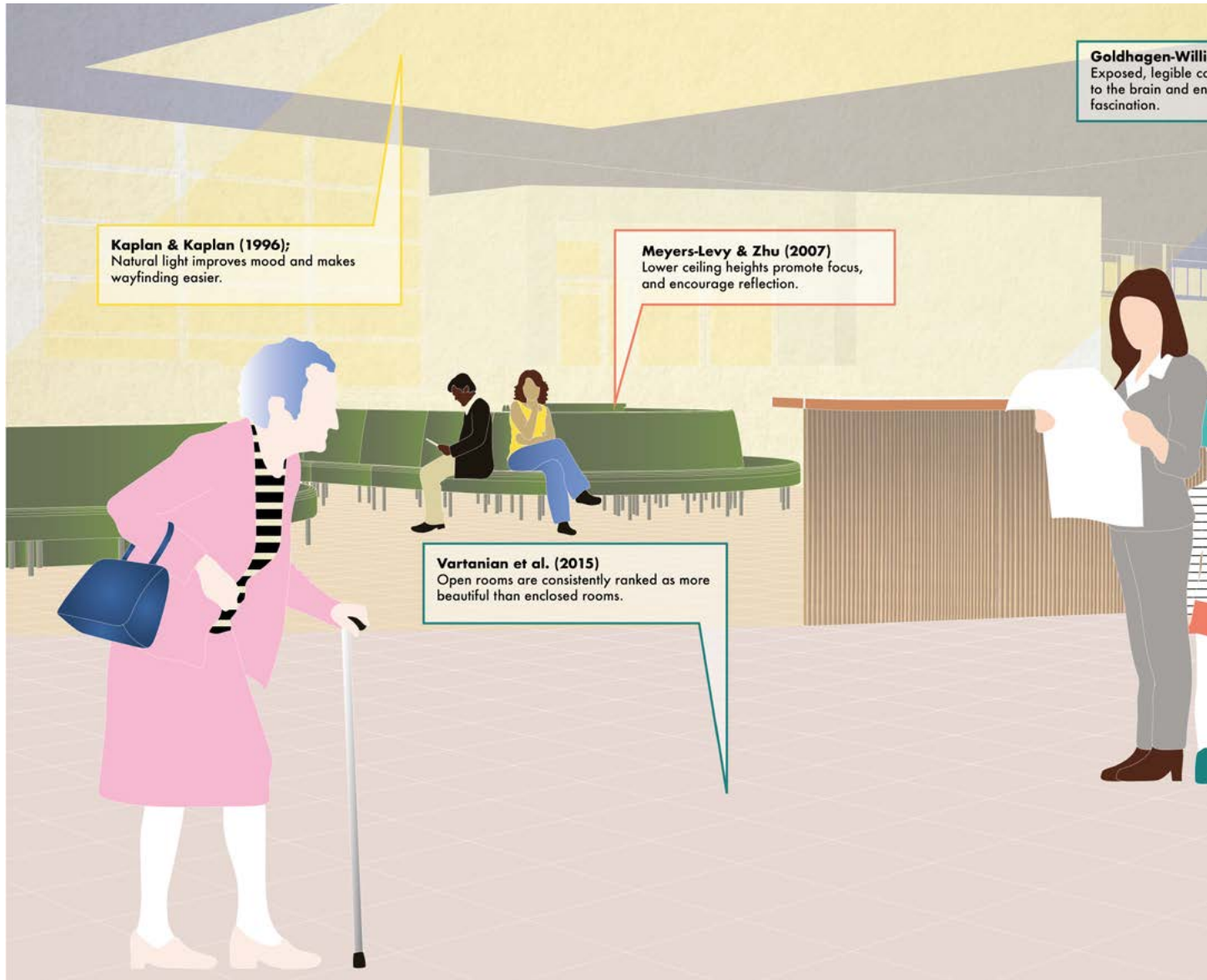
fig. 5\_10 (LEFT) Proposed kit-of-parts system configuration to implement Big Six guidelines

fig. 5\_11 (ABOVE) View of existing cove row seating

fig. 5\_12 (RIGHT) Key plan locating proposed and existing views







**Kaplan & Kaplan (1996);**  
Natural light improves mood and makes wayfinding easier.

**Meyers-Levy & Zhu (2007)**  
Lower ceiling heights promote focus, and encourage reflection.

**Vartanian et al. (2015)**  
Open rooms are consistently ranked as more beautiful than enclosed rooms.

**Goldhagen-Willi**  
Exposed, legible ceiling  
to the brain and encourage  
fascination.

**SEATING AREA 3: EXTROVERTED OPEN SEATING**

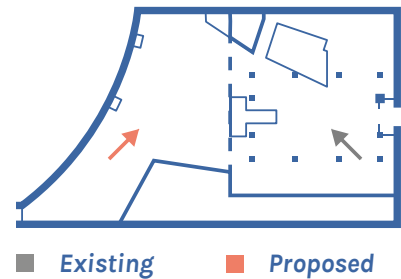


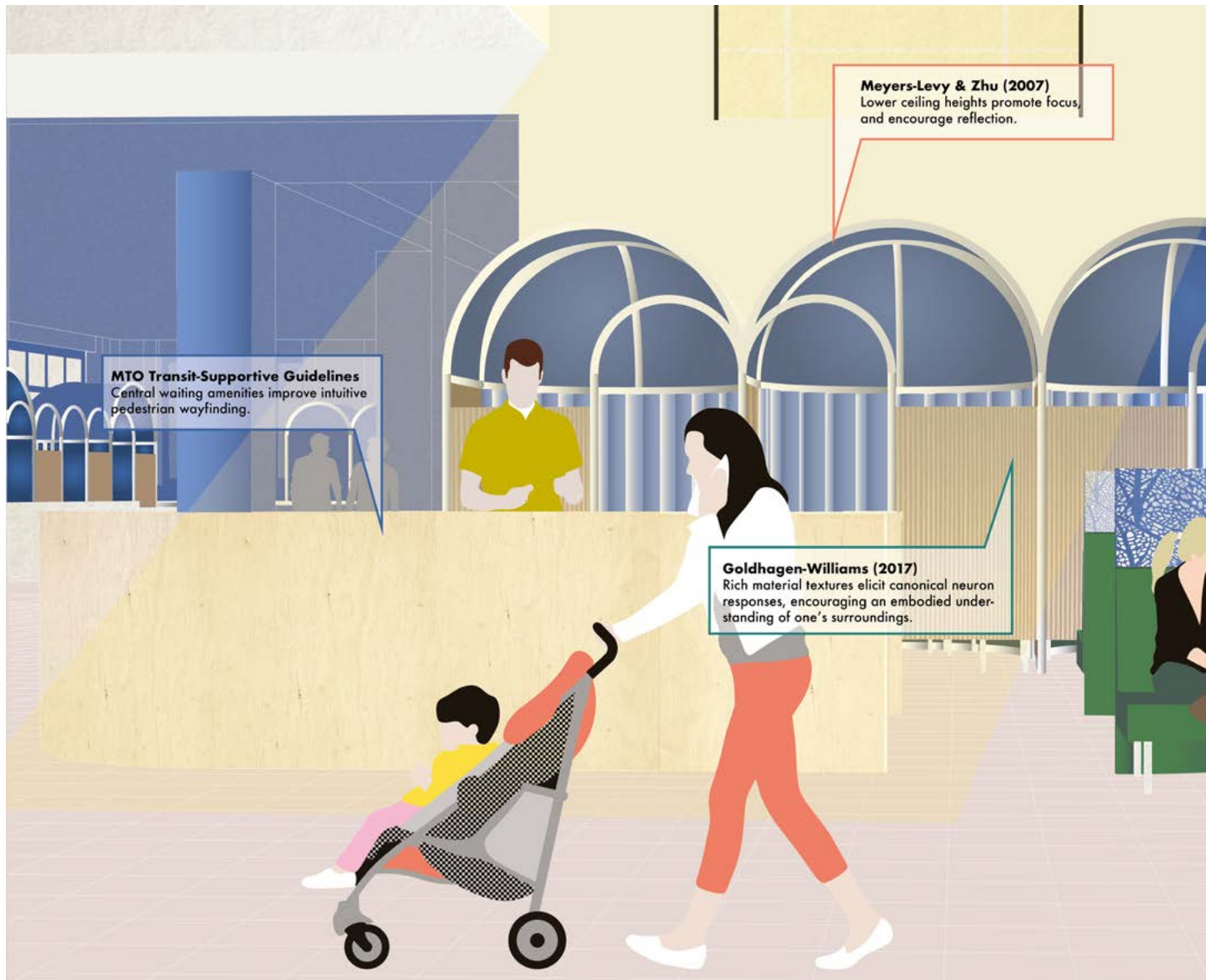
Open or 'extroverted' seating describes over 70% of the existing waiting area, and ~50% of the proposed. The curved seating configurations allow for people-watching and clear views to the bus yard.

fig. 5\_13 (LEFT) Proposed kit-of-parts system configuration to implement Big Six guidelines

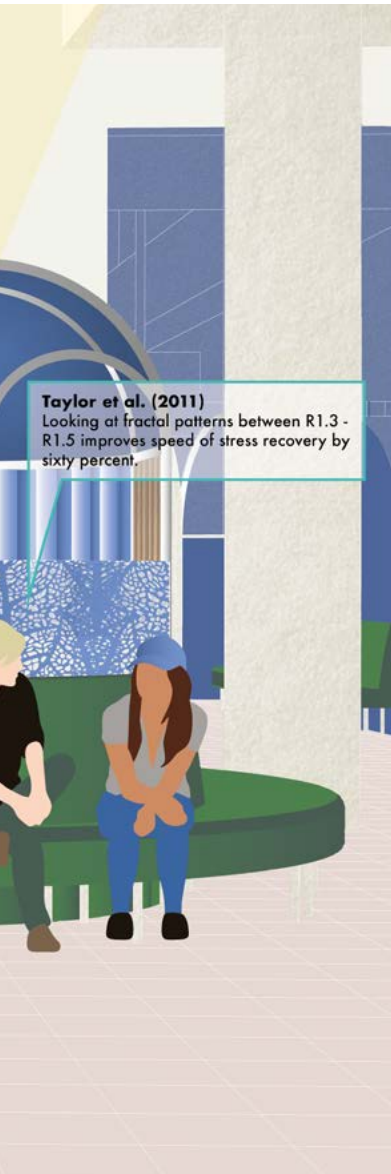
fig. 5\_14 (ABOVE) View of existing open row seating

fig. 5\_15 (RIGHT) Key plan locating proposed and existing views





**AMENITIES: CONCESSION AND CAFÉ**

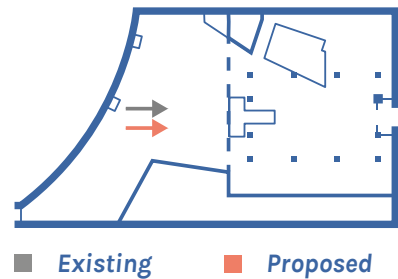


A central concession booth is easily accessible in both schemes. Drawing the concession into a more central location improves sightlines and the curved form is pleasant to navigate around.

fig. 5\_16 (LEFT) Proposed kit-of-parts system configuration to implement Big Six guidelines

fig. 5\_17 (ABOVE) View of existing open row seating

fig. 5\_18 (RIGHT) Key plan locating proposed and existing views







## **Discussion**

In looking outside the teachings of architecture to inform spatial design, there is always the risk of the outcome being compromised by translation of non-native entities. However, returning to the assertion that architecture is an inherently hybrid discipline reminds us that to avoid engagement with outside information is not an option either. Architects should celebrate aesthetics, but we are not artists. We have a duty to those who inhabit the cities we are building, and through current research in the life sciences, we have the knowledge required to make a built environment which provides respite, stimulation and opportunity for the many diverse needs of people. This diversity of environmental requirements should be looked at by designers as an opportunity: while many standards promote a one-size-fits-all approach, the Big Six Factors for Restorative Design promote flexible and adaptive design. By empowering users to tune their environments which bookend public transit to act as opportunities for human restoration, there emerges a potential to shift collective attitudes toward public transit and improve resilience at a population level. By recasting waiting as a small, meaningful respite from the blur of a fast-paced schedule rather than a necessary frustration, people may experience, if not less stress, a quicker and more regular recovery from stressors. Since increasing urbanization brings with it an increase in both waiting and stress that impact city dwellers so severely, better access to and more seamless integration of restorative environments in the waiting areas of the public realm would play a role in the management of stress across a wider population. With every project, architects should be asking their teams how they can further integrate restorative spaces into the city, as the impacts on a population's resilience and general health can be great.



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