How do buildings make us feel?
How can they make us feel better?

Through research in the emerging intersection of neuroscience and architecture, **Constructing Health** explores how our mind, and its various sensory systems, interacts with our built environment to enhance or harm health and well-being.

Although the biological brain is physically housed in the skull, recent research reveals that the mind, the brain's operating system, extends through and beyond the body to engage with our surroundings. This raises urgent questions about the role of architecture and placemaking in creating mind health.

Constructing Health bridges the gap in knowledge between the therapeutic medical world and the design community to reveal how the intentional shaping of our environment can support our physical and neurological health and well-being. It draws on research in fields of sensory integration theory, environmental psychology, occupational psychology, human factor psychology, experimental psychology, cognitive neuroscience, and attention restoration theory, as well as related non-clinical areas of health enhancement that include biophilia, neurodiversity, sensory impact, neuroaesthetics, neuroarts, neurophenomenology, neuro wellness, environmental neuroscience, and neurourbanism.

Constructing Health explores recent discoveries in cognitive psychology (the science of the mind) and neuroscience (the science of the brain) on how we form salutogenic, health-giving, person-to-place relationships that are similar to healthy and meaningful person-to-person relationships.

Through the study and application of environmental enrichment, **Constructing Health** shows how we can intentionally design our environments to make them more generous and offer affordances that help us in our daily life. This not only reduces environmental damage but also enhances physical, societal, and mind health.

Tye Farrow offers an engaging and accessible way forward in how we can construct health through specific, measurable design qualities and characteristics which enhance human performance in the cities we live, the homes we dwell, the places we learn, and the spaces we heal.

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Constructing Health

How the built environment enhances your mind's health

Tye Farrow

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How the Built Environment Enhances Your Mind's Health

An exploration of generous architecture through the neurological, psychological, and emotional benefits of enriched environments.

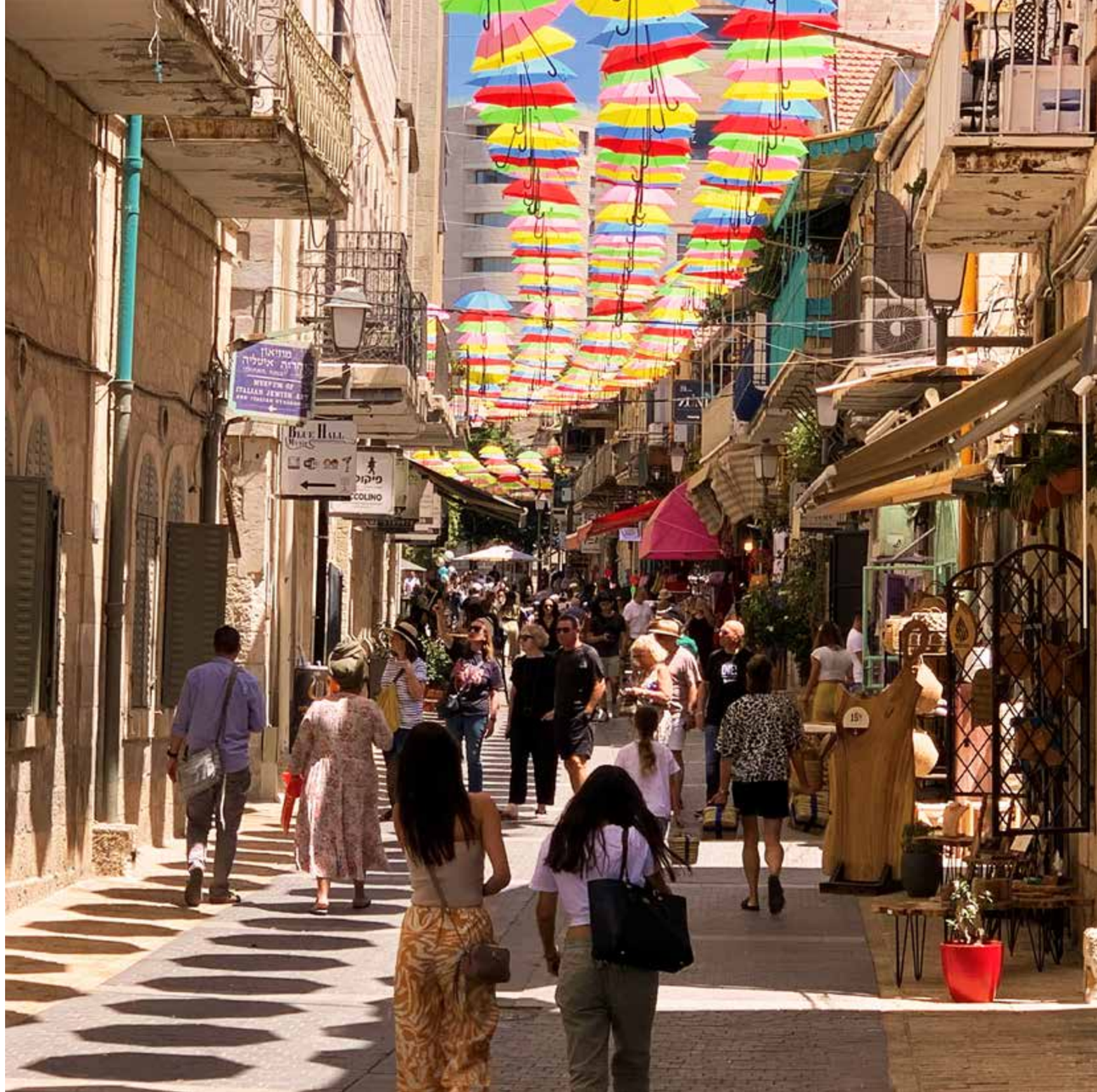
Tye Farrow

What causes health?

Credit Valley Hospital, Farrow Partners.

What if health were the basis for judging every public space and building?

“Umbrella Alley,” Yole Moshe Solomon Street, Jerusalem, Israel.



What if we stopped tolerating design that causes boredom, dis-ease, and depression?

Minoru Yamasaki's Pruitt–Igoe.
Photograph by United States Geological Survey.

How do buildings make us feel?

Cubicle farm.

How can they make us feel better?

One Bucket at a Time (2017),
by 5468796 Architecture and Factor Eficiencia.

There is no such thing as neutral space.

What we build affects how we experience the world and therefore either causes or undermines health.

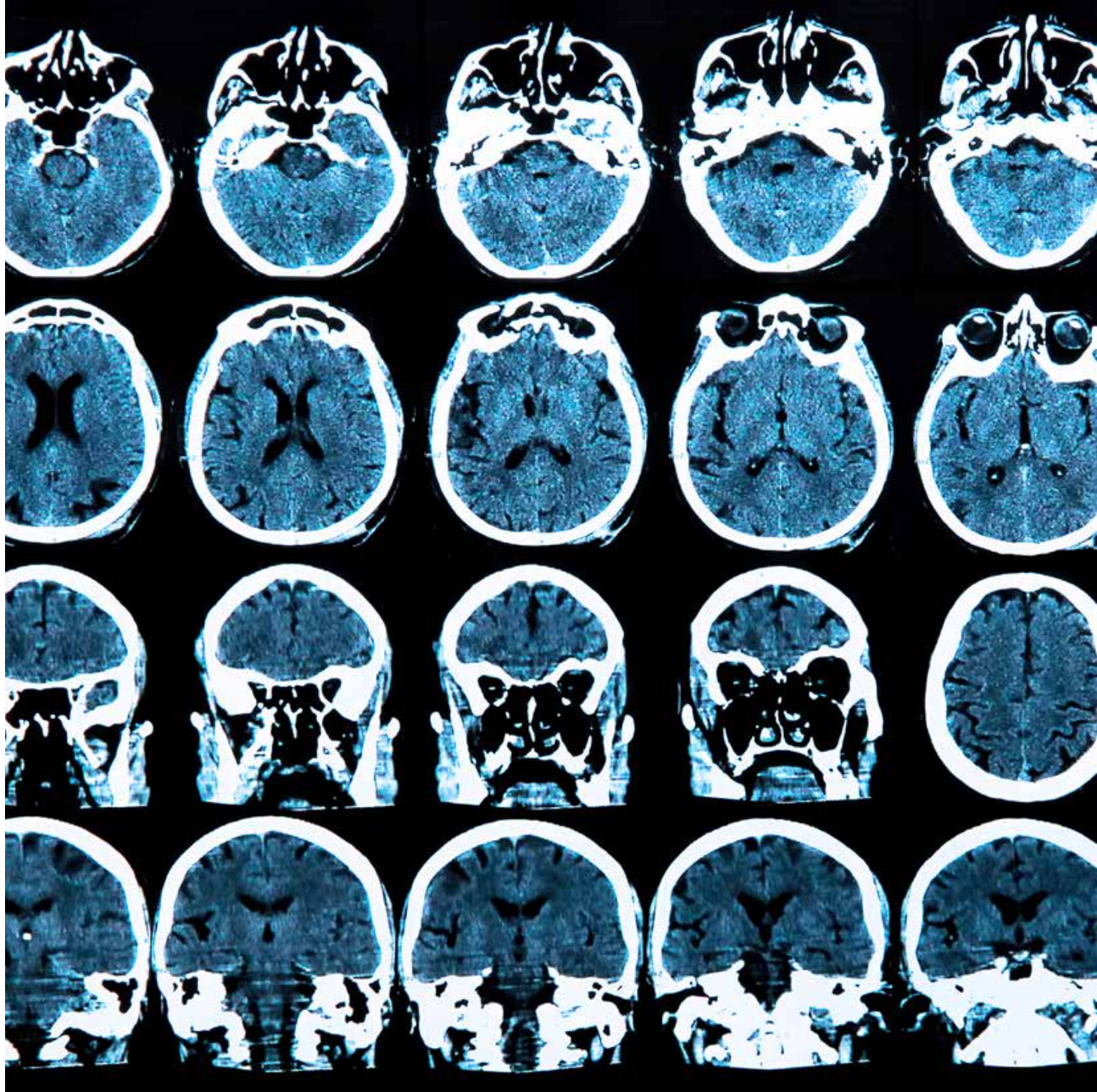
Historically, attitudes toward health have been holistic and salutogenic, focusing on the origins and causes of mental, physical, and societal health.

Architecture and design have frequently followed suit. Recently, however, Western medicine has embraced pathogenesis, or the causes of disease.

Why?

Brøndby Garden City, 1964.
Photograph by Axel Berkhoff.

Medical researchers have identified more than 8,000 diagnoses or symptoms of diseases.

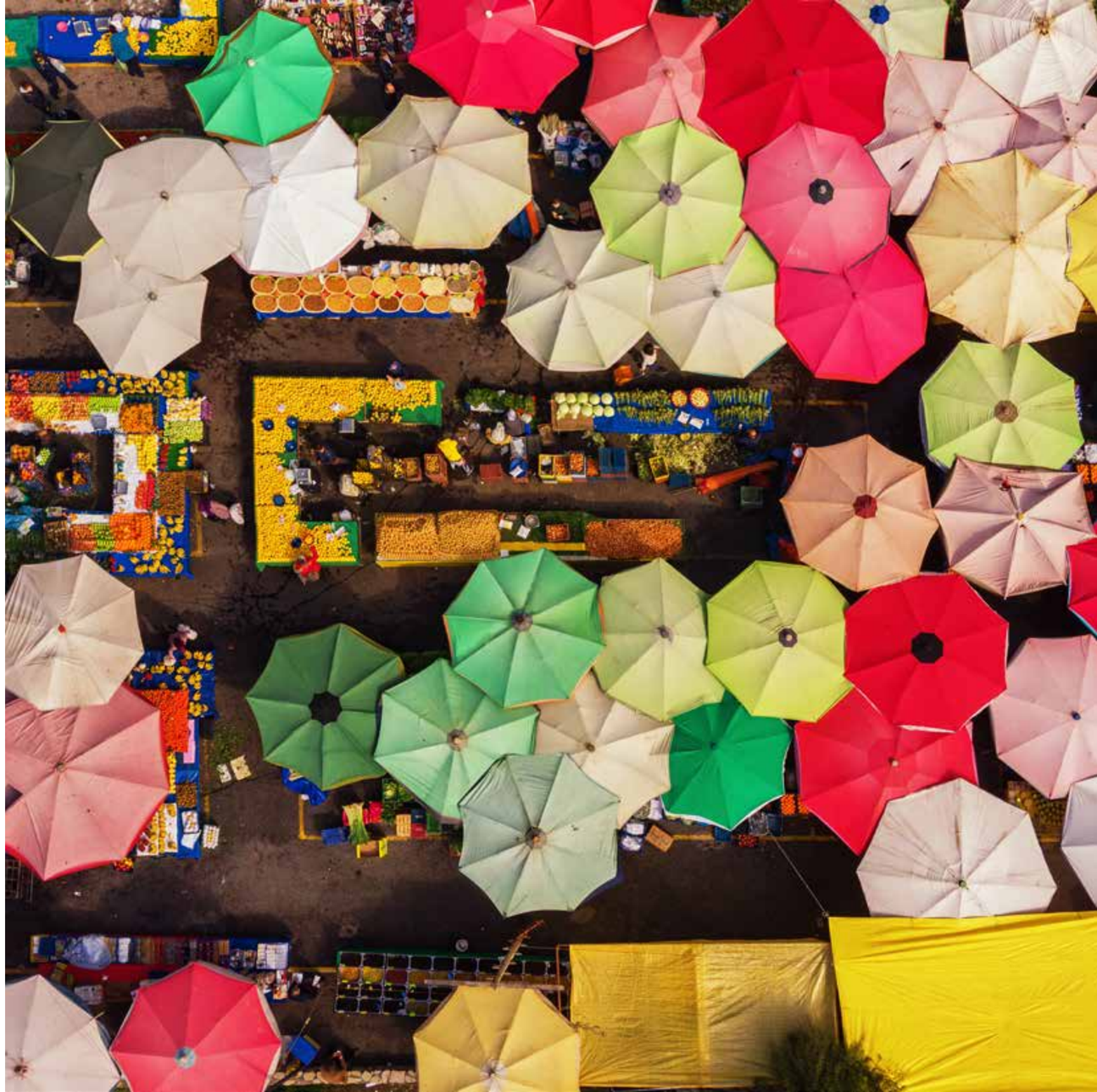


fMRI scan of the human brain.

Why haven’t we identified 8,000 causes of health or symptoms of wellness that lead to a healthier society?

One finds what one looks for.

Market stalls, Izmir, Turkey.



What if we created high environmental and human performance buildings – nutrient-rich environments – that would accelerate optimal health?

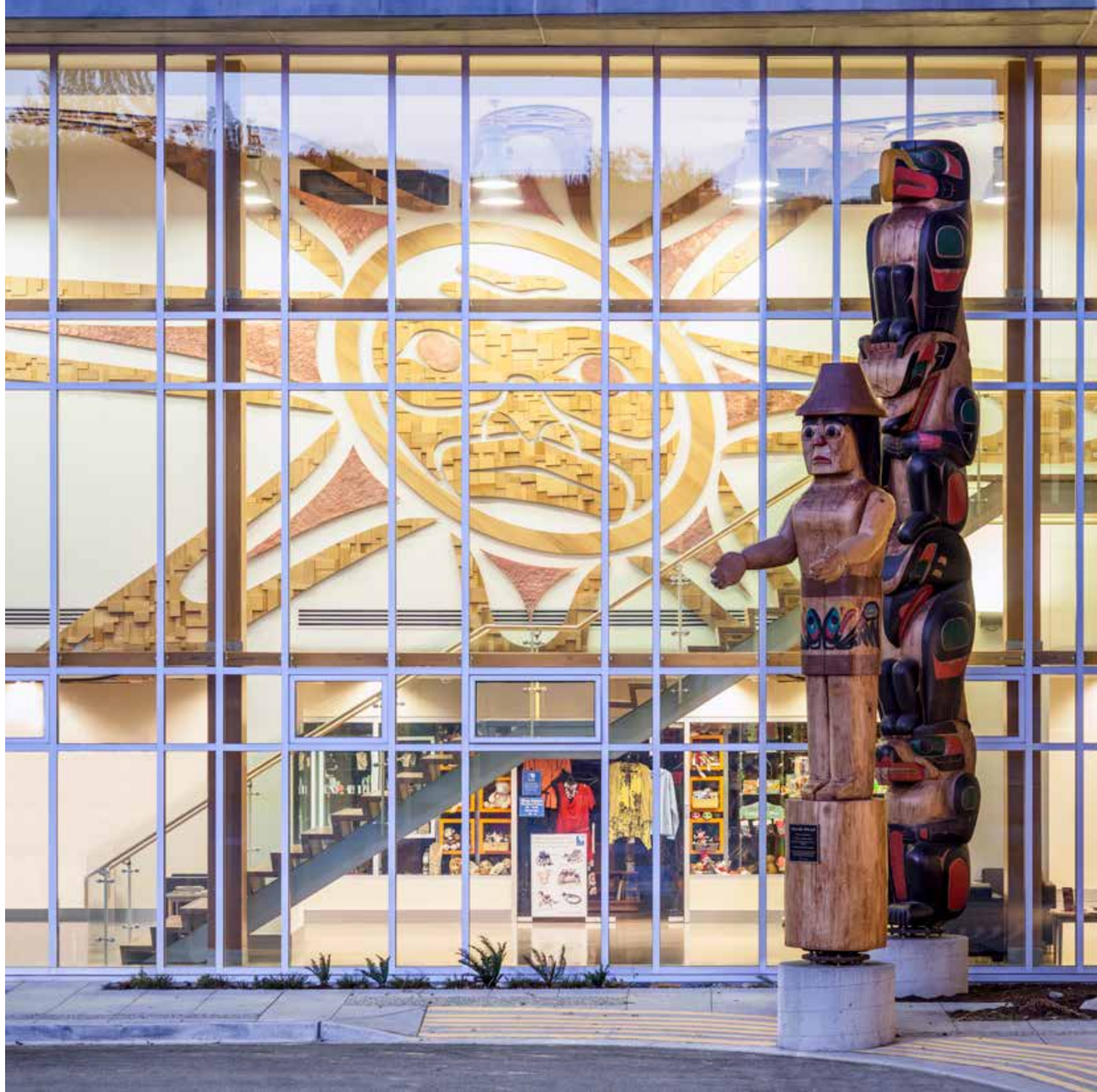
Bosco Verticale, Milan, Italy,
Sefano Boeri Architetti.

What if we re-embraced salutogenic design – design that actively causes health?

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

What if we transformed the built environment to construct meaningful and salutary person-to-place relationships in the same way we construct salutary person-to-person relationships?

Sechelt Hospital,
Farrow Partners and Perkins + Will.



What if we celebrated design that stimulates enriched experiences based on qualities and values of generosity, variety and vitality, authenticity, hope, nature, silence and stillness, solidity, and intimacy?

Studio INI's Urban Imprint installation.
Photograph by Luke Walker.

What if we could construct health?

Credit Valley Hospital,
Farrow Partners.

These are questions I have been exploring for years, both informally and through my research and my built work.

Constructing Health explores the role that our built environments play in encouraging, enhancing, and causing ecological, physical, societal, and mind health. Through a discussion of neurological science, research, and a series of case studies, this book will help us better understand how our surroundings make us feel — and how they can make us feel *better*.

Roxborough House,
Farrow Partners.

Credit Valley Hospital,
Farrow Partners.

What do I mean by constructing health?

Our surroundings speak to us on many levels. As they communicate messages, we form a cognitive relationship with them that we can evaluate and modify to improve social interaction, memory, intelligence, health, and well-being. Today's world places a high value on visual perception and stimulation. This often results in architecture that emphasizes external form, sometimes to the point of visual overstimulation. However, we now know that our other senses have deeper, more lasting and meaningful influences on how we feel. We can effectively tune our environments like a musical instrument to stimulate all our senses and help create the conditions in which we flourish.

Architecture is never neutral. Good architecture has neurological and therapeutic aspects that can help people of all ages do the things they want and need to do. Built environments can not only improve functionality and increase productivity but also enhance human comfort, creativity, connections, and health.

Regrettably, many spaces create stress and dis-ease as a result of their design. Significant literature in the fields of medical therapeutics and social services identifies how to reduce these negative effects. But comparatively little has been written about the opposite – that is, how building design can act as a noninvasive therapeutic treatment to not just reduce stress but also increase comfort, induce a positive range of feelings, and enhance the conditions in which we prosper and grow. And not just how buildings influence our human actions, but also how buildings influence our biological, psychological, sociological, and spiritual states, which in turn shape our human becoming. This book is an attempt to bridge the gap in knowledge between the therapeutic medical world and the design community, and to show how intentional design of our environment can support our neurological health and well-being and enhance mind health.

I deliberately use the term *mind health* instead of the more common term *mental health*. Thankfully, society now openly discusses the once taboo subject of mental health and directs appropriate resources to it. The World Health Organization (WHO) defines mental health as "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively is able to make a contribution to his or her community.[1] However, the term mental health is also often associated with mental illness and a deficit-based view of health, which results from the pathogenic medical lens through which we view many things in society today.

Alternatively, the term mind health encourages an asset-based view of health, rooted in the idea of salutogenesis, or that which actively *causes* health. At its core, salutogenesis is about what makes people healthy. The environment, both natural and built, has an immense impact on our health at every level. If we apply salutogenic thinking to architecture, we can make informed and intentional design choices that create neurological experiences that enhance human performance. Taking a salutogenic and mind health approach, we can intentionally construct architecture that enhances human health. We can use placemaking to design the conditions in which we flourish.

I believe we need to imagine a new path forward wherein placemaking is conceived of as a health-generating system, which, at its roots, is an accelerant for psychological, physical, and biological health. A system that causes health.

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Inside Cover: Credit Valley Hospital, Farrow Partners. Photograph by Tom Arban.

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Constructing Health

How the Built Environment Enhances Your Mind's Health

An exploration of generous architecture through the neurological, psychological, and emotional benefits of enriched environments.

Contents

I wanted to understand the difference between Heaven and Hell, so I visited them both.

I first went to Hell. There I found long tables piled high with sumptuous foods, but the people who sat at them were starving. They had spoons six feet long and their arms were splinted so that their elbows could not bend. They starved because they could not bring food to their mouths.

Then I went to Heaven. The people there were also sitting around long tables piled with amazing foods. They too had splints and six-foot spoons, but they were well nourished because they fed each other across the table.

Then I understood.

Heaven and Hell offer the same conditions. The difference is in the way people care for each other.

Attributed to a story Rabbi Haim of Romshishok, Lithuania, told his congregation. The allegory has become folklore across most religions around the world – Christianity, Judaism, Buddhism, Hinduism – which all have similar teachings, each slightly tweaked to reflect local culture and traditions.

With thanks to Adam Robarts and his book *Nineteen* for bringing it to my attention.

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

01

Place, Health, Well-Being, and the Mind

We are witnessing an emerging interest in using our environments to intentionally activate optimal mind health, growing out of a renewed appreciation for how the mind is shaped by how the body receives and interprets signals from the places around it. Our surroundings feed us a constant sensory diet that can either nourish and supercharge our minds and add to the conditions in which we flourish, or leave us feeling unfulfilled and empty.

We spend more time inside buildings than some whales spend under water.

The average North American spends 87 percent of their life indoors, which translates into less than one day per week outdoors. In fact, we spend more time inside buildings than some whale species spend underwater.[1] Given that more than 56 percent of the world's population live in cities, the spaces we inhabit have a considerable effect on overall human health and well-being.[2]

We know the built environment influences how we feel and perform, mostly through our experiences of poorly designed spaces. But we have also all experienced buildings where we sense something is wonderfully different the moment we walk through the door.

We know our human-made environment has a significant impact on the health of natural ecosystems. The architecture and design community has responded with rating systems and standards – for example, the Leadership in Energy and Environmental Design (LEED) Certification, the Living Building Challenge, Passive House Building Certification, the Delos WELL Building Standard, and the Fitwel Rating System. For the most part, these focus on construction methods that positively impact physiological health as a result of indoor air, water, and light qualities. While most environmental sustainability initiatives focus on the potential damage to our physical resources, only recently have we begun to understand how tightly human and environmental health are intertwined. This can be seen in concepts such as One Health, which is gaining global recognition for its acknowledgment of how human health is interwoven with animal, plant, and environmental health. One Health is an increasingly useful approach in addressing zoonotic diseases, antimicrobial resistance, food safety and security, and environmental contamination, all of which affect the entire living planet.

Planetary Health

In 2015, the Rockefeller Foundation and *The Lancet* introduced the concept of planetary health, which they define as "the health of human civilisation and the state of the natural systems on which it depends."[3] Planetary health shifts the focus of public health from just human populations to one that also incorporates natural ecosystems and recognizes the interdependence between the natural and human-made systems that support humanity.

We know that how we design our neighborhoods and communities has a significant impact on societal health. Good design can reduce social inequities, limit food swamps and deserts, and create conditions for people to connect in meaningful ways. Health imbues the design of public space beyond the physical design of streets, parks, and urban squares. Design both represents and communicates the possibility of engaging in a spontaneous, generous social life that activates optimal societal health on both a neighborhood and city scale. Design can arguably even unite or divide a community.

An illustration of food swamps characterized by the prevalence of fast food chains.

Active Design

We know design can disrupt physical health and trigger a tsunami of chronic diseases such as obesity, diabetes, heart disease, and hypertension, as witnessed in car-dominated suburbs. Design can also improve health; for example, New York City's Department of Design and Construction's *Active Design Guidelines* offers a range of tools to reduce obesity and diabetes through design strategies that promote walking.[4] These include the convenient placement of comfortable stairs, protective canopies, or an activated street front at the base of a building, as well as facilities that support exercise through pedestrian-friendly exteriors and massing, multiple entries, and stoops.

Mind Health and Our Environments

Our mind health – our cognitive abilities, productivity, social interaction, memory, and general sense of well-being – is measurably affected by the qualitative design choices we make. As the green building movement transitions to the healthy building movement, we are beginning to understand and quantify how intentional design creates comprehensibility, manageability, and meaningfulness. Together, these form a sense of coherence, which is a strong predictor of mind and body health and well-being.

The city plan of Barcelona, highlighting the historic block structure within the gridded Cerdà Plan.

As I will demonstrate, placemaking can positively affect health. Where we live, work, and play can have more impact on individual health and well-being than the medical system – beyond episodes of serious disease, of course. Why then, have so many people become numb to the harmful effects of denatured, disconnected, and dismal design? We can and must create environments that reverse the recent surge of lifestyle-related diseases and alleviate the drowning of the human spirit. This book illustrates how we can construct health through intentional design choices by connecting the dots between psychological, cognitive, and precognitive reactions that have physiological responses. It shows how these responses fundamentally enhance mind health, human performance, and our ability to grow. Design is an essential element of a holistic strategy for regeneration and creating living conditions that enable us to flourish and prosper rather than merely survive.

Environments communicate the possibility of engaging in spontaneous and generous social life that can activate optimal societal health. Market Bridge, Toronto, Farrow Partners.

Current Placemaking Research

Space is like a prescription that can improve health or cause troublesome side effects. The choices we make

in designing spaces have positive or negative consequences for our mental and neurological health. Like vitamins or healthy food, these design choices can create nutrient-rich environments that enhance our capacity to flourish, or, like junk food, they can undermine it. Scientists, psychologists, and others have explored this subject for over half a century. Some of their research is summarized here.

Sensory integration theory was developed by Dr. Jean Ayres, an American occupational therapist and psychologist, in the late 1960s and 1970s. It examines how our brains receive, process, and integrate sensory signals from our bodies and environments, which makes it possible for us to live our daily lives through spatial and social interactions in a meaningful way. For example, sensory integration enables us to eat, drink, ride a bike, make friends, and have a profession.

Other fields of research, primarily in areas of psychology, have built upon Ayres's work and look at the relationship between perception and the physical environment. These include:

- **Environmental psychology** – how we individually connect and interact with space.
- **Occupational psychology** – how we shape our working environments and how that impacts and enhances productivity.
- **Human factor psychology** – how our surroundings create meaning and metaphors through perception.
- **Experimental psychology and cognitive neuroscience** – the analysis of visual patterns and our responses to them, positive or negative.
- **Biophilia** – the role nature plays in well-being – that is, psychological and physiological health – by lowering one's stress, blood pressure, and heart rate, improving performance and short-term memory, and increasing creativity and originality.[5]

- **Attention restoration theory** – explores how our ability to concentrate improves after we spend time in nature, linked to two types of focus: voluntary and involuntary.

Related nonclinical tools for enhancing health include:

- **Social prescribing** – a form of therapy in which the patient engages with art, music, or nature through physical or sensory events as a way of enhancing health.
- **Neurodiversity and sensory impact** – expands on conventional notions of inclusive building design by addressing sensory design considerations, such as lighting, acoustics, flooring, and aesthetics, which can cause human neurological ailments, ranging from serious diagnoses to milder but common complaints such as unsteadiness, migraines, or stress.[6]
- **Neuroaesthetics** – combines the study of art with cognitive psychology and the neurobiology of perception, emotion, and empathy.
- **Neuroarts** – the study of how the arts and aesthetic experiences measurably change the body, brain, and behavior, and how this knowledge is translated into specific practices that advance health and well-being.
- **Neurophenomenology** – the study of how experience, the mind, and consciousness are related through the embodied mind, where the mind extends throughout the body and beyond to the surrounding environment.
- **Neuro wellness** – explores the integrated and inseparable interconnection between the brain and the body relating to cognitive function, emotional regulation, and overall health through complementary techniques that include encouraging mindfulness and social connection, and physical, nutritional, and cognitive stimulation.
- **Environmental neuroscience** – combines environmental psychology and social and cognitive psychology with social, cognitive, and behavioral neuroscience to investigate how the natural and built environments pair with social structures to affect behavior.
- **Neurourbanism** – based on transdisciplinary research between the urban environment and mental health, investigating how different elements of urban environments influence people psychologically and physiologically.

Research of this type marries cognitive psychology (the science of the mind) and neuroscience (the science of the brain). We now recognize that when we study perception, emotion, empathy, learning, creativity, and memory, we must also study the biological mind, since they are not separate, as previously believed, but all part of a single, complex, intertwined network.

Neuroscience and Architecture

A new and growing field of study particularly relevant to this book combines cognitive science, neuroscience, and architecture. It applies neuro- and cognitive science research to the design of the built environment in order to enhance it. In 2018, Iuav University of Venice became the first university in the world to offer an international postgraduate master's degree in Neuroscience Applied to Architectural Design. NewSchool of Architecture and Design (NSAD) in San Diego, California, also offers studies in this field.

In 2003, the San Diego Chapter of the American Institute of Architects (AIA) founded the Academy of Neuroscience for Architecture (ANFA) as a legacy project to the AIA's annual convention. ANFA promotes and advances knowledge that links neuroscience research to a growing understanding of human responses to the

Charles Pétillon's Heartbeat (2015) installation at Covent Garden, London, England, consisting of 100,000 white balloons illuminated from within.

Phototropism demonstrated by a flowering shamrock reaching toward the daylight.

built environment by fostering collaboration among neuroscientists and architects. By using scientific methods to explore the range of human experiences with elements of architecture, the Academy's goal is to validate the knowledge that results from this collaboration and to propagate it to professionals and students alike.[7]

Feeding Our Minds

People are clearly more and more interested in how we can use our environments to intentionally activate optimal health, sometimes referred to as whole health, and specifically mind health. This has evolved out of the recognition that our minds are shaped by how we interpret signals from the spaces around us. Our environments continuously feed our minds a sensory diet. As we have begun to explore, our surroundings can nourish us, like the vitamins and minerals in what we call "superfoods" do. Or they can be the built equivalent of junk food, leaving us feeling tired, hungry, and even causing hypersensitive reactions or illness.

Psychologist Roger Barker and his associate Herbert Wright demonstrated this in a pioneering study they conducted in the small town of Oskaloosa (disguised as "Midwest"), Kansas, between 1947 and 1972. Through thousands of data points they gathered about the town's inhabitants over twenty-five years, the so-called Midwest Study proved that our surroundings dramatically influence the way we think and behave. This upended the earlier belief that human behavior depends on innate intelligence regardless

of environment. Architect Christopher Alexander pursued the findings of the Midwest Study further in his 1979 book *The Timeless Way of Building*, in which he wrote that "a person is so far formed by his surroundings, that his state of harmony depends entirely on his harmony with his surroundings. Some kinds of physical and social circumstances help a person come to life. Others make it very difficult."[8]

Sensing Our Surroundings

Everything from an amoeba to a human being ensures its survival by sensing and responding to its surroundings. Every living organism naturally avoids things that shorten its life and moves toward things that extend it. For example, think of a flower opening and moving with the changing angle of the sun, then closing at night for protection. In his controversial 2016 bestseller *The Hidden Life of Trees: What They Feel, How They Communicate*, German forester Peter Wohlleben argued that trees have complex root networks that communicate warnings and distress about threats, such as fungi, droughts, and insect infestations, and thus control the well-being of the tree and the larger forest.[9] In biological terms, this is known as homeostasis, the primary, internal, self-regulating process by which an organism maintains stability while adapting to surrounding circumstances in order to preserve its existence.

The Mind and Consciousness

What differentiates humans from simpler organisms is our ability to perceive our being and, as a result, to feel and know. Simple organisms adjust to their surrounding environments to perpetuate and maintain a homeostatic state but without a mind and consciousness.[10] In the words of neuroscientist Antonio Damasio, "we are feeling creatures that think and thinking creatures that feel."[11] Both physiological and sociocultural pain or pleasure affect our homeostatic state. The pain of a broken arm or the pain of social shaming, the pleasure from the caress of a hand or a compliment, send similar physiological messages to the human mind through distributed cognition.

Distributed Cognition and the Extended Mind

Distributed cognition is an approach to cognitive science formulated by cognitive anthropologist Edwin Hutchins. He believes that mental representations in our brains are distributed outward into our sociocultural systems that we then use to perceive and make sense of our surrounding world. In other words, knowledge lies not just within the individual but in our social and physical environments. Building on Hutchins's work, philosopher Andy Clark developed the theory of extended cognition in an influential 1998 paper he co-authored with his colleague David Chalmers, titled "The Extended Mind."[12] As we will examine further in chapter 3, this theory hypothesizes that the mind does not live solely in the brain, or even just the body, but stretches out into the world around us.

To feel its surroundings, an organism must have a nervous system that senses what is happening and creates a representation of its internal organs and its external surroundings in its mind. It must then be able to communicate signals from both of these through its body and back to its mind, creating a response. It must be able to sense the state of its internal homeostasis as well as the state of the surroundings that influence it. This sense of knowing – as investigated in the branch of philosophy called epistemology, which explores how we know and how we make knowing possible – this cognition of the conditions of the organism's body within itself and within its environment, is determined by inputs from the senses – sight, scent, sound, touch, taste, and two lesser-known senses of proprioception and the vestibular system.[13] The organism's level of intelligence is also tied to its ability to feel, and to its consciousness, perception, reasoning, and memory.[14]

The Body as a Radar Dish

At the same time we use our bodies to "listen" to our environments, we also "listen" to our internal bodies to help us make sense of our surroundings. The human body is like a radar dish, collecting signals and communicating them back to the mind for interpretation. Sometimes the communications are conscious, and other times they are preconscious or subconscious. Sometimes we intuit when something doesn't feel right, but we can't quite put our finger on it. Other times, when something surprises us, our heart pounds, our eyes open wide, and our skin perspires. The surprise can be positive or negative, leading to feelings of joy or fear. These responses can range widely, from subtle to intense, from primordial to sophisticated. But wherever they are on the spectrum, they are all internal communications from the body that tell the mind what action it needs to take to preserve homeostasis in our constantly changing environment.[15]

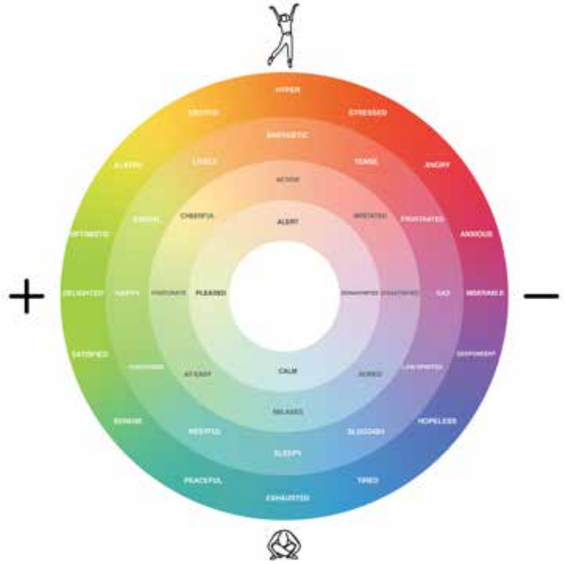
Constructing Emotions, Feelings, and Moods

We often use the words *emotions*, *feelings*, and *moods* interchangeably, but each has a different meaning and role in how the mind interprets and responds to interoceptive signals (signals from within the body), proprioceptive signals (signals at the surface of the body and from its kinetic movement in space), and exteroceptive signals (signals from outside the body).

Emotions are the communications the interoceptive (internal) body sends to the

mind on the present state of things. They are bottom-up communications – that is, physiological changes to the body, such as a pounding heart, sweating, trembling, muscle tension, or a tight feeling on the gut – sent to the cerebral cortex in response to the changing environment.[16] In fact, the root of the word *emotion* is derived from the Latin verb *emovere*, meaning to remove, dislodge, stir, or agitate the state of a physical organism. These responses do not differentiate between pain and pleasure; interpretation occurs in the conscious feeling of them (the James–Lange theory). The more powerful the awareness of our bodily interoceptive signals, the more powerful our emotional experiences will be, and the more intentionally we can interpret them in order to decide on a suitable response to the signals from our surroundings.

Animals have two main motivators – approach and avoidance – but human emotions are more layered. Human emotions arise from the core somatic nervous system, which relays sensations from the body to the central nervous system and the brain. Emotions enrich our mental state, facilitate social reactions and communication, influence rational behavior, and, like in animals, help us escape danger and approach pleasure. As psychiatrist and neuroscientist Eric Kandel writes, “Emotions are instinctive biological mechanisms that help us deal with the fundamental tasks of life: seeking pleasure and avoiding pain. Emotions are *dispositions to act* in response to someone or something important to us. It seems likely that the full, rich spectrum of human emotions evolved from the fundamental dispositions to action of simple organisms such as snails and flies.”[17]



James Russell’s circumplex model diagrammatically representing all emotions, where valence (the range from positive to negative emotions) is shown on the horizontal axis, and arousal (the intensity of the emotions) is shown on the vertical axis.

Feelings, on the other hand, are the conscious experience of emotions that takes place after the body’s physiological response. They are top-down reactions to the internal emotions the body sends to the mind that result in an action. Some psychologists believe we have more than 30,000 specific feeling responses. In the two-way flow of information between body and mind, the mind interprets somatic bodily responses as feelings and then communicates them back to the body through chemical and muscular instructions for action. Intense feelings, such as grief, fear, rage, and love, come after we first experience strong bodily reverberations, while less intense bodily feelings, such as pleasure, are connected with subtler emotions.

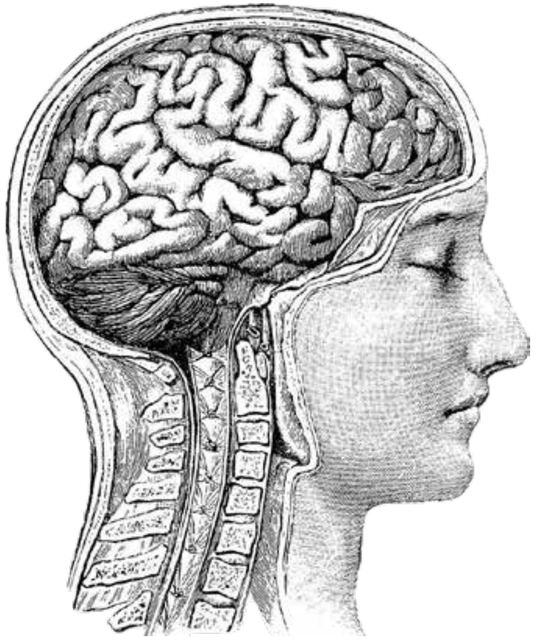
Charles Darwin outlined six universal components of feelings, framed by the animal extremes of approach and avoidance. At one end of the spectrum is happiness-approach, ranging from ecstasy to serenity. At the other end of the spectrum is fear-avoidance, ranging from terror to apprehension. Between the two are feelings of surprise (amazement to distraction), disgust (loathing to boredom), sadness (grief to pensiveness), and anger (rage to annoyance). For Darwin, feelings can be blended. Awe is the mixture of fear and surprise; submission combines fear and trust; love combines joy and trust.[18]

Emotional cues from the body can elicit very different feeling responses, depending on the situation. For example, imagine hearing a loud noise behind you. As an emotional bodily response, your heart begins to race. If you turn to see a friend you haven’t seen in years, your felt response to the emotional bodily cue, your interpretation, is probably pleasure-surprise. If you turn to see a mugger with a knife, it is fear-surprise. Feelings are rooted in things we have learned, past experiences, and what we remember, all of which affect the way we process emotions and the intensity we assign to our felt response.

As Finnish architect Alvar Aalto noted, “I don’t think there’s so much difference between reason and intuition. Intuition can sometimes be extremely rational.” [19]

Moods are a third type of response, in which we experience feelings over a long period of time. While our feelings are usually more powerful responses that last quite briefly and result from an emotional stimulus, moods are states of being that are not as concentrated, are not necessarily provoked by an environmental stimulus or event, and can last for days, weeks, or months on end. For example, when we experience persistent optimism, zeal for life, depression, or lethargy, these are moods.[20] Moods are usually described in positive or negative terms, as in a “good mood” or a “bad mood.”

We often think of the brain as a computer that processes and stores information and experiences, but this metaphor isn’t ideal for understanding its overall workings. The brain has a number of regions that process, interpret, and vividly remember specific experiences, and their resulting emotions and feelings, as felt through sight, smell, taste, and touch. Some event recollections, known as eidetic memories, are hyperreal reminiscences of both physical and emotional imprints in the mind. All these emotions and feelings are interconnected, and we interpret them through qualities – good or bad – and quantities or degrees – a lot or a little, great or awful.[21] The brain is therefore less like a computer that stores photographs of events and more like a collection of multisensorial sensations – a full-on immersive experience, both in our conscious and subconscious perceptions. Sigmund Freud believed the subconscious to be shaped in such a way that reality and fantasy are indistinguishable; both are shaped, interpreted, and mixed in the mind, which is why one person experiences the “reality” of the same event very differently from another person.



While the brain is housed in the skull, the mind extends well beyond these limits. Hardwired into our senses, body, and skin, our minds are closely interconnected with our surrounding environments.

The Anatomy Lesson of Dr. Nicolaes Tulp (1632),
by Rembrandt.

02

Health and Well-Being: Our View through History

For most of the past 5,000 years, humanity took a holistic, asset-based view of what constitutes health and well-being. We understood health as the maintenance of health-generating practices rather than the curing of disease. More recently, our definition has taken a pathogenic, deficit-based view, which focuses on of the origins of disease. However, we have recently, and particularly since the COVID-19 pandemic, witnessed a rebirth of a more salutogenic approach, where we look at what causes health and well-being, specifically as it relates to both societal health and resultant mind health. Importantly, we have come to realize that our physical surroundings contribute significantly to the maintenance of healthy relationships, either as accelerants or dampeners of societal health.

2

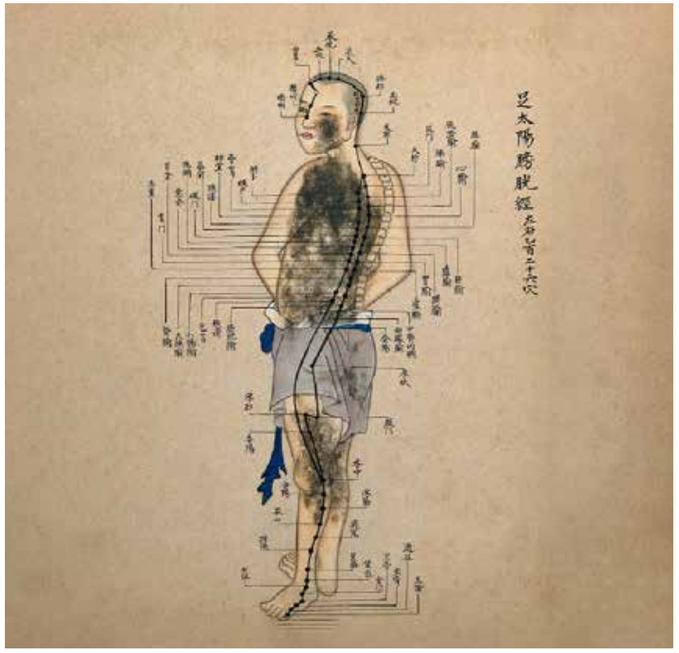
To understand what causes health, first we need to define health and well-being, terms we often use synonymously. Here, we explore how our views of ourselves and the world around us are intertwined with our concepts of health and well-being and with theories in psychology, cognitive science, neuroscience, and architecture that have evolved over the centuries.

Health: An Evolving Ideology
The concept of human health originates in holistic perspectives that focused on interconnected networks of the mind, body, environment, and community.

The ancient Egyptians likely devised the theory of humorism, which held that four different bodily fluids, or what they referred to as "humors," were the biggest influence on human health and well-being. If these four humors – blood, yellow bile, black bile, and phlegm – were not in balance, a person would become mentally and/or physically ill. An imbalance of the humors could result from what one ate, drank, and inhaled as well as through the actions of daily life. The theory of humorism was further systematized by ancient Greek thinkers.

Traditional Chinese medicine (TCM), some 3,000 years ago, aspired to health and well-being by focusing on cultivating harmony in one's life, built on the belief that mind, body, spirit, and nature are a bound, interconnected, and integrated whole.

Where rationalism forms the backbone of Western evidence-based medicine, the Taoist belief in yin-yang – a concept that describes opposite yet complementary and interconnected forces – structures the basis for TCM. First referenced in 700 BCE, yin-yang, which translates as "dark-bright," conveys the notion that everything in nature consists of parallels and



Traditional Chinese medicine sees the body as a microcosm of the surrounding macrocosm whereby changes in nature are reflected in one's body and health.

opposites that are always in a state of flux. Although shifting and cyclical in nature, these forces must simultaneously remain harmonious and in balance.

TCM sees the body as a microcosm of the surrounding macrocosm. Changes in nature – the seasons, times of day, times of life, and different geographies – are reflected in one's body and health. Salutogenic in nature, TCM is based on the belief that we are born with a natural self-healing ability, similar to the regenerative characteristics of nature, whereby the body reveals signs of our health, which we actively respond to and enhance.

Working in collaboration, TCM physicians and spiritual masters aspire to be in harmony with natural law – the underlying principles of morality and human reasoning that can be discovered through spiritual practice. They achieve inner vision by undertaking deep meditative and spiritual journeys through perceptual time and space.

According to TCM, meditation allows one to connect with invisible energy fields – the life forces that power our body and organs. Further linking back to nature, TCM believes the body's functions are tied to the five major elements: wood, fire, earth, metal, and water. As such, it presents a unified and integrated holistic view of health and well-being.

North American Indigenous views of health are similarly grounded in a balanced understanding of community health, encompassing physical, emotional, cultural, spiritual, and ecological well-being. Indigenous determinants of health include environmental stewardship, social services, justice, education, language, heritage, economic development, employment, health care, and housing. Well-being is not grounded in a deficit-based view of health but in an asset-based view that emphasizes strengths and resiliencies. As with TCM's relationship to nature, Indigenous people believe land stewardship and living in thriving natural environments is essential to communal and individual health.

The medicine wheel, originating from Plains Cree philosophies and largely adopted by many other First Nations and Inuit communities across Canada, embraces a broad view of life. Symbolized by a circle, it celebrates the interrelationships of time, seasons, cosmology, birth, womb, and earth. A more recent representation of Indigenous views of health is the First Nations Mental Wellness Continuum Framework, a circle with four directions and outcomes based on hope, belonging, meaning, and purpose. The twentieth-century salutogenic concept of a sense of coherence, which we will learn more about shortly, appears to have its early roots in these Indigenous views of health and well-being.

The medicine wheel, symbolized by a circle, embraces a broad view of life that celebrates the interrelationships of time, seasons, cosmology, birth, womb, and earth. Galt Museum and Archives, Akaisamitohkanao'pa.

Andrea McIntosh, a Canadian graduate architect and neuroscientist of Cree and Western descent, describes the word *health* as being used "interchangeably in the physical, mental, and spiritual sense of the word. This intentionally challenges the limitations of categorizing well-being as a set of separate conditions. Rather, health may be thought of as the maintenance of relationships between interdependent systems within and beyond the body."[1]

The ancient Greek physician Hippocrates is often considered the father of modern Western medicine. Nearly 2,500 years ago, he emphasized diet, lifestyle, and environmental factors, not only to prevent illness but to create health. Similarly, the Greek philosopher Aristotle, whose work in ethics was foundational to Hellenistic philosophy, promoted the concept of *eudaimonia*, commonly translated to mean "happiness," "welfare," or "human flourishing," as a core pillar of society.

The Romans built upon the Greek way of thinking, promoting a healthy diet and lifestyle, which they supported through vast public infrastructure projects such as baths, aqueducts, and sewer systems that dramatically improved the health of many of those living within the Roman empire.

The Middle Ages began with the fall of the Western Roman Empire in 476 CE and ended with the emergence of the Renaissance in fourteenth-century Italy. Where the Romans had extensive, primarily male-centered public health systems throughout their empire, medieval Europe was divided into thousands of

small territories run by feudal lords, with little to no public health services. Given that illiteracy was widespread and education was largely controlled by the Church, many medical methods faltered, and superstitions flourished, with so-called wise men and witches offering ineffective herbs or spells to cure illness.

Churches and monasteries began to fill the void, using prayers to saints and a mixture of animal, mineral, vegetable, and herbal concoctions to try to ward off ailments and enhance health. Monasteries became beacons of care, playing the role of today's hospitals, or more accurately, our hospices, where monks cared for and housed the sick, poor, blind, orphaned, and those suffering mental illness. In a world of poor to nonexistent public health measures, recurrent plagues, and frequent wars, the monastic hospital model combined medical and spiritual guidance to provide some measure of relief.

During the Crusades, ancient Arabic scientific and medical texts, along with Greek, Roman, Indian, and Islamic knowledge related to medicine, health, and well-being, were rediscovered. Crusaders brought a myriad of texts back to the monastic libraries of Europe, where the monks, who were among the only educated and literate people at the time, absorbed them eagerly.

Later, when the theocentric worldview of the Middle Ages was replaced by the anthropocentric worldview of the **Renaissance**, many of these ancient texts were translated into Latin by classical humanists and read by artists, scholars, and physicians across Europe. This set the stage for renewed scientific and medical research, experimentation, and progress by figures such as Leonardo da Vinci, Andreas Vesalius, Ambroise Paré, William Harvey, and Paracelsus.

European societies from the 1600s through the 1800s underwent major ideological shifts that stemmed from advancements in science, technology, and human rights. A variety of religious, medical, and intellectual movements arose that featured self-healing and holistic approaches to health. Among these were homoeopathy, osteopathy, chiropractic, naturopathy, hydrotherapy, herbalism, and spiritual anthroposophy. A number of

In the Middle Ages, churches and monasteries were the center of health care, using prayers and a mixture of animal, mineral, vegetable, and herbal concoctions to try to ward off ailments and enhance health. Triptych showing the Hôtel Dieu in Paris, c. 1500.

these movements continue to flourish and influence some of our views of health and well-being today.

The Enlightenment, however, was the dominant intellectual and philosophical movement of this period. It was primarily a response to the Scientific Revolution, which started in the late Renaissance and was led by scientists and thinkers such as Nicolaus Copernicus, Isaac Newton, and Galileo Galilei. Out of their observations and experiments grew the belief that human behavior is guided by reason, which determines human thoughts and decisions and allows us to make logical choices based on goals and objectives. By contrast, what they viewed as human emotions were frequently regarded as irrational and untrustworthy.

Enlightenment philosophers believed that we attain enlightenment through reason, our minds above and in control of, indeed, disconnected from, our bodies, emotions, and feelings. They were convinced that we deduce meaning rather than intuit it, an attitude summed up by René Descartes when he famously said, "I think, therefore I am."

In medical science, Enlightenment philosophy expressed itself in a shift from spiritual diagnosis for an ailment to rigorous observation and critical analysis of patients to determine the causes and patterns of disease. Literature and art followed, moving away in the nineteenth century from Romantic or religious subjects conceived in the studio toward more naturalistic work derived through close observation of what actually existed. Fiction, such as Émile Zola's novels set in northern French mining communities, described the emerging societal problems of slums and poverty caused by the rise of industrialization. Impressionist painters, such as Edgar Degas, documented the daily lives of Parisian café patrons, ballet dancers, and prostitutes. Others, for example, Claude Monet, literally went out to the fields to capture atmospheric effects and the way light fell on haystacks and other land- or cityscapes at different times of day. Neo-impressionist, pointillist painter Georges Seurat was fascinated by optics and the properties of natural versus artificial light, whether it was a hazy afternoon on the banks of the Seine or gas lights in a theater, which mesmerized the public at the time.

At the turn of the twentieth century, an entire cultural scene sprung up that explored the subconscious thoughts and impulses that were believed to guide our supposedly rational thought, as seen in Egon Schiele's 1917 painting The Embrace (Lovers II).

Around the turn of the twentieth century, a group of predominantly German-speaking scientists, scholars, and philosophers began to question the idea of the rational mind, which had dominated philosophical thought since the 1600s. Austrian psychoanalyst Sigmund Freud and Swiss psychiatrist Carl Jung began to explore the subconscious thoughts and impulses they believed shaped and guided our supposedly rational thought. Their work marked the beginning of cognitive psychology and the study of the internal complexities of the mind as they relate to the external world we create and inhabit.

An entire cultural scene sprung up around these new theories of psychology and psychoanalysis, most notably in the salons of Vienna, where painters Gustav Klimt and Egon Schiele brought the conscious and subconscious desires of their (mostly female) clients and subjects to the canvas with an overt eroticism that shocked viewers who were accustomed to more outwardly innocent subject matter. A rejection of the separation of reason and emotion in favor of deeply submerged emotional complexity was also manifest in the novels of Arthur Schnitzler and Hermann Hesse. In medicine, this thinking translated into strong anti-rationalist movements, such as homeopathy and naturopathy, which remain strong to this day.

The *Flexner Report*
Meanwhile, in the United Kingdom and the United States, the long-held holistic view of health was gradually supplanted by a more evidence-based medical mindset through the nineteenth and early twentieth centuries. In 1910, the Carnegie Foundation funded an assessment of North America's medical education system. The *Flexner Report* declared that anything other than Western, evidence-based medicine was effectively witchcraft.

"White Wings" members cleaning New York streets in the 1890s.

Dead horse in the streets of New York, c. 1905.

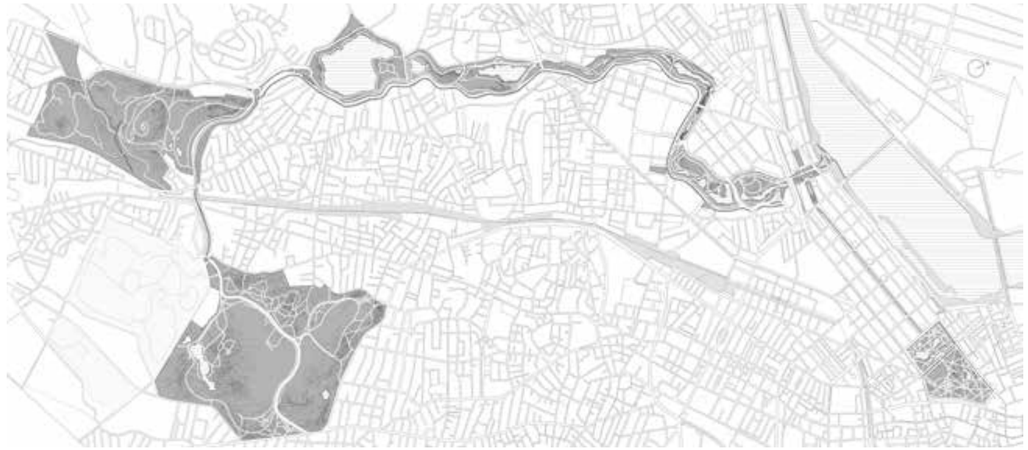
This set the stage for a disease-oriented, pathogenic approach to medicine, where health became synonymous with health care.

The Western, evidence-based model began to extinguish the older, more comprehensive approach that linked physical, spiritual, and mind health with societal well-being. It prioritized separate elements, unrelated to each other and slotted into specific silos, over intertwined networks. Modern medicine (focused on the body) and modern psychology (focused on the mind) are separate from each other and attempt to heal and repair something that is considered weakened and/or damaged. This view of health is very different from the earlier, more holistic view of a continuum of health, in which the body and spirit are nurtured even when no illness is present. Modern medicine began to focus on disease within the "container" of the human body rather than on the conditions the container experienced that resulted in disease. Scientific experiments were data-driven and seen as fact-based, whereas "experiences" were considered subjective and less reliable. As we will see, this Descartian way of thinking, this separation of the rational and the emotional, specifically in cognition, is no longer valid.

Today, a disease-based view of health care still dominates in the West. A Google search for the words "cause health" bears this out, as it generates countless variations on "cause health problems," "cause health abnormalities," "cause health risks," and "cause ill health." Nearly every link is for health-care deficiencies and disease prevention based on a deficit-based view of health versus an asset-based mindset.

Well-Being and the Public Health Movement
Over the last 200 years, our views on public health have also evolved. In his paper "From Disease Prevention to Health Promotion," American physician and public health pioneer Lester Breslow identified three main eras of modern public health.[2]

The first era of public health was the industrial period, up to the early 1900s, when overcrowded cities were overwhelmed by communicable diseases. Lack of sanitation, access to clean air, and other basic necessities led to the establishment of the public health movement. At that time, urban planners and building and landscape architects worked together with public health officials to create healthier environments, including extensive park systems. Cities created urban design guidelines to reduce overcrowding, increase access to daylight, improve air circulation, and enhance sanitation. New York City's building massing urban design guidelines are an example of this, as is the work of Frederick Law Olmsted, who is famous for New York's Central Park and Boston's Emerald Necklace Conservatory, but whose work as head of the US Sanitary Commission (a predecessor to the American Red Cross) is just as significant. He was one of the first public figures in the United States to highlight the mental health drawbacks of industrialized cities, and he recommended using immersive naturalized parks as "sanitary institutions" to target mind health.



Frederick Law Olmsted's Boston "Emerald Necklace" park system, 1894.

The second era of public health began in the 1940s, when the reduction of infectious diseases through large-scale vaccination programs and water chlorination meant that people began to live longer. The resulting dampening of waves of communicable diseases led to an upsurge in noncommunicable and chronic diseases, which are the main hallmark of this era.

In 1986, the Ottawa Charter for Health Promotion called for a "new public health," rooted in the belief that health could be created in people's everyday lives. The Charter committed to a social model of health that evolved out of concepts coming from the social sciences and humanities: peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice, and equity. The Charter also proposed five action areas: building healthy public policy, creating supportive environments, strengthening community action, developing personal skills, and reorienting health-care services toward the prevention of illness and the promotion of health.

In 1997, the World Health Organization (WHO) introduced the concept of the health arena, which recognized the role of where we work, live, learn, and play in promoting and enhancing human health.

In 2011, the United Nations (UN) General Assembly identified noncommunicable diseases, such as heart disease, cancer, and diabetes, which are also often tied to our surroundings, as a major socioeconomic challenge – a first for this world body.

Four years later, the UN General Assembly went further and announced the **Sustainable Development Goals** (SDGs), a collection of seventeen interconnected global goals designed to be a "blueprint to achieve a better and more sustainable future for all."[3] Each goal contributes, directly or indirectly, to positive health outcomes. The goals are (1) no poverty; (2) zero hunger; (3) good health and well-being; (4) quality education; (5) gender equality; (6) clean water and sanitation; (7) affordable and clean energy; (8) decent work and economic growth; (9) industry, innovation, and infrastructure; (10) reduced inequalities; (11) sustainable cities and communities; (12) responsible consumption and production; (13) climate action; (14) life below water; (15) life on land; (16) peace, justice, and strong institutions; and (17) partnerships for the goals.

We are now entering the **third era of public health**, where we activate optimal health by creating enriched environments with generative elements that cause health. We are beginning to see society shift to a well-being mindset instead of a "health care" mindset, as illustrated by the UN's SDGs and the WHO's broader, more holistic view of health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[4]

Salutogenesis
The central concept that illustrates the shift from a deficit-based view of health to an asset-based view is that of salutogenesis. The term was coined by Israeli-American medical sociologist Aaron Antonovsky in his 1979 book, *Health, Stress, and Coping*, where he begins to unravel, in his words, "one of the greatest mysteries in the study of people: How do we manage to stay healthy?"[5] The term is derived from *salus*, the Latin word for health, and *genesis*, the Greek word for origin. Thus, salutogenesis focuses on the origins of human health and well-being as opposed to the origins of disease (pathogenesis). It reframes health as the positive force of health-generating practices rather than disease mitigation, and it emphasizes the ways in which we can build the resources needed to optimize health.

Antonovsky believed that health promotion could only reach its full potential if firmly rooted in a theory of health and society. So, he further fleshed out the concept of salutogenesis in his 1987 book, *Unraveling the Mystery of Health*, by identifying, operationalizing, and quantifying its core attribute, a sense of coherence.

A Sense of Coherence
Antonovsky defines a sense of coherence as "a global orientation that expresses the extent to which one has a pervasive, enduring, though dynamic feeling of confidence that one's internal and external environments are predictable and that there is a high probability that things will work out as well as can reasonably be expected."[6] A sense of coherence is shaped by life experiences and refers to our ability to resonate with our mind-body-soul systems (our perceptions, affects, feelings, cognitions, and actions) as well as our outer environments, mirroring and connecting to the physical spaces around us. This relatedness to place, along with our continuous interactions and experiences of the mind-body-soul system, create a sense of coherence within the built environment. A strong sense of coherence helps us mobilize the resources we need to cope with stressors and manage tension successfully, and it helps determine our movement on the health ease/dis-ease spectrum.

Antonovsky's concept of sense of coherence consists of three elements that serve balanced, sustainable, health-creating life processes in humans: comprehensibility, manageability, and meaningfulness.

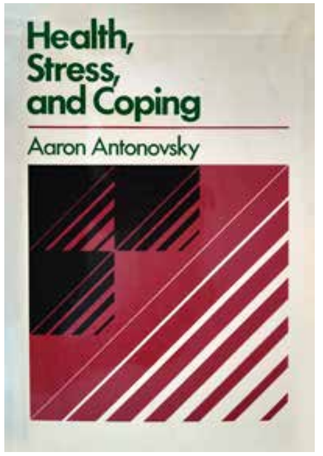
Comprehensibility is "the cognitive dimension, [and it] refers to the extent to which one perceives internal and external stimuli as rationally understandable, and as information that is orderly, coherent, clear, [and] structured. To understand one's context and one's own part in it."[7]

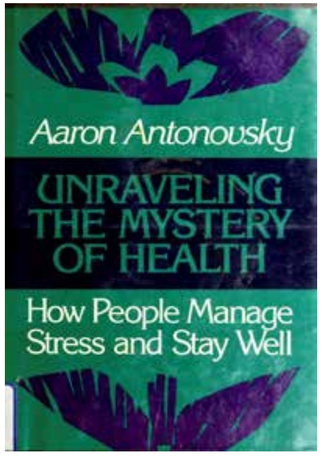
Manageability is "the instrumental or behavioral dimension, defined as the degree to which one feels that there are resources at one's disposal that can be used to meet the requirements of the stimuli one is bombarded by."[8]

Finally, **meaningfulness** "expresses the motivational dimension, [and] refers to the extent to which one feels that life has an emotional meaning."[9]

Antonovsky's salutogenic model has only seen limited uptake in the social sciences and Western medical practice, which is still mainly based on a pathogenic model. However, research in environmental psychology has revealed how places and settings can promote health and reduce stress and negative emotions. This research has been consolidated in two primary theories.

Stress Recovery Theory
The first is stress recovery theory, developed in 1983 by Roger Ulrich, an American architecture professor and influential evidence-based health-care design researcher. It assesses the impact of stress on a person facing a demanding situation or one that threatens their well-being, particularly in an urban environment. Ulrich argues that after being in a stressful space, individuals experience an almost automatic biological compulsion to leave that space and seek out a natural environment, which regulates the physiological effects of the stressful space, recharges the individual's energy, and thus produces a positive emotional change.





Two of Aaron Antonovsky's seminal books.

Attention Restoration Theory
The second is attention restoration theory, developed in 1995 by American environmental psychologists Rachel and Stephen Kaplan. It proposes that "mental fatigue and concentration can be improved by time spent in, or looking at nature."[10] It even suggests that just looking at photos of nature can positively affect attention, concentration, and focus.

Voluntary and Involuntary Attention
ART research identifies two types of focus or attention: voluntary and involuntary. When staring at a computer screen or reading a book, we are using our voluntary attention. When we are in nature, natural settings, or an environment rich in natural materials and forms, our minds shift to an involuntary, more intuitive focus. Involuntary attention is very important for human health, because when in this mode, our minds restore and reinvigorate our ability to engage our voluntary attention.

Restorative Environments
It is clear that nature is a restorative environment with the ability to heal at a cognitive, physical, and social level. However, salutogenic research goes beyond pure environmental psychology, in that it extends to environments and resources that can vary greatly over time.

Given that a sense of coherence and generalized resistance resources, which are the biological and psychosocial factors we use to perceive life as understandable and consistent, are key for human health, well-being, and restoration, architects and designers need to ask which environmental conditions support these resources and, conversely, which could deplete them.

According to Ken Yeang, a leading sustainable architect, and Alan Dilani, founder of the International Academy for Design and Health,

> salutogenic design highlights the impact of design factors … to help create a healthy society by developing urban design that stimulates healthy behaviour, the promotion of health, and the prevention of diseases. Considering a salutogenic design approach also means favouring social innovation. Ecological design with salutogenic design requires an interdisciplinary application of psychosocial design factors within architectural design, in order to promote a healthy lifestyle. To reduce the global burden of disease in an efficient way, major investment needs to be made in the promotion of healthy lifestyles and the development of healthy spaces.[11]

Furthermore, say Yeang and Dilani, "salutogenic architecture leads to social innovation and economic growth, through the interdisciplinary application of sciences such as architecture, medicine, public health, psychology, design, and engineering along with culture, art, and music."[12]

As already noted, the terms health and wellness are often used interchangeably. However, the **Global Wellness Institute** defines wellness as "the active pursuit of activities, choices, and lifestyles that lead to a state of holistic health."[13] In other words, wellness, or well-being, emphasizes the holistic, active, and embodied physical engagement that leads to mind and body health – that which is ultimately good for a person and enhances one's quality of life.

We can deepen our understanding of wellness further with the concepts of **hedonic and eudaimonic well-being**. Hedonic well-being relates to the sensations that give us pleasure and happiness that we anticipate and seek out, and which are often associated with sexual pleasure and gastronomic delight. The concept of eudaimonic well-being, as we noted earlier, was developed by the Greek philosopher Aristotle and is achieved through personal growth, fulfillment, and experiences of meaning and purpose. This relates closely to the more recent concept of salutogenesis – a sense of coherence, expressed through meaningfulness, comprehensibility, and manageability.

The distinction between causing health through a sense of coherence versus merely doing no harm is crucial. The constructing or causing health approach focuses on leveraging human assets and capabilities, regardless of their current state, to optimize health.

As a result of the worldwide COVID-19 pandemic, popular interest in causing health has arguably never been higher in our lifetimes, particularly because, for the first time, mental illness is increasing faster than physical disease. Wellness has become the number one priority for citizens and will likely remain so for the foreseeable future. The large number of companies moving into the wellness sector in recent years supports this view.

The Emerging Health Economy
According to the Global Wellness Institute, the global wellness economy was a USD$4.2-trillion market in 2018: "The global wellness industry grew 12.8% from 2015–2017, from a $3.7 trillion to a $4.2 trillion market … nearly twice as fast as global economic growth (3.6%). Wellness expenditures ($4.2 trillion) are now more than half as large as total global health expenditures ($7.3 trillion). And the wellness industry represents 5.3% of global economic output."[14]

The world of real estate development has woken up to the economic benefits of health creation through what and how we build. In the past, the main goal of developers was usually to keep initial construction costs down. That transitioned into ensuring a building's long-term operating costs (energy, waste, and water) were as economical as possible. This became an important focus of the early green building movement. However, as British engineer Raymond Evans pointed out in a 1998 publication, *The Long-Term Costs of Owning and Using Buildings*, the ratio of initial construction costs of a building, to the maintenance and operating costs over the life of the building, to the business operating costs (salaries of people working in the building) is 1:5:200.[15] While others have debated the accuracy of Evans's numbers, it is nevertheless clear that building operating costs (i.e., people) always far exceed construction and maintenance costs, and therefore the focus of the business case for any building should be human performance and human flourishing.

A Culture of Health
In 2016, the Harvard Business School and the Harvard T.H. Chan School of Public Health hosted a joint symposium to explore the concept of a "culture of health," funded by the Robert Wood Johnson Foundation. The focus was on consumer, employee, community, and environmental health. This led directly to greater corporate investment in companies with strong environmental, social, and governance (ESG) records, in which companies are judged not only on their financial strength but also on how their decisions reflect the values of ESG. The corporate ESG movement reflects a broader shift toward a richer understanding not only of environmental health but also of human, community, and societal health and well-being.

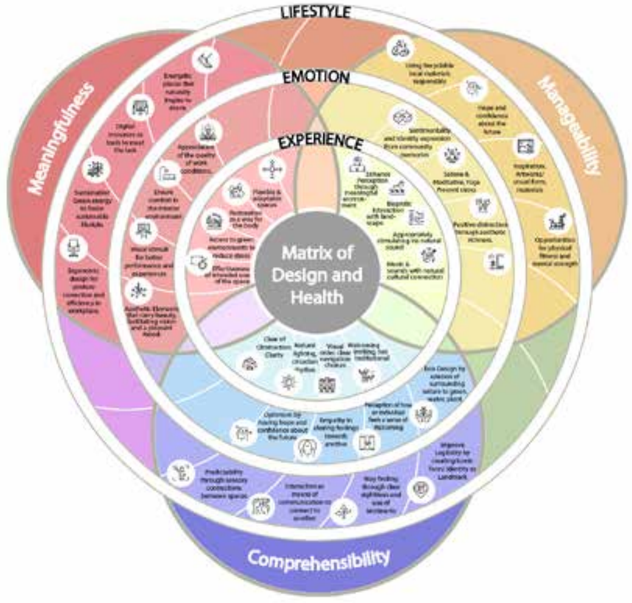
Human Flourishing
Also in 2016, another research team at Harvard University's Human Flourishing Program partnered with the Baylor Institute for Studies of Religion to launch the USD$40-million Global Flourishing Study, with the goal of measuring human well-being. They framed well-being as the sum total of one's physical and mental health, along with happiness and life satisfaction, sense of meaning and purpose, character virtue, and close social relationships, a definition that is reminiscent of Antonovsky's sense of coherence. The Global Flourishing Study is the largest, most geographically and culturally diverse study of human well-being ever embarked on to date, following close to a quarter of a million people in twenty-two countries over five years.

According to the Human Flourishing Program (HFP), "many topics that are fundamental to human well-being, such as happiness itself, or virtue, religious community, meaning, and purpose have traditionally been viewed as principally falling within the purview of the humanities, often of philosophy or theology. However, a robust empirical research literature on these topics has now developed from sociology, political science, economics, education, psychology, medicine, public health, and other empirical sciences."[16] The goal of the program is to link knowledge across diverse disciplines with the intent of joining such knowledge into an intelligible whole in order to better understand the pieces that contribute to human well-being and the ability to promote it, creating the conditions in which people can flourish.

"We study physical health very well," said the HFP's co-director, Tyler VanderWeele. "We also study income and wealth very well." But while these are important, he points out that people also care about being happy, having a sense of meaning and purpose, and trying to be a good person: "Why aren't we studying these topics with the same level of empirical rigor as we study physical health and income? … What we measure shapes what we talk about, what we focus on, what we aim for, and policies put in place to achieve it."[17]

Hope, Meaning, Purpose, Well-Being, and Economic Health
Based on research by Canadian economist and scholar John Helliwell, government policymakers are also beginning to pay attention to how their constituents feel about hope, meaning, purpose, well-being, and happiness. Helliwell uses measures of subjective well-being from around the world to help understand what makes lives better, with special attention paid to social factors. For example, he has shown that a person's trust in their neighbors is a more reliable predictor of happiness than income.[18] This has huge implications for all levels of government.

In 2019, New Zealand's then prime minister, Jacinda Ardern, unveiled the country's first "Wellbeing Budget." It prioritized five key areas: mental health, child well-being, supporting Indigenous populations, building a productive nation, and transforming the economy. Among other things, it allocated billions of dollars for mental health services, child poverty reduction, family violence prevention measures, and Indigenous well-being. Ardern was one of several national leaders who was moving away from just measuring their country's economic health using gross domestic product (GDP) to incorporate the Happiness Index metric, which includes environmental health, psychological health, cultural elasticity, quality of living, and community vivacity, for a more saluto-



The distinction between causing health through a sense of coherence (comprehensibility, manageability, and meaningfulness) versus merely doing no harm is crucial, as it focuses on leveraging human assets and capabilities, regardless of their current state, to optimize health. Design matrix developed by Alan Dilani and Ken Yeang, diagram by Farrow Partners.

systemic way of shaping government economic policy.

In Canada, Statistics Canada has begun to collect data on citizens' sense of meaning and purpose on behalf of the Department of Finance in order to help shape future federal budgets that promote happiness and human well-being as well as a productive economy. Since the COVID-19 pandemic, which upended so many preconceptions and assumptions about what matters, many people have come to realize that health and well-being in all aspects of our lives has never been more important. It is evident that human flourishing should become a central consideration in our federal budgets and policy. This includes how we design and shape our physical environments, so that buildings can become an accelerant for long-term human health and we can rediscover how our physical surroundings can support and benefit societal health.

Bond of Union (1956),
by M.C. Escher.

03

Where Does the Mind Stop and the Rest of the World Begin? The Embodied Brain, the Extended Mind

Does the mind stop at the periphery of the skull? As we will discover, recent research shows that the mind extends well beyond this limit and through the boundaries of the skin and body, forming close interconnections with the surrounding environment. These relationships play a significant role in the health of our extended minds and inform the role architecture plays in enhancing mind health.

3

We commonly assume that thinking only happens inside the mind, as though the mind were disembodied. As we have seen, however, the mind is tuned in to the internal sensations of the body and senses the interoceptive messages the body communicates, the proprioceptive messages at the surface of the body and from its kinetic movement in space, and the exteroceptive messages of the surrounding environment in relationship to the body. While the brain is housed in the skull, its perceptual system, the mind, extends to include the entire body as well as past the edges of the body's surface area. The mind perceives what is occurring around us and communicates this information back to the brain for interpretation and to determine next steps.

Andy Clark and David Chalmers, cognitive philosophers at the University of Sussex, first proposed the idea that the mind is embodied in a 1998 paper titled "The Extended Mind." Contrary to the common belief that the mind stops at the "demarcation of the skin and the skull," they argued that the mind extends throughout the body and beyond to the surrounding environment. They proposed "an *active externalism*, based on the active role of the environment in driving cognitive processes."[1]

Embreathment, an emerging concept in embodied cognition, is the use of one's physiological breath during immersive experiences to enhance presence in the moment and body awareness, examples of which include body scan meditation and progressive muscle relaxation. This awareness can be used to reduce claustrophobia, anxiety, and other negative cognitions by enhancing agency, hopefulness, and interoception in situations where one's ability to act is restricted, such as in medical MRI suites. Using breath awareness to increase one's sense of calm and control has been shown to decrease one's sense of the symptoms of anxiety disorders. We will explore the application of embreathment further in chapter 13.

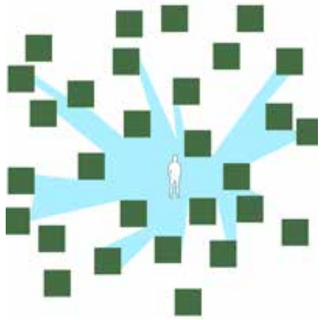
Ramp-step stairs communicate various bodily affordances for the user. Robson Square, Vancouver, British Columbia, by Arthur Erickson.

The Extended Mind Thesis

Clark and Chalmers's extended mind thesis was further developed by researchers in embodied cognition, a field that explores the role of the body in thinking. Exteroceptive situated cognition studies how our minds sense beyond our bodies and how the places we inhabit influence our thoughts. Distributed cognition studies how we think with and through others and how we maintain healthy social relationships with the people in our surrounding communities. We don't just think in our heads; we think in and through our bodies by internalizing our social interactions and the surrounding built environment. This has important implications for how architecture and design relate to mind health.

Affordances

In 1966, American environmental psychologist James J. Gibson coined the term *affordances*, by which he meant the opportunities the environment provides or furnishes to the animal (and, by extension, to the human being). When we apply this to architecture, we understand that different building forms offer different natural *bodily affordances* – opportunities – by communicating messages through implicit suggestions of movement, actions, and behaviors. One way of doing this is by enhancing curiosity and encouraging the physical exploration and discovery of a space. Movement through a space also creates a reciprocal effect in our minds. For example, we visualize how we might climb a set of stairs, twist a door handle, move across a threshold, or walk down a curved corridor to discover what is around the bend. Some of the best experiences we have with built spaces involve much more than observing them from a fixed point. Great places nurture and encourage our bodies to explore them through haptic engagement – that is, touch – which allows us to mediate our lived experience with the wider world. As architect and author Sarah Robinson rightly observes, "We cannot touch without being touched in return."[2]



Clifford Tandy's isovist concept, where the volume of any space is perceived from a given point of an individual.

The movement of our bodies through the spaces we inhabit, together with our haptic interaction with environments, influences how we think and feel about ourselves. It spurs imagination, memories, and past associations in our minds and increases awareness. Paraphrasing French phenomenologist Maurice Merleau-Ponty's description of the paintings of Cézanne, Finnish architect Juhani Pallasmaa describes the task of architecture as the need "to make visible how the world touches us."[3]

Place and Space

When we discuss perception and the importance of our bodies moving in space in the act of perception, it is important to differentiate between the terms *place* and *space*. Space is a Descartian concept based on mapping Cartesian coordinates of objects in space, in which the relationship of one object to another never changes but is fixed and defined. It is locational, geographic. Place, on the other hand, is the phenomenological experience of space, in which the perception of objects in relationship to each other, and to one's own body, is continuously in flux due to ever-changing conditions. Place gives space cultural and personal meaning – it is informed by human learning, memory, and emotional experience. Space exists independent of us and our interpretations, whereas we make place.

James J. Gibson, who developed the concept of affordances, was also an important thinker in the realm of visual perception. He explored the relationship between people and their surroundings, based on their perceptual cone of view linked to perspective and geometry. British landscape architect Clifford Tandy expanded on Gibson's work in the late 1960s when he developed the concept of the *isovist*, which is the volume of space that is visible from a given point of known location in space by an individual. The isovist is one approach that can be used to describe spatial properties from a beholder-centered perspective.

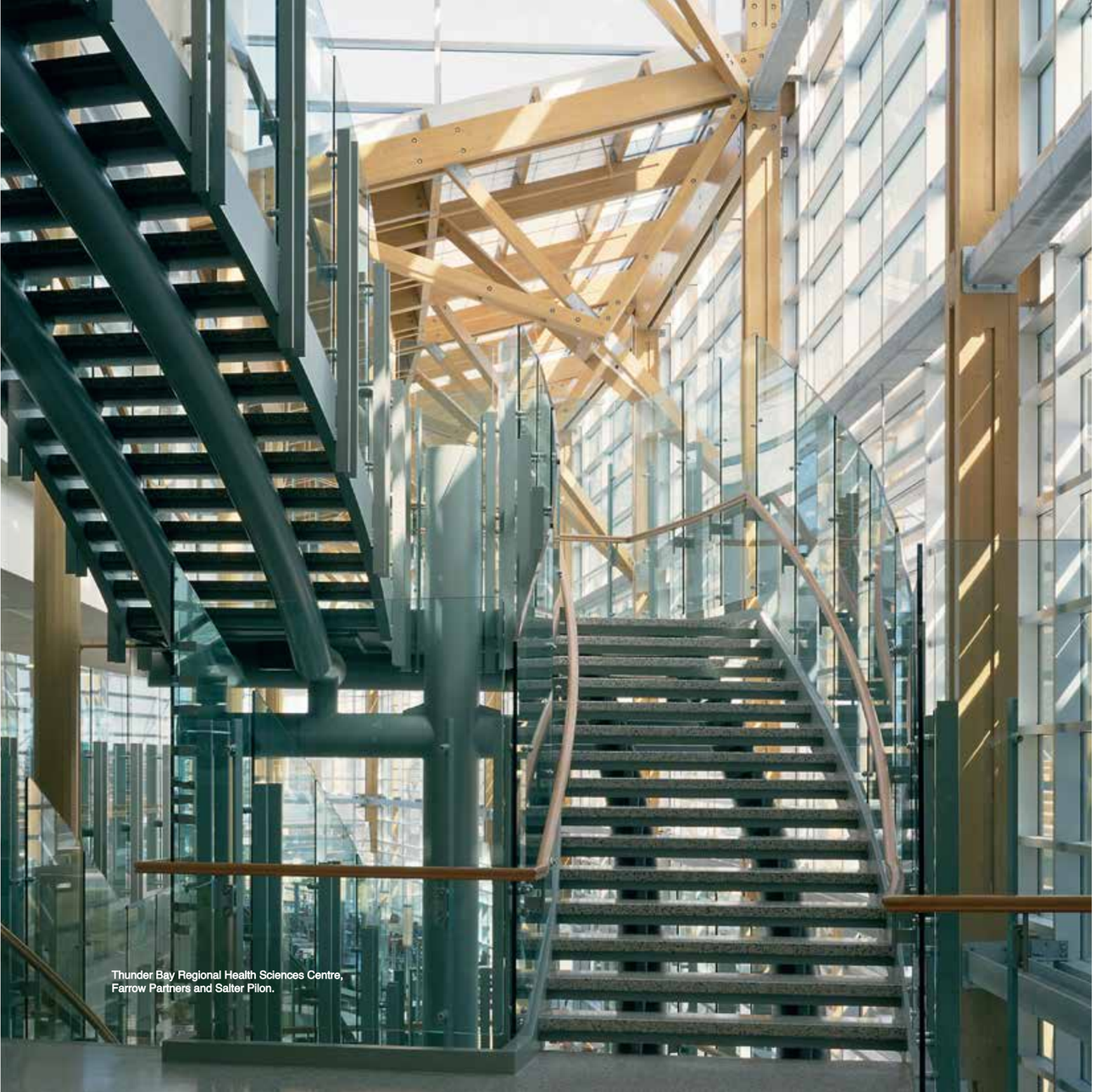
Multimodal Bodily Experiences

Our perception of the places we inhabit, however, is not just based on visual perception. It is multimodal. The bodily experience of moving through a space affects all our senses. How we relate to an environment – and make sense of it – is a direct result of how we experience the world. How do we connect on a behavioral and biological level to our surroundings? The neurophysiological discovery in 1996 by Vittorio Gallese and Giacomo Rizzolatti, called *neural mirroring*, has shown that we model, or feel into, the same behavior or feeling we observe in another person. For example, if someone smiles, we are wired to reflect or mirror that same action back. Similarly, when we look at a painting with pronounced brushstrokes or a sculpture with prominent carving marks, our mind mimics the movements of the artist at work. The same is true when we watch the movements of a dancer or athlete.

Primary, Motor, and Metaphoric Affordances

Even as we perceive the materials and physical elements used to construct a building, we also connect with the human intentions of its architects, engineers, and builders that can continue to radiate for centuries. We physically manifest the sense of astonishment and exaltation we feel in the Pantheon in Rome through a tilted back head, wide open eyes and mouth, and expanded chest cavity, which simultaneously reflect the thoughts, desires, and intentions of those who conceived and constructed this iconic building nearly 2,000 years ago. We sense all this because of the way the Pantheon's design invites us to interact with and use it. In neuroscientific terms, this is known as the *primary affordance* of an object, whereas what it communicates can be both a *motor affordance* – a door handle that offers clues as to how the hand should push, pull, or turn it – or a *metaphoric affordance*, such as a lofty dome that communicates upward motion but doesn't result in an immediate action beyond drawing our eyes and heads up toward it.

Affordances encourage an embodied simulation or experiential understanding of what we should do with an object or place through the motor and perceptual actions they prompt. In so doing, this also contributes to a sense of connection with our environment, expressed as a sense of coherence within us.



Thunder Bay Regional Health Sciences Centre,
Farrow Partners and Salter Pilon.

04

Affordances and Generosity

We often focus more on function, program, and what a building is and less on the “effects” the design solutions have, what a building does, and the type of relationship it will form with us. The design choices we make, by intention or not, communicate clues as to a building’s affordances – the actions it might offer us based on our individual potential and capabilities. Will it simply be transactional in achieving its function, or will it be health-giving and – by design – generous in what it offers the people that use it every day?

4

Affordances and generosity are two words we rarely hear in the same sentence. Furthermore, we don't often discuss these concepts in the context of architecture, except in some instances of industrial design. In the previous chapter we began to explore the concept of affordances, as defined by environmental psychologist James J. Gibson. In earlier chapters we also examined how the spaces we occupy can be health-giving by creating a sense of coherence, thus helping us make sense of the conditions in which we find ourselves. Now we will explore how places can be described as generous and how architectural affordances can be generous by design. In other words, we will learn how we can shape our built environment in order to change its affordances to align with our values and needs.

A fast food hamburger, one example of transactional nutrition.

Transactional Spaces or Transformative Places

Many buildings can be described as transactional, doing only what is asked of them. Using a food metaphor, this type of building is the equivalent of a fast food hamburger. It is functional and convenient – it solves the immediate problem of filling the void in your stomach, and you do not need a plate, knife, and fork to consume it. The ketchup, mustard, and relish add some visual and gustatory zest, while the lettuce and pickle give a bit of crunch to an otherwise bland and uniform texture. But the meal leaves you feeling tired and empty after an hour as the high sodium levels, sugar, and carbohydrates result in a sudden spike in blood sugar levels, which then plummet again just as quickly. Fast food is transactional food, unlike a nutritionally balanced home-cooked meal or superfoods, which flood the body with enormous amounts of vitamins and minerals. Like the fast food hamburger, home-cooked meals and superfoods address the problem of hunger, but they also improve your health and can thus be described as generous; doing more than simply providing protein.

Focusing on a building's function is essential when beginning the design process. The affordances of a building or place are what we can do with it – what actions are possible – based on our individual physical capabilities. We can also describe this as **action potential** in the relationship between a person and a place – that is, what action we perceive a building offers us through its design simply as a result of looking at or moving around and through it.

Some **affordances** are obvious, others less so. One example of this are the utensils we use to eat: the fork and knife in Western societies, and chopsticks in Eastern societies. Without being shown how to use each respective tool, their affordances may not be obvious to the user who is not from that cultural background. Interestingly, the spoon is ubiquitous in all societies and readily and easily communicates what actions are possible through its shape.

Some affordances are ***natural***, such as the canopy of a tree providing shade and shelter, while others are ***primary***, such as low branches that allow us to climb higher to safety or to see a view over the horizon, or a fallen tree that offers a place to sit and rest.

An object or place can offer ***motor*** affordances, which encourage us to interact with and move through it. However, what is an affordance for one person may not be an affordance for another. For example, a staircase is an affordance for an able-bodied adult but not for a toddler or a person in a wheelchair. For them, the affordance becomes a barrier.

When we look at Michelangelo's unfinished sculptures of slaves, who appear to be struggling to free themselves from their individual blocks of marble, we see a clear example of a ***metaphoric*** affordance. Thanks to the residual marks of the artist's hammer and chisel, we can perceive Michelangelo pounding on the stone, just as we feel the entrapped figures attempting to twist free from the confines of the solid marble. Of course, all of this occurs in our minds, without a resulting bodily action.

In his book, *The Design of Everyday Things*, cognitive scientist and usability engineer Donald Norman further develops Gibson's concept of affordances (which is based purely on users' physical capabilities) to include perceived affordances and action possibilities – that is, actions that users consider or perceive as possible. Because perception depends on an individual's past experiences, future aspirations, ambitions, and beliefs, perceived affordances are broader and more nuanced than basic affordances.

Metaphoric affordance: Michelangelo's unfinished Young Slave (c. 1525–30).

Norman also introduced the term ***signifier*** into the conversation. A signifier is some sort of perceivable clue or suggestion about what you can do with an object. As a result, a lot of design has more to do with signifiers than affordances. For example, a door handle affords us the opportunity to open a door. In some instances, the design will offer signifiers about how to use the handle to open the door, while in other instances, it is anything but clear.

Well-designed signifiers can increase the generosity of affordances. A transactional door handle will signal to us that we use it to open and close a door. Hopefully, its form also offers some clear clues about how to use it – whether to turn, twist, pull, or push – and its material communicates whether it will be warm or cold to the touch.

Consider Spanish architect Antoni Gaudi's design of the window handles for his Casa Milà in Barcelona. He modeled the handle out of clay to achieve a sensuous form that matches the embrace of a human hand before he cast it in metal. As a user, we feel that Gaudi has gone above and beyond what was strictly necessary as an architect and designer. He has created a handle that recognizes and makes us feel our shared humanity and therefore uplifts us. This is generosity by design.

Generosity and the Urban Environment

On a city scale, streetscapes and buildings can be generous by the physical affordances they offer: a colonnade to provide shelter from the rain, benches to sit on, trees for shade, open storefronts, stone paving that allows pedestrians to enjoy the gentle sounds of rhythmic footfall, and buzzing cafés with canopies to provide protection from the sun.

Such generous urban gestures can also be seen as democratic, as Lesley Lokko, curator of the 18th International Architecture Exhibition, La Biennale di Venezia, has noted:

> The OED's primary definition of "shade" is "comparative darkness and coolness caused by shelter from direct sunlight." In African cities from Kinshasa to Khartoum, trees are the primary source of shade, providing not just respite from the blinding light but also from the heat. In places where the midday temperature can rise to over 40°C, the chance to sit – even for 10 minutes – under a neem tree is more than simply welcome: it is essential. … Shade is not regulated: it is accidental, democratic, public-spirited. … No one remembers who planted the trees, or indeed to whom they might "belong."[1]

Metaphoric affordances are equally or more important. While these types of affordances don't result in an immediate physical action, our mind imagines and constructs the resulting physical action, and this imagined perception is as strong as that of the actual physical movement.

Health Care and Human Needs

Generosity isn't a word that we usually associate with hospital design. Usually, the highest value is efficiency. Architects and designers spend a lot of time figuring out how to reduce the walking distance of nurses, as every step saved increases the time a nurse can spend with patients versus traveling between rooms. Efficiency also informs the notion that all rooms should be same-handed – that is, have identical layouts so that nurses can easily perform repetitive tasks. This type of hospital design thinking derives from the lean and automated processes successfully employed in the manufacturing and automotive industries. However, what works for machines does not necessarily work for people. The COVID-19 pandemic clearly reminded us that health-care workers are human beings with human needs, not programmable machines that can perform under any conditions.

In most hospitals today, working environments are far from generous.

Support and off-stage spaces where workers can recharge mentally, physically, and emotionally are often relegated to broom closets or other tiny, windowless rooms. The human dimension has been sacrificed to industrial notions of efficiency and performance. For an automated machine, it is indeed valuable to move shorter distances on a production path. But what is more valuable for a human being: a shorter walk along a double-loaded corridor with no view to the outside, or a longer walk along a window-lined corridor, with access to daylight, views of trees and the horizon, and a sense of the changing cycles of the days and seasons? Generous design is immersive and has qualities that make us realize we are human and feel alive. Unlike transactional design, which treats us like machines, generous design restores our minds and bodies and improves our health through the affordances the design solutions offer.

What We Communicate through Design Choices

Many buildings and communities throughout history have been intentionally designed to alienate certain portions of society and be generous only to specific people or groups. For example, the American post-colonial homestead, conceived by Thomas Jefferson as a building block for a new society, was built on a Cartesian grid pattern intended to represent a utopian society based on equality and freedom from corruption.

The grid ignored all natural features, including hills, valleys, and rivers, and instead assigned everyone their own garden, which they were expected to cultivate themselves. But the system was conceived in a period that relied on slave labor to maintain these large expanses of manicured and cultivated landscapes. And the white picket fence, while designed with the intention of upholding the values of private property and individualism, also took on the cultural meaning of a segregated society, where white people were on the inside and Black people were kept out.

In South Africa, before Nelson Mandela and the anti-apartheid revolution, the government used settlement and land use policy as a form of racial violence and architecture as propaganda. A predominantly classical vocabulary communicated visually which histories were considered important and worth remembering and which were not. In contrast, civic architecture that was built after the fall of apartheid is visually and physically more open, less institutional, and more vernacular. It puts less emphasis on the grand object with clearly defined edges and more emphasis on common ground, which communicates the value

Design choices communicate messages: Thomas Jefferson's main plantation, as painted by Jane Braddick Peticolas in View of the West Front of Monticello and Garden (1825).

society now places on celebrating many histories, voices, and backgrounds.
In this context, the post-apartheid South African government held an international competition for a new building type called a Health Promoting Lifestyle Center (HPLC). It was to have a mixed-function typology combining facilities for health clinics, education, skills training, fitness, and social uses, unlike the usual single-use health clinics, sports center, or school. The Ministry of Health planned to build these in all provinces – in cities, townships, and rural areas – as vehicles for wider community health creation, particularly for the most vulnerable citizens who were so often left behind.

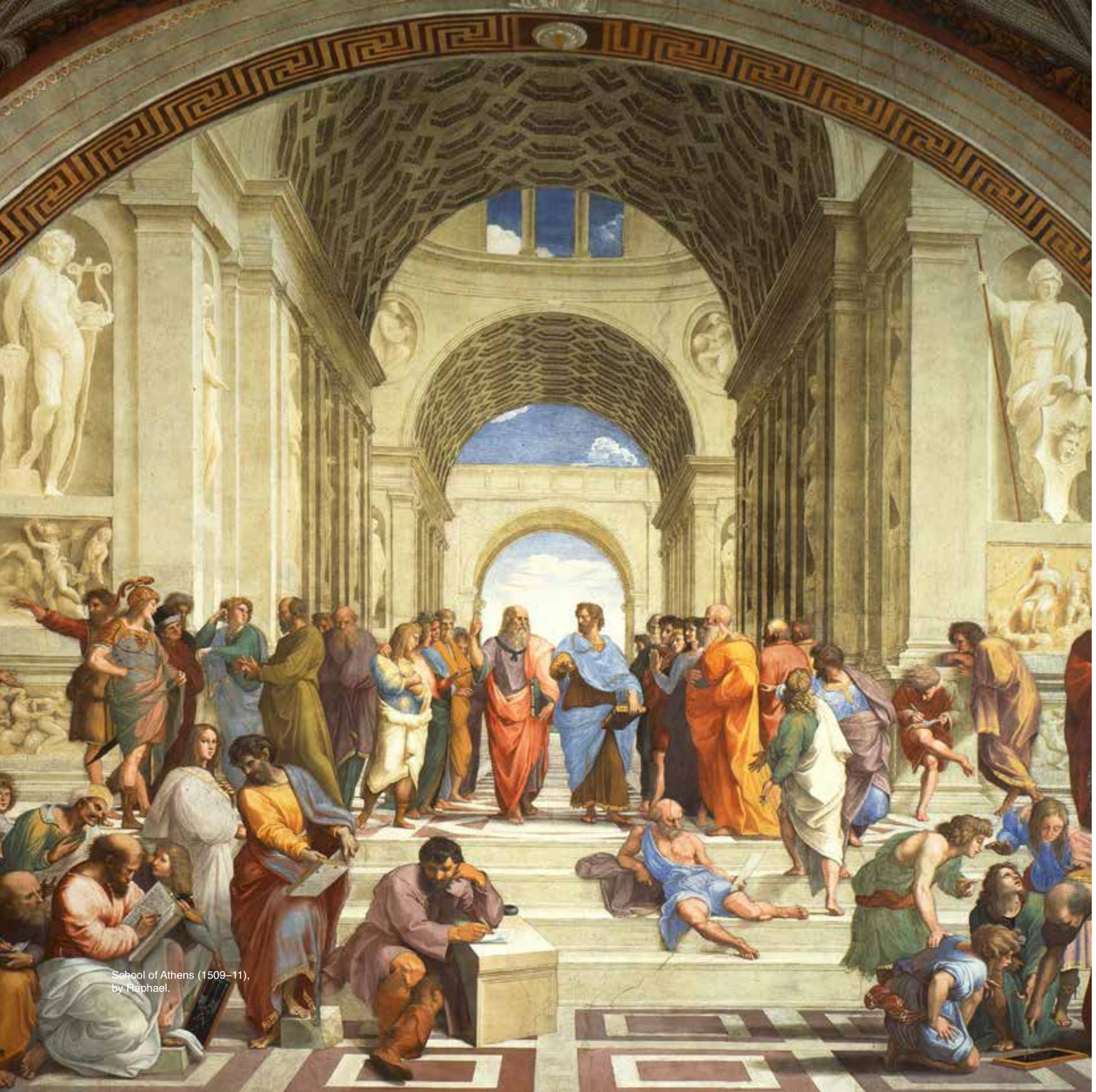
Metaphors and Symbols of Health

I assembled a design team that won the competition. We chose the South African protea flower as the inspiration for the design of our Health Promoting Lifestyle Center. The protea flower changes in form, color, and shape in the different provinces of the country and takes its name from the Greek god Proteus, who could adapt his form to suit changing circumstances, a metaphor for our individually evolving and changing health conditions. The protea flower is also health-giving – its blooms attract bees, which carry pollen from flower to flower and fertilize the fruits and seeds that create future prosperity.

We designed our HPLC buildings to communicate these values, to act as a symbol on the horizon that was opening, plentiful, adaptable, and giving to the community around it. This was intentionally generous architecture, in which each person could see the many affordances the building offered them, regardless of their individual backgrounds. When society and politics undergo dramatic change, we can consciously change our built environments to create affordances that go beyond strictly functional requirements to reflect our new priorities, values, and needs. Arguably, the inverse is also true – we can make social and political change through generous design that treats people as human beings, not just machines; one that causes health.

The design choices we make, by intention or not, communicate clues about the type of person-to-place relationship that forms through a building's affordances. As we will see in the next chapter, these clues are similar to how our bodily mannerisms indicate the kind of future relationship we will form with another person. Do we want shallow, tenuous, unreliable, petty, cool, impatient, and transactional relationships, or do we want solid, trustworthy, durable, warm, authentic, honest, and generous relationships that are part of something bigger and more lasting?

Metaphors and symbols of health: South Africa's Health Promoting Lifestyle Center, Farrow Partners, Clark Nexsen, and Ngonyama Okpanum and Associates.



School of Athens (1509–11), by Raphael.

05

The Theory of Constructed Emotion: How We Construct Internal and External Relationships, Person-to-Person and Person-to-Place

How we construct enriching person-to-person relationships, which offer a sense of coherence, comprehensibility, manageability, and meaningfulness, is similar to how we construct salutogenic person-to-place relationships with our built environments. Whether we interpret them as salutogenic enriching relationships depends on how we remember and interpret these experiences through our bodily actions and senses.

5

The **theory of constructed emotion** was developed by Canadian psychology professor Lisa Feldman Barrett to explain how we experience and perceive emotion. She hypothesizes that "in every waking moment, your brain uses past experience, organized as concepts, to guide your actions and give your sensations meaning. When the concepts involved are emotional concepts, your brain constructs instances of emotion."[1]

Barrett elaborates: "Your mental concept of what a 'Bee' is … not only includes information about the bee itself (what it looks and sounds like, how you act on it, what changes in your autonomic nervous system allow your action, etc.), but also information contained in other concepts related to bees ('Meadow,' 'Flower,' 'Honey,' 'Sting,' 'Pain,' etc.)."[2] According to her, when we see a bee, our brain uses these preexisting concepts to stimulate our interbody systems, such as heart rate and breathing, while it also interprets our body's external sensory input. We therefore base our reality and emotions on our interpretations of these sensory inputs, which we filter through our broad social and cultural experiences (learned) and our own past experiences (remembered). Only then do we decide what action we should take as a result of the circumstances in which we find ourselves. Our brain interprets external inputs from the world, along with interoceptive internal inputs and interpretations, which are overlaid with internal predictions of the best output action based on learned and remembered experiences.

Let's unpack this a bit. Imagine encountering a bee. The external inputs and our brains' interpretations of them depend on the context: Do we see the bee on a busy city street or in a peaceful mountain meadow? Do we see a swarm of bees or an individual bee on a flower?

The environments around us communicate clues, which our mind interprets, as to the relationship we will have with it. Duke of York Square, London, England.

The **interoceptive internal inputs** and interpretations can be equally varied, from sound input (the strong and persistent buzzing of a swarm of bees or the intermittent buzzing of a single bee) to visual input (a bee waggle dancing between flowers or dozens of bees swarming). We could also experience touch input (a bee gently bumps into our skin and then flies away or it stings our arm), olfactory input (the scent of summer meadow flowers or a hot, dirty street), or taste input (mountain meadow honey or the dry mouth taste of a hot summer day in the city).

Internal predictions of the best output action can also vary widely and depend on our learned and remembered experiences. Perhaps we have recently read a news story about the dramatic increase in Africanized "killer" bees, or perhaps we have childhood memories of a playful busy bee character from Saturday morning cartoons. We may have had a past bee sting that resulted in a severe allergic reaction and hospitalization, or we may have had a high school summer job helping a beekeeper. Consequently, we could respond to the bee encounter in any number of ways. Our resulting predicted outcome action could range from continuing our leisurely walk through the mountain meadow or running for our life down the crowded city street.

Now let us repeat this thought process to see how the same mental interpretations can occur in the built environment using a city street as an example. The external inputs and our brains' interpretations could be as follows: Do we see a car-dominated street or a pedestrian-only street? Do we see an ocean of asphalt and concrete or a street lined with trees and flowers? Is there an absence of street furniture, or are there benches and café seating? Are the walls of the street lined with opaque windows or filled with open shops, cafés, and bakeries? Do the building edges go straight up from the sidewalk or are there weather protection canopies or covered arcades?

Reality is a combination of each person's assessments, beliefs, and understanding, recalled by memory and a number of sensory stimuli. Diego Velázquez's Las Meninas (1656).

The interoceptive internal inputs and interpretations could be as follows: sound – the squeal of car brakes or human laughter and gentle footsteps on the sidewalk; visual – a barren street with no sign of people or lots of active storefronts; touch – the feel of cracked asphalt under your feet or cobblestones; olfactory – the smell of car exhaust or that of trees and freshly baked bread; taste – the sulphur of car exhaust in your mouth or an almond croissant.

The internal predictions of the best output actions depend on the following: Does this feel like a great neighborhood, or does it feel crime-ridden? Is this a familiar neighborhood, or are you in a foreign city? Do you know where you are going, or have you become lost and don't know your directions? Is it a sunny day or a dark night with few streetlights? Are you in a group or by yourself? Are you young and fit or elderly and unsteady on your feet?

Based on the wide range of possible external and internal inputs and interpretations as well as all the possible internal predictions and outputs, the resulting predicted outcome action could vary from continuing a leisurely stroll down the city street and stopping for a coffee or getting away from the street as quickly as possible.

Experience: A Means of Interpreting Our Surroundings

What we call experience is really just the interpretation and classification of external signals absorbed through our senses and filtered through the lens of knowledge and memory. As Chris Frith reminds us, "We do not have direct access to the physical world. It may feel as if we have direct access, but this is an illusion created by our brain."[3] Without classification, there would be no perception. Sensory information allows our minds to construct and reconstruct reality. Reality is a combination of each person's assessments, inspirations, beliefs, prospects, and understanding, recalled by memory and thanks to a number of sensory stimuli, only one of which is vision.

As we have seen, the mind responds to an environment using not only bottom-up sensory clues but also top-down emotional and cognitive clues – including beliefs, memories, experiences, empathy, and actions – to interpret our individual environments and initiate a predictive response through an action; predictive responses that enhance our sense of agency regarding the situation we encounter or face.

These internal mental representations of the world around us shaped by past experiences are known as *cognitive schemas*. In *Meaning in the Visual Arts*, art historian Erwin Panofsky identifies three levels of aesthetic interpretation.

First, there is pre-iconographical interpretation – that is, interpretation through intrinsic elements of line, color, shape, form, subject matter, and emotion. This level of interpretation is based on intuitive experience without cultural overlays. The second level is iconographical interpretation, or how we interpret a form's meaning and expression in a universal understanding of the subject. The third level is the iconological interpretation, which is a narrower view based on the viewer's learned frame of reference and myths due to culture, experience, religion, and history. Panofsky gives the example of an image of thirteen people around a table. Some people think of *The Last Supper*, others recall family Thanksgiving, and to yet others this is just some friends having a meal. Panofsky therefore frames interpretation as, first, symbol interpretation; second, cultural interpretation; and third, personal memory interpretation.

That said, cognitive schemas are not formed by sight alone but are in fact heavily dependent on all of the senses – something that is easy to forget in today's world, which often prioritizes the visual over all other qualities. In his book The *Nine Quarters of Jerusalem*, Matthew Teller recounts a wonderful childhood sensory experience and memory of the walled Old City of Jerusalem:

> All my life cumin has meant my first trip to Jerusalem. I can't make an informed comparison – I was only a child, then – but I'd guess the city I saw in 1980 was very different from the city today. What I have in my mind's eye from then is a scatter of impressions: flagstones worn smooth underfoot, gaudy colours and textures hung high over my head in narrow alleyways, my father doing something he wouldn't dream of doing today: changing money at a Palestinian-owned booth inside Damascus Gate. And the smells. So many smells. Sweet things. Burnt things. Rotting things.

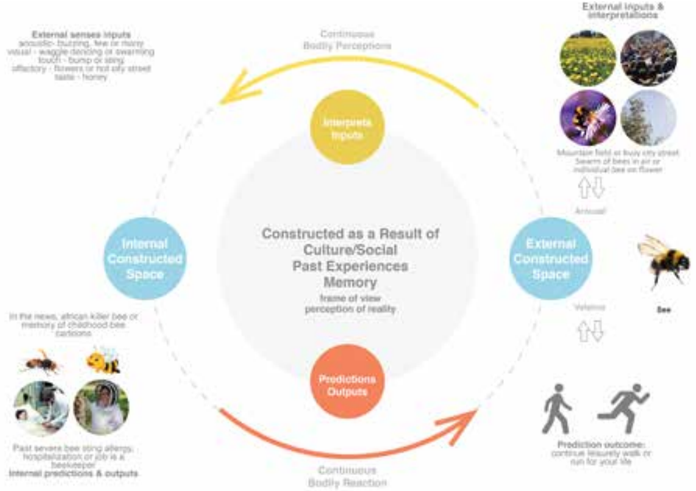
Cognitive schemas are shaped by symbol interpretation, cultural interpretation, and personal memory interpretation. Stained glass depiction of The Last Supper, Knox Church, Oakville, Ontario, Canada.

Cognitive schemas are not formed by sight alone but are heavily dependent on all of the senses. Damascus Gate, Jerusalem, Israel.

Laundry soap. Hot bread. New leather. Smells I knew nothing about.

It was years later, at a time when spices had become a more normal thing for a suburban London family to buy and use, that I was able to put a name to the earthy scent I'd filed in my head for years as "Jerusalem." So that's what it was. Cumin. Then as now, cumin's crimson-brown sniff of old warmth would plant me mentally in the middle of Jerusalem's walled Old City, amid a crush of elbows on the crossroads of glittering, dizzying roofed pathways where the Souk al-Bazaar, or David Street market, turns left to Souk al-Lahameen, the Butchers' Market, as multiple smaller markets crash in from both sides and the main alleyway doglegs downward to form Tarig Bab al-Silsila, the Road of the Gate of the Chain, on its way toward holy places. Everything was there, at that intersection: gold, fabrics, money, fresh bread, fresh fruit, fresh meat, leather, fenugreek, perfumes, heat, sweat, colour, new faces, new languages, new people, new ways of being. I watched but I didn't understand. I didn't know how much I didn't know. That was cumin.

For years I put cumin in everything. I was really putting Jerusalem in everything.[4]



An illustration of a "person-to-place" relationship using the example of a bumble bee.

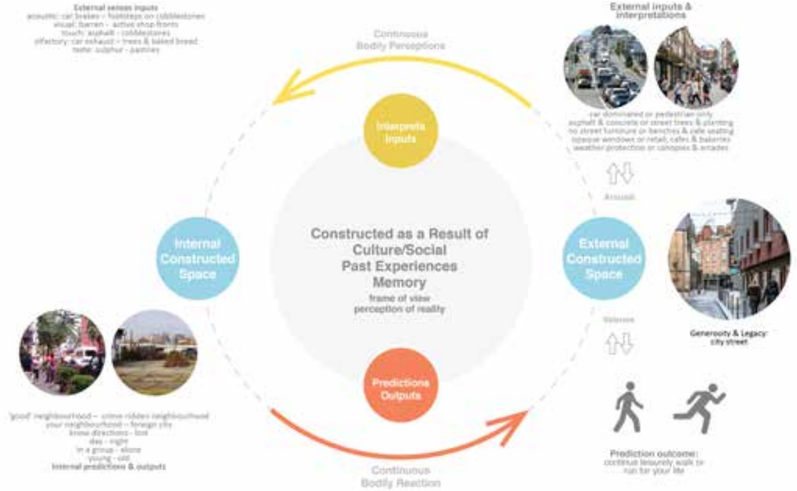
While Teller's recollection of cumin is positive, multisensorial memories of disturbing events in one's life can be equally seared into the mind's eye. Salman Rushdie describes such an event in his 2022 *New Yorker* article titled "A Sackful of Seeds" about a young Indian lady in the southern city of Kampila Raya. He writes,

> For the rest of her life, Pampa Kampana, who shared a name with the river on whose banks all this happened, would carry the scent of her mother's burning flesh in her nostrils. The pyre was made of perfumed sandalwood, and an abundance of cloves, garlic, cumin seeds, sticks of cinnamon, and other spices had been added to it as if the burning women were being prepared as a gourmet dish to set before the sultan's victorious generals, but those fragrances – the turmeric, the big cardamoms, and the little cardamoms, too – failed to mask the unique, cannibal pungency of women being cooked alive, and made the odor, if anything, even harder to bear. Pampa Kampana never ate meat again, and could not bring herself to remain in any kitchen in which it was being prepared. All meat dishes exuded the memory of her mother, and when other people ate dead animals she had to avert her gaze.[5]

The Qualities and Values of Enriching Relationships: Person-to-Person and Person-to-Place

Internally constructed enriching relationships that develop from person-to-person interactions are generous, open, animated, engaging, optimistic, natural, full of variety and vitality, authentic, honest, caring, comfortable, and safe.

While completing our doctoral work at the Iuav University of Venice, Claire Daugeard, Carolin Vogelei, and I studied the characteristics of enriching relationships by examining supportive and helpful psychotherapeutic relationships between clients and doctors. Two relational factors seem to be most important for the client. The first is feeling emotionally safe in the therapeutic relationship in order to be able to open up to processes of development and growth.[6] The second is the activation of the client's resources so they may experience their own success and competence (self-efficacy) within this relationship.[7]



An illustration of a "person-to-place" relationship using the example of a city street.

What does feeling emotionally safe mean? It means feeling understood and accepted in a relationship that is solid, warm, authentic, long-term, reliable, and trustworthy. Being emotionally safe creates a space that is intimate and familiar enough to feel confident and sensitively held, allowing one to open up and show oneself, unquestioned and unconditional. It provides calm and comfort. It is connective, restorative, adaptable, and generous. Unasked, it kindly gives what is needed – and often more – without expectation or obligation.

"Safe spaces" are often seen on university campuses, demarcated with a pink triangle surrounded by a green circle. These safe spaces are environments where marginalized communities can find a place or persons free of bias, conflict, criticism, threating ideas, and microaggressions that are otherwise often directed toward them. This gives them the opportunity to activate their inner resources and develop a sense of coherence.

What kind of a relationship supports the activation of a person's inner resources? It is one that feels variable and manifold (but not overstimulating) and encourages active involvement, exploration, co-creative interaction, and the experience of self-efficacy. It feels vital and engaging, internally and externally connecting with life energies and increasing one's own body awareness; it offers hope, reassurance, and encouragement, enriching person-to-person relationships, which offer a sense of coherence.

Externally constructed person-to-place relationships have similar characteristics and qualities to person-to-person relationships. Enriched environments are person-to-place relationships with health-giving characteristics. Like salutogenic person-to-person relationships, they help build of a sense of coherence, comprehensibility, manageability, and meaningfulness.

As architects, we can create enriched environments through deliberate design choices and decisions that enhance human performance by constructing places and buildings that stimulate salutogenic and bodily interceptive, proprioceptive, and exteroceptive responses, intentionally tuning and enriching our built environments to improve health and well-being.

A mouse in an enriched environment.

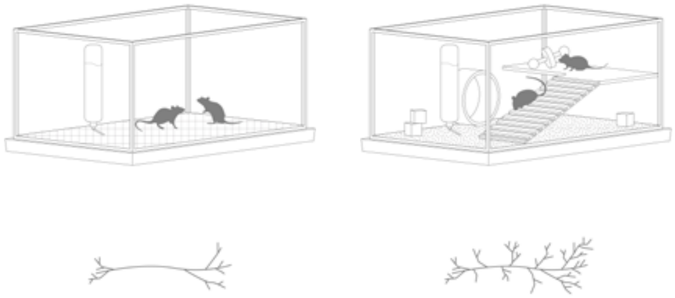
06

The Study of Environmental Enrichment

Research has shown that by consciously and intentionally tuning the design of a built environment, we can enhance human health and performance through specific spatial characteristics that increase therapeutic and health-generating capacities for optimal health and well-being. This is known as environmental enrichment.

6

Environmental enrichment was first studied by Canadian psychologist Donald O. Hebb in 1947. In an experiment with lab mice, he provided one control group with larger enclosures, toys of various material and colors, and running wheels, while the other group received only standard cages. He found that the mice in the enriched environments lived longer, had fewer behavioral issues, were physically healthier, and performed better on cognitive tests than the mice in the regular cages. Hebb's research pointed to the influence of the environment on well-being, intelligence, and longevity and gave birth to the field of environmental enrichment, which looks at the therapeutic and health-generating capacities of the built environment.[1]



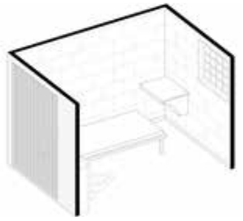
Hebb's experiment on enriched environments demonstrated how a bare cage and an enriched cage affected the development of a mouse's cerebrum nerve cells.

In 1960, American neuroscientist Marian Cleeves Diamond advanced Hebb's notion of environmental enrichment. She became one of the first to publish evidence demonstrating that the brain changes through experiences and improves with enrichment, a process now known as neuroplasticity. Diamond, along with American psychologist Mark Rosenzweig, further advanced the study of environmental enrichment at the University of California, Berkeley, when they compared the brains of mice in enriched cages, regular cages, and impoverished environments.

They found that the brains of mice who grew up in enriched environments had better enzyme cholinesterase activity and increased cerebral cortex volume, and that they formed thicker cerebral cortices containing 25 percent more synapses, a process of renewal known as synaptogenesis. The cerebral cortices, the outer portion of the brain, of the enriched environment mice also grew by 6 percent compared to those of the mice in regular cages, while the cerebral cortices of the mice in impoverished spaces actually shrank. The mice in the enriched environments were also more visibly active and curious. This pioneering research proved that the brain can rewire itself and create new pathways as a result of environmental stimulation in daily life.

Impoverished environments damage not only the brains of mice but also inhibit synaptogenesis and damage the human brain. This was demonstrated, quite tragically, in the landmark class action lawsuit by Robert King against the State of California. King was one of a group of African American men known as the Angola Three, who were dubiously convicted for murder and placed in solitary confinement for decades. They were kept in rooms no bigger than 6 x 9 feet (2 x 3 meters), with no windows and virtually no human contact, for twenty-three hours a day in the Louisiana State Penitentiary (also known as Angola Prison) before their convictions were appealed and overturned. King himself served twenty-nine years. The severe conditions and almost complete lack of sensory stimuli resulted in corrosive damage to his hippocampus, which is responsible for memory, emotional regulation, and spatial orientation. King lost his ability to navigate through space and, at one point, was unable to recognize faces. Like a plant without sun and rain, parts of his brain withered from lack of stimulation and use.

The neuroscience and scientific quantification of the changes in Robert King's brain that resulted from his environmental conditions played an important role in King winning his appeal,



Recreation of Herman Wallace's 6 x 9 feet (2 x 3 meters) solitary confinement cell.

Impoverished environments: recreation of a "white room" torture technique room wherein a prisoner is placed in solitary confinement with a complete lack of sensory stimulation.

a milestone case in the United States for what it proved about the relationship between where we reside and how it can enhance or impede brain development.

Beyond the withering effects of solitary confinement cells, certain governments are using what are known as **"white room torture"** techniques over extended periods to deprive political prisoners of all sense of identity and thereby inducing irreparable mental and physical damage. Prisoners are individually held in rooms that are all white, including all the furniture and the prisoner's own clothes. Surfaces are all smooth, devoid of any texture. Lights are positioned overhead so they cast no shadows, and there are no windows to capture the changing light and weather conditions. All-white food is served, with minimal taste and scent. Prisoners are denied all forms of social interaction, and cells are soundproofed, so all a prisoner can hear, twenty-four hours a day, is their own breath and heartbeat. Tragically, these intentionally designed impoverished environments, prisoners report, create a feeling of unbearable loneliness, which never leaves them, even long after they have been freed.

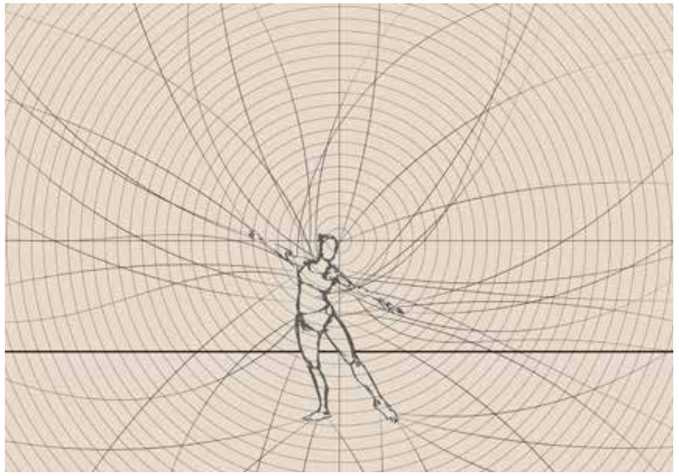
Subsequent psychological and neurological research makes it abundantly evident that how we relate to our environments has a significant effect on our mind health and well-being. Given that the average person spends 87 percent of their life indoors, this has clear ramifications for how we design the places we live, work, learn, heal, and play. Unfortunately, this realization is still often sorely lacking as a driver in how we shape our buildings and neighborhoods.

In a research paper published in 2010, British psychologist Craig Knight and his colleague S. Alexander Haslam revealed what they had learned about the role that **lean, enriched, and empowered environments** play in human performance. They had asked volunteers to carry out a number of tasks in different office environments: a lean or sparse space, an enriched environment that was thoughtfully arranged with images of nature, an empowered environment where volunteers could move things around as they wanted, and a disempowered environment where everything was fixed. Their research showed that participants in the enriched and empowered spaces worked harder, were more productive, and performed better than those in the lean and disempowered environments, with a 30 percent increase in what they were able to achieve.[2]

The results of the above studies raise the question of whether intentionally tuning our built environments through design in

order to improve health and well-being could not only limit negative effects on the brain but also create the conditions in which we can flourish and thrive. A recent research paper by Zhiwei Xu et al. at the Beijing Institute of Radiation Medicine indicates that the answer is clearly yes.[3] The research evolved out of concerns about drug addiction in society and the effects of various environmental conditions on the susceptibility of people to drug abuse. Previous research had already indicated that enriched environments could prompt long-term alteration of neural functions, which may hinder the appearance of pathogenic behaviors such as drug addiction. The Beijing research team looked at the effects of enriched environments on morphine-induced behavior in mice and discovered that enriched environments weakened the desire of the mice to willingly consume morphine. This suggests that enriched environmental conditions led to a decrease in the sensitivity of the mice to morphine-induced reward behavior. If we apply these findings to the widespread opioid epidemic, it is hard not to wonder what role some of the mind-numbing living, working, learning, and healing spaces we have created plays in human drug addiction.

Stimmung: Monk at the Hieizan Temple, Kyoto.



Gaining knowledge through interacting with our environments: drawing inspired by German artist and designer Oskar Schlemmer's "Slate Dance."

Creating Enriched Environments
By consciously and intentionally tuning the built environment, we can shape the meanings, values, and moods that spaces communicate to their inhabitants. Spaces can evoke and reinforce emotions and bodily feelings – from surprise, happiness, alertness, or calm to tension, anxiousness, aggression, or lethargy. Design that supports greater sensory, perceptual, motor, and physiological harmony builds a sense of coherence – comprehensibility, manageability, and meaningfulness. Like architectural super vitamins, such designs create nutrient-rich environments through specific spatial characteristics, both cultural and causal, that can enhance and activate optimal performance and health, as measured through neurological, physiological, psychological, and sociological feedback.

The Growing Mind: The Biological Mechanisms of Learning and Memory
American neuroscientist Elizabeth Gould's ongoing research in neuroplasticity and neurogenesis at the Princeton Neuroscience Institute is beginning to raise awareness that learning capacity and memory can be improved by our surroundings. Not all aspects of the brain are fixed or destined to deteriorate over time, as was previously assumed. Instead, Gould's research shows that the brain is changeable or "plastic" throughout adulthood, with the potential to create new neural networks under enriched conditions.

Built deeply into human nature is the robust propensity to learn. On a neurobiological level, learning results from the strengthening of synapses influenced by genetic and environmental contributors.[4]

Stimmung as demonstrated in J.M.W. Turner's Norham Castle, Sunrise (1845).

The learning process, also known as long-term potentiation (LTP), stems from the strengthening of neural networks that result from repeated behaviors, thoughts, and actions. Synapses are cellular connectors that reach outwards from the body of a neuron toward other neurons, creating an incredibly complex constellation of cells unique to each individual.

LTP is a primary contributor to the plasticity of the brain. Plasticity refers to our capacity to learn and adapt throughout our lives due to the ever-changing nature of the connections between neurons. As actions and behaviors change over time, so does the strength of the synaptic connections between neurons. Learning and memory are therefore in a constant state of flux, being substantially pliable during early childhood development and continuing to contribute to the learning and personal growth of adults in later life.

The cognitive development of children is influenced by the types of environments they experience. Swiss psychologist Jean Piaget's seminal research on the process of acquiring knowledge in children, now known as Piaget's theory, recognized learning and memory as a progressive reorganization of biological mechanisms influenced by environmental experiences.[5] Piaget's work contributed significantly to our growing understanding of how children and young adults gain knowledge, as well as the role that biology and enriched environments play in brain development.

We Consume Our Environments
As previously suggested, architecture, in many ways, is like food. It can enrich the mind-body or starve it, encourage social engagement or create loneliness – it all depends on the architectural "nutrients" we consume. Many of the buildings we live and work in are like empty calories, the built equivalent of unhealthy diets. Fast food is associated with not cooking or eating together – it is nutrient- and sensory-deprived, as well as socially and mentally unfulfilling (not to mention unsustainable as a food source and practice).

As with our built environments, this empty-calorie attitude has adverse results, ranging from obesity and chronic disease to the absence of the socially unifying conditions of sharing a table and breaking bread together. In many cases, food and cooking have become purely transactional and functional, providing only the bare minimum in protein and calories — just as many of the places we occupy provide only shelter – and no more.

Today, many people have higher expectations for what and how they eat, how and where food is grown, and how food practices support local economies. They see themselves as more than consumers of unhealthy and monotonous meals. Instead, they consider themselves part of a movement that appreciates food sustainability and nutrition, enhances the social and sensual experience of cooking and eating, and has a more sophisticated level of societal appreciation. The same expectations need to be cultivated as they relate to the places in which we live, work, learn, play, and heal.

House and Home
Just as we have seen that space and place are two different concepts, so are house and home. A house is the physical, spatial measurements and programmatic elements that make up a residence in which one or more people reside.

Central panel of Duccio di Buoninsegna's Maestà (1308–11).

Raphael's Small Cowper Madonna (1505).

A home, where we dwell, often described in metaphors, transcends those Cartesian coordinates; it is a place shaped by an individual's or a family's specific collections of items that creates an architectural atmosphere and holds memories, personal feelings, and meanings. Home environments are filled with experiences, events, and stories that linger in the occupants' memories and are projected onto and through the structure of physical elements. As Sarah Robinson notes, "Even the English words *dwell* and *dwelling*, like the word *building*, are both nouns, verbs and gerunds," which emphasizes both the place and the action of inhabiting a home.[6] A house provides necessary shelter. A home creates a sense of meaning and belonging.

Stimmung and the "Atmosphere" of Enriched Environments

Places have a psychological "temperature" that we "feel" into – a concept expressed by the German word *Stimmung*, meaning mood, attunement, and atmosphere, all of which "speak to us." Think of the English Romantic artist J.M.W. Turner, an acute observer of nature, whose oils and watercolors veer close to abstraction due to the considerable lengths he went to capture his experience of the changing atmosphere of the places he painted.

The roots of the word *Stimmung* are from the German word *Stimme*, meaning "voice." The word is associated with human mood as well as with music and the tuning of an instrument. Atmosphere, as it relates to architecture, is a harder concept to define. It is more nebulous, of the moment, and "invisible, intangible, elusive, without physical limits, unstable, instinctive, highly subjective, and often described through metaphors."[7] Atmosphere is the "sign impressed on our senses and our intellect by the experience of the architectonic space," either consciously or, more often, unconsciously. It is "a state that is hardly defined, not because it is rare and unusual but, on the contrary, because it is omnipresent – even though at times unnoticed – as the emotive situation."[8]

Importantly, *Stimmung* refers to both the mood "attunement" of an individual's mental state and the atmosphere of a specific place at a certain point in time. I am using the word *attunement* as Mexican-Canadian architect Alberto Pérez-Gómez describes it: how certain places seem to have a voice that speaks to us, where we feel connected – attuned – as inhabitants of a specific location, as a multisensorial "communicative" setting that links human health and self-understanding. In contrast, when we are distracted, we are not attuned, not in harmony, neither with ourselves nor our environment. In this sense, attunement relates back to the salutogenic concept of a sense of coherence.

Pierre-Auguste Renoir's Young Mother (1881).

Dorothea Lange's Migrant Mother (1936).

Stimmung and Art

In *The Story of Art*, Austrian art historian Ernst Gombrich outlined how art evolved from the medieval period, when artists didn't understand how to capture *Stimmung* or perspective and had limited ability to render subtle color variations. During the early Renaissance, artists began to master the use of perspective, meaning they could now paint what they saw, resulting in more life-like, three-dimensional, realistic depictions of people and places. The advent of photography in the nineteenth century changed painting forever, as the camera could capture reality but not necessarily the subtle, fleeting moments. The French Impressionists addressed this by trying to capture Stimmung, or mood, and the temporal, atmospheric, and sensual aspects of a place and experience. Painters began to shift from capturing reality to capturing and representing emotions and feelings. Objects went from being simply perceived to also being emotionally felt.

As neuroscientist Eric Kandel wrote, "Art enriches our lives by exposing us to ideas, feelings, and situations that we might never have experienced, or even want to experience. … [It] gives us a chance to explore and try out in our imagination a variety of different experiences and emotions." [10]

I would reason that architecture's role is the same.

Identity, Place Attachment, and Sense of Place

Although a sense of community doesn't necessarily imply a particular place or location, place attachment, health and well-being, and sense of place are all firmly tied to space and the environment. Usually intertwined, a sense of community and place attachment both have a positive impact on one's health and quality of life. According to American writer and architecture critic Sarah Williams Goldhagen, place attachment represents "the affective bonds we develop with the places and spaces of our worlds. It constitutes an elemental need, analogous to an animal laying claim to a given territory. The density of our contact with a place and the intensity of emotions we associate with it determine the quality of our attachment."[11] Goldhagen believes that home is the most important constructed place of all when it comes to place attachment. The concept of home is, however, flexible and can refer to a room, a building, a street, a neighborhood, a city, or a country.

How can the built environment help us situate ourselves in place? Three main factors guide our decisions about how we engage with places other than our own homes: (1) how the design of a place facilitates human activities and the correspondence among those activities; (2) the patterned arrangement of objects in spaces; and (3) the association the place's form elicits. These factors create multimodal and multisensorial experiences.

In environmental psychology, place attachment relates to phenomenology (the study of structures of consciousness as experienced from the first-person point of view) and topophilia (the love of place). Place attachment can be extremely varied in scale, from a particular tree to an entire country, and it can include places where a person lives or visits regularly, or places they have never visited but which represent for them an idea or a place that has been lost.

Spice Bazaar, Istanbul.
Photograph by Miomir Magdevski.

07

The Qualities of Enriched Environments

The qualities of enriched environments are not prescriptive devices used to achieve exact or identical outcomes in every situation. They are more like spices we add to a meal. These spices have specific and distinct qualities and characteristics that are generally universal, but people employ them differently according to learned and remembered psychological and physiological experiences and cultural norms. The qualities of enriched environments are generosity; variety and vitality; authenticity; hope; nature; and silence, stillness, solidity, and intimacy.

7

The four seasons succinctly capture the changing mood and atmosphere of our natural environments.

The qualities of enriched environments are non-Cartesian, innate, and distinctive. They create an architectural aura of place – *Stimmung* – activated by the cycle of action-perception-learning-memory-emotion-mood[1] and offer two types of attributes: those associated with the emotional realm, and those related to the physical space. In addition to the functional purposes of a space, they define a set of feelings that the architecture can convey. As Sarah Robinson observes, "How you are has very much to do with where you are."[2]

These qualities of enriched environments function both independently and together to create, propagate, and amplify multimodal, multisensorial experiences that create a sense of place. In much beloved places, a constellation of qualities works together; this combination of qualities, rather than just one, causes the psychological and physiological effects we experience – qualities in our environment that help us to be more aware of the rapture of being alive.

Objective and Subjective Interpretations
In 1878, Irish novelist Margaret Wolfe Hungerford famously wrote, "Beauty is in the eye of the beholder." In other words, what one person finds beautiful, another may find repugnant. We also know that emotions as communicated by facial expressions, from misery to joy, are not universal but based on culture, context, and experience. How does this relate to how we interpret the atmosphere of our environments? Are there common characteristics, like our emotional responses to person-to-person relationships, in the person-to-place relationships we form?

Mood in architecture refers to the atmosphere of place that is communicated when we walk through the front door. Does it welcome us or encourage us to move along quickly? Many believe that a place communicates the same meaning – more or less – to everyone who enters as a result of its massing, detail, and unique sound and quality of light. But the truth is that each of us brings our own objective and subjective interpretations to our understanding and interpretation of our surroundings based on cultural and social experiences (learned) and past experiences (remembered).

Qualities and Characteristics of Spices
The qualities of enriched environments are not like prescription drugs that achieve specific health outcomes. They are more like spices, which have distinct qualities and characteristics that are generally universal, but that each person responds to differently based on learned and remembered experiences. For example, in Northern and Western cultures, cinnamon is often associated with winter – think of mulled wines or a roast duck. In Indian culture, it is more likely to be associated with a chicken biryani. In both instances, cinnamon's lightly sweet, warm, woody flavor is present, but a range of other factors tune the overall atmosphere or mood.

A joint study by researchers from the Karolinska Institute in Sweden and the University of Oxford found that while culture and learned or personal preferences play a role in our perception of odors, people share odor preferences regardless of cultural background. The structure of the odor molecule determines whether we consider a smell pleasant or not, though there are variations for personal preference. The study engaged 235 individuals from nine diverse, non-Western cultures, from remote hunter-gatherers to city dwellers, to rank ten odorants from least to most pleasant. Across the board, participants considered vanilla the most pleasant and sweaty feet the least pleasant.[3] While we use the expression "vanilla" to mean basic or even boring, in our perception the spice is anything but, and is universally associated with creaminess, warmth, caring, and sweetness, with exotic undertones – which might explain why it is so popular as an ice-cream flavor.

Distinctive Characteristics and Individual Interpretations
The qualities of enriched environments are similar to scents. They have distinctive characteristics, and our psychological and physiological interpretations and responses to them vary according to who we are and the surrounding context, but broadly speaking, we experience them in a similar way, regardless of our cultural backgrounds.

Let us now examine the qualities of enriched environments: generosity; variety and vitality; authenticity; hope; nature; and silence, stillness, solidity, and intimacy.

Generosity

The notion of generosity in architecture has emerged in various ways and for various purposes. The term is generally perceived to be employed synonymously with abundance, taking on a positive sense in its connotation of something initially unrequested being voluntarily added to a built project – a gift offered beyond the requirements.

Think of buildings that offer the user something more than what the spatial program dictated that makes them more than simply transactional. This may be anything from the cognitive legibility of a door handle that fits your hand and the affordances it offers, to a gathering space positioned between buildings that offers a sunny place to sit on a spring morning or shade on a hot summer afternoon.

As the 2022 book *Generosity and Architecture* notes, "the makers of vernacular architectures worldwide build from limited means, even from poverty, yet rarely are their environments merely utilitarian; instead, they are rich in symbolic content and spatial invention, and often exuberant."[4]

As such, generosity in architecture is not simply about giving more, in the sense of that which is unnecessary or superfluous. Often it means the opposite – doing more with less. It can be on a large scale or through small gestures and details.

There is generosity in the architect who imagines more from the program they were given than the client originally intended. Indeed, an imaginative design response can change the understanding of how we think of economizing in our built environments. Anne Lacaton, one of the two Pritzker Prize–winning founders of the French firm Lacaton & Vassal, describes how "economising doesn't mean reducing, but rather doing more with the same amount of money."[5]

We respond positively to surroundings that give us more than they are asked to, that communicate a higher purpose, and that are aspirational and suggest something bigger. The feeling of being part of something larger than ourselves increases our sense of connection, empathy, comfort, and hope and enhances our well-being. Design that embodies generosity exhibits responsibility and is durable beyond any basic requirements for sustainability. It positively affects inhabitants and makes lasting contributions to our health by becoming part of our conscious and subconscious experience as we interact with it.

Juhani Pallasmaa and Matteo Zambelli define generosity in architecture as the idea that the architect, through design, provides their view of the world and life. The person using the building experiences the architect's generosity, which transcends the "naïve realist view of architecture as a professional craft that serves only practical and economic purposes by means of building technology."[6] In Pallasmaa and Zambelli's words, "an 'architectural courtesy' refers to the way a sensuous building offers gentle and subconscious gestures and pleasures to the occupant."[7]

Similarly, French architect and critic Francis Rambert advances the idea of architecture that is "generous versus generic" and that gives "cultural, contextual, spatial, and habitable more" to a city and its citizens. He believes generosity also relates to how architecture allows a space to change, adapt, evolve, and be appropriated to suit those who use it, thus making it their own.[8] This echoes English architect Cedric Price's concept of an "architecture of enabling," represented by his conceptual Fun Palace project, whose notions of flexibility influenced Renzo Piano and Richard Rogers's Pompidou Centre in Paris.

Citing Pallasmaa and Zambelli again, generous architecture "offers an open field of possibilities, and it stimulates and emancipates perceptions, associations, feelings, and thoughts. A meaningful building does not argue or propose anything; it inspires us to see, sense, and think ourselves. A great architectural work sharpens our senses, opens our perceptions and makes us receptive to the realities of the world. The reality of the work also inspires us to dream … but it does not indoctrinate or blind us."[9]

Thus, generosity in architecture offers three potential schemas for its occupants. The first is how a building evokes an emotional response – sometimes thought of as the qualitative aspects of our engagement – due to its spatial characteristics that may communicate kindness, selflessness, and ultimately trust. The second is how programmatic elements can be added, or more done with less. This is often thought of as the quantitative aspects, like a gift that transcends the transactional requirements to accommodate a building's spatial needs. The third schema goes beyond the design of a building to the design of a co-creative process that generates the conditions in which many voices can find a home. We will develop this idea further in chapter 10 through our exploration of a saluto-systemic approach to city making.

Venice Archipelago Project, Farrow Partners.

Variety and Vitality

Spaces with variety and vitality offer a range of experiences and a sense of discovery. They stimulate positive emotions and subconscious bodily feelings of seeking, curiosity, a sense of freshness, and energy that moves us into action through both motor and metaphoric affordances.

Many buildings are directional, with linear wayfinding that offers limited choice for where to go. Other buildings encourage people to stroll, wander, and discover instead of simply getting from point A to point B. One could even say these buildings seduce users with a variety and vitality of multidimensional and multisensorial experiences, even as they create a sense of coherence.

American architect Steve Mouzon observes how variety within limits makes for great places:

> The most-loved places are comprised of buildings with an endless variety of details within a limited range of architecture, giving distinct and recognizable character. … People judge the vitality of a place by the amount of variety. Create everything out of five standard models, and it will appear dead. Allow things to vary slightly from one building to the next, and the place starts to live. So the narrow range is necessary to define the character of a place, while the wide variety is necessary to make it live. Combine both, and you have a chance of creating what Christopher Alexander calls "the quality without a name." Or put another way, a narrow range without great variety creates mechanical objects; great variety without a narrow range creates disconnected randomness. Combine the two, and you have a chance of creating a living thing.[10]

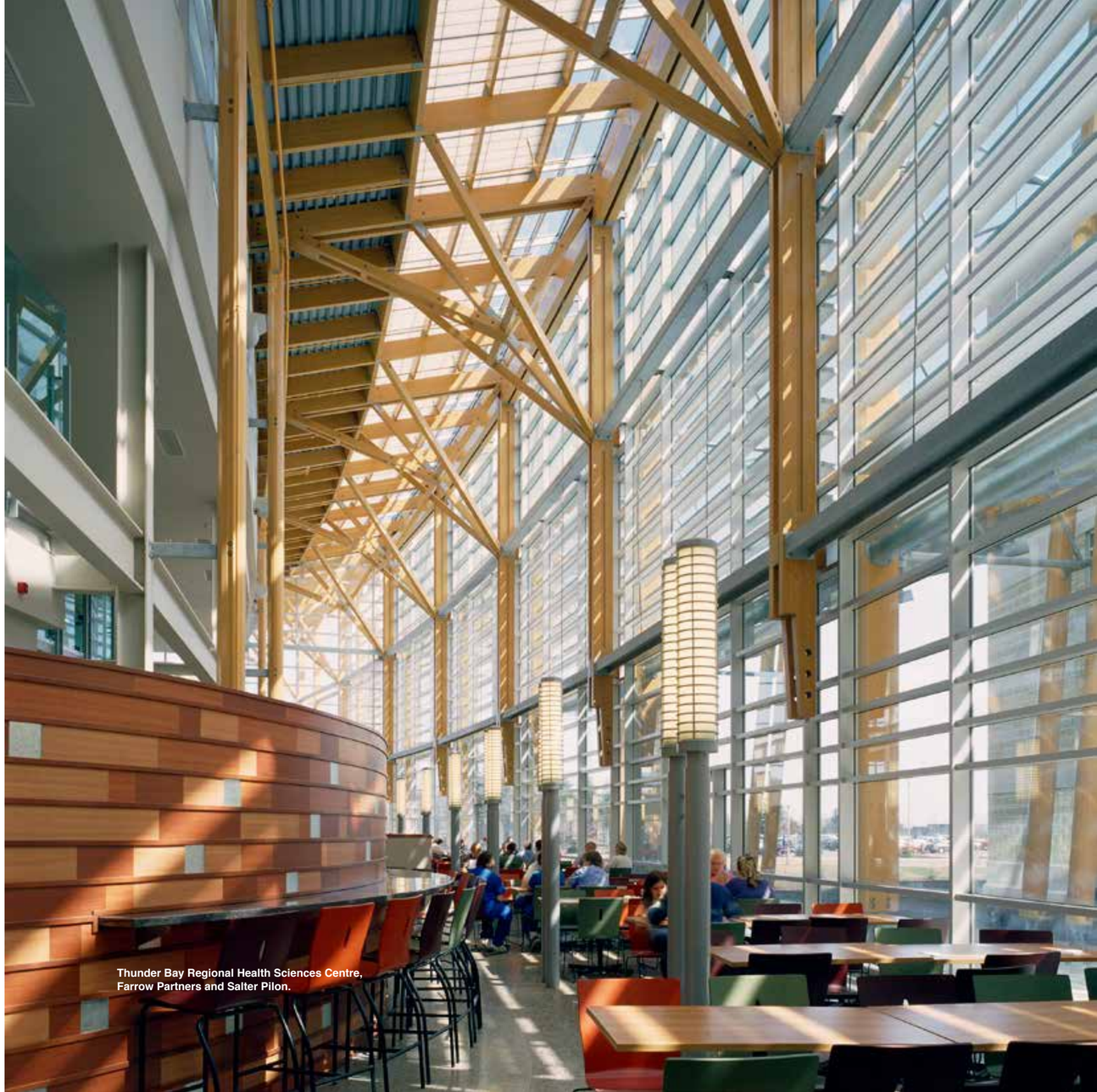
Tokyo, for example, hasn't developed in the image of what we might view as a typical, orderly, Western city with a rational street grid and associated architectural styles. Instead, it consists of meandering streets and loosely connected neighborhoods based on topography and waves of bottom-up rebuilding after numerous human-made and natural disasters.

Teeming *yokocho* alleyways and varied facades are not a symbol of a disregard for the public realm but result from building by-laws addressing each site individually. This is a different approach from attempting to make every building contextual – that is, blending it in with the others around it – which is often the norm in Western urban design circles.

In *Tokyo: A Spatial Anthropology*, Japanese architectural historian Jinnai Hidenobu describes the rhythms, variety, and vitality of the city that result in "no clear logical system in Edo [former name of Tokyo] that would bring a variety of elements together into a single whole as in a European city." Rather, "like a mosaic or a kaleidoscope," the metropolis "sparkled with myriad different images created by the particularity of individual locales, their terrain and their histories."[11]

Spanish architect Jorge Almazán further develops this idea in *Emergent Tokyo* when he describes how the city has "emerged" organically instead of having had a pattern imposed on it by authorities. The resultant vitality and richness of the city texture is a consequence of property owners and architects responding to their changing surroundings, much as a flock of birds naturally finds its shape, which is why Tokyo feels idiosyncratic, human, familiar, and fresh.[12]

Variety and vitality are also good for the brain. Recent neuroimaging research has revealed that people who spend time exploring and discovering new neighborhoods experience persistent positive emotions that last beyond the initial experience. Wandering stimulates both the hippocampus and the ventral striatum regions of the brain, the places associated with memory, learning, decision-making, and reward processing. As we will see in later chapters, places without characteristics such as variety and vitality, known as impoverished spaces, lack appropriate sensory stimulation, intensify brain atrophy, and slow down the recovery process of brain lesions in stroke victims. They are the equivalent to fast food, which is transactional, leaving you feeling hungry. Simply put, wandering in areas that have qualities of variety and vitality makes us happier and more mentally resilient.[13]



Thunder Bay Regional Health Sciences Centre, Farrow Partners and Salter Pilon.

Authenticity

Authentic environments exude a sense of reality and rootedness – we feel that time has passed there. The moment we first enter a building, room, or area of a city, we consciously and subconsciously experience its atmosphere and mood, just as when we meet someone new and intuit immediately whether they are genuine or fake.

American cognitive scientist Scott Barry Kaufman's comments on healthy human authenticity in a 2019 *Scientific American* article also ring true for our built environments: "The science of authenticity does show that feeling in touch with your real self (even if there doesn't actually exist such a thing) is a strong predictor of many indicators of well-being. … Healthy authenticity … involves accepting and taking responsibility for your whole self as a route to personal growth and meaningful relationships."[14]

"Authenticity is subtle and nuanced," observes British architect Adam Robarts in his book, *Nineteen*, about the lessons he learned from his son who died of cancer. "I see a young man who is comfortable in his own skin and beyond that, in his being. A word that comes to mind is natural, rather than forced or artificially compliant … genuine, usually understated rather than dramatized for effect."[15] Robarts's son makes such a deep impression on him not because of a dramatic effect but because of the simple power of his authenticity.

Authentic people don't pretend to be someone else. Like authentic buildings, they are legible and transparent. In architecture, these qualities refer to an ability to see how each component's manufacturing and construction reflect its time and age. Architectural historian Colin Rowe and architectural theorist Robert Slutzky differentiate between literal and phenomenal transparency in architecture. *Literal transparency* is when light passes through glass, a void, or an opening to reveal what is within and allows us to see what is before us. *Phenomenal transparency* is when a building reveals the layering and organization of its components, revealing its materiality and texture through light and shadow. It is a transparency of interpretation and legibility – an openness to the building's construction, materiality, systems, and purpose.[16]

Buildings communicate their authenticity through our senses – in the way our feet touch the floor or sounds carry off the walls. We often describe environments as warm or cold, depending on the materials used. Some surfaces physically absorb heat from the environment or from our hands when we touch them. Think of the differences between how wood and stone make you feel as opposed to glass and steel.

Shapes, forms, and symbols can communicate a reality and rootedness – or the opposite. A 2013 University of Toronto study into how fast food can reduce happiness found that symbols of "impatience culture" – such as standardized Styrofoam containers stamped with a fast-food logo – undermine our ability to experience happiness and positive emotional responses when exposed to pleasurable events. This happens through a psychological effect called *priming*, wherein our subconscious is influenced by exposure to visual and other sensory clues. For example, the study's participants were all shown images of scenic natural beauty. Half of the participants were also shown images of fast food from McDonald's. When asked to rate their happiness afterwards, the group that also saw the McDonald's symbols rated their happiness lower than those who didn't. Their results indicate that we think and react differently based on the authenticity or shallowness of our surroundings.[17]

Sechelt Hospital,
Farrow Partners and Perkins and Will.

Hope

Areas with hope radiate youthfulness, abundance, and life. They often project a sense of weightlessness, light, lightness, and flight that defies gravity and encourages an upward gaze.

Places that shape our embodied cognition invigorate us and make us feel more alive. They expand our horizons and allow us to contemplate new possibilities. Places with hope express purpose, promote well-being, and celebrate life. By being inclusive, they enhance our self-belief and our ability to create social change regardless of where we come from, our abilities, or our beliefs.

"Hope is not the same as optimism or wishful thinking," explains Israeli radiation oncologist Dr. Ben Corn. Rather, it is a perception of what is possible. "Hope is a very active concept, and nobody needs it more than the cancer patient and the people surrounding that patient," says Corn, who is systematically advancing the concept of hopefulness in clinical practice.[18] Corn's work builds on psychologist Charles Snyder's model for hope, known as hope theory, which is oriented around setting goals that are plausible and meaningful with far-reaching applications.

British anthropologist Tim Ingold reinforces Corn's observations: "With plans and predictions we can be optimistic that their realization is just around the corner. There is light at the end of the tunnel. But hope and optimism are not the same. The difference is that optimism anticipates final outcomes; hope does not. The verb 'to hope' is not transitive [that is, a verb that uses a direct object] – like 'to make' or 'to build' – but intransitive, like to 'to grow' and indeed 'to live.' It denotes a process that does not begin here and end there but carries on through."[19]

In his book, *Disturbing Peace*, former dissident and president of the Czech Republic Václav Havel writes, "Hope is not the same thing as optimism. It is not the conviction that something will turn out well, but the certainty that something makes sense, regardless of how it turns out … that gives us the strength to live and continuously to try new things, even in conditions that seem as hopeless as ours do, here and now."[20]

A central responsibility of architecture, beyond functional requirements, is to capture and express our aims, aspirations, attitudes, thoughts, and hopes – to offer up and facilitate a better world in the sphere of the real and the tangible. Architecture of hope offers not an end but a measurable way forward based on qualities of comprehensibility, manageability, and meaningfulness. As we have seen in Antonovsky's concept of meaningfulness as framed by salutogenesis, hope refers to "the extent to which one feels that life makes sense emotionally, that at least some of the problems and demands posed by living are worth investing energy in, are worthy of commitment and engagement, are challenges that are 'welcome' rather than burdens that one would much rather do without" – that there is a high probability that things will work out as well as can reasonably be expected.[21]

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

Nature

Human perception is, and always has been, deeply influenced by nature and its cycles. The idea of paradise has deep roots in the ancient myths and traditions of many cultures as a symbol of fertility, abundance, harmony, spirituality, and an idealized representation of the world and our place in it. Equally, the changing seasons are a universal symbol of perpetual motion, transition, and a metaphor for life's journey. The term *biophilia* was first used by German psychologist and philosopher Erich Fromm to describe an innate attraction to the natural world. American biologist and Pulitzer Prize-winning author Edward O. Wilson further developed Fromm's hypothesis in his 1984 book *Biophilia*, wherein he defines it as "the innate tendency to focus on life and life-like processes," or the subconscious human urge to seek connection with nature and other forms of life.[22]

Biophilia is becoming an overused, generalized term, but we must ensure that the concept continues to refer to the specific positive, emotional affiliations that certain conditions of the natural environment offer, such as the openness of savannahs, compared to the negative or "biophobic" conditions that, as Roger Ulrich observes, many fear, such as dark, wild forests and the dangerous animals, spiders, and snakes within.[23]

The connection between certain forms of nature and human well-being has been well studied. We are hardwired to perceive nature's fractal patterns, from the form of a tree's trunk and branches to the fine veining of its leaves. Some fractals repeat regularly, while others have patterns that are more chaotic. Certain ranges of fractal dimension, or density, are more pleasing to our eyes. Our pupils naturally employ fractal search patterns, first scanning larger elements, such as tree trunks or cloud patterns, and then shifting to finer elements, such as the shape of branches and the curves of clouds. Similarly, the rhythm, pattern, shape, light, and shadow of a building's form can reflect a midrange dimensional complexity that creates a "visual sweet spot" we resonate with emotionally, as Professor Richard Taylor is exploring in his ongoing research at the University of Oregon.

Beyond the visual, there has been only limited research into the wider, multisensory impact of nature on the mind in the field of cognitive neuroscience. But in this research, nonvisual passageways for natural experiences have been found to enhance well-being, including touching natural textures, breathing nature's varied scents, and listening to its sounds.

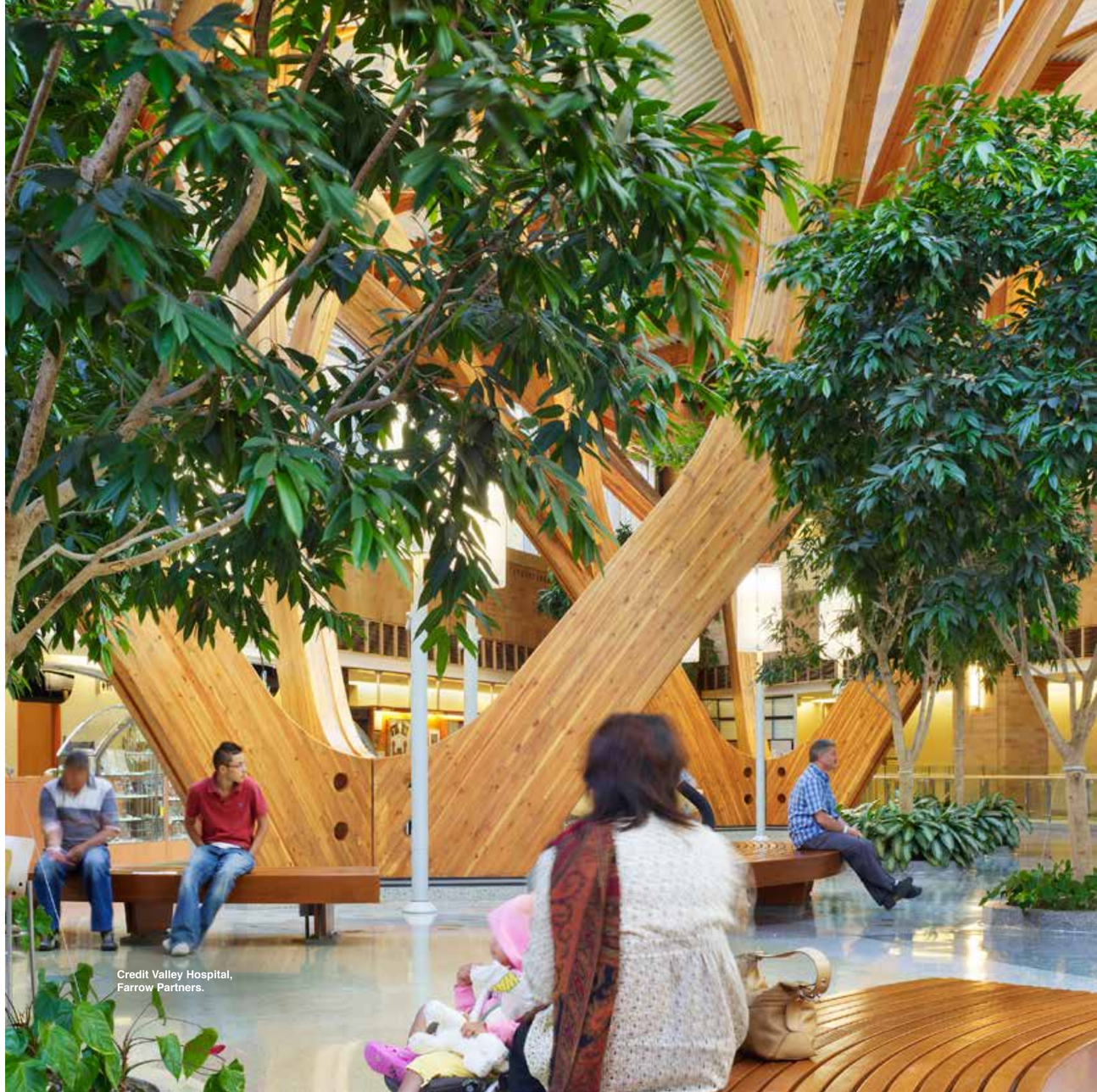
In one interesting study, researchers at the Brighton and Sussex Medical School in England explored the restorative effects of the sounds of nature on both mind and body health. They found that nature-based sounds altered the default mode network in participants' brains, which is located in an area of the cortex tasked with activating relaxation, thereby lessening ingrained "fight or flight" predispositions and enhancing well-being.[24]

Used as design elements, sensory strategies can increase the restorative role that place plays in helping us cope with stress and mental fatigue as well as enhance health and well-being. For example, the use of natural and local materials creates connections to land and place with their many layers of history and cultural identity. Some people believe that places that provide protection, refuge, and a view of the horizon offer a primal sense of comfort that can be traced back to our early hunter-gatherer societies. Natural shapes, such as curves, often convey feelings of ease and friendliness, while sharp angles can convey tension and hostility.[25]

Related to biophilia is the newer concept of *hortophilia*, coined by British neurologist Oliver Sacks. Based on the Latin word *hortus*, meaning garden, Sachs defines it as our deeply ingrained "desire to interact with, manage and tend nature."[26] Hortophilia adds a phenomenological and kinetic animation to our engagement with nature. The power of nature to improve our health is more than spiritual and emotional; it also involves physiological and psychological-neurological responses.

American author Parker J. Palmer has captured nature's constant state of transition in his booklet, "Seasons: A Center for Renewal," in which he describes life's "eternal cycle of seasons."[27] Interestingly, he doesn't journey through the seasons in a typical calendar sense by starting with spring, but begins with autumn, the season associated with a riot of color and the abundance of harvest. He then shifts to a more melancholy tone and "a sense of impending loss that is only heightened by the beauty all around," as he describes the colder and shorter days of late autumn, when plants and trees shed their leaves, and we smell the scent of winter in the air. Palmer writes about the paradox of autumn – even as death is coming, the conditions for spring's rebirth are being prepared through the spreading of seeds that will bring new life: "on the surface it seemed that life was lessening, but silently and lavishly the seeds of new life were always being sown."[28]

When we shape our buildings to intentionally capture and help make us aware of the changing atmospheric conditions within a day or from season to season, it helps us make sense of our beginnings and our human existence.



Credit Valley Hospital, Farrow Partners.

Silence, Stillness, Solidity and Intimacy

Rapid, vigorous, deafening, attention-grabbing, entertaining, and psychologically all-consuming. With the shock, speed, spectacle, and constant bombardment of culture expressed through social media, a lot of architecture is now designed to be an eye-catching novelty that competes for our attention. This is an era of architecture for Instagram and TikTok. Indeed, the sound of silence can be frightening when we are no longer accustomed to hearing our own breathing and heartbeat. Some people need silence and stillness to recharge, while others view it as an extreme punishment. It sometimes seems we have forgotten the pleasure of silence.

Silence isn't just the absence of sound and clatter but a condition that stimulates our recollection and awakens our sensory awareness to the world around us – not a void, but a resplendent fullness of perceptual existence. For example, walking the narrow streets of Venice, Italy, with its absence of traffic noise, we become acutely aware of the sounds of footsteps, people's voices, rhythmic water, and daily life. This allows us to consciously absorb our surroundings and turn inwards toward contemplation, either calming or insightful, which is transformative and empowering.[29]

This is an unplugged architecture that allows us to listen to our inner being and feel protected and safe. It is human scale, layered, with subtle compositions. It does not offer the absence of sound but of visual noise, and even in a busy world, it includes places that offer stillness. An architecture of silence, stillness, solidity, and intimacy allows us to draw delight from what often goes unnoticed and what we might otherwise consider unimportant.

Silence, stillness, and relaxation also enable the unconscious mind to be free to wander and perform its important roles in the bottom-up processing of perception and emotion. In *The Lonely City: Adventures in the Art of Being Alone*, British writer Olivia Laing explores how a range of New York City visual artists, including Edward Hopper and Andy Warhol, led emotionally solitary lives in a busy city, even when achieving fame, which helped enhance their creative output.

In his 2019 exhibition NEW CIRCADIA *(Adventures in Mental Spelunking)*, American-Canadian architect and scholar Richard Sommer posed the following question: "Have our tech-infused lives caused us to forget the benefits and pleasures of losing ourselves in states of repose and reverie? What would happen if we disconnected from standard time and external stimuli within a dream-like space specifically designed for relaxation, reflection, and repose?"[30]

An enriched environment offers a more human scale and proximity, establishing a relationship between our mind, body, and the environment. An enriched environment can reflect the range of sounds around us and transmit them back to our bodies to be perceived and heard. Think of the warm tones that vibrate and resonate off wood compared to the cooler, emptier tones that reflect off glass.

In *The World of Silence*, Swiss philosopher Max Picard describes "the place where silence is listening," which I interpret as the surroundings that communicate with us.

"When two people are conversing with one another … a third is always present: silence is listening. That is what gives breadth to a conversation: when the words are not moving merely within the narrow space occupied by the two speakers, but come from afar, *from the place where silence is listening*. That gives the words a new fullness. But not only that: the words are spoken as it were from the silence, from that third person, and the listener receives more than the speaker alone is able to give. Silence is the third speaker in such a conversation. At the end of the Platonic dialogues, it is always as though silence itself were speaking. The persons who were speaking seem to have become listeners to silence.[31]

In enriching person-to-person relationships, qualities of solidity manifest themselves in mutual trust, respect, and verbal and nonverbal signs of support, often seen as the foundations of a sturdy relationship. In the built environment, solidity is one of the three founding principles of architecture as defined by Roman architect Vitruvius, who singled out the qualities of *firmitas*, *utilitas*, *venustas*, translated from Latin as solidity, usefulness, and an embodied "desire" for beauty. In the rapid, fleeting spectacle we find in today's daily news cycles and on social media, the characteristic of solidity in architecture is an often-underrated quality in the places we live, work, learn, and heal.

Silence, stillness, solidity, and intimacy – these are the qualities that define the places where we want to enter, linger, and listen. Places that draw us in and make us feel at home and at peace. Places that we want to get to know versus those we want to pass through quickly. The tonalities of light and shadow and how light falls on a surface; the materials used and their surface depth, sheen, and reflectivity; the sound of a space and its shape and form – such qualities allow us to listen beyond our bodies and within our bodies, adding a sensation of stillness and intimacy to our experience of architecture.

Roxborough House, Farrow Partners.

Other Meaningful Emotions Within Architecture

Enriched environments have qualities that positively affect mind and body health. These qualities emerge from the theory of constructed emotion (how we shape external and internal person-to-person relationships) and from the characteristics of supportive and helpful psychotherapeutic relationships (which make one feel emotionally safe, understood, accepted, and able to activate one's own resources, leading to an experience of one's own success and competence).

We can represent meaningful person-to person-relationships in the two-dimensional circumplex model, diagrammatically representing all emotions, where valence (the range from positive to negative emotions) is shown on the horizontal axis, and arousal (the intensity of the emotions) is shown on the vertical axis. This circumplex model is relevant to us as architects because, as we have seen, how we construct person-to-person emotional relationships is similar to how we construct person-to-place relationships with our built environments.

Enriched environments have qualities that support the emotions on the right half of the circumplex model – that is, emotions associated with a sense of coherence (comprehensibility, manageability, and meaningfulness) and which promote balanced, sustainable, and health-giving life processes; spatial characteristics that enhance health and well-being.

But what about the emotions on the left side of the circumplex model, representing those on the fear-avoidance spectrum, including longing, distraction, loathing, boredom, melancholy, grief, pensiveness, rage, and annoyance? Do they have a role in the creation of architecture?

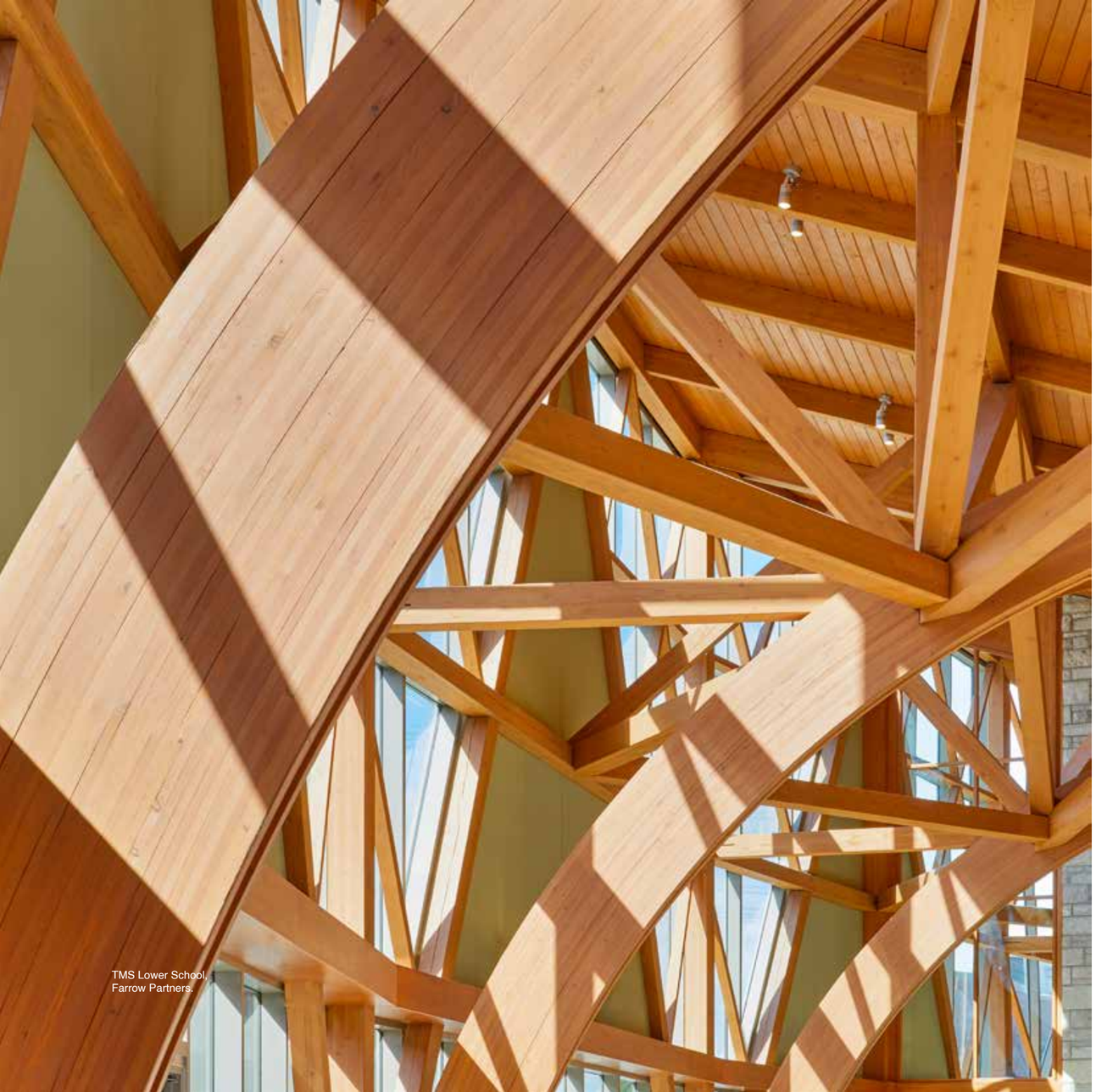
The answer to that question is layered. These emotions are indeed important factors in the spaces we create, and they play a vital role in helping us understand that we are human beings. However, architects rarely try to evoke these emotions deliberately through the qualities of their built spaces. Rather, these qualities are usually the inadvertent result of abstract concepts that either don't work in real life or that haven't been sufficiently thought through from a human-centered design perspective.

That said, in some cases, a building intentionally evokes feelings such as sadness, fear, anxiety, and self-reflection in service of a deeper understanding of the human condition, including the tragedies and horrors we experience and inflict on others. One building that does this in a very powerful way is Daniel Libeskind's Jewish Museum Berlin.

From the moment visitors enter the building through an underground tunnel, they leave the trivialities of daily life behind. The sloped, underground corridor axes, sharply angled walls, shard-like windows, and bare concrete spaces (often without heating, air conditioning, or normal lighting) communicate a profound feel of insecurity and disorientation. The Holocaust Tower – a void 79 feet (29 meters) high, its only light emanating from a sliver of a window near the top – is deeply unsettling. As the heavy metal door clangs shut behind you, you feel the physical emptiness that resulted from the expulsion, destruction, and annihilation of Jewish life by the Nazis. This is further heightened as visitors walk across Israeli artist Menashe Kadishman's art installation *Shalekhet (Fallen Leaves)*. It consists of more than 10,000 faces with open mouths cut from round, heavy iron plates scattered across the floor that clang and bang as one walks across the uneven surface they create. Loss becomes palpable as visitors experience Kadishman's installation and Libeskind's architecture.

The design of the Jewish Museum Berlin is intended to convey unfathomable evil to visitors and does so exceptionally well. But if a similar architectural vocabulary were applied to other building types – housing, offices, or shopping centers – the unsettling effect on visitors would not just be undesirable and without purpose but disastrous. When we make design choices, we must be clear about their desired purpose, not as a prescriptive act but with the understanding that we interpret each building we encounter through what we have already learned and experienced. The past is the lens or filter through which we experience our built environments.

Israeli artist Menashe Kadishman's art installation Shalekhet (Fallen Leaves) in the Jewish Museum Berlin consists of more than 10,000 faces cut from heavy iron plates scattered across the floor that clang and bang as visitors walk across the uneven surface. Photograph by Terry Michele Fuller.



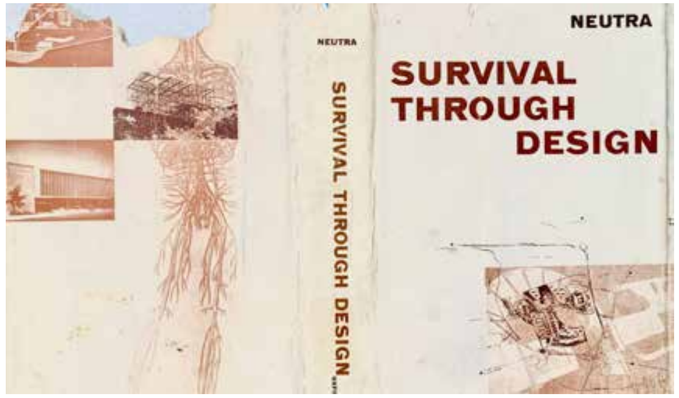
TMS Lower School,
Farrow Partners.

08

The Theory of Positive Ambiguity: Interweaving the Qualities of Enriched Environments

We are taught in school not to be ambiguous. Statements should be clear, and solutions definitive. Most of the time, clarity and certainty help human beings survive. But in our surroundings, whether in buildings we find enchanting, paintings we find mesmerizing, or music that transports us, a degree of positive ambiguity creates pleasure in the mind.

3



Richard Neutra's Survival through Design (1954).

Positive ambiguity: Rubin's vase.

The human brain uses up to 500 calories a day. That is up to 20 percent of the body's expenditures and more energy than any other organ. In a five-year-old child, the brain can use more than 60 percent of the body's energy – a tremendous amount when we consider that the brain is one of seventy-eight different organs and only the third largest after the skin and the liver. Because of this, the mind has been designed to be as efficient as possible. As we have seen, it uses its senses to make predictions as quickly as possible based on information inputs and past learnings and experiences. Straight lines, such as the horizon or a linear corridor, are easier for us to understand than irregular lines, as are basic geometric forms, such as squares, circles, triangles, or similar forms common in nature.

In *Survival through Design*, Austrian-American architect Richard Neutra writes,

> In our everyday life we are assailed continuously by a chaotic complexity of forms, shades, colors, smells, noises. But a differentiating, abstracting, and then synthesizing process takes place, until the chaos around us is somehow articulated into more or less distinct objects and organized entities. This mastication of an outer world in individual bites, followed by a suffusing of all particles into a digestible world picture, is a device not unlike chewing, salivation, and digestion for the assimilation of physical food. Our mind seems bent on processing the amorphous intake of the senses by means of a specific secretion of its own – namely, order.[1]

Recognizable shapes, geometries, and symmetries are intrinsic to how we perceive, categorize, order, and make predictions about the world around us. Neutra continues: "Plato ascribes a solemn mystical significance to abstract ideas, to simple numerical relations and geometrical patterns. Mental economy evidently favors what can be easily conceived, visualized, memorized, and communicated. Thus, a square, a circle, or an equilateral triangle is more readily defined, envisioned, and recalled than a figure of irregular shape and anomalous proportions."[2]

Our minds enjoy patterns, but they also specifically enjoy breaches in patterns. Neutra explains: "Occasionally … positive value is ascribed also to elements that supply a titillating taste of contrast to a prevailing regularity. Certain deviations from common proportion or rhythm do just that. A bit of syncopation, a slightly startling dissonance can enliven a conventional musical score. Irregularity is a spice in the Platonic dish."[3]

As an example, Neutra describes a creek flowing and gurgling through a rocky canyon, creating a complex natural symphony in which one "perceives no rhythmic laws or differentiated notes, but merely sound agreeably diffused."[4] The same occurs when light dances through trees, or a cool breeze ebbs and flows with no discernible pattern, yet we feel a sense of peace.

Natural fractal patterns: Franklin Park photographed by Geoffrey James.

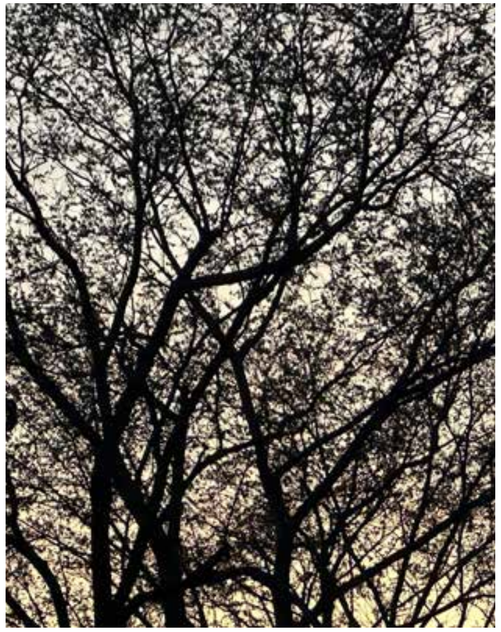
Positive Ambiguity
Positive ambiguity allows each person to contribute consciously and unconsciously to the physical constructs of place. This type of response to place is a kind of empathy, where the viewer temporarily steps back from the complexities of daily life and is absorbed in the spatial experience that envelops them.[5] Alvar Aalto describes the experience as "a simultaneous solution of opposites," a positive tension of seemingly incompatible components that transforms into a meaningful simulation within the viewer's mind during an encounter with a space.[6]

Allowing Different Interpretations
Because positive ambiguity allows for different interpretations, it stimulates, challenges decision-making, and can result in feelings of enlightenment and awe. What is in front of us doesn't change, but our interpretation of the sensory information does. Often situations that create the most wonder are ones in which two interpretations can occur simultaneously. An example of this is Rubin's vase (also sometimes known as the figure-ground vase), an image developed in the early twentieth century by Danish psychologist Edgar Rubin. The image shows both a gray vase on a white background and the white silhouettes of two identical faces looking at each other across a gray space. As one looks at it, the mind sees both images at the same time and works constantly to understand how they can be so different and yet the same.

Fractal Patterns
In 1975, mathematician Benoit Mandelbrot articulated the concept of fractals and established the mathematical laws that apply to them. Fractals are infinitely complex patterns that are self-similar across different scales and are often associated with nature, such as fern leaves or tree branches. As we have already noted, a midrange in the density and complexity of fractal patterns – not so complex as to be confusing and not so simple as to become boring – is the most appealing to the human eye and mind.

Professor Richard Taylor, head of physics at the University of Oregon, was curious about why so many people are drawn to American abstract expressionist artist Jackson Pollock's drip paintings and speculated that their midrange fractal complexity might be the answer. So Taylor performed a series of experiments to measure people's physiological response to images of nature and Pollock's paintings. The results, which he and colleagues published in the journal *Nature* in 1999, showed that the fractal dimension complexity of photographs of forests and Pollock's paintings were identical.

Midrange fractal complexity: Jackson Pollock at work.



Tree canopy midrange fractal complexity in early spring.

Effectively, Pollock distilled the patterns of nature and reproduced them in his paintings in a highly systematic process he perfected over the years.[7] This is why, when we look at his paintings, it results in stress-reduction triggered through a physiological resonance that happens when the fractal structure of the eye aligns with the fractal image we absorb visually. Our mind responds the same way to a Jackson Pollock painting as to the canopy of a forest in early spring which is about to burst into leaves.

The rhythmic, swirling drips of Pollock's paintings also provoke powerful and pleasant bodily metaphoric affordances within our minds, just as Michelangelo's unfinished sculptures of slaves, which we discussed in chapter 4, offer metaphoric affordances where we perceive the artist's bodily action of the hammer and chisel pounding on the stone as we see the slaves twist in the appearance of trying to free themselves from the marble. Additionally, when we look at a drip painting by Pollock or an image of a forest, it creates an experience of positive ambiguity. Our minds enjoy comparing and contrasting the patterns in which rhythm, pattern, and shape, as well as other sensory conditions, such as light, shadow, scent, sound, and touch, combine and recombine. The experience of positive ambiguity is like being in a mental gymnasium that exercises our minds, exploring and understanding what is around us and why and how it is composed, an experience we find emotionally mesmerizing.

"Forest Room" dining hall at the TMS Upper School, Farrow Partners.

The Doctrine of Flux and the Unity of Opposites

The concept of positive ambiguity has its roots in the Doctrine of Flux and the Unity of Opposites, developed by ancient Greek philosopher Heraclitus of Ephesus (c. 535–475 BCE). The Doctrine posits that everything is in flux and that opposites are identical and inseparable from each other, so everything both is and is not at the same time. This is why although we value stability and certainty and usually view change with apprehension, we also find comfort in things that are in a state of constant change and transformation. The clearest illustration of this is found in the cycles of nature and life. Heraclitus gives the example of a river, in which the water flowing through it is always different, yet the river remains the same, creating a unity of opposites. It is this ambiguity that we find pleasurable and desirable.

Art and, by extension, architecture have a similar effect on us. Eric Kandel elaborates: "Paintings engage us, in part, by creating ambiguity. As a result, a work of art will evoke different responses from different viewers, or even from the same viewer at different times. Indeed, the perceptual reconstruction of a work of art by two different viewers may be as distinct as the same landscape painted by two different artists. Our relationship with a painting involves a continuous, unconscious adjustment of our feelings as our eye movements scan the work for suggestions on how to proceed and for confirmation or disconfirmation of our response."[8]

Kandel believes that the ability to handle ambiguity requires a sophisticated understanding of nuance of which only the human brain is capable.[9] According to him, creativity depends on the ability to construct metaphors, reinterpret data, resolve contradictions, eliminate arbitrariness, break free from unwarranted assumptions, and form novel connections.[10] Often, this process requires silence, stillness, and relaxation so that the mind can be free to wander and the unconsciousness let loose to perform its important role in the bottom-up processing of perception and emotion.

Gestalt Theory

Gestalt theory, which comes from the German word for shape, form, or figure, teaches that the whole is greater than its individual parts in how we perceive an object, place, person, or thing. Each part influences the reading or perception of each other part, thereby creating the larger meaning. What the viewer brings to the interpretation due to memory and past experiences also plays a critical role. The perception, comparison, and contrasting of individual parts can create positive ambiguity by accentuating personal experiences and memories through external sensory stimuli to create enhanced, positive, emotional engagement. An example of this is how a

Positive ambiguity and different interpretations: Thunder Bay Regional Health Sciences Centre, Farrow Partners and Sandy Pilon.

symphony's full meaning and experience is only possible through the sum of its individual notes.

We often associate perception with vision, but the other sensory, sensual, and haptic perceptual faculties are just as important. As Juhani Pallasmaa writes, the sense of sight "separates us from the world whereas the other senses unite us with it."[11] Sometimes our sense of smell, sound, or touch are even more powerful than sight, as they can trigger memories that flood back in vivid detail. Our mind interprets external information and stimuli through a lens of memory and experience to construct a present reality. Sometimes, however, it is difficult to distinguish between reality and illusion, since they are both similarly constructed by our minds and fused with little distinction between one another.

Focused and Peripheral Vision

When it comes to vision, there are two types: focused and peripheral. Focused vision is, for example, when we are reading the words on a page, and peripheral vision is what we see on the edges. Both perform very different tasks. Focused vision provides detailed, conscious information, while peripheral vision communicates unconscious aspects of mood and atmospheric qualities of a place. American philosopher David Michael Levin has described focused vision, or the assertoric gaze, as being narrow, dogmatic, inflexible, and unmoved, while peripheral vision, or the aletheic gaze, is linked to a pluralistic, contextual, inclusionary, and caring approach.[12] Our experience of architecture and cities is deeply shaped by unconscious peripheral vision – by the combination and relationship of all design choices and qualities rather than the detail of one element on its own – resulting in the stimmung we previously explored.

Peripheral and focused vision: Simon Hantai's Study (1969).

Positive Ambiguity and Our Other Senses

Beyond sight, positive ambiguity also creates pleasure in the mind through our other senses, including scent. In his 1992 *Details* magazine article, "Scents and Sensibility," British musician Brian Eno delineates how our sense of scent is different from that of sight. For example, we can quantify our perception of colors through properties such as brightness and saturation, chart them, and assigned them a number, as we see in paint stores and the Pantone system. Smell, however, doesn't have the same easily definable Cartesian system, so the scents we experience around us often provoke wonderful positive ambiguities. Eno explains:

> Perfumery has a lot to do with this process of courting the edges of unrecognizability, of evoking sensations that don't have names, or of mixing up sensations that don't belong together. Some materials are in themselves schizophrenic (or is it oxymoronic?) in that they have two rather contradictory natures. Methyl octane carbonate, for example, evokes the smell of violets and motorcycles; Dior's *Farenheit* uses a lot of it. Orris butter, a complex derivative of the roots of iris, is vaguely floral in small amounts but almost obscenely fleshy (like the smell beneath a breast or between buttocks) in quantity. Civet, from the anal gland of the civet cat, is intensely disagreeable as soon as it is recognizable, but amazingly sexy in subliminal doses (it features in Guerlain's *Jicky*, probably the oldest extant perfume, and one whose market has changed over the hundred years of its existence …). Courmarin, the primary ingredient in Cacharel's *Lou Lou*, has the characteristic smell of late summer, from whose flowers and grasses it is derived, but then it carries strange overtones of powder, boudoirs, bedrooms.[13]

This positive ambiguity generated by perfumes is what creates their seductive appeal and is why fragrances can instantly draw us back, often many years later, to the time when we first experienced them.

E'Terra Samara Resort,
Farrow Partners.

09

Awakening All Our Senses: Creating Enriched Environments

The conscious and unconscious effects of space on all our senses, and as a result our emotions, have the ability to strengthen our connections to the places we inhabit through the choices and tools we use to create enriched environments that support body and mind health. The word “place” implies an emotional connection with a spatial construct and suggests that the bonds we make with our buildings shape our views of self and the world around us. In this chapter, we deepen our understanding of the regions and workings of the brain and therefore explore how perception, through our senses, can be enhanced through environmental enrichment.

9

In the first chapter of this book, we began to explore the interrelationship between the places we create and how they influence the health and well-being of our minds. We also began to understand the subtleties between the science of the mind and perception (cognitive psychology) and the science of the biology of the brain (neuroscience) and how when we study perception, emotion, empathy, learning, creativity, and memory, we must also study the biological mind, since they are not separate, as previously believed, but all part of a single, complex, intertwined network.

In chapter 3, we came to further understand that while the biological organ, the brain, is housed in the skull, its perceptual system, the mind, extends to the entire body, as well as past the edges of the body's surface area. Andy Clark and David Chalmers codified this concept of the embodied mind in their influential paper, "The Extended Mind." Contrary to common belief that the mind stops at the "demarcation of the skin and the skull," they proposed that the mind extends throughout the body and beyond to the surrounding environment. Before we get into how we can enhance embodied perception through environmental enrichment, we will delve deeper into the biology of the brain as it relates to our mind through our senses.

The Regions and Workings of the Brain

The mind's perception of our surrounding environments, and architecture, is generated by one's experience of the body's interoceptive messages (such as inner bodily feelings of fatigue or hunger), the proprioceptive messages at the surface of the body, the exteroceptive messages of the surrounding environment in relationship to the body (sensing external stimuli such as light and sound), and the body's kinetic movements through space.

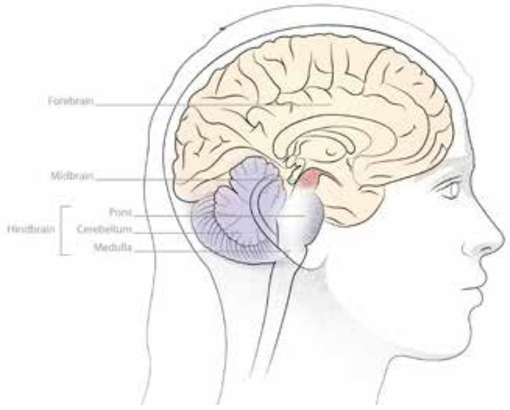


Diagram illustrating the spinal cord, hindbrain, midbrain, and forebrain.

We first experience architecture through the receptors of the synapse – that minute space between neurons where neurons connect and communicate with each other and help disseminate information across the neuronal network. Such representations of our internal and external worlds stem from our interactions with millions of sensory signals within and outside of our bodies. These data points are then communicated to the body's central nervous system, consisting of the brain and the spinal cord. Within the brain, around 86 billion neurons are connected by synapses. They are the core biological data transmission elements and are fundamental to our ability to perceive sensory signals. The central nervous system receives and filters this data, communicating to the body what is happening in one's environment and within oneself, along with how the bodily organs and muscles should respond to these external messages through action.

The spinal cord connects to the brain in a region known as the hindbrain, which includes most of the brainstem and the cerebellum and coordinates breathing, motor activity, sleep, and wakefulness. Just above the hindbrain is the midbrain, a very small area that helps us process visual and auditory signals and is tied to our how our eyes move, our attention and focus, and the perception of reward. Above and enveloping the hindbrain and the midbrain is the forebrain, which consists of the right and left cerebral hemispheres. These cerebral hemispheres are wrapped with a blanket-like covering of billions of neurons, called the cerebral cortex. When we think of what a brain looks like, with its folds, peaks, and valleys all scrunched together, we are picturing the cerebral cortex.

The forebrain's right and left cerebral hemispheres are for the most part the same. The two hemispheres are further divided into four lobes: the frontal lobe, the parietal lobe, the temporal lobe, and the occipital lobe.

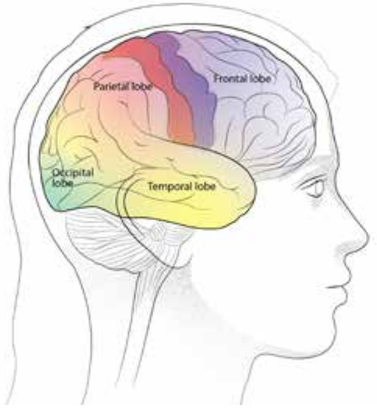


Diagram illustrating the frontal, parietal, occipital, and temporal lobes.

The frontal lobe – just behind the forehead – deals with the primary functions of organizing and planning muscles and movements, reasoning, and intensity of emotions. The parietal lobe – toward the back of the skull – is responsible for shaping one's understanding of and attention to the surrounding environment and one's body in it. This includes alerting us to and processing the sense of touch or temperature on our skin, sensory integration, and language processing. The occipital lobe – located in the back and bottom of our cerebral cortex and wrapped by the other lobes – is where we process visual signals from our eyes, while beside it, and at the bottom of the cerebral cortex, is our temporal lobe, our home for hearing, language, and reading, as well as the storage and retrieval of memory and the processing and managing of emotions.

This experience and memory of emotion in the temporal lobe results from its connection to five other areas buried within the middle bottom of the brain: the hippocampus, the amygdala (found in both the right and left sides of the brain), the striatum, the thalamus, and the hypothalamus.

The thalamus is where our sensory perceptions (excluding what we smell) enter the brain; it also has specialized areas for vision. Nearby is the basal ganglia, a group of subcortical nuclei responsible for learned cognition; motor learning and control; evaluating goals, prospects, and risks; and developing incentives and motivations. Under the structure of the thalamus, deep within the center of the brain, is the hypothalamus, which produces hormones that manage essential bodily operations, including pulse and heart rate, body temperature, appetite, and weight.

Both the forebrain's right and left cerebral hemispheres coordinate our cognition, perception, and actions, but each do so in unique ways. Our right hemisphere deals with more of what we typically deem the creative sides of things, such as language and information, while the left side focuses more on the analytical aspects of the information it receives and to which it responds.

All of these areas of the brain are designed to process and respond in a unified manner to the senses our embodied mind communicates to it. This ranges from sight, sound, touch, taste, temperature, and perceived atmospheric effects (generated from within and outside our bodies and resulting in actions), to neuronal systems based on social and cultural experiences (learned) and our own past experiences (remembered).

Sight

As previously mentioned, sight is a dominant aspect of our perception field – even more so in our current hyper-mediatized world and cultural environment – and especially so in architectural composition. In chapter 8, we reviewed how our eyes use two types of vision for spatial awareness: focused vision when we fixate on, for example, the words on a page, and peripheral vision, which is the perceptual reading of the edges. Focused vision provides detailed conscious information, while peripheral vision communicates unconscious aspects of mood and atmospheric qualities of a place.

The eye registers and communicates light waves through receptors in the retina called rods and cones. These light wave signals are converted into electrical signals that travel along the optic nerve to the occipital lobe of the brain, where they are perceived as vertical, horizontal,

or diagonal lines, and where color and intensity of light and tone are also read. Vision allows us to recognize objects, distinguishing between the familiar and the unfamiliar. It automatically directs our attention, which helps us prioritize visual information and give a sense of relevance to cognitive experiences. Vision also allows us to derive pleasure from aesthetic qualities, such as the nuance and intentionality felt when looking at patterns, gradients, and compositions.

Scent
As we evolved as a species, smell became one of our key senses, leading us to foods that were both nutritious and tasty and repelling us from things that could make us sick. The human nose can differentiate between an astonishingly wide range of odors. Once a scent meets your noise as small molecules, these molecules interact with the internal membrane of the nose cavity. Neurons and their networks then convey the molecules to the olfactory bulb, which begins to define the characteristics of the scent, which is then connected to the temporal lobe for processing.

Sometimes a scent brings back a vivid flood of memories. This is because scent is housed in the same portion of the brain that is responsible for memory and emotions. Even the subtlest scent can bring back remarkably immersive memories of the place where you first encountered it, often overlaid with the visual, sound, and atmospheric qualities of that place. Think of the scent of magnolia trees in the spring, the first cut of grass after a long winter, or burning incense in a soaring, dimly lit Gothic cathedral. Yet, unlike light or sound, architects rarely consider scent in the design process of a building.

Sound
As noted earlier, sound can be different

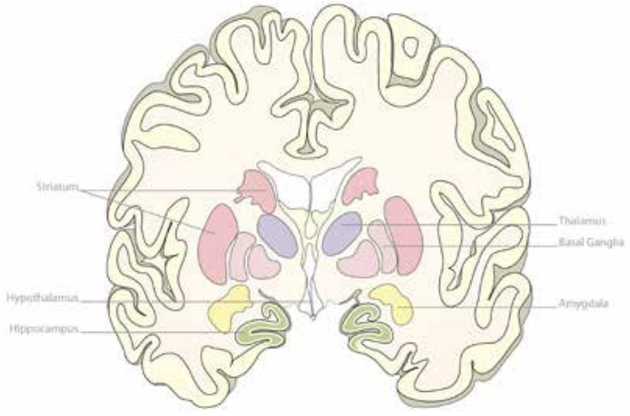
Diagram illustrating the general location of different senses and controls.

from noise, and silence and stillness don't necessarily mean the absence of sound but rather the characteristics and qualities of sound compared to noise. Our sense of sound is also spatially specific, functioning through our two-ear apparatus that captures soundwaves, vibrations, frequency, and tone as they move through the ear canal and into the cochlea, a shell-like structure that uses fluids to gather and translate the vibrations into electronic signals to our auditory cortex in the temporal lobe.

Like scent, which is also located in the area of the brain responsible for memory and perception, sound can bring back very colorful, multisensorial images in the mind's eye. We read earlier about how the mind uses neural mirroring – for example, when we see a smiling face, we instantly smile back. The tempo, frequency, and tone of sounds can have a similar effect on our bodies. Music with a tempo that aligns with a resting heart rate can relax us, while more upbeat tunes make us want to dance.

For the most part, outside of concert hall design, the intentional tuning of space for sound, beyond ensuring that it isn't raucous or echoing, is rarely a primary design consideration in creating enriched environments today.

Touch
When one's hand glides over a wood or leather surface, the material radiates a different condition and quality of warmth compared to stone, glass, or steel. Touch is such a powerful sensation that it can communicate detachment, attraction, love, metaphorical warmth or coolness, generosity, and a sense of permanence or transitoriness. It can also anticipate the type of experience a person is about to have. The touch of a baby's body to its mother's flesh is one of the



Sectional diagram illustrating the temporal lobe's connections with five area.

most fundamental actions in human life, because touch is one of the earliest formed senses in the body, and it releases powerful hormones that modulate our emotions, blood pressure, and heart rate.

Housed in the somatosensory cortex within the parietal lobe, which is also responsible for spatial perception, the sense of touch triggers vivid memories of other senses, including vision and smell. How we touch, embrace, or shake a person's hand communicates powerful messages about our relationship with that person, filtered through our broad social and cultural experiences (learned) and our own past experiences (remembered).

Similarly, the materiality of architecture is a powerful element in how we experience our built environments. As we explored in chapter 4, our haptic perception allows for metaphoric affordances to occur. We used the example of Michelangelo's unfinished sculptures of slaves, who appear to be struggling to free themselves from their individual blocks of marble. When we see the rough gouges and chips in the stone, we can imagine the artist pounding away at it with his hammer and chisel. This sense of materiality informs our relationship to space by registering how materials were formed and constructed, and it imbues cultural symbolism and meaning into the places we create.

Taste
In earlier chapters, we used the metaphor of taste and ingredients to describe characteristics of architectural space. Your taste buds can identify tens of thousands of different flavors as they touch your tongue. They translate the flavors into electronic signals that connect back to your gustatory cortex, located in the cerebral cortex. The gustatory cortex is further comprised of the anterior insula (on the insular lobe of the brain) and the frontal operculum (on the frontal lobe). This portion of the brain is tasked with managing thinking, emotions, executive judgement, memory, and bodily movements.

Taste is not something we consciously think of in architectural design, as we don't typically give buildings a good lick. Yet it is important to realize that because the sense of taste is located in the memory area of the brain, design can accentuate the perception and intensity of taste through the multimodal sensory connection between vision, scent, sound, touch, and taste.

Other Senses?
While we have considered the five commonly known senses of sight, scent, sound, touch, and taste, two lesser-known senses are also important as they relate to architecture – those of proprioception and the vestibular system. Proprioception is our sense of our body in space, while the vestibular system regulates our sense of movement and balance, both of which can change dramatically within the same space, depending on where we are within that space. Think of a two-storey courtyard surrounding a garden, lined by a colonnade. Our experience of place is very different if we are within the central garden, at its edge, or overlooking it from above. This ties back to a view of sensing architecture from a beholder-centered perspective, and to the concept of the isovist, which is the volume of space that is visible from a given point by an individual. Arguably we could expand the meaning of the isovist to engage all the senses we use to experience space from a given point.

The Ancient Brain
Some of our remembered sensory experiences of sight, sound, scent, touch, and taste relate to what is called the ancient brain, the reptilian brain, or the primal brain, which governs our

preprogrammed self-preserving actions associated with instinctive, animal-like survival. Biophilia, which is the subconscious urge humans have to seek connection with nature and other forms of life, is also a deeply remembered, primal response. This is because, over the past 7 million years, humans have spent 99.99 percent of their time evolving as a species in nature.[1]

There is a growing appreciation of the inherent need for humans to engage with natural settings in order to benefit from their healing properties. We have long undervalued our relationships with natural ecologies within the built environment. Strengthening those relationships offers us opportunities to enrich our lives.

Nature and Well-Being

A lot of today's research into the various senses that stimulate and enhance our emotional, psychological, and physiological health connects the dots between nature, natural materials and forms, health and well-being.

Spending time in nature among trees has restorative and healing qualities that people in all cultures around the world have observed for thousands of years. *Shinrin-yoku*, or "forest therapy," is the Japanese tradition of slowing down and spending time in the company of trees, bathing in forest light. Studies of the psycho-physiological benefits of forest therapy have reported lower blood pressure levels and acute and long-term reductions of negative thoughts in participants.[2]

Another notable example is the Norwegian practice of *friluftsliv*, or "open-air living," which holds that being in nature promotes physical and mental well-being by revitalizing the body and mind. If you spend time in the Nordic countries, it is common to see people taking lunchtime walks or runs in nearby parks or woods, bicycling or skiing to work, and enjoying outdoor pleasures such as hiking on the weekends. "Open-air schools" and "forest schools" are also a common phenomenon there. As well, many Indigenous communities around the world have spiritual and physical relationships with the land that are interconnected through the use of storytelling and tree-based medicines.

Wood and Human Performance

Our built environments should reflect values that support and strengthen us. On an emotional level, wood gives the impression of timelessness; its qualities of generosity and hope allow us to connect to something greater than ourselves. Every piece of wood is unique and authentic – qualities that support enriched places. Additionally, wood conveys realness and rootedness, which implies sincerity and dignity.

The use of wood in buildings increases well-being, improves concentration and learning, and leads to greater personal and professional satisfaction.[3] For example, when students have access to learning environments with wood finishes, they experience reduced anxiety levels.[4] As well, student learning and test performance are better in wood environments than in spaces with mostly artificial finishes. The restorative effects of wood have also been documented in medical facilities. The oft-cited research of Roger Ulrich on the power of nature and healing found that when patients had access to views of trees from their rooms, they recovered more quickly and had fewer postoperative complications.[5] In addition, wood structures in medical and long-term care facilities inspire hope, as demonstrated in a 2014 Finnish study that recorded residents' subjective experience in their exposure to wood interiors.[6]

Nature and well-being: shinrin-yoku (forest therapy) in Japan and friluftsliv (free-air living) in Norway.

Wood structures also make employees happier. In LEED-certified and green buildings, particularly those with wood structures, there is greater employee retention, reduced burnout, and higher recorded levels of workplace satisfaction and well-being.[7] In an educational setting, when staff feel good, they are more present and better able to have positive and meaningful interactions with their students. The emotional, physiological, and psychological benefits of the healing properties of wood make it well worth finding ways to incorporate wood into all building types, beyond just incorporating it for its well-known ecological and carbon storage benefits.

Wood is not just beneficial to cognitive health but to physical health as well. A meta-analysis published in the *Journal of Wood Science* in 2017 by Harumi Ikei, Chorong Song, and Yoshifumi Miyazaki, which reviewed papers on the physiological effects of wood on humans, found that sensory intake from wood-derived olfactory, auditory, tactile, and visual stimulation resulted in a host of physiological benefits. Olfactory stimulation by the scents of pine, cedar, and cypress chips reduced participant blood pressure and cortisol levels, and auditory stimulation from the tapping of wood planks calmed theta and beta waves in the brain, indicating a greater sense of relaxation and calm.[8]

The olfactory experience of environments built of wood is unique compared to other building environments, because the scent of wood changes with the seasons and in different environmental conditions. Wood changes with air temperature and humidity, so it smells different on a spring morning compared to a summer day, an autumn evening, or a crisp winter night. In a world where many spaces we occupy are hermetically sealed from our surroundings, wood helps us experience and connect to the changing seasons.

Lighting and Well-Being

As we know, the qualities and characteristics of lighting play a significant role in how we experience our built environments. Buildings that are welcoming, that feel enriching and generous, offer optimal lighting conditions to their occupants. The most valuable and important light source is the sun – an endlessly giving and renewable resource that has always played a role in architectural design. The Pantheon in Rome is a notable example of how access to daylight transforms the experience of a building. Constructed by the Roman emperors Trajan and Hadrian nearly 2,000 years ago, it was originally lit by a single light source, a 27-foot (8-meter) oculus at the top of the dome, which casts a beam of light that moves around the rotunda with the sun, indicating the time of day and yearly events such as the spring equinox.

Over the past 70,000 years, humans have developed artificial lighting technologies ranging from log fires, torches, candles, and oil lamps to incandescent lights, fluorescents, neon, and LEDs. Access to artificial light was once a symbol of socioeconomic status, but over the past 500 years it has completely transformed our cities and buildings. Artificial light derives its energy from various natural resources, which can have social and ecological challenges. But only recently have we begun to study the effects of artificial light on human health, specifically its physiological and psychological effects in our daily lives.

Nearly every cell in the human body contains a circadian clock, guiding our biological mechanisms and the sleep/wake cycle. It exists in almost all living organisms, influencing physiological responses such as the opening and closing of flowers and the intuitive need for nocturnal animals to leave their dens at night. For humans, the circadian clock runs on a 24-hour cycle orchestrated by the hypothalamus, a highly sophisticated regulatory mechanism within the brain that helps optimize bodily processes. It is also highly sensitive to light, an external cue that influences multiple aspects of body and mind health.

In a study on the sleep/wake patterns of college students, irregular light

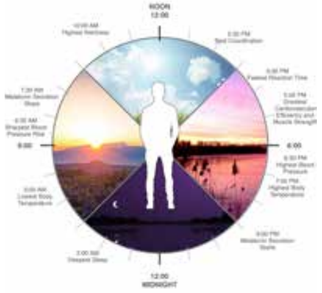


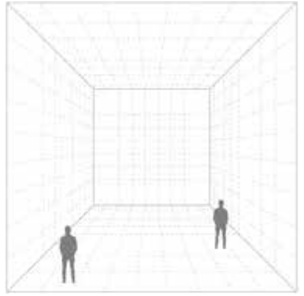
Illustration of a balanced circadian rhythm.

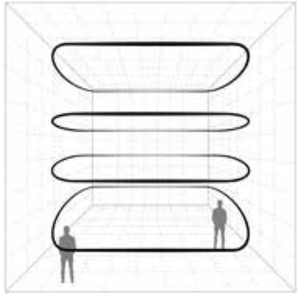
exposure was associated with a delayed circadian rhythm and lower academic performance.[9] Increased exposure to daylight desensitized the circadian clock to the effects of artificial light at night. Another study has found large inter-individual differences in circadian rhythm vanished when individuals were only exposed to natural outdoor light.[10] These findings suggest that the duration and types of light students are exposed to affects their sleep regularity and academic performance.

One compelling study connecting light with human performance compared the test scores of more than 20,000 students, primarily on the West Coast of the United States. It found that students with the most balanced daylight in their classrooms performed 20 percent better in math tests and over 25 percent faster on reading tests than students in classrooms with poor lighting or glare.[11]

There are multiple considerations when it comes to regulating artificial lighting for human health. Traditionally, electric lighting environments have either been too dim during the day or too bright at night, contributing to circadian dysfunction and a decrease in learning outcomes and attention. Certain qualities of artificial lighting curb these negative effects, including hue or color temperature, spectral power distribution, spatial distribution, architectural geometry, and surface reflectivity.

Ultimately, daylight exposure is best for providing circadian benefits, however artificial lighting is necessary in today's world. Ensuring that people have sufficient exposure to natural light contributes significantly to the internal workings of our biological clocks, which contributes to physical and mind health. As knowledge about how lighting affects us increases, we will further see how various other sectors





This page and opposite page: Diagrams illustrating Bernhard Leitner's Soundcube research into sound spatialization within an architectural space.

continue to understand and use lighting to improve occupant well-being.

Auditory Awareness

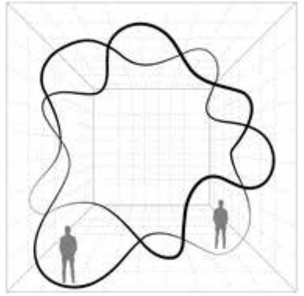
The environment reflects the sounds around us and transmits them back to our bodies to be perceived and heard. Think of how differently sound vibrates from wood or glass, and how it can create a warm tone or feel reflective and empty. Our ability to recognize and interact with sounds is integral to how we experience the built environment. Sound develops our relationship to place. It has emotional, perceptual, material, and aesthetic dimensions. In the mind's eye, sound shapes our understanding of space, as visual cues only contribute in part to our perception of reality. Qualities of sound, such as spectromorphology, timbre, texture, pitch, and amplitude transcend the spaces in which they occur, immersing the listener in their surroundings.

Design informs the layering and altering of sonorous qualities through the absorption and reflection of reverberation into space. Architecture is in some ways a curation of auditory experience, with buildings as literal sounding boards for the activities taking place within their walls. How we design the interaction between program elements and materials shapes how we perceive the spatial possibilities of our environments. Yet curating our sonorous experience in the built environment is rarely discussed at the outset of a design exercise, beyond ensuring a space isn't too lively because of sound reverberation.

The ability to distinguish between sounds to respond to and sounds to ignore is one of our earliest instincts, originating even prior to the evolution of the prefrontal cortex. The brain records and recognizes sound based on sensation and perception. Sensation is the capability of the ear to detect physical characteristics of sound, such as tone and intensity, whereas perception is the capability of the brain to consciously experience and interpret sound – to understand whether it emanates from a predator or a friendly tribe member, for example.[12]

Sound and Performance

Sound and auditory awareness are intrinsically linked with human cognition, learning outcomes, workplace satisfaction, and overall well-being. Design



interventions can either support or disrupt our interactions with sound in our daily lives. For example, placing a classroom next to a music room or busy road without installing proper sound baffling directly harms the attention capacity of students and teachers. Once you lose a person's attention, it takes a lot of time and effort to regain it. Some people are more sensitive to noise pollution than others. For example, some may be unable to focus in the presence of continuous incongruent sound, whereas others can regain attention faster or even be able to work through any noise and therefore be less emotionally and psychologically affected by it. Often students are labeled incorrectly with learning disabilities, when in fact the learning environments in which we place them cause an inability to concentrate because of poorly designed acoustics or other related sensory distractions. The time and effort teachers spend trying to hold or win back students' attention because of sound pollution would be much better used on supporting learning.

Many studies of auditory cognition have focused on the relationship between hearing and concentration in learning environments. They show that acute noises that are unrelated to assigned tasks significantly impair the short-term memory of children.[13] This phenomenon is called the irrelevant sound effect (ISE). Some theories suggest that it happens because irrelevant sound competes with verbal and spatial information in short-term working memory,[14] while others believe that ISE is caused by the attentional burden of trying to ignore irrelevant sounds.[15]

In 2021, Turkish researchers interviewed a group of teachers on the effects of unwanted noise on their personal well-being and found that an increase in sensitivity to sound led to greater irritability and a reduced tolerance limit.[16] Some teachers stated that being unable to control the unwanted sound made them more likely to think of early retirement. Another study on the psychological effects of sound on preschool teachers found that 40 percent were regularly exposed to more than 50 decibels of noise, a level that has been shown to cause difficulties in creating interpersonal relationships.[17]

The study of acoustics on student and teacher well-being suggests that if we want to create salutogenic learning environments, it is essential to limit noise pollution that causes cognitive fatigue and anxiety, while designing learning environments with acoustic qualities that support speech and language acquisition. Schools that are designed to allow for sounds that relate to the learning tasks at hand – whether by offering privacy, quiet, amplification, or greater accuracy — make our educational experiences more rewarding.

Scent and Well-Being

We all – consciously and unconsciously – use scent to influence our moods every day. We may go on a walk to uplift our spirits by smelling fresh-cut grass or spring flowers. We may relax in a bath of lavender Epsom salts. We choose a laundry detergent because it makes our clothes smell "fresh," which we associate with cleanliness. And, as many people learned during the COVID-19 pandemic, losing one's sense of smell makes food bland and unappealing. We are even attracted to other people – often unconsciously – based on their scent. Recall the study by the Karolinska Institute and the University of Oxford that showed while culture and learned or personal preferences play a role in our perception of what smells good or bad, we also share many scent preferences across cultures as a result of our molecular wiring, with vanilla universally ranked as smelling the best and sweaty feet as the worst.

Many natural materials, such as wood, stone, and earth, cause olfactory stimulation that can reduce our blood pressure and cortisol levels. Reduced cortisol levels may decrease our probability of heart disease, type 2 diabetes, osteoporosis, and a variety of other chronic diseases. In other words, simply by making scent a factor in our environmental design choices, we can improve our health.

The MSC Divina cruise ship in the Venice lagoon.
Photograph by Stefano Rellandini.

10

City Making: Affordances, Generosity, and a Saluto-systemic Approach to Placemaking

If we want to live in more healthy urban communities, we need an approach to city making that is based on a more comprehensive model of health than that on which we currently rely. This renewed model contains many circular, interwoven layers of healthy actions that enhance social, cultural, ecological, economic, and mind health as a result of place making. A truly saluto-systemic approach to city making combines formal, health-causing architectural design elements with a collaborative, participatory design process.

A floating fruit and vegetable market, Venice.

Diagram of a saluto-systemic approach to city making.

In this chapter, we will look at five case studies. The first, which is at the scale of an entire city, is the Venice Archipelago Project in Italy. The second, which reimagines existing urban infrastructure as mixed-use community assets, is the Market Bridge and Brick-Bridge Park Precinct Project in Toronto. The third rethinks main streets in a post-pandemic context, and the fourth rethinks how our urban high-rise towers can communicate a message of materiality and sustainability. The fifth, which explores silence and stillness in our often hurried and cacophonous urban environments, is the Knox Common Community Urban Park Project in Oakville, Canada. All projects embody some of the themes we have already explored that contribute to health-giving metropolitan design solutions, including the theory of constructed emotion, affordances, generosity, silence and stillness, and salutogenesis.

As we recall, the theory of constructed emotion addresses how we construct internal and external relationships, both person-to-person and person-to-place. The qualities and values we use to internally construct enriching person-to-person relationships have similar characteristics to how we construct external salutogenic person-to-place relationships with our built environments. Whether we ultimately interpret these relationships as salutogenic and enriching is based on how we remember and interpret these experiences by and through our bodily actions and senses. This is why, as we saw earlier in chapter 5, different people respond in different ways to situations such as encountering a bee or walking down a city street.

City Making, Affordances, and Generosity

Recall also the relationship between affordances and generosity. The design choices we make, by intention or not, communicate clues as to the type of relationship the environment will form with us and the affordances (possibilities of action according to our individual physical capabilities) it will offer. Environments that are more than transactional in achieving their functions are generous in what they offer those who use the place and typically increase one's sense of well-being.

Generosity may, in fact, be the most important, and most overlooked, quality upon which cities should be judged. Many aspects of city design over the last hundred or so years have been single-use in their intent, and a mechanistic drive for efficiency, along with the needs of cars, have often taken priority over the needs of people. However, the COVID-19 pandemic reawakened our collective desire for a sense of coherence in our communities.

Just as early public health pioneers did, we realized that the public realm – the physical qualities of our communities, streetscapes, parks, and other public spaces – can enhance or impede our individual and collective health and well-being.

A saluto-systemic approach to city making embraces a broader concept of health, in which multiple circular, interlinking systems of healthy action – physical, mental, social, sociocultural, ecological, economic, and spatial – all flourish in the support of human health and well-being. If we understand our urban habitat as a complex, multilayered system with the potential to contribute to the thriving of its inhabitants, we can integrate and apply this mindset to the architecture and urban design of our cities' fabric. This kind of saluto-systemic approach refers both to the formal ideas in architectural design that cause health and to a healthy process of designing. At its core, a co-creative, collaborative, participatory community process promotes transformative narratives, which in turn lead to healthy habits and behaviors.

A Sense of Coherence and Our Urban Environments

We have learned that a sense of coherence grows out of the concept of salutogenesis, a term we recall was coined by Aaron Antonovsky in *Health, Stress, and Coping*. Salutogenesis focuses on what causes health as opposed to what prevents disease. One of the problems of modern urban life is the growing disconnect – the incongruence, if you will – between what we need on a basic, personal, human level and what our cities provide us with on both a social and an environmental level. How can we come (back) to a more coherent concept of urban life? And how can a more interlinked, consciously human-focused design of our individual, social, and environmental spaces contribute to this saluto-systemic approach to city making which combines health-causing architecture, with a collaborative design process?

For example, how can we design our cities to make them more intuitive and comprehensible? How can we make our neighborhoods more accessible and flexible, offering greater manageability? How can we make our urban places more inviting, where we can reconnect with nature and its restorative effects through our body movements, thoughts, memories, and interactions with other people? How can we authentically root a place in history and ensure its alignment with the present and the future to generate meaning? These are questions we must explore in order to create a renewed sense of coherence in our urban environments.

Venice Archipelago project highlighting new islands. Farrow Partners.

Venice 1960: 175,000 residents.

Venice 2019: 55,000 residents.

Venice 2019: over 50,000 tourists per day.

The Venice Archipelago Project and the Market Bridge and Brick-Bridge Park Precinct Project
The Venice Archipelago Project in Venice, Italy, and the Market Bridge and Brick-Bridge Park Precinct Project at the Prince Edward Viaduct in Toronto, Canada, are two examples of city making that combine affordances and generosity, overlaid with a saluto-systemic approach to urban design. Both projects explore new research hypotheses in human and health-centered urban design strategies for complex urban systems and build strong person-to-place relationships by prioritizing the reverberation between inner space (individual) and outer space (environment) through the theory of constructed emotion.

The Venice Archipelago Project
The Venice Archipelago Project is a previously unimagined and practical way for Venice to address the "twin floods" of rising sea levels and mass tourism, which have inundated the city and had devastating effects on it over the last fifty years. Research and planning for the project grew out of collaborative work in 2019–22 at Iuav University of Venice between Professor Davide Ruzzon, Claire Daugeard, Carolin Vogelei, and myself. Using saluto-systemic human and health-centered strategies for designing complex urban systems, my architecture practice, Farrow Partners, subsequently developed and continues to evolve the plan.

Distinctive among Italy's great cities, Venice is consistently rated as one of the world's most beautiful places. A UNESCO World Heritage Site, it is renowned for its unique urban island fabric, extraordinary architecture, exceptional concentration of art masterpieces, and global cultural biennale gatherings, as well as for its storied glassblowing industry and for being the birthplace of composer Antonio Vivaldi and of opera.

Over 20 million tourists visit Venice each year for arguably one reason: to experience its *Stimmung* – its atmosphere and mood – that which is "invisible, intangible, elusive, without physical limits, unstable, instinctive, highly subjective to the individual, and often described through metaphors."[1] These tourists will keep arriving in the hopes of experiencing something they can't experience back home, because little like it exists anywhere else in the world.

Venice offers a truly different, yet high-quality, way of life. Because there are no cars, one has to walk everywhere. It is city scale, but small enough that one constantly bumps into friends, so impromptu coffees and spritzes are a fact of everyday life. The atmosphere is social and convivial, with virtually no violent crime. You can enjoy the therapeutic aspects of living on the water, yet the city is also overflowing with culture, architecture, and beautiful public spaces. Plus, because its citizens walk several miles a day over dozens of bridges, one rarely sees an overweight Venetian.

A Failed City?
But despite its rich history, beauty, culture, and enviable urban form, Venice is in some ways a failed city. This once model city has lost more than 70 percent of its resident population over the last fifty years, doing untold damage to its social, economic, and building fabric. A recent article published by Bloomberg Media lamented "the long, slow death of Venice … with no turnaround in sight."[2] A result of years of frequent flooding and tourist hordes, Venice's state of decline may be close to the point of no return. Unfortunately, many local politicians are not willing to change course, or perhaps they don't know how. They have become too accustomed to the easy money that mass tourism brings, which has resulted in a brittle monoeconomy and rampant short-term political thinking.

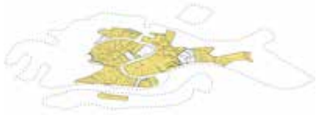
Born Out of Water – and Threats
Venice is a manufactured city – an artificial collection of 118 mostly man-made islands linked by bridges. Although fishermen had always inhabited the lagoon, the "Floating City" was born in 568 CE when a tribe of mainlanders called the Veneti fled the onslaught of Lombard and Ostrogoth tribesmen laying waste to northern Italy after the fall of the Western Roman Empire. The tidal mudflat islands at the mouth of the Po River, with their ever-changing, hard-to-navigate channels, provided a naturally protected compound of islands for those seeking refuge.

The city grew over the next 1,000 years, as Venetians drove long poles of wood into the seabed and layered wooden planks and stones over them to form new islands and link them to existing ones. As the main gateway between Europe and the Holy Land, the city became enormously rich during the Crusades, and its traders and noble class built vast fortunes. Venice also built a formidable navy that ensured its commercial and political independence, if not dominance, for several centuries, during which time the city experienced one of the most extraordinary cultural florescences the world has ever seen. Its population peaked at 200,000 in the 1600s, but by then its power and influence had already started to wane. Venice lost its independence to Napoleon in 1797, and in 1866, it was absorbed into the Kingdom of Italy. By the mid-1960s, its population had fallen to 175,000 and has continued to fall since.

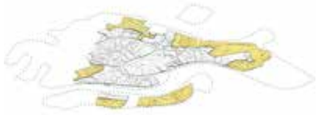
Acqua alta and a Population Exodus
In 1966, Venice experienced the largest recorded flood in its history when a combination of high tides, rain, and a *scirocco* wind raised the water level to a record 76 inches (194 centimeters). The flood destroyed many homes and initiated the first big population exodus from

Venice in the present day.

Venice c. 1100.

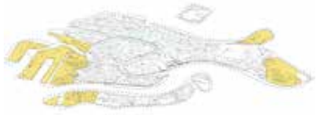


Venice c. 1300.



Venice c. 1500.

Venice c. 1800.



Venice in the present day.

Venice's continued evolution: a new archipelago.

The devastating acqua alta flood, November 2019.

Venice to Mestre, the town on the other side of the causeway that links Venice to the mainland. Most of these Venetian inhabitants never returned, and many of those who maintained properties in Venice converted them to short-term tourist rentals.

The Twin Floods
Since the historic *acqua alta* of 1966, the city has suffered the curse of the "twin floods" – recurring high water and tourists. Both have wreaked havoc on the physical and social fabric of the city, making it extremely fragile. Today, the city has approximately 50,000 permanent residents, a number that is shrinking by about 1,000 people per year as the older population dies out and younger people leave due to a lack of affordable housing and decent jobs.

Current Threats: The Impacts of Climate Change and a Monoeconomy
Venice faces potentially devastating dangers from climate change. Rising sea levels and ever more frequent flooding have rendered the ground floors of a third of all buildings uninhabitable. In 2018, the city saw 121 days of high tides, in which the water rose 31 inches (80 centimeters) or more above sea level, and parts of the city, including Piazza San Marco, were temporarily flooded. Usually, the city deals with this by erecting raised wooden walkways, and people – inhabitants and visitors alike – don rubber boots and continue about their day, but every time it floods, the seawater erodes and damages the material building base of the lagoon city.

What was once a winter phenomenon is now occurring through late spring and in early fall as well. In November 2019, while I was there, the city saw another devastating *acqua alta* flood, the second highest in recorded history after 1966. Ground-floor shops lost everything, boats were smashed or thrown up onto bridges, and waterbus stations were destroyed. Most of this damage has been repaired by now, but the flood caused another exodus. Moreover, many banks will no longer insure buildings that are at risk of regular flood damage, nor will they lend money to upgrade or renovate them, perpetuating a downward spiral of building decay.

The MOSE Flood Barrier: Single-Use Infrastructure
Recently, Venice completed a multibillion-dollar flood barrier known as MOSE (*Modulo Sperimentale Elettromeccanico*, or "'Experimental Electromechanical Module"), which was twenty years in the making: a single-use infrastructure system of mobile gates constructed in the sea just outside the city's lagoon as a protection against episodic storm surges. MOSE has been successfully used several times, but it is only a partial – and temporary – solution. First, it only gets activated when flooding is expected to go above 43 inches (110 centimeters); otherwise it would damage the fragile ecosystem of the lagoon. So flooding still happens, just at comparatively moderate levels. Second, it does not address the root problem of the flooding and will only be effective in protecting against storm surges that do not exceed 118 inches (300 centimeters). Even with MOSE, if the earth's temperature rises to 1.5°C above preindustrial levels, one-third of Venice will be permanently underwater because of continuously rising sea levels due to climate change. If the earth's temperature rises by 2.5°C, as it is currently on track to do, only 25 percent of the city's existing landmass will remain above water. Remarkably, still no viable solutions to arresting the city's probable fate of permanent submersion have been brought forward.

Overtourism
As with water, Venice is equally flooded by tourists. More than 20 million tourists visit every year, with a daily average of 55,000 visitors, in a city with a population of only 50,000, to as many as 110,000 per day during peak tourist season. The negative

effects of mass tourism on Venice include overcrowding, long queues, security barricades, and the over-commercialization of historic sites. Since many tourists are day trippers who either arrive on cruise ships or stay overnight on the mainland, there is relatively little meaningful spending in Venice itself. Most arrive for a few hours, take selfies at the Rialto Bridge and Piazza San Marco, eat a low-quality pizza, and buy a mass-produced trinket or T-shirt, usually manufactured outside of Italy, from shops that have displaced vital businesses that once created economic diversity and stability in the city.

To quote a 2020 research paper by the Global Wellness Institute, "Local residents are becoming resentful, alienated, and displaced, as their rents rise, their neighbourhood character changes, and tourism-focused businesses drive out local services while bringing few direct benefits to locals. Transport, energy, water, and sanitation infrastructure are overloaded. Over the long term, over tourism brings environmental degradation and puts at risk the very existence of the world's most loved cultural and natural treasures."[3]

Fortunately, some Venetian citizen initiatives, such as Venezia NON è Disneyland, We Are Here Venice, Gruppo 25 aprile, Venezia da Vivere, and others, are fighting the trends that threaten to turn Venice into an overpriced theme park. The group Comitato No Grande Navi – Laguna Bene Commune was instrumental in having cruise ships banned from the Giudecca Canal because of the pollution and wake damage they caused to building foundations. New local arts and culture initiatives are also gaining traction, and Venice is now trying to attract young, mobile, international knowledge workers who can work from anywhere to help repopulate it. If one goes a bit off the beaten tourist track, one still finds remarkable pockets of a vibrant, creative, and flourishing living city.

Cost of Living
Unfortunately, the cost of living and housing has skyrocketed because of low-to-no housing stock availability due to building deterioration and the proliferation of Airbnb rentals, which are more lucrative than long-term leases to locals. A typical residential building in Venice might have ten apartments, four of which are Airbnbs, four of which are the holiday homes of wealthy foreigners, and only two of which are rented to locals.

Buying is no easier. Mass tourism has led to extreme property speculation, and the price of buying a house or flat in Venice is out of reach for most Italians. Consequently, once day-trippers leave and night falls, Venice is surprisingly quiet. It is common to see entire residential buildings with no lights on because nobody lives there permanently.

Furthermore, shopping for everyday necessities in Venice is not easy. Many community-based stores and businesses have disappeared or been bought up by overseas investors and converted into shops catering to tourists. The fact that everything in Venice arrives by boat adds an additional expense. Many Venetians now go to the adjacent mainland city of Mestre to do their shopping, or order from Amazon and other online retailers. With a lower tax base, services for residents have been curtailed, which further diminishes the quality of life and raises the cost of living for those who remain.

Employment Opportunities
Work opportunities in Venice are very limited. Aside from a few well-paying, stable jobs with the city, the universities, banks, insurance companies, and major cultural institutions, such as the Venice Biennale or public museums, most jobs are directly or indirectly linked to the tourism industry, and many are seasonal, part-time, or insecure. Since Venice cannot offer young people the opportunities they need to establish and build careers and start families, many move away. Although the city has three internationally ranked universities, a renowned fine art academy, and a music conservatory, very few students choose to stay in Venice after they graduate to start a career and raise a family, as they often do in vibrant cities with strong university ecosystems. As a result, the resident population of Venice is much older than the national average.

Export Base and Food Security
In addition to fishing, Venice has a long history of food production and exportation. For centuries, locals cultivated reclaimed land with a wide range of agricultural crops, including artichokes, asparagus, squash, peas, beans, wheat, and various fruits. Vineyards grew on the island of Mazzorbo, and honey was made on Sant'Erasmo. The massive Molino Stucky factory on Giudecca Island, built between 1884 and 1895, operated first as a flour mill, supplied by boats from across the lagoon, and then as a pasta factory. But in the early 2000s, it was, not surprisingly, converted into a luxury hotel and conference center, which only added to the growing tourism monoculture.

While fruit and vegetables from Sant'Erasmo continue to be prized for their quality and taste, and good wine is still made on Mazzorbo, Venice's food export base today is very low. Most food now comes from somewhere else – honey from Eastern Europe and China, olive oil from Greece and Spain, citrus fruits from Spain, garlic from China, and dairy products from Germany, to name some examples. A few markets and independent vendors sell local produce and other foodstuffs, but

Mass tourism: a "traffic jam" of tourist gondolas in the center of Venice.

food in supermarkets is almost never from Venice, and even the fish at the daily Rialto Market often doesn't come from the lagoon anymore.

Economic Health
By late 2016, Venice was effectively bankrupt, with a major budget deficit and debts in excess of €400 million. In June 2017, the Italian Republic had to bail out two regional banks, at a cost of €5.2 billion, plus a further guarantee of up to €12 billion to cover nonperforming loans, in order to prevent potential country-wide contagion in the banking system.

While some forms of tourism can make a very positive and healthy contribution to a city's economy, Venice's municipal leadership made many poor choices over the years that led to the decline of a robust and diverse economy and the emergence of a tourism monoculture.

The untenable nature of this was further revealed when COVID-19 hit and all tourism ground to a halt. Businesses collapsed, and many Venetians suffered extreme financial hardships when their only source of income dried up. On the positive side, the long-forgotten spatial characteristics and qualities of the normally overcrowded city became perceivable again. The ecological impacts of mass tourism also became obvious; for the first time in living memory for many, the water of the canals ran clear, and Venetians witnessed fish, ducks, and even dolphins swimming in them. The air became cleaner, the colors more saturated, and the city enjoyed a silence and languid atmosphere that reminded those old enough to remember of the 1950s. Residents spent more time in their *sestieri* (neighborhoods), enjoying the newly realized old qualities of living in Venice.

1. The existing Venice islands network.

2. It is predicted that one-third of Venice will be under water by 2050.

3. Water levels must be lowered by 1 meter to historic levels.

4. Archipelago: creation of a necklace of new and existing islands.

5. The archipelago creates a cruise ship barrier.

6. The archipelago is porous, with locks, to allow small/mid-sized boat traffic to continue.

7. De-central park, a 32 kilometer connected necklace of active and passive green space.

8. Park pavilions: a range of agri-tech food production throughout the park necklace.

View of the new northern archipelago islands with the Dolomite Mountains in the distance.

Tourists have now returned to Venice, but many small shops, bars, and restaurants have disappeared for good, and the scars of COVID-19 remain in the Venetian consciousness and city fabric.

A Way Forward

The Venice Archipelago Project proposes a new way forward for Venice, using human and health-centered strategies for designing complex and robust urban systems. Our research team at Iuav began working on the project in early 2019, a few months before COVID-19 broke out in Italy. While the project takes as its starting place the many issues that predate the pandemic, both from the point of view of short-term visitors and permanent residents, it is very much colored by the city's experience of this recent global health crisis. The pandemic made it all the more obvious that Venice, despite its striking beauty and atmospheric nature, suffers serious long-term social, economic, environmental, and demographic issues, and that it requires a radical, forward-looking rethink.

An Aqua-Emerald Necklace

The Venice Archipelago Project continues the city's 1,500-year-old tradition of building islands in the shallow lagoon seabed by creating an "aqua-emerald necklace" of new islands that wrap around and connect the existing islands of Venice – Murano, Le Vignole, La Grazia, and Giudecca – in an interlinked water (and cruise ship) barrier. The project is similar in concept to the Netherlands' approach to protection against storm surges and rising sea levels and includes dikes, dams, and floodgates, all spanned by bridges in the tradition of Venice.

Like the historic city itself, the 20-mile (32-kilometer) Venice archipelago will be another human-made landscape that combines flood defenses with new, ecology-driven park, recreational, cultural, and agricultural uses. The water contained between the new islands and the original islands will be lowered by approximately 5 feet (1.5 meters) to its pre-1500s level, enabling stabilization, restoration, and normalization of existing building stock. This mixed-use flood protection infrastructure intervention is based on ideas of safety, welfare, health, and well-being, and it has similarities with other global initiatives that counter rising sea levels, such as the Dryline, a 10-mile (16-kilometer) protective system and waterfront park around Lower Manhattan designed by Bjarke Ingels Group in the aftermath of Hurricane Sandy in 2012.

The Venice Aqua-Emerald Archipelago Primary Urban Design Elements

The Venice Archipelago Project consists of four primary elements:

(1) A Flood and Cruise Ship Barrier: The interlinked necklace of new and existing islands will form a legible, circular, string-like flood and storm surge barrier, purposely designed to be low in profile and hug the waterline to preserve iconic views from Venice to the Dolomite Mountains to the north, Murano to the northeast, the Lido to the southeast, and the open lagoon to the south and west. The new islands will be of different shapes and uses, separated by watercourse locks spanned by pedestrian bridges. This will allow small- to medium-sized boat traffic between and around existing islands to continue while creating a barrier against cruise ships, which have done considerable damage to the lagoon and historic islands and buildings of Venice through pollution and the erosion caused by their powerful wakes.

But unlike single-use infrastructure projects such as the MOSE flood barrier that only protects against storm surges, this multi-use piece of infrastructure combines environmental resiliency measures with social, recreational, and economic activities that enhance the quality of life for inhabitants and visitors alike. In the same way that a necklace conforms to the contours of a person's neck, shoulders,

and chest, the aqua-emerald necklace form bends, moves, and responds to the changing conditions of Venice, including lagoon bed depths, tidal flow routes, views to and from islands, weather, wind, and seasonal light.

(2) De-central Park: In addition to protecting against floods and cruise ships, the Venice Archipelago Project creates a continuous, 20-mile (32-kilometer) mixed-use park system of active and passive green space. Not a *central park*, as can be found in many dense urban cities, but rather a *de-central park*, similar to a countryside, where residents of the city can go to experience nature, leaving the built city behind.

Venice's new de-central park will offer a range of recreational and social amenities, including walking and bike paths, running routes, sports fields, playgrounds, dog runs, skating rinks, outdoor fitness areas, rock climbing walls, gentle hiking hills, flexible open areas, performance and art spaces, beaches and lagoon promenades, picnic and barbecue venues, nature preserves, outdoor education classrooms, bird sanctuaries, salt marshes, filtered swimming pools, and fishing areas. The de-central park will also focus on local food production through community allotment gardens, micro farms, and flower markets. No cars will be allowed; access and servicing will continue to be provided by boat traffic.

While there is a surprising amount of green space in Venice, most of it is in private gardens and therefore inaccessible to the public. The many *campos*, or public piazzas, are very popular for socializing but generally lack trees and greenery. During the COVID-19 pandemic, parks became essential to many people's lives. The 2021 Canadian City Parks Report, which looked at thirty-two cities across

New northern archipelago, with agri-tech seed farming below, Farrow Partners.

Canada, discovered that the pandemic created tremendous pressures on parks but also gave them a new sense of life and purpose. Nearly two-thirds of those surveyed said that "their appreciation of parks had increased during the pandemic," particularly with respect to their mental health, physical health, and social connection benefits.[4] Similar studies around the globe reveal that the pandemic left a lasting impact on how we view and use parks. This has set the conditions for a new park culture similar to the one of the mid-1800s that worked to advance public health through the city park system movement and the work of public health advocates and landscape architects like Frederick Law Olmsted, who used immersive naturalized parks as "sanitary institutions" to target mind health. The new park system created by the Venice Archipelago Project is influenced in part by this type of thinking.

(3) Active Precision Agriculture and Aquaculture Pavilions: As already noted, the archipelago will support community allotment gardening, but it will also offer a range of sustainable commercial activities located in agri-pavilions throughout the park. These activities will build on the long history of local agriculture in the Venetian lagoon, from the growing of fresh fruit and vegetables to the production of wine, honey, flour, and pasta, and it will create sustainable job opportunities for Venetians in active precision food production, which improves crop yields while reducing water use and pesticides.

The agri-pavilions will include hydroponic seed production using carefully controlled lighting conditions to optimize photosynthesis; greenhouse production of vegetables, such as tomatoes, peppers, fennel, and eggplants, in conditions that greatly reduce water use, virtually eliminate disease and the use of pesticides, and protect against extreme weather; and land-based aquaculture fish farms that remove waste from water using recirculating aquaculture systems and don't cause the

Four new island zones correspond to themes of the four seasons, Farrow Partners.

environmental damage that open ocean cages do, thus creating one of the most sustainable seafood choices available.

The agri-pavilions are inspired by the Crystal Palace, built for the 1851 Great Exhibition in London, England. But instead of exhibiting the new technology of the Industrial Revolution, the agri-pavilions will showcase revolutionary methods of food production through active precision farming and agri-tech methods, in which a collection of Italian companies are global leaders. They will also provide university research and education program opportunities, high-quality jobs, as well as continue the traditions of producing food to be sold in Venice on pop-up vegetable boats and for export to other areas of Italy and beyond.

(4) Four Zones That Correspond to the Four Seasons: The archipelago is divided into four segments oriented to the four cardinal directions of North, East, South, and West. Each zone has its own mood, related to its location, and is overlaid with a seasonal *Stimmung* of winter, spring, summer, or fall. This reminds residents of the constant cycle of nature and is also a nod to Venice's most famous son, Antonio Vivaldi, composer of *The Four Seasons*.

The northern segment, with its views to the snow-capped Dolomite Mountains to the north of Venice, takes on the mood of winter. Its park system includes winding footpaths, gentle hills, climbing walls, lookout areas, and stone coves and grottos. Its agri-pavilions include precision seed farming in below grade vaulted agro-industrial buildings, capped with a stone promenade.

These pavilions would be occupied by companies such as ONO Exponential Farming, a Verona-based agri-tech start-up, which has developed the first "seed-to-pack" vertical farming platform, a patented technology for hydroponic cultivation. Crops, insects, and algae move automatically inside the ONO module according to growing requirements managed by ONO's AI engine, which changes the current vertical farming paradigm from product to process.

The eastern segment, consisting of the existing natural and agricultural island known as Le Vignole, is layered with the character of spring. Its park system includes community allotment gardens, rain gardens, micro farms, flower markets, bike and running paths, flexible open areas, picnic and barbecue areas, naturalized areas, soft sea edge nature preserves, outdoor education facilities, bird sanctuaries, and salt marsh pools. Its agri-pavilions encompass apiculture – beekeeping and honey production – along with wisteria fields; asparagus, artichoke, and pea farming; traditional vineyards; and flower and produce markets.

The southern segment, south and east of Giudecca Island and looking toward the Lido, is primarily water, with a scattering of smaller geometric islands. It assumes the characteristics of summer, with amenities that include boardwalks, swimming and fishing areas, boat and water bike rentals, performance and art spaces, an amphitheater, picnic and barbecue areas, and coves for water concerts and movies. Its agri-pavilions emphasize enclosed exterior fish farming pools surrounded by an extensive public boardwalk network.

The western segment is connected by bridges and locks to the western end of Giudecca. With its history of large gardens and industrial uses, such as the mammoth late-nineteenth-century Molino Stucky flour mill and pasta factory, it takes on the characteristics of a busy market, with the harvest and production season of autumn in full swing. Its recreational park system includes bike and running paths, sports fields, playgrounds, outdoor fitness equipment areas, flexible open

Western segment of the new Archipelago, with glasshouses and market plazas, Farrow Partners.

areas, performance and art spaces, picnic and barbecue areas, naturalized areas, boat rentals, micro farms, and community allotment gardens. Its agri-pavilions include glasshouse vegetable production paired with public plazas, food markets, and micro restaurants and eateries.

The design hypothesis for the Venice Archipelago Project resonates with life principles and cycles that are deeply embedded in human life and the "architecture" of our brain and body-mind-soul system. Nature teaches us to understand the whole by looking at the mutual interrelatedness of its parts, and the archipelago can therefore help create relational bridges between the internal and external world for residents of Venice.

As such, we can offer people places that have the potential to feel like a good relationship, as different as these spaces might be from each other. Through architecture and design, we can translate qualities of enriched relationships into elements of enriched environments, creating mutually resonating person-to-place interactions and relationships between outer space (environment) and inner space (individual) as conceived by the theory of constructed emotion.

Discourses on Transformative Development for Venice … and Beyond

Humanity is often resistant to change, especially large-scale, highly visible change. This can be particularly true for cities like Venice, where the average building is at least several hundred years old, and where the urban fabric hasn't fundamentally changed in centuries.

Any modern intervention is often met with considerable opposition, no matter how beneficial it might be for the city and its inhabitants. The idea of an archipelago of new islands in Venice – even though it would protect the historical city and

Northern archipelago agri-tech pavilions, Farrow Partners.

Eastern archipelago apiculture pavilions and allotment gardens, Farrow Partners.

Southern archipelago with boardwalks and performance areas, Farrow Partners.

Western segment glasshouses, as seen from the Laguna, Farrow Partners.

improve residents' quality of life – challenges the traditional view of Venice and might even go beyond the thinkable for Venetians and those who love the city. However, if we think of the human imagination as frame-widening, as literally space-opening, we may realize that sometimes resistance to change is nothing more than a mechanism to protect our often unconscious beliefs of how things ought to be.

Certainly, resistance to change is a natural human tendency that we must respect, understand, and empathize with. But sometimes long-held and deeply felt beliefs no longer serve current circumstances. Sometimes our guiding concepts or schemas are actually detrimental to human life and the well-being of the larger whole because they inhibit a healthy resonance with our immediate environment and the larger macrosystem in which it is embedded.

If we accept that some action patterns resulting from our beliefs in fact endanger the larger whole and our habitats within it, then we might take these uncomfortable truths as opportunities to nurture and evolve, in saluto-systemic terms, as we reimagine the future of the areas we live.

Rather than sliding back to old ways that threaten the complex multi-level system that Venice is, this seems an appropriate time to revisit guiding, principles, concepts and coping strategies – a time to co-creatively imagine and explore different paths forward, that might inspire and bring about healthy development and transformation for the urban community of Venice. In this sense, the Venice Archipelago Project offers an invitation to participate in a shared discourse about the widening of spaces, literal and metaphorical, and the opportunities of health-oriented, generous, saluto-systemic thinking on an urban scale.

Market Bridge section showing various uses, Farrow Partners.

Bloor Viaduct as it currently exists.

Market Bridge with plazas and pavilions, Farrow Partners.

The Market Bridge and Brick-Bridge Park Precinct Project

Today, infrastructure reuse projects are bringing environmental, social, cultural, and economic gains to cities around the globe, from the High Line in New York City to the Camden Highline in London, England, to the Viaduc des Arts and reimagined Champs-Élysées in Paris. As Toronto has become denser, land prices have gone sky-high, and obtaining land for community use and open space has become more and more challenging. Finding imaginative ways to create community through shared and beloved civic spaces has never been more important, and we can achieve it by transforming single-use infrastructure into new multi-use urban assets – that is, by creating enlightened infrastructure, much like the Venice Archipelago Project we already explored.

The Market Bridge Project is an attempt to reimagine one of Toronto's great pieces of infrastructure – the Prince Edward Viaduct, also known as the Bloor Viaduct. The COVID-19 pandemic offered a rare opportunity to imagine a more refined balance between transportation needs, the public realm, and flexible community space that would create a more salubrious urban environment for the citizens of Toronto. The Prince Edward Viaduct is an important component of the city's fabric, spanning the Don River. Our intent is to create a generous new civic, social, and pedestrian-centered destination for Toronto that mixes public space, plazas with public art, and socially driven market stalls housed in mixed-use, market-like pavilions.

History of the Viaduct

The Prince Edward Viaduct was designed by Thomas Taylor and Edmund W. Burke under the guidance of Public Works Commissioner R.C. Harris. An elegant, three-hinged concrete and steel arch bridge almost five football fields in length, the viaduct was completed in October 1918, just before the end of the First World War. Upon its completion, it became an important symbol of progressive engineering and material and construction innovation, fulfilling the civic aspiration of being a connector and facilitator of human and vehicular traffic flow to the eastern portion of the city, spurring growth and prosperity.

Aerial view of Market Bridge with pavilions and plazas, Farrow Partners.

The viaduct was an elegant, urbane, broad boulevard divided by lampposts, paved with cobblestones, and endowed with generous sidewalks 131 feet (40 meters) above the river valley. It quickly became a new destination to stroll, to see and be seen, and to admire the views of the Don Valley below and Lake Ontario beyond.

The viaduct facilitated contiguous east–west car and public transportation, with a central streetcar line on its surface as well as water and electricity lines below. Its designers also anticipated future public transportation by providing space within the bridge's structure for a subway line, which wasn't completed for another half century. By all accounts the Prince Edward Viaduct was a symbol of truly enlightened public infrastructure, as measured by engineering, civic, and social innovation.

By the 1960s, the viaduct had experienced a number of disastrous alterations that have had long-lasting and ultimately tragic consequences. When the subway line was installed below the surface, the cobblestone central tramline paving band was replaced with asphalt, along with additional car lanes, and the graceful lampposts were replaced with overscale highway light standards in the middle of narrowed sidewalks. These alterations fundamentally changed the proportions, character, and perception of the viaduct as a public, pedestrian, and civic realm.

The surface was now dominated by five lanes of car traffic, which had the feeling of an expressway. Today, buffered bike lanes have been added on either side, and there are now four traffic lanes instead of five, but the viaduct still has the air of an unencumbered raceway that naturally encourages drivers to speed.

But even more disturbingly, this now desensitized space, full of cars and largely

Aerial image of the Market Bridge and new Brick-Bridge Park Precinct, Farrow Partners.

devoid of pedestrian life, became a magnet for suicides. By 2003, the viaduct had become infamous as the second most popular site for suicides in North America after the Golden Gate Bridge in San Francisco, with approximately 500 people taking their lives annually.

In 2003, the City of Toronto erected a 16.5-foot-high (5-meter-high) suicide barrier, known as the Luminous Veil. While it is a sophisticated and thoughtfully designed piece of urban jewelry that is visually harmonious with the bridge's structure below, on the surface, its height accentuates the vastness and lack of human scale of the multi-lane roadway and therefore makes the viaduct even more unwelcoming to pedestrians. Tragically, while the barrier stopped suicides from occurring on the viaduct, it did not reduce the total number of suicides by jumping in the city. Arguably, the Luminous Veil was a great design response to the wrong question. The design competition asked the pathogenic question of how to stop deaths rather than the salutogenic question of how to cause health. The barrier stopped suicides, but it didn't encourage life, health and well-being, community growth, new civic opportunities, or the connecting of individuals with others at this important location in the city.

New Life for the Viaduct

The Market Bridge Project is an attempt to help the Prince Edward Viaduct regain its original civic optimism and role as a great connector and creator of opportunities and prosperity within and beyond its ends. Simply put, it makes more room for people and turns the viaduct into a more welcoming place to go to walk and enjoy it as it once was.

The Market Bridge strategy envisions a vibrant, connected urban precinct of public spaces, urban activities, community gathering pavilions, socially driven micro market retail, arts interventions, and charitable activities, all high up in the air with an unprecedented view of the Don River Valley, the city of Toronto, and the lake beyond. Imagine a destination for watching street performances and musicians, buying fresh local fruits and vegetable, tasting artisanal cheeses, chocolates, and baked goods, and wandering among fresh flower stalls. Think of sampling from specialty food stalls, enjoying cafés and restaurants, checking out retail incubators, or going to a meeting or event in a joint community space, all driven by the social and civic goal of causing health for the wider community.

The road section of the viaduct is reconfigured from the existing four lanes of traffic, flanked by bike lanes and a sidewalk, to three lanes of traffic (one of which is for loading and parking at off-peak hours), two bike lanes, and a pedestrian precinct that is almost half the width of the viaduct. The proposed road section is similar to the majority of road sections that presently exist on Bloor Street to the west and Danforth Avenue to the east. Squares and promenades of varying size run the length of the new pedestrian promenade, which will include bicycle racks, benches and tables, trees, and urban planters with a range of greenery that provide a mix of textures and scents.

Interspersed among the squares and public space are market pavilions containing a mix of different-sized merchandising offerings. The single-storey vaulted ceiling pavilions are designed to maximize the flexibility of interior spatial configurations, ranging from open arcade-like stalls to accessible booth merchandising, over-the-counter service, and single-tenant uses. Public washrooms and related common services are clustered at either end of the viaduct. The streets and public realm that

Market Bridge plazas, Farrow Partners.

Brick-Bridge Urban Park, Farrow Partners.

Ramp from surface to park level, Farrow Partners.

The new park under the viaduct span, Farrow Partners.

connect the west end of the viaduct to Castle Frank subway station and the east end of the viaduct to Broadview subway station are reconfigured to provide more generous sidewalks, enhanced green space, and separate pedestrian and bicycle routes to ease the flow of traffic from the east end of the bridge onto the northbound Don Valley Parkway.

A New Brick-Bridge Urban Park Precinct

Beyond enhancing Toronto's most important east–west artery and turning it into a greater civic space, the Market Bridge Project is part of a larger design for a new Brick-Bridge Urban Park Precinct that would enhance the existing Lower Don system with expanded trails and active and passive park activities. The entire precinct would be framed by a new direct connection to the Evergreen Brick Works, a cultural, environmental, and market facility and community hub to the north, through a light steel-frame accessible ramp at the center of the viaduct's length that connects Bloor Street and Danforth Avenue directly to the valley trail system below. The west side of the Don River, north of the viaduct, would be made accessible by new bridges and trails, and the existing land would be revitalized into ecological, sustainable places and waterways linked to the existing Evergreen Brick Works, so that anyone can experience the grace of the Don Valley system in any season. At present, it is very difficult to access the Lower Don Valley trail system from either Bloor or Danforth, but the addition of the new vertical circulation system will turn the viaduct into an important connector for adjacent neighborhoods to the base of the Don River Valley, north to the Brick Works and the Taylor Creek and East Don Trails, and south to the Great Lakes Waterfront Trail.

The market pavilions on the top of the viaduct would be made of state-of-the-art, lightweight construction materials and building technology developed in Canada by NUCAP Industries, a long-time product development collaborator of my office. A wood glue-laminate roof structure and timber block walls would be post-tensioned together and held in place by sticky metal strips that are similar to Velcro. The blocks have the environmentally sustainable qualities of cross-laminated timber (CLT), the strength of concrete, the lightness of plastic, and the flexibility and ease of assembly of Lego. The vaulted ceilings and roof – constructed of a lightweight, translucent, Teflon-coated, fiberglass-reinforced membrane – maximize diffused light penetration while reducing glare and have insulation qualities while also being durable and strong.

In some ways, the Market Bridge has echoes of Venice's Rialto Bridge or Florence's Ponte Vecchio. But rather than charging exorbitant rates to high-end jewelry stores or tourist traps, the Market Bridge has the potential for a larger civic and social mission. In addition to being a strong urban design intervention, it would also be used as an incubator and accelerator for entrepreneurs with a social cause or mission, such as a baker who uses only sustainable and local ingredients, an up-and-coming chef who

Main Street Pavilions, Farrow Partners.

employs and creates opportunities for youth and disadvantaged people, or a clothing designer who uses only recycled materials. Like a tech incubator, the Market Bridge would offer prime retail space to micro entrepreneurs to launch their ideas to the city at affordable rents. Once these start-ups have reached a level of success that ensures their continued viability, they would release their Market Bridge spaces to new entrepreneurs with fresh ideas, creating a long-term business development cycle that would benefit the entire city.

A Saluto-systemic Approach
The Venice Archipelago Project and the Market Bridge and Brick-Bridge Urban Park Precinct Project demonstrate how design choices we make in our cities can create enriched urban environments, which are health-giving to those that use them on a daily basis. Such environments evolve out of a saluto-systemic approach to city making that embraces a broader concept of health, in which multiple circular, interlinking social, cultural, ecological, economic, and spatial systems support human health and well-being.

Rethinking Our Streets: The Main Street Pavilions Project
This project grew out of our thinking on the Market Bridge Project, where we begin to reimagine, post-COVID-19 pandemic, how we could rebalance the needs of transportation, the public realm, flexible retail, and community space on our main streets to create greater variety, vitality, and a sense of occurrence in our neighborhoods.

Like many cities during the pandemic, the City of Toronto developed a program for restaurants to occupy space normally reserved for street parking with outdoor dining areas, thus keeping people out of enclosed indoor spaces. The program became very popular, transforming neighborhoods and streetscapes into busy and dynamic destinations for residents, and it continues today as a permanent city program from April to November each year. However, the initial temporary nature of the intervention, with concrete construction barriers and orange warning cones, left much to be desired when the goal changed to creating a visually engaging and enduring environment.

We teamed up with a local business improvement association for one of the

Grip Global Tower mass timber structural system, Farrow Partners.

city's primary high streets, along with an innovative Canadian timber block fabricator called GRIPBlock, to create prefabricated canopied street pavilion models to house retail and restaurant experiences, as well as to provide for various fitness and community uses, along the main streets. Studying street pavilions from some of the great avenues of the world, we developed a range of modular pavilions, including a one-storey pavilion with internal and street-facing seating, and a two-storey, double-decker bus–inspired pavilion, with an upper level that offers a good perch from which to watch city life pass by.

Similar in concept to the Market Bridge Project, the Main Street Pavilions Project reflects our belief that it is time to move beyond temporary interventions and create permanent, reimagined ways that residents of high-density neighborhoods can spend more of their daily lives out on our high streets, thereby strengthening community health and well-being.

Rethinking Our Skylines Using Mass Timber: The Grip Global Tower
If we want to live in more healthy urban communities, we need an approach to city making that is based on a more comprehensive model of health. While the Market Bridge Project and Main Street Pavilions rethink the way we experience our high streets and what they communicate to residents about city life, the Grip Global Tower aims to communicate the nature of its primary building material – mass timber – in the context of a high-rise structure. We wanted to explore whether the "nature" of timber could be expressed in a building's form, beyond wood's altered, manufactured state as rectilinear planks and beams.

In its early use, the plastic, fluid properties of concrete were conveyed in the work of Finnish-American architect Eero Saarinen. German-American architect Ludwig Mies van der Rohe revealed new possibilities for steel when he designed repetitive, rectilinear, modular steel frames. What about wood? We try to communicate the growing, twisting nature of this organic material in a forty-four-storey, CLT tower. The design begins to explore the use of fractal patterns at a city scale, combined with the positive ambiguity of the fractal and twisting forms of the tower's section as it is expressed on the city skyline.

Knox Common Community Urban Park, Farrow Partners.

Aerial view of existing Knox Church context.

Knox Common Community Urban Park, Farrow Partners.

Knox Common Community Urban Park
The Market Bridge Project and Main Street Pavilions explore how we engage with the energy of our high streets, and the Grip Global Tower studies the primacy of nature in high-rise building in our cities. The Knox Common Community Urban Park in the Canadian lakeside town of Oakville, Ontario, examines how we can create places of silence, stillness, solidity, and intimacy in our hurried and cacophonous urban environments. More than ever, we need contemplative places with qualities that encourage us to enter, linger, and listen instead of pass through quickly and zone out – places that allow us to listen within our bodies and explore thoughts beyond our bodies that are otherwise drowned out by overstimulating cityscapes.

The Knox Common Community Urban Park Project grew out of a commission to renovate and restore a historic church in the geographic center of Oakville, which is punctuated by a tall spire in an otherwise low urban fabric.

Oakville, as the name suggests, was born out of an unusually lush oak forest surrounding Sixteen Mile Creek on the north edge of Lake Ontario and was originally a busy shipbuilding harbor due to the abundant supply of wood.

Today, the residential areas continue to feel like a community within a generous tree grove, while the main commercial area is now largely devoid of a lush, leafy canopy. One block west of the church is the town's main square, a slightly sunken plaza that follows the town's Cartesian grid. In the center of the square is a grassy area, and on one edge of the square, a former street was transformed into a linear paved pedestrian walkway. The square is designed and programmed to hold urban markets, music festivals, and other community events throughout the year.

The Knox Common Community Urban Park metaphorically turns the church inside out, opening the original brick building up programmatically to wider community uses, in alignment with the congregation's mission of greater community engagement. Like the entrance to the sanctuary, the main entrance to non-worship areas of the building is also now visually and physically accessible from the public high street, across a previously unused stretch of grass now reimagined as a community common. We also expanded this green area over the adjacent, unusually wide two-lane road with curb parking to create a verdant, contemplative urban park in the center of the otherwise hard surfaces of the downtown. This provides citizens with an equal but opposite experience to the main square a block away.

As per the theory of constructed emotion, the community common explores how our external environment shapes our internal health and well-being. Landscape architect and neuroscience researcher Agnieszka Olszewska-Guizzo has further expanded on this concept with her "Contemplative Landscape Model," which focuses on qualities of spaces that induce positive mind health. She maintains that there are "two types of contemplation: calming and insight contemplation. The former focuses predominately on the elimination of thought and could be compared to a trance or hypnosis … On the other hand, insight contemplation stimulates reflective states of mind, which promote cognitive and emotional development."[75]

The Knox Common Community Urban Park creates a figurative yin-yang of garden areas, bisected by an S-shaped promenade that stimulates seeking and curiosity. Adjacent to the promenade, landscape elements create immersive calming and peaceful places, while other spaces within the common enhance sensory experiences of changing light and seasons.

This is a shared, public place with abundant nature and natural stimulants for all our senses that also offers much-needed opportunities for quiet reflection, silence, and stillness in an otherwise hurried urban environment.

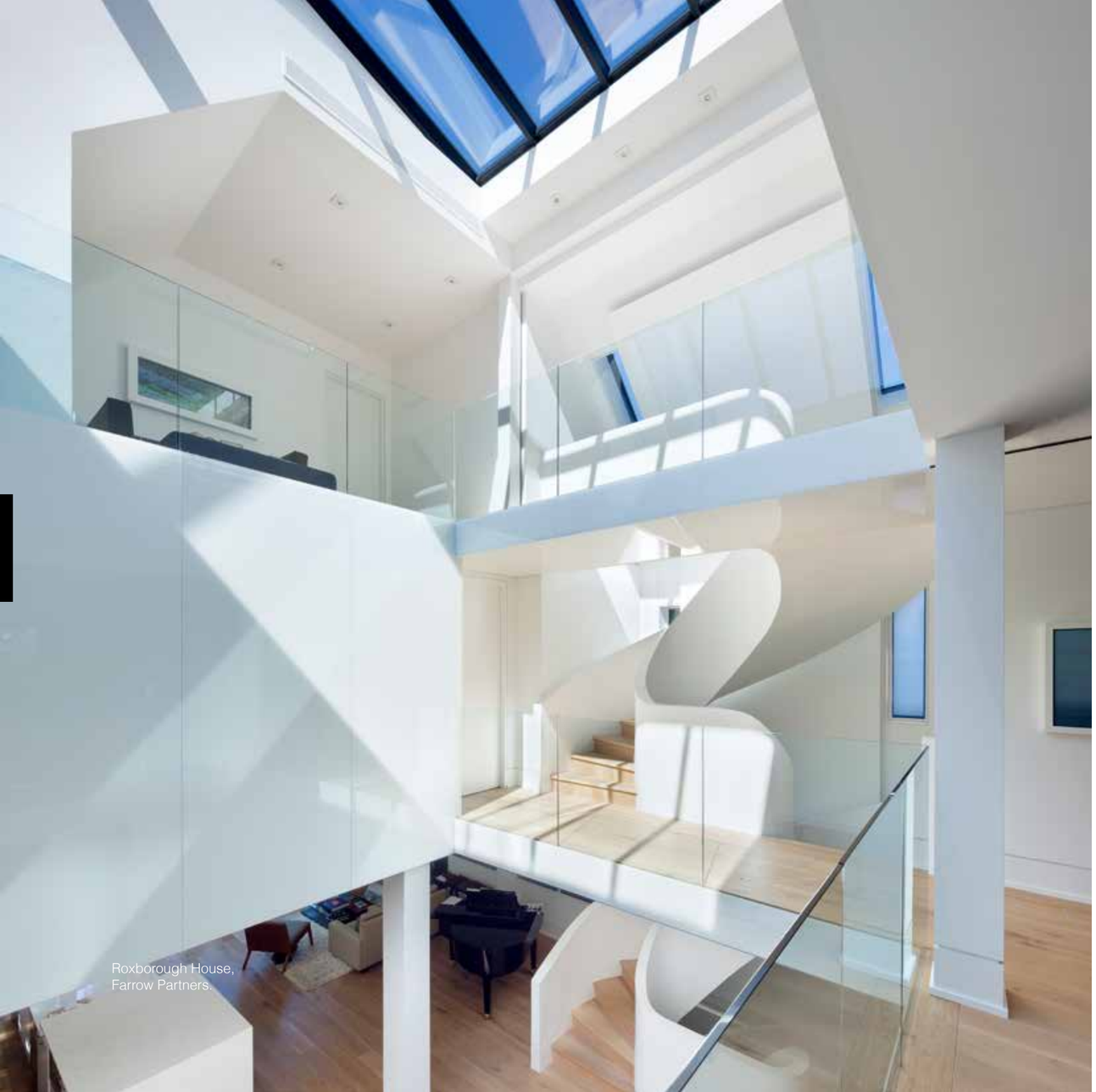
Knox Common Community Urban Park at dusk, Farrow Partners.

Boswell House,
Farrow Partners.

11

Living Places:
House, Home, and a Sense of Coherence

Cities are often thrilling places to live, but the noise they produce can drown out the subtler natural sounds that envelop us, from birdsong to the rhythms of our breathing and the beating of our hearts. Home is often a counterbalance to these forces – a place where we seek refuge and repose, where we want to enter, linger, and stay a while, where we feel drawn in and at peace. The qualities of light and shadow, how light falls on a surface, the surface depth, sheen, or reflectivity of materials, the way sound reverberates or is absorbed, and the shape and form of a space all affect how we experience home. We “listen” with all our senses to the spatial language of home with our bodies, within our bodies, and beyond our bodies. A warm and generous home provides a sense of stillness and intimacy while also being a place to share our most human milestones and celebrations that occur throughout life. The place we call home can often be one of the most important contributors to a sense of coherence in life.



Roxborough House,
Farrow Partners.

The influence of our surroundings on our cognitive health, well-being, social cohesion, and sense of belonging are most evident in the places we call home. As we discussed earlier, the terms house and home are often used interchangeably. However, they are distinct concepts based on very different fundamentals.

A House or a Home?
A house is a physical Cartesian spatial measurement that includes the programmatic elements that are needed for its residents, such as living, dining, and sleeping spaces. A home refers instead to the interconnections between material and immaterial qualities of domestic place – the architectural atmosphere, or Stimmung.

Homes hold emotional memories that linger and spin intangible stories in the minds of those who reside there and help define a sense of coherence. Home is where we perform our intimate rituals – the social and material practices of family traditions, expectations, customs, and beliefs that develop out of our understandings and interpretations of our surroundings, based on cultural/social experiences (learned), past experiences (remembered), and layered cultural iconography. The act of making a home is a social practice, deeply connected to performative representations of place-identity. There is a reason why we say "make yourself at home" instead of "make yourself at house."

Person-to-Place Domestic Relationships
Creating the conditions for home is always top of mind when we design a house or dwelling. We aim to create environments with the potential to construct person-to-place relationships that have the same qualities and characteristics of healthy, relevant, and enriching person-to-person relationships, and that offer inhabitants a sense of coherence, comprehensibility, manageability, and meaningfulness. Translating the characteristics of human relationships into the built form as enriched domestic environments means designing houses that feel welcoming, generous, open, authentic, full of variety and vitality, natural, caring, safe, solid, still, and intimate.

The projects shared in this chapter – Roxborough House, Millbank House, MacPherson House, the R-Hauz V2 Prefabricated Laneway Houses, Boswell House, Cedar Ridge House, King City Guest Houses, the Treehouse Multigenerational Living Building, the E'Terra Samara Resort, and the Living Bridge – all embody these qualities on a domestic scale, overlaid by the concept of *Stimmung*.

Unusual Inspirations for Domestic Environments
While it might at first sound unusual, many of the characteristics of these domestic environments evolve out of our thinking on one of the most complex institutional buildings our office has completed: a cancer center, which includes a cancer radiation treatment bunker (explored further in chapter 13). Radiation treatment bunkers, as the name suggests, are rooms encased in 5 feet (1.5 meters) of high-lead-content concrete. In order to contain the radiation, many have a thick, vault-like door that closes behind you with a heavy thud. Typically, a radiation treatment bunker is not a space that is particularly inspirational to someone on a cancer treatment journey or one that you might imagine as an enriched environment. It is certainly not the sort of space that would normally inspire the design of someone's home.

During the cancer center design process, I learned from the project's physicist that radiation dies out exponentially over time and distance. This meant that by changing the shape of the path the radiation traveled from the treatment area to the entrance, we were able to remove the lead door and also bring daylight into the space through a sculpted skylight. Our radiation treatment bunker is one of only a handful in the world to achieve this.

For a person alone in the space undergoing treatment, facing what might be an uncertain outcome at the time, this is an extremely meaningful design choice. If a cloud passes in front of the sun, the space pulses and changes. If a storm blows through, with dark clouds, lightning, and rain, and then the sun comes back out, the person becomes part of the natural surroundings. Simply put, it reminds people that they are alive and part of a larger cycle. Too many places we inhabit remove that simple yet profound element of connection to nature, with all its constant change.

Cycles of Nature and Life
On a neurological level we know that connection to the natural environment stimulates our minds and bodies in very meaningful ways and promotes positive health outcomes. Clearly, when a person is on a cancer journey, this simple act of generosity through what the space affords – of connecting them to the cycles of nature and life through the atmospheric effects of *Stimmung* – reminds them of their own humanity. This is, of course, of great significance to them, not to mention to the staff who work in the space all day, every day, often under tremendous pressure.

The connecting and awakening qualities of space that make a difference to the person undergoing cancer treatment are just as important for those intimate and personal places we call home; the places that hold some of our most emotional memories.

Roxborough House,
Farrow Partners.

The Roxborough House, in Toronto, Canada, appears from the outside to be a rather typical three-storey, late-nineteenth/early-twentieth-century detached brick house, complete with a wide, wooden front veranda. Once inside, however, the narrative of silence and stillness begins to reveal itself.

Deliberate design decisions foreground the qualities of nature in the home, allowing for the stimulation of one's senses, as one becomes aware of the changing light, color, and atmospheric conditions of the days and seasons.

We carved out the original center of the house to create a full-height, enclosed interior courtyard, thereby in effect creating two houses, front and back, linked by bridges and a central stair, which draws our view upward to clerestory windows and a skylight. The west wall is extended slightly into the side yard, like a drawer pulled out from a cabinet, creating thin, diagonal interior views to the front and rear of the property.

The middle of the glazed-covered courtyard is occupied by a long dining table opposite the double, half-elliptical staircase, which resembles a wisp of curling smoke or a twisting torso. The staircase appears to have a shimmering twin, as it is reflected in white, back-painted glass panels that cover the walls and underside of the bridges that connect the "two houses." While many of the projects we show in this book use a lot of wood in their structures and finish, Roxborough House is mostly white, save the floor, with extensive use of back-painted glass and glass railings.

This may seem at odds with the desire to create a warm environment, but the interior is anything but cool. This is because the white back-painted glass and glass railings capture the changing light conditions, becoming a moody, swirling canvas of multihued foliage or blue, pink, and grey skies. As a result, one feels connected to nature, becoming aware of day transitioning into night or summer to fall to a much greater degree than one normally would in a house with the usual front and back exposures in a dense urban setting.

Roxborough House, Farrow Partners.

The Millbank House, also in Toronto, is the forerunner to the Roxborough House (and was built for the same family). It explores a similar narrative of atmospheric *Stimmung* in an urban condition, for residential life.

A solid, mid-1950s, two-storey pitched-roof house, deeply set back into a ravine to the rear, already existed on the site. Rather than demolish the original house, we preserved it to maintain a sense of authenticity and added a new “front house” to the building. Here, we designed a series of “light drawers” – walls that are intentionally pulled up and out to capture daylight and distant views through strategically placed windows.

An enclosed courtyard, similar to the one in the Roxborough House, is located between the new front house and the preexisting one to the rear. Views to the side of the property are carefully filtered, while, again, the main prospect is upward.

Millbank House, Farrow Partners.

Millbank House massing model showing the existing house to right.

Millbank House entry hall, Farrow Partners.

MacPherson House, Farrow Partners.

The MacPherson House, built prior to the Millbank and Roxborough Houses, was the first of the three to explore the somewhat nebulous, ephemeral concept of *Stimmung* in a domestic environment. Also situated on a tight urban property flanked by taller houses, the existing 1911 single-storey yellow brick cottage was complemented with a two-storey rear addition. The height of this new structure is just above the ridgeline, allowing the original cottage to retain its mass and authentic presence on the Toronto street, while hinting at the volume within. We carved out the interior of the cottage to its roofline and housed a spacious living room with a thin mezzanine inside. The living room/mezzanine and the center of the house are lit by a long skylight above a central staircase located between the new and existing buildings, as well as by a narrow clerestory above the original ridgeline. The main living room is an early exploration of our interest in the interior courtyard typology, with primary prospects upward and more narrow, controlled views toward the street and side yard.

Original MacPherson House.

MacPherson House living room, Farrow Partners. Photographed by Ted Yarwood.

R-Hauz V2 prefabricated laneway house, 40-foot-wide option, Farrow Partners.

R-Hauz V2 prefabricated laneway house, 40-foot-wide option, Farrow Partners.

R-Hauz V2 prefabricated laneway house, 20-foot-wide option, Farrow Partners.

R-Hauz V2 prefabricated laneway house, 40-foot-wide option, Farrow Partners.

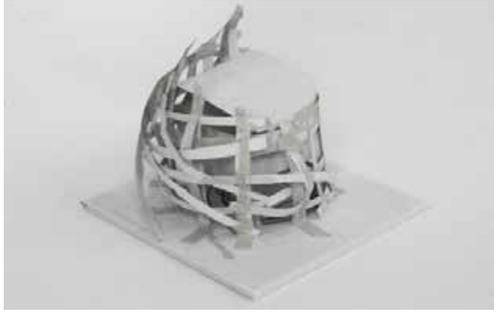
The R-Hauz V2 Prefabricated Laneway Houses, designed after the MacPherson, Millbank, and Roxborough houses, continue to explore the concept of light drawers in urban environments that are intentionally pulled up and out to capture atmospheres and thin, focused views, but with a great deal more potential variety.

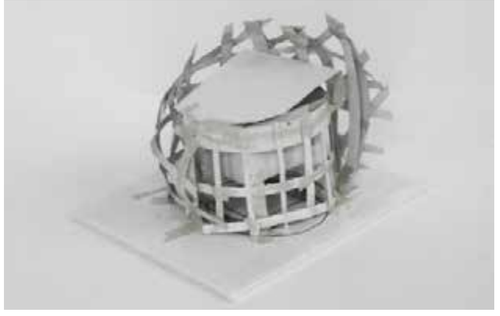
The designs include a range of prefabricated homes, using individual elements that can be combined in properties ranging from 20 to 40 feet (6 to 12 meters) in width, preassembled and stacked in place, thereby reducing on site construction activities and costs. Designed for a Toronto developer and builder with a focus on affordability and sustainability, these houses are intended for very urban, back-lane conditions, where there is usually a lot of overlook from surrounding buildings.

By placing the living areas on top of garages, we do not compromise on the quality of light or the sense of *Stimmung*, even in such dense environments, yet ensure a sense of privacy for those living in these laneway homes.

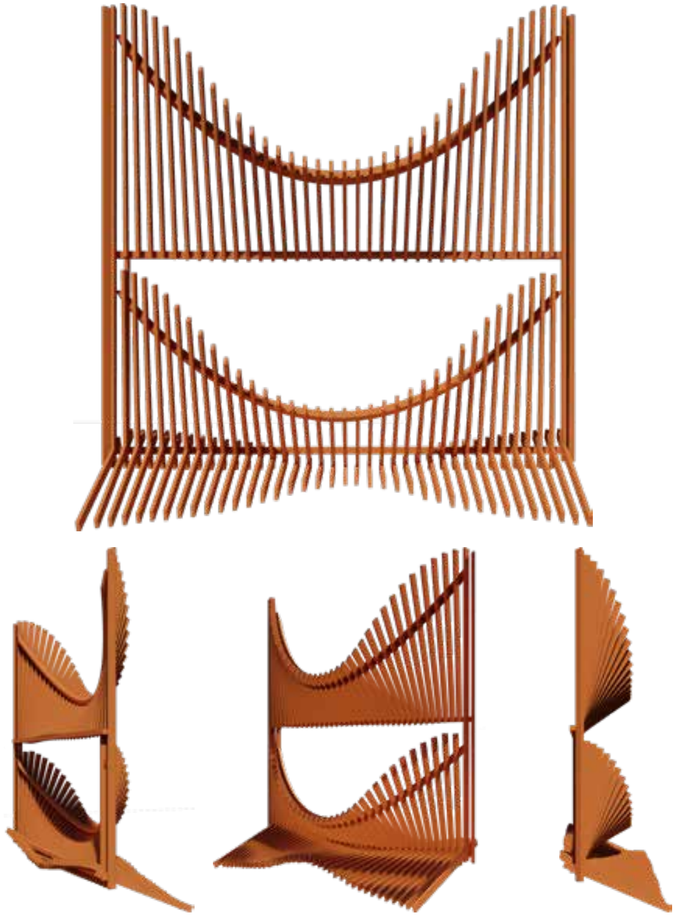
R-Hauz V2 prefabricated laneway house, 40-foot-wide option, Farrow Partners.

Boswell House, Farrow Partners.





Cedar Ridge House massing models, Farrow Partners.



Boswell House terracotta screen seen from different vantage points, Farrow Partners.

With the **Boswell House** and the **Cedar Ridge House**, we continued to explore the ability to capture changing atmospheres, but through exterior screens that wrap portions of the buildings rather than through light drawers. In the Boswell House, the veil is made of terracotta, while in the Cedar Ridge House, it is in the form of timber bent and curved in two different directions.

The Boswell House is on a Toronto street consisting mostly of red brick, single-family or duplex buildings with thin front yards. The house is a narrow, glazed, detached three-storey structure, layered with a screen of tightly spaced terracotta brise soleil that are vertically oriented on the sides and gently lower toward the center, opening views outward while raising in profile again at the edges to create internal privacy, even as they filter the changing light conditions.

Instead of taking its design cues from neighboring houses, the rhythm of the street-facing part of the veil is inspired by the branches and structure of a large adjacent tree. The veil continues the thinking which began with a treehouse resort project of ours from ten years earlier. The design emerged from a desire to not only be “in the trees,” but also “of the tree.”

The Cedar Ridge House in Toronto further explores natural and fractal patterns, in this case derived from the forms of surrounding trees – their trunks, branches, and the fine veining of their leaves – through the use of curved and layered wooden boards that form a spherical wrapping of the cube-like enclosed structure of the house. The changing density of the wooden boards creates ever-changing rhythms, patterns, through light, and shadow on the interior of the modest square enclosure, exploring a midrange dimensional complexity “sweet spot” that resonates with us emotionally.

King City Guest House exterior view, Farrow Partners.

King City Guest House interior views, Farrow Partners.

Above and below: King City Guest House various massing configurations, Farrow Partners.

The King City Guest Houses are a result of our ongoing product development collaborating with NUCAP and their sticky metal system. We used the guest houses to explore the forgotten pleasure of meditative silence in a world of saturated stimulation.

The guest house designs imagine an unplugged architecture, located on a rural site surrounding a small lake north of Toronto. Several modestly scaled rooms, each 9 square feet (2.75 square meters) in width and height, are placed in square tubes of various lengths. These tubes can be stacked on one another in different configurations to create a range of experiences, from projecting over the water's edge to providing long views across the rolling landscape.

Each space within these houses are lined with natural wood, offering guests the opportunity to be still and listen to their surroundings and their own being. Spending time within this architecture of silence and intimacy allows the usually unnoticed to come to the forefront of our sensual and emotional perception.

Treehouse double height mid-level common space with residential suites above and below, Farrow Partners.

The Treehouse Multigenerational Living Building, on a larger scale than the single-family houses, proposes a new typology for senior living as a community-based concept that integrates the benefits of timber with a design that improves the physical and mind health of older people.

The name “Treehouse” derives from the concept’s key feature: a double-height common area and exterior terrace, located four stories above ground level. Accessible by an elevator, but primarily by a set of generous stairs, this upper-level perch offers a constant connection to the outside world though aerial views and tree canopy sightlines, providing residents with an ongoing relationship with the changing seasons, weather patterns, and time of day.

Typically, multi-unit housing locates common areas, such as dining rooms and shared kitchens, on the ground level, with residential units above. Several benefits emerge when these gathering spaces are placed higher up, where windows bring in daylight. The visual prospect and sensory stimulation derived from aerial views is especially important for those who may have mobility issues and can’t easily venture outdoors.

The building’s design actively encourages physical exercise as a daily routine. We have transformed what could have just been a typical, functional fire exit into an open and generous staircase, with multiple landings and shallow risers to make the prospect of climbing or descending enjoyable. Even residents who have difficulty walking up stairs may find themselves able to walk down them, thereby helping to maintain their mobility and increasing leg strength. Stairs leading to all the common areas also increase the chance of bumping into neighbors and having personal interactions.

Treehouse double height mid-level community kitchen, dining and living areas, Farrow Partners.

Two key elements of Treehouse are its scale and location. Topping off at six stories, the development can be inserted into vibrant high streets that become an extension of the building itself. With an active street life and a host of nearby conveniences, older occupants can maintain their autonomy through easy access to grocery stores, banks, libraries, coffee shops, and parks. When our elders live in the midst of the action, they are much more likely to feel connected and empowered, to feel a sense of coherence, which enhances mind and body health.

Ground-level suites are arranged as two-storey street or garden townhouses for multi-generational families. Here, young adults can benefit from the informal childcare provided by older residents, while elders can benefit from the variety, energy, and spontaneity that younger people bring, and children can gain insights from spending time with an older generation that brings a wealth of knowledge, experience, and different perspectives to their lives. In name alone, Treehouse recalls childhood adventures and prompts associations with nature, curiosity, freedom, and exploration.

Made largely of mass timber, Treehouse also smells good, which conjures up positive memories. As we have seen earlier, the emotional benefits of wood’s aromatic scent and warm, tactile qualities have many physiological and therapeutic benefits. Studies also have shown that older adults surrounded by nature, and natural material, generally have a greater sense of agency and acceptance regarding the transitions of life than those who live in more unnatural environments, because they feel more connected to and in tune with the cycles of nature.[1]

Post COVID-19, multiple polls show that more than 80 percent of people over fifty-five will do anything to stay in their own homes rather than move to the types of shared living arrangements that currently exist for seniors.[2] Treehouse attempts to create a health-giving alternative, which offers added connections and agency in one’s life.

In the trees, and of the trees: the E'Terra Samara Resort Pavilion, exterior and interior views, Farrow Partners.

Inspiration: Kenrokuen Garden, Japan, in winter.

The E'Terra Samara Resort Pavilion structure is prefabricated off site in three sections, Farrow Partners.

The E'terra Samara Resort project was designed for a client in rugged Grand Bend, Ontario, Canada, who runs a five-star eco-resort committed to creating a restorative place in a natural setting that addresses the mental, physical, and spiritual dimensions of their guests' health.

The design emerged from a desire to not only be "in the trees" but also "of the trees" and is therefore conceived of as twelve one-bedroom dwelling villas that are suspended in the forest. Both the name and dominant form of the project are inspired by the samara, more commonly known as the maple key. Samaras have a winged, fibrous, papery propeller shape that enables the autumn wind to carry the maple seeds (or what biologists refer to as the "fruit") farther from the parent tree than regular seeds, which simply fall to the ground.

As we have explored, research into biophilia indicates that there is an instinctive bond between human beings and other living systems. E'terra Samara Resort provides guests with the opportunity for sheltered yet direct contact with the surrounding forest, essentially allowing them to experience camping in the trees. At night, the irregularly placed structures glow in the foliage, suggesting the bioluminescence of fireflies.

Rather than following the common practice of nailing the dwelling to the tree, the structures, made of locally harvested wood, are suspended from a series of cables attached to a collar that hugs the tree higher up the trunk. The design of this collar and its construction methodology is inspired by the umbrella-like yukitsuri ropes that intentionally support the branches of black pine trees in Kenrokuen Garden, Kanazawa, Japan, so they don't bend under the weight of heavy snow.

The suspended villas are prefabricated off-site in three sections using a construction methodology that draws on lightweight wooden sailboat construction techniques from Atlantic Canada. Polytetrafluoroethylene (PTFE) fabric bonnets attach to the wooden frame and function like the leaves of a tree, providing shade and comfort while actively neutralizing airborne pollutants.

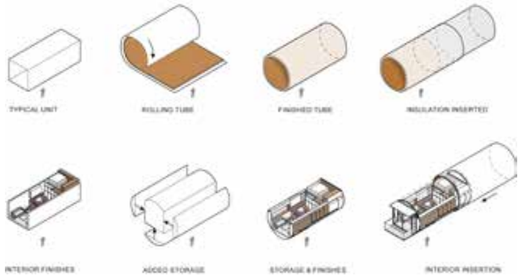
Electricity is self-generated through a decentralized photovoltaic power grid, and the bathroom/toilet system is similar to that of a boat. To minimize disturbance to the delicate flora, each samara villa frame is hoisted into place and bolted together in the winter months.

The E'terra Samara Resort treehouses points towards a growing interest in using our built environments to intentionally activate optimal health and well-being, based on the understanding that the mind is shaped by how the body receives, processes, and interprets signals from the places we inhabit.

Hungerford Living Bridge, London, England, Farrow Partners.

Living Bridge, Toronto, Canada, Farrow Partners.

Living Bridge typical residential suite interior, Toronto, Canada, Farrow Partners.



Living Bridge typical residential suite structural system assembly diagrams, Farrow Partners.

The Living Bridge continues our interest in multi-use infrastructure that we outlined earlier in the Venice Archipelago Project. In this instance, the project explores using existing bridges to accommodate other uses, including reasonably priced housing in dense urban cities where available and affordable land is a scarce commodity; think of the Rialto Bridge in Venice or the Ponte Vecchio in Florence, which long ago combined infrastructure with human-scale, walkable, mixed uses, thereby creating beloved urban environments and landmarks.

Vibrant cities around the world are facing urgent demand to offset an alarming side effect of their success – a high quality of life that rapidly becomes inaccessible for people who are essential to nurturing healthy and resilient communities but can't afford to live there anymore. This includes nurses, schoolteachers, and police, among others, who have to face long commutes from suburbs and exurbs because of unaffordable living conditions in the city itself.

Paired with this, we are seeing rising levels of metal health issues, specifically among young people, seniors, and those who live alone, due to growing levels of isolation in mind-numbing high-rise condominiums and apartment buildings. Many of the affordable projects being built also consist of only one age or socioeconomic group, versus being multi-generational and economically and socially diverse, which creates more vibrant, helpful, and healthy communities.

The Living Bridge is a cost effective, micro-housing solution using modular, rapid-assembly, lightweight building systems that emerged out of the automobile sector and that we have been involved in adapting to the construction sector. Individual suites are constructed of rolls of Velcro-like hooked metal, layered and pressed together with sheets of wood veneer that has been infused with a polymer, thereby creating a lightweight tubular structure out of natural carbon fiber material. When linked together, the tubes form a chain-like structure.

Instead of the flat ceilings of typical residential units, these suites feature curved wood ceilings formed by the shape of the exterior structural tubes, creating warm and authentic homes that give off the perception of spaciousness

Waverley Living Bridge, Edinburgh, Scotland, Farrow Partners.

in micro-housing suites. The interior walls and floor are at right angles so that infill panels can provide maximum in-suite storage, with residents not having to rely on basement storage lockers as is usual in condominiums. Cupboards and shelving are built into the space between the curved form of the exterior structure and the interior right-angled walls.

Located above the bathroom under the curved ceiling, a bedroom loft provides additional space for these compact, efficient suites. Here one can enjoy silence, stillness, solidity, and intimacy – qualities of places where we want to enter, linger, and live. Places that draw us in and make us feel at home and at peace.

TMS Lower School community entrance atrium, Farrow Partners.

12

Where We Are Learning: The Neurological, Psychological, and Emotional Benefits of Enriched Learning Environments for Students and Faculty

The effects of the built environment on health and well-being are significant and increasingly well documented in the fields of cognitive psychology and neuroscience. The COVID-19 pandemic, which forced us to spend more time indoors, made these effects more apparent than ever. In particular, the pandemic underscored the importance of learning environments on mind health. The physical closure of schools and campuses created a vacuum of community connection that was very often difficult for students, teachers, and parents. We must make it a priority to design places of learning that optimize enriched experiences – immersive learning environments that enhance the opportunities of students to excel, connect, and improve their health and well-being.

2

When we hear something, we often forget it; when we see something, sometimes we remember it. When we touch something or do something, experiencing it through our minds and bodies, it becomes embedded within us. How we design our learning environments affects the quality of the spaces that students and teachers experience and thereby directly influences their moods, behaviors, actions, and ultimately the experience of learning. School design should intentionally contribute to the four main factors of optimal health that we explored earlier in this book: environmental health (our interactions within ecological systems), physical health (design's influence on bodily movement), societal health (individual and community interactions), and mind health (how places make us feel and how they can make us feel better).

Seeing Ourselves through Our Surroundings

Our places reflect who we are and what we value. Therefore, the design of learning environments should reflect the philosophies and attitudes we seek to encourage in those who occupy them. When we see ourselves represented in our buildings, we are more open to the influence of their spatial qualities that support health, personal growth, and inspiring relationships with others. Conversely, badly designed buildings can exacerbate poor health, personal stagnation, and inequality. Through design choices that accelerate well-being for students and teachers alike, schools can become powerful and enduring accelerants for learning and social justice.

This raises several questions. How can school buildings empower students and support their ability to learn and adapt throughout their lives? In what ways can they enhance health and well-being? And how might the design of schools offer students and faculty a greater sense of coherence in their lives?

Human Perception and Well-Being

Addressing these questions requires holistic design that is based on the principles of environmental enrichment. The findings of cognitive science and neuroscience, in particular those that focus on how place affects human perception and well-being by stimulating learning, memory, and social interaction, should be at the root of decisions administrators and architects make about program needs, scale, materials, lighting, sound qualities, and physical and visual access to nature.

Advanced, enriched learning pedagogies place students at the center of the experience. They tend to support students' individually preferred modes of learning and offer flexibility to evolve, improve, and advance collaborative and creative experiences. Unfortunately, the physical places in which students learn often work against these objectives. Indeed, school design typically falls into one of two categories: mind-numbingly repetitive (based on a mechanistic, industrialized approach to learning), or garishly animated (featuring excessive use of bright colors, bold patterns, and oddly shaped spaces that are childish instead of child-like).

Environmental Enrichment in Learning Environments

Environmental enrichment, which we have previously discussed, together with one's own lived experience, tells us that the quality of an environment substantially influences well-being, intelligence, and longevity and can uplift us as well as enhance mind health. The reasons for this are multifaceted. On a neurobiological level, feeling good lowers levels of cortisol (the stress/anxiety hormone), which reduces the incidence of high blood pressure, heart problems, headaches, and immune system deficiencies. Of particular importance for students, environmental enrichment also enhances learning and memory while strengthening neural networks.[1]

One well-documented example of the power of the built environment to affect well-being is the Snoezelen room, a controlled, multisensory environment used to treat disruptive thoughts and behaviors through a combination of light, color, sound, and sensation from a variety of sources, including bubble tubes, fiber optics, aroma diffusers, textured surfaces, and interactive screens. First developed by two Dutch therapists in the 1970s to treat people with special needs, including very autistic children and older adults with severe dementia/Alzheimer's disease, Snoezelen rooms are not only effective in helping children develop spiritually, intellectually, mentally, and physically but also in treating those with autism spectrum disorder (ASD), a neurodevelopmental disorder categorized by difficulties with sensory processing, communication, and social interaction.[2]

The Snoezelen room is tailored to the individual. A therapist, in concert with their patient, determines the sensory presets (auditory, tactile, gustatory, visual, and olfactory) of the room in order to create a space that meets the child's individual sensory needs. In this way, it can aid healing, learning, and development, relax an agitated or anxious young mind, or increase alertness.

A 2010 study by researchers Leonardo Fava and Kristin Strauss on the effectiveness of spatial and sensory manipulations on the well-being of ASD patients found that disruptive behaviors decreased, and pro-social behaviors increased, for ASD children who spent time in Snoezelen rooms.[3] These study

The Arc, at the Green School, Bali, Indonesia, reinforces positive ideation. Designed by Elora Hardy / IBUKU.

results recall Donald Hebb's work with lab mice placed in appropriately stimulating environments containing running wheels and other toys, resulting in mice that lived longer, had fewer behavioral issues, were physically healthier, and had higher cognitive test results than mice in standard lab cages (see chapter 6).

Positive Ideation and the Built Environment

Studies show that the built environment is also an important factor in the cognitive development of gifted children and those in enhanced learning programs. While feeling supported and reflected in their efforts at home, at school, and with their peers certainly contributes to the motivation of these students,[4] positive perceptions of the built environment demonstrably improve academic performance[5] and contribute to their desire to learn as well.[6] An oft-cited challenge for gifted students is not having their social and emotional needs met within standard learning environments,[7] which was further complicated by the widespread and in some cases permanent introduction of remote learning during the pandemic.

Learning environments have both immediate and long-term effects on student well-being and cognitive development. The quality of spaces and how program elements are assembled is significant in building the capacity of students to flourish in all areas of their lives. Places that cultivate positive ideations of self, encourage curiosity and learning, and support opportunities to develop fulfilling relationships with others and the natural world are essential for creating impactful learning environments, yet they are not always accessible to all. This creates an opportunity for decision-makers to foster well-being and equality in the next generation by prioritizing purposeful design and material interventions in schools.

Human Beings Are Wired to Learn

Neurobiologically, learning results from the bolstering of synapses affected by genetic and environmental contributors.[8] As we have seen, this is known as long-term potentiation (LTP), a process in which neural networks strengthen as a result of repeated actions, ideas, and behaviors. Synapses are cellular connectors that reach outward from each neuron toward the other 100 billion neurons in the brain, creating an extraordinarily intricate cosmos of cells unique to each of us. Any neuron may be connected to 10,000 other neurons, creating super networks that pass signals to each other through a quadrillion synapses.

Brain Plasticity

LTP is a primary contributor to brain plasticity, a term that refers to our ability to learn and adapt throughout our lives due to the ever-changing character of the connections between neurons. As our actions and behaviors change over time, so does the strength of the synaptic connections between cells and regions in our brains. Learning and memory are in an endless state of change, although they are most substantially pliable during childhood and adolescence. This is why our years at elementary and secondary school have such an enduring effect on our lives.

Jean Piaget's research on how children acquire knowledge recognized learning and memory as a progressive reorganization of biological mechanisms influenced by environmental experiences. His work contributed significantly to our evolving understanding of how children and young adults develop cognitively, along with the role that biology and environment play in brain plasticity.

Bishop Strachan School, student center, Farrow Partners.

Designing for Learning and Well-Being
As we have seen, the design of the built environment affects the psychological health and, as a result, the physiological and sociological health of young people.

Design affects our ability to learn, collaborate, and grow together as part of a community. Through salutogenic design of our learning environments, we can create a measurable dimension of comprehensibility, manageability, and meaningfulness in our schools. Most importantly, can we create the sense of coherence that is such a strong predictor of positive health and wellness outcomes in young people, and which has a long-lasting impacts on their adult lives as well.

Educational facility design has largely focused on the transfer of knowledge rather than the creation of spaces that support learning and well-being. But now that we have a greater understanding of how enriched environments improve learning outcomes and employee satisfaction, we can build a strong argument for quality of space as an active contributor to student and teacher well-being. Developing salutogenic design strategies that support and accelerate health, reduce stress, create a sense of self, uplift us, and make us feel better inevitably leads to improved student learning and staff career outcomes.

Absorbing Our Surroundings
As we have previously noted, architecture is like food – we consume it through all our senses, and it can either enrich or malnourish the mind, body, and spirit. Many schools are the architectural equivalent of empty calories – either lacking in sensory stimulation and therefore mentally unfulfilling, or overstimulating, like sugary junk foods. However, just as nutrient-dense superfoods enrich our bodies, we can fine-tune our built environments to enhance our capacity for thinking, creating, concentrating, and engaging with others.

One of the greatest architectural superfoods that supports early childhood learning is the incorporation of nature and natural or nature-inspired elements into school design. This is particularly evident in Montessori schools, with their emphasis on wood furniture, natural lighting, plants, and naturally made learning materials. When buildings strengthen our relationships with nature – whether it be through bringing nature inside, views of nature, the use of natural forms and materials, an abundance of natural light, or design elements that contain midrange fractal patterns of dimensional complexity that we find in nature – they create a deeper connection to the natural world around us.

Learning from Nature
Environmental education – the use of the natural world as a setting for teaching purposes – strengthens positive ideations of self and supports healthy personal development. Exposure to nature increases self-discipline, promotes imagination, and supports cognitive development in young students.[10] These facts, together with the growing acceptance of naturalist Edward O. Wilson's theory of biophilia, which hypothesizes that we are hardwired to seek connections with nature and other forms of life, is now influencing both curriculum and building design.

How we design educational facilities has both a significant short- and long-term impact on the mental, physical, and emotional health of students and staff.

Because the neural mechanisms involved in learning, memory, and brain plasticity can be reinforced by the quality of spaces people experience, enriched environments have a vital role to play in supporting

Architecture is like food – we consume it with all our senses: Bishop Strachan School, student center, Farrow Partners.

student well-being, cognitive development, and even longevity. How we perceive and interact with spaces contributes to how we view ourselves, which is of utmost importance to young people trying to make sense of the complex and ever-changing world and social networks around them. In short, the qualities of our person-to-place relationships influence our person-to-person relationships.

Designing For a Higher Purpose
Deliberately designing our schools to include elements of enriched environments creates better learning and working environments that promote health and well-being for the entire school community. This means designing schools that offer a sense of vitality and variety, stimulate our curiosity and ability to learn, prompt us to feel and think in new ways, offer hope, invigorate us, and feel abundant. Such schools offer natural environments that are both visually satisfying and physiologically rewarding. They create spaces for stillness and intimacy that allow us to slow down and listen to our own being. They are authentic and rooted spaces that project a sense of legacy and warmth. Most importantly, they are generous spaces that communicate a higher purpose and make us more empathetic to those around us.

We will explore these themes in several schools our office has designed, including buildings at Toronto Montessori School (TMS), Royal St. George's College (RSGC), the Country Day School, the Bishop Strachan School, the York School, Elmwood School, and Holy Name of Mary College School.

Toronto Montessori School
Before starting the design of a new addition to this school, we spent considerable time researching the pedagogical philosophy of Dr. Maria Montessori, the Italian physician and educator whose Montessori method is practiced by Montessori schools around the world. Montessori believed that children learn through materials and through the way in which both the teacher and the design of the learning environment promote self-directed engagement with those materials. She also believed that every child has an innate love for nature, and therefore the objects children engage with should be made of natural materials and shapes. Furthermore, these objects should be manipulable and designed to support learning of sensorial concepts such as dimension, color, shape, and texture as well as more academic concepts in language, mathematics, literature, science, geography, and history, many of which have their origins in the cycles, experiences, forms, and fractal patterns of nature.

Importantly, Montessori believed that education should support the activation of children's own resources. This includes being variable and manifold without being overstimulating, creating abundant resonances, encouraging active involvement, exploration, co-creative interaction, and self-efficacy, and internally and externally connecting with life energies and the awareness of one's own body in space.

Montessori's approach is, in fact, very similar to the salutogenic goal of creating a sense of coherence. A student with a strong sense of comprehensibility can imagine a positive future; a student with a sense of manageability believes they have the resources to meet life's challenges and demands; and a student with a sense of meaningfulness is motivated to continue on the path they are traveling, in this case, the path of their studies.

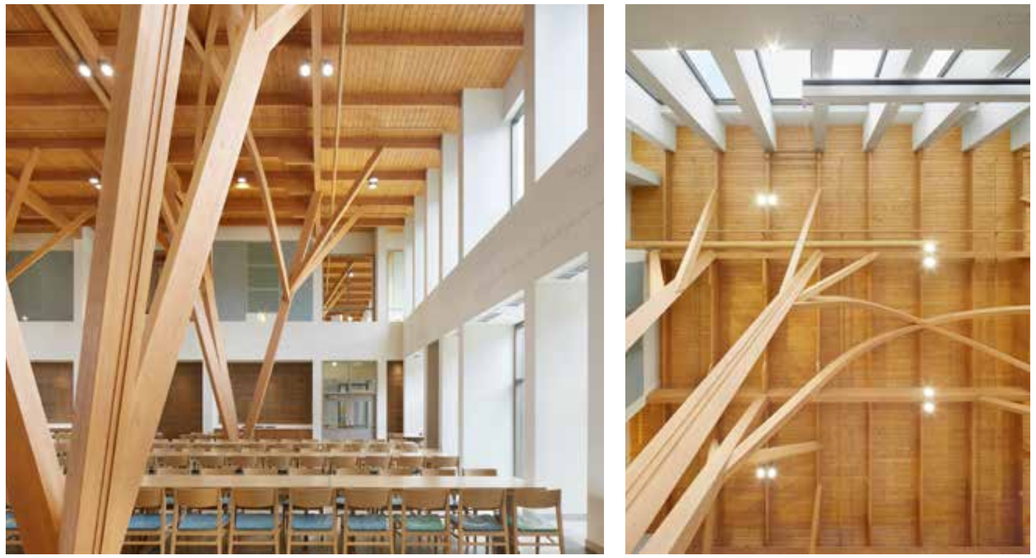
TMS Lower School community entrance atrium, Farrow Partners.

TMS Lower School (Bayview Campus)
The TMS Lower School's new entrance building, which houses a central atrium reception, administrative and community spaces, a gym, and related support spaces, expresses these values through architectural characteristics and qualities of space that include nature, variety, vitality, a sense of occurrence, optimism, and generosity. Its semicircular concave facade frames your approach like an embrace as you pass from the parking area from the north along winding paths through a new garden and plaza to the main entrance. Here, you are greeted by a single-storey, colonnaded, veranda-like space that edges the building and creates cover and seating areas for students, teachers, and visitors. The northern section of the building is lower at the entrance than at the opposite south side, with the roof appearing to hover a foot (about 30 centimeters) above the wall. This creates a visible break in the wall-roof connection, which provides a narrow, unencumbered view to the sky beyond. The roof then slopes noticeably upward toward the south, where an exterior, grove-like courtyard filled with ferns and multistemmed birch trees separates the new building from the older one.

Inside, the sloped ceiling balances asymmetrically on large, semicircular wood arches, radially positioned along the length of the space and spanning from side to side. Smaller straight beams spring out from the arches in triangular patterns toward the secondary beams in the roof plane, creating spark-like connection points to the arches. All structural elements are made of wood, with their steel connections concealed. The architectural forms of the space encourage mental movement through it, which also creates a reciprocal effect of physical motion and exploration in the mind.

The convex southern wall of the building is a mix of floor-to-ceiling glass, fine triangular interior wood brise-soleil grillage, and large green triangular sail-like solid forms. Paired with constantly variable daily and seasonal light conditions, this creates moody and ever-changing light and shadow conditions in the space that feel alive and run the range from subtle and subdued to celebratory and spiritual, for the school community that uses it daily.

The mix of circular and fractal triangular shapes along a radial plan allows one to see the same arches from different visual perspectives while standing at the same point within the space. This, along with the changing light conditions, creates a perceptual positive ambiguity, which stimulates the mind as it traces the crisp corners of the triangles and the sensual edges of the curves. This is further accentuated by the contrast between the natural smooth surfaces of the wood and the rough surface of the stone fireplace at the end of the space, diagonally across from the main entrance.



TMS Upper School “Forest Room” dining hall, Farrow Partners.

TMS Upper School (Elgin Mills Campus)
In two new additions at the TMS Upper School – a dining hall and adjacent middle school building – we explore similar themes to the ones in our entrance building at the Lower School.

The dining hall is a modest, two-storey rectangular building situated next to a new exterior courtyard containing multistemmed birch trees and fern gardens, which separates the new building from a preexisting one. Its ceiling is supported by six multistemmed timber column groupings, each consisting of three diagonally placed straight columns arranged in a triangular plan. As the columns rise to the ceiling, they branch out into two secondary timber columns. Each primary column grouping is also mirrored in either direction by the primary column grouping opposite it, creating a fractal interplay.

The six column groupings are overlaid with six smaller, branch-like timber columns, springing from the primary columns to the opposite column groupings along the long axis of the room.

Similar to the new atrium lobby at the TMS Lower School, the interplay of the straight, triangular, and curved forms of the dining hall enhances feelings of positive ambiguity, as our eyes follow the subtle shifts and changing arrangements of similar but different forms that create a sense of perpetual motion and growth.

The diagonal and curved branches encourage us to lift our eyes and expand our chest cavities, as our eyes follow the paths of the timber elements from one column to the next and across the room to the groupings on the opposite side of the hall. These forms offer us natural bodily affordances – opportunities that are communicated through implied suggestions and the encouragement of movement and actions – enhancing our curiosity and our desire to explore the Forest Room.

TMS Upper School “Forest Room” dining hall, Farrow Partners.

TMS Upper School, middle school wing, Farrow Partners.

Consonance and dissonance: the TMS Upper School's middle school wing exoskeleton timber structure, Farrow Partners.

The interior walls of the dining hall are lined with closely spaced, 3-foot-deep (1-meter-deep) white plaster fins placed perpendicular to the walls. This creates light baffles that capture changing moods of light and shadow throughout the day and reflect it back into the hall. As one moves through the hall, the depth and height of the baffles appear to change and therefore give the impression of delicately opening or closing to reveal the windows and views beyond.

TMS Middle School (Elgin Mills Campus)
Adjacent to the dining hall is a new middle school building addition where we continue the investigation of positive ambiguity, this time through an exoskeleton timber structural system made of a mix of fan-shaped, curved, and straight timber columns that run parallel to the facade of the building.

The arrangement of the fan columns recalls the positive ambiguity of consonance and dissonance found in music, in which a listener has the impression of both constancy and tranquility (consonance) and motion and tension (dissonance), depending on the composition of tones and notes. This creates constant back and forth between consonance and dissonance, giving both shape and a sense of direction to the exterior and interior learning spaces through increased and decreased harmonic tension.

The design of the TMS Upper School continues our exploration of attention restoration theory, in which attention, concentration, and focus can be reinvigorated by engaging with nature, natural settings, or environments with natural materials and forms. In these types of places, our minds shift from a voluntary focus to an involuntary focus. As we know, involuntary focus is very important in restoring and reenergizing voluntary attention, which we use for tasks such as studying and problem-solving.

Royal St. George's College, Ketchum Hall, Farrow Partners.

Royal St. George's College, Middle School, Farrow Partners.

Royal St. George's College, Senior School, Farrow Partners.

Royal St. George's College
The root of my personal interest in exploring positive ambiguity and natural bodily affordances, in which the building form communicates implied movement, actions, and curiosity, can be traced back to one of our first education buildings at Royal St. George's College, an independent all-boys school in Toronto.

In the first of many projects on the RSGC campus, we took what was originally an old gymnasium and transformed it into a dining hall. We pierced the modest rectangular volume at the top with a long, thin skylight, below which we placed two half-petal-shaped timber ceilings, raised slightly upward toward the central skylight.

A triangular web of timber beams overlays and supports the ceiling, radial in pattern and growing in spacing and length from the outer edges toward the center. Above the ceiling and below the skylight is another layer of timber beams, placed horizontally and parallel to one another and running perpendicular to the main, long axis of the dining hall.

The combination of diverse design elements creates the conditions in which alternative views and interpretations of the once simple rectangular building volume can occur, consciously and subconsciously, allowing one to become sensorially immersed in the spatial experience.

Our designs for a middle school common space below the dining hall, completed a few years later, and a future new upper school building continue our exploration of positive ambiguity and natural bodily affordances.

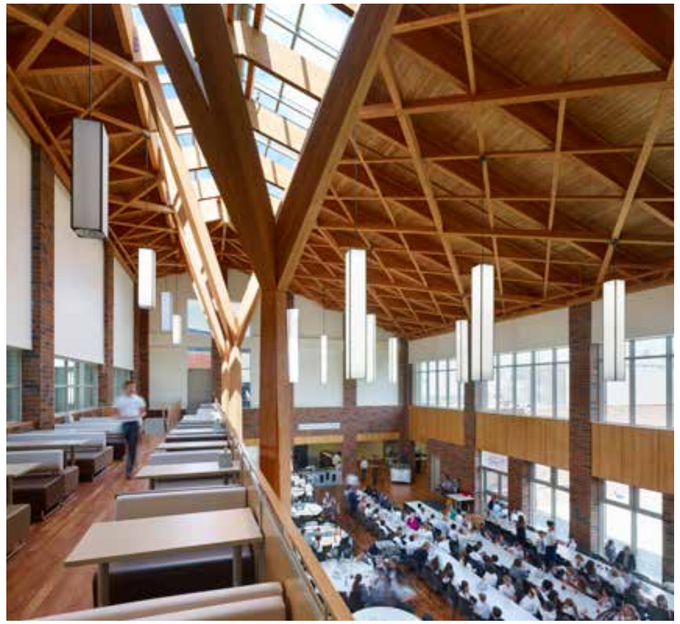
Royal St. George's College, Senior School addition, Farrow Partners.

The Country Day School
The Country Day School is a private school located in King City, Ontario, north of Toronto. Its new main entrance, central atrium, dining hall, and upper school represent some of our earlier explorations of midrange fractal patterns in the form of repeating triangles and diamonds.

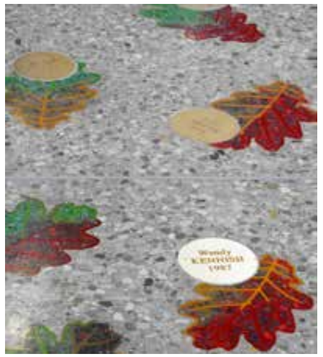
Because the project was built relatively early in our research into enriched environments, its different components did not explore the concept of positive ambiguity as did later education projects, such as the TMS and RSGC additions, where we began to overlay triangular and circular forms.

The Bishop Strachan School Student Centre
Our goal with the new student center for the Bishop Strachan School, located in Toronto, was to expand the existing facilities with an open atrium where students could meet during academic down time. Fully glazed along its length, the building enters into a dialogue with the school's historic facade across an open court. Set against this background, the ensemble of rough-hewn stone and warm woods respects the school's architectural tradition while communicating a future direction. The student center was an early building in our journey to understand and explore enriched environments. However, its glazing and hung ceiling share some DNA with the educational buildings discussed above, and the center allowed us to investigate the layered multidirectional interplay of semicircular form as we continued to explore our interest in positive ambiguity.

Country Day School, central atrium, Farrow Partners.



Country Day School, dining hall, Farrow Partners.



Bishop Strachan School, student center with terrazzo floor leaf pattern, Farrow Partners.

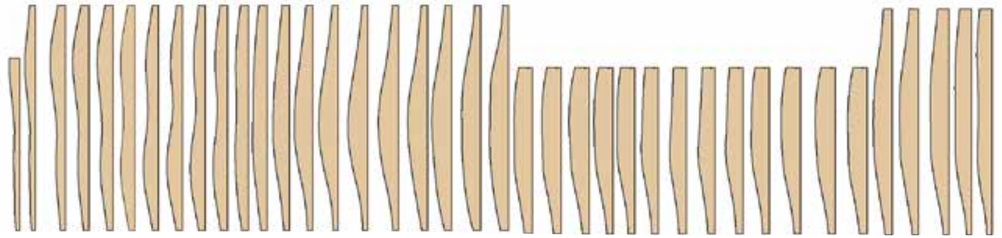
The York School Centre for Wellbeing Douglas fir timber ceiling, Farrow Partners.

The York School Wellness Centre, The Centre for Wellbeing at the York School, located in Toronto, completed after I had finished my Master of Neuroscience Applied to Architectural Design at Iuav University of Venice.

The design demonstrates how enriched environments can use silence and stillness to create a sense of calm and enhance student well-being. With its intimate family room–like space, which includes a gas fireplace, conceptual "kitchen table" space, meeting rooms, offices, and a refreshment counter, it provides a performance enhanced, culturally and socially inclusive space for students and facilitators.

The ceiling of the Centre for Wellbeing is composed of 140 Douglas fir beams, each with different radiuses, creating a rippling effect that evokes the sensation of being under a large tree canopy on a summer day. The scale and proximity of the ceiling establishes a relationship between the mind, the concept of embreathment, and the surrounding environment, through and with the body.

The gentle, flowing rhythms of the beams stimulate our recollection and sensory awareness, allowing us to consciously absorb our surroundings, yet also prompting us to turn our awareness away from our external surroundings and toward our inner being. This is an example of "unplugged" architecture, whose subtle composition and rhythmic ceiling encourage us to listen to our own inner voice, breathing, and heartbeat. It allows for reflection, and is therefore calming and replenishing, while simultaneously creating a sense of awaking.



The York School Centre for Wellbeing's rippling wood ceiling, consisting of 140 different profiled beams, Farrow Partners.

Elmwood School
Elmwood is an independent all-girls school in the Rockcliffe Park neighborhood of Ottawa. We were engaged to complete work on a new entrance, dining hall, student commons, and related spaces. Designed before the York School's Centre for Wellbeing, Elmwood was one of our first attempts to capture silence and stillness in architecture, albeit in spaces associated with the energy of people gathering or sharing a meal together. This may seem contradictory at first, until we recall that in enriched environments, silence is not the absence of sound. Rather, it is our sensory experience of the space that creates an awareness of ourselves in our own bodies and of our bodies within the surrounding environment.

Similar to the new entrance building at the TMS Lower School, our Elmwood School building is radial in plan and links two preexisting buildings. The new main entrance is on the upper level, while the dining hall is on the lower level, where it opens up to a field and views to the heavily treed neighborhood beyond.

While the structural elements of our TMS projects show a finer, branch-like composition, those of the Elmwood building explore the mass and surface of heavier timber. The dining hall's timber ceiling is supported by large, thick, L-shaped laminated timber columns and beams, with a gently curved piece of timber linking the two components. Through its curved plan and section, the space evokes memories of ancient archeological sites such as Stonehenge – pure, unadorned places now defined only by the structures that have survived for centuries. In this way, the large volume of the dining room becomes an intimate gathering place that communicates silence, stillness, and solidity.

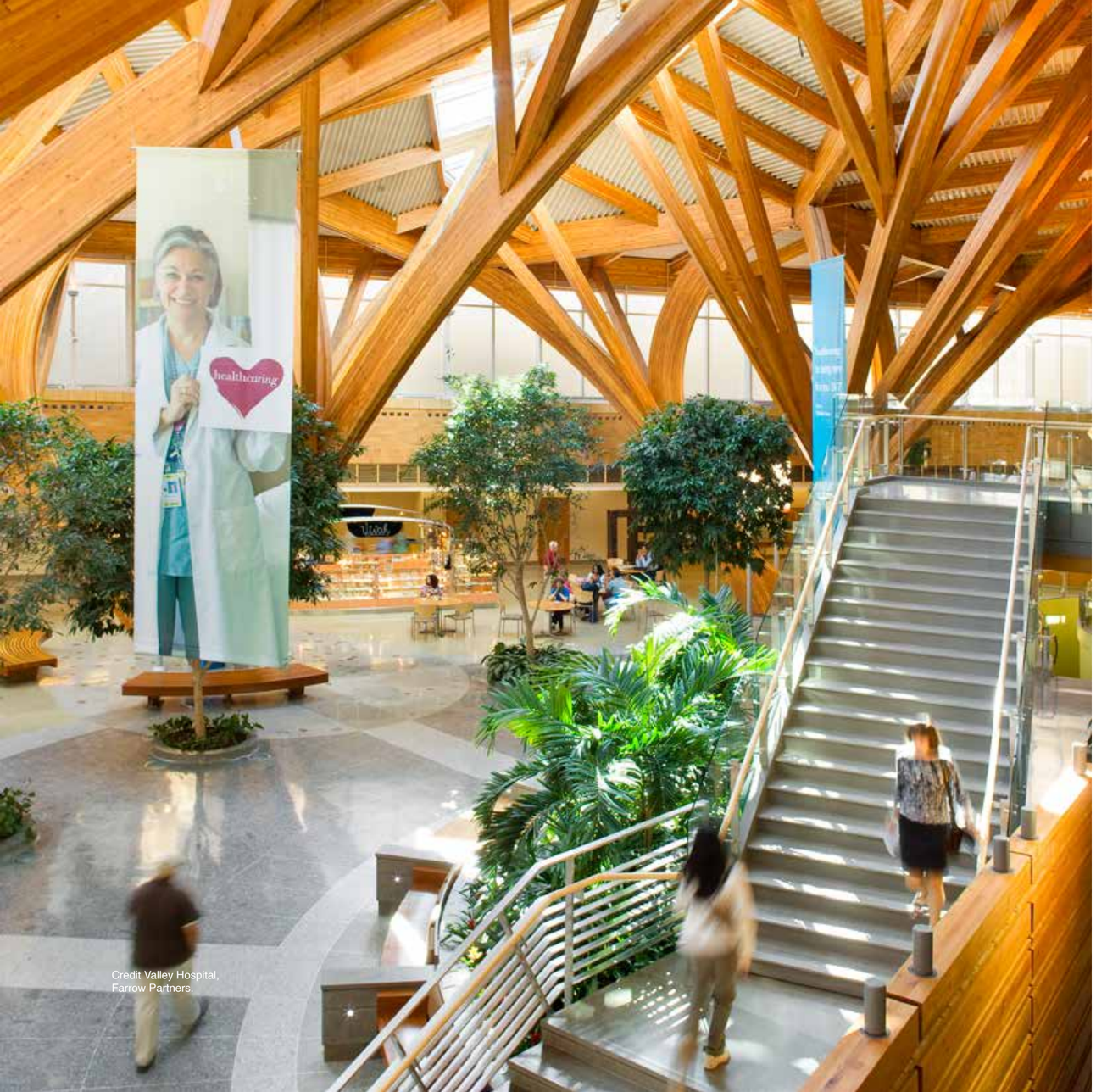
Holy Name of Mary College School
Holy Name of Mary College School was built in Mississauga, Ontario, Canada, in the 1960s. Its austere, boxy, rectangular, inward-looking floor plate and double-loaded corridors reflect its early roots as a seminary and all-girls school. Although the original building is located in a forest clearing surrounded by pine, hardwood trees, and an apple orchard, it has little connection to these natural features from within. The school's pedagogy, however, has changed significantly from its early days, when it emphasized rote learning and submission to authority, to one that nurtures curious, courageous, and compassionate young women. We believed the new building should reflect this shift, both on the inside and the outside.

Among our several design interventions, we added a one-storey community common space with a roof terrace to the southeast corner of the building. This also serves as a new main entrance and common exterior veranda overlooking the front lawn in the forest clearing. The form of the new veranda was intended to communicate the transformation in learning happening within the school, from the natural sciences to music, dance, and visual studies. The timber facade again reflects our interest in the interplay between the consonance and dissonance in music, where stability and repose coexist with tension. It has tones of a rhythmic heartbeat, a twisting strand of DNA, the logarithmic spiral of a seashell, and the pulsating movements of a dancer.

Within the new common space, the timber screen creates interior shadows that will constantly change with the weather, the seasons, and the position of the sun, making occupants feel they are part of something bigger than themselves. This is a space that is designed to mirror the school's progressive new pedagogy and mandate, providing a sense of coherence and well-being.

Elmwood School,
Farrow Partners.

Holy Name of Mary College School, community commons, Farrow Partners.



Credit Valley Hospital,
Farrow Partners.

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A Saluto-systemic Approach to Health-Care Environments

Today, the word health has become synonymous with health care. Debates over efficiencies, wait times, and delivery systems have obscured the much larger question of how to reduce overall usage of and dependence on medical services. If we wish to transform the culture of health and reduce its costs, we need to rethink hospital design. For this to happen, we need a saluto-systemic approach to both the process of designing and the formal ideas in architectural design. This kind of perspective would promote transformative narratives, leading to healthy habits and behaviors for those who spend time in our hospitals as patients, staff, and visitors.

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The hospital as a building type is one of the most complex construction undertakings in today's society. On the one hand, intricate procedure rooms, operating suites, and cancer radiation treatment rooms are served by very sophisticated and ever-improving medical, mechanical, electrical, and information technology and systems. Increasingly complex workflows, infection control procedures, and safety protocols can come into conflict with continuous pressures for greater efficiencies. All of this is overlaid with multifaceted goods and services that feed the hospital organization 24/7.

On the other hand, we experience some of the most profound and fundamental moments and milestones of human existence in hospitals. Most of us are born and see our own children born in a hospital. At other times, we arrive with health emergencies or for other unanticipated treatments that threaten to upend our lives. Finally, hospitals are often where we exhale our last breath, and where families and friends begin the grieving process that follows death.

Hospitals are also places where highly capable and devoted people work long hours in service of their communities, often under very difficult conditions. Doctors and nurses know their decisions and actions have momentous effects on both the people under their care and the many people touched by the illness of a family member or friend.

For many governments, health care devours the largest percentage of spending, in many cases between 40 and 50 percent of a government's annual budget. It is highly questionable whether these spending levels are sustainable, as they compete with spending on education, social services, national defense, and government debt servicing.

COVID-19 has shed light on medical staff burnout and what is called "compassion fatigue."

Before COVID-19, hospitals were under constant pressure to be more efficient and less costly. But the pandemic laid bare how fragile our health-care systems are, with many already teetering at the breaking point. The additional demands the pandemic placed on our hospitals forced governments to introduce prolonged lockdowns, sacrificing economies so the hospital system could survive.

Throughout the COVID-19 pandemic, doctors and nurses continued to serve their communities under enormous stress and at great risk to themselves and their families. Now, burned out and suffering from PTSD and what is known as "compassion fatigue," they are leaving their professions in unprecedented numbers. As a result, many hospitals and emergency departments are being closed and procedures canceled due to a lack of staff, which only serves to increase the fragility of the system.

Sadly, for many of us, like in the Middle Ages, hospitals have become places to avoid at all costs due to increased risk of infection. New forms of telehealth systems, paired with advances in communication technology, have shown that many common ailments can be dealt with virtually through our phones, tablets, and home computers. We no longer always need to consult with a medical professional face-to-face or travel to a brick-and-mortar site, prompting a rethink as to what services should be housed in these types of structures. In fact, artificial intelligence in the health-care sphere is pushing the boundaries of our need to speak with a human at all. From a design standpoint, the pandemic and the high-tech revolution have caused the model of what a hospital is to be fundamentally reimagined.

A Brief History of Hospitals

Before we examine how architects can respond to this revolution in the understanding of what a hospital is, it is worth looking at the history of hospitals. The word *hospital* and the related words *hospice*, *hostel*, and *hotel* all come from the Latin word *hospes*, meaning guest,

A frieze depicting first aid being given to a Roman soldier during battle.

visitor, or host. As we recall from chapter 2, the **ancient Egyptians and Greeks** emphasized a balanced approach to life, which included diet, lifestyle, and environmental factors. Death was accepted as a fact of life, a concept we have lost, and the earliest infirmaries were run in conjunction with places of wellness and spiritual treatment. The Greeks developed the concept of wellness between 1,000 BCE and 100 CE and took a holistic attitude toward human health, which included body, mind, and spirit. This was one of the first periods of what we would consider a cohesive method of delivering health care.

The Roman Empire

The Romans built on the Greek's holistic approach and emphasis on healthy diet and lifestyle with vast infrastructure projects such as baths and aqueducts that improved public health. Later in the Roman Empire, however, the focus of health care and hospitals shifted away from public well-being to serving the military. The primary task at hand was treating soldiers wounded in battle at field hospitals and healing them enough to return them to the front as quickly as possible.

The Middle Ages

The collapse of the Western Roman Empire naturally created a void in attitudes to health and well-being. As in most areas of life during this period, this void was filled by superstitions and the Roman Catholic Church. During the Middle Ages, monasteries and churches used prayers to saints, combined with herbal concoctions, to ward off ailments and enhance health.

In 516 CE, Benedict of Nursia wrote *The Rule of Saint Benedict*, a book of precepts that stated, among other things, that it was the responsibility of Benedictine monks to welcome every guest as though they were Christ. However, the sick and poor at the abbeys were typically looked after by lay brothers, their families, or Catholic military orders created specifically for this task. The earliest of these was the Order of Knights of the Hospital of Saint John of Jerusalem, commonly known as the Knights Hospitaller, which was founded in the early eleventh century in Jerusalem to care for sick or impoverished pilgrims to the Holy Land. Soon after, other similar orders, such as the Knights Templar, were founded and remained strong throughout the Crusades. Many successors to these medical orders still exist, including the Sovereign Military Order of Malta and the Order of Saint John, which continue to play a role in health care today.

While religious orders provided the caregivers of the Middle Ages, abbeys and monasteries provided the physical locations in which the care of the sick and injured took place. Infirmaries were designed with long, parallel aisles and a chapel in the east end to allow the ill to focus on the altar and the healing power of faith.

Founded in 1153, the Hôtel-Dieu of St. Jean in Angers, France, is one of the best-preserved hospitals of this type. The design of its 200-foot-long (61-meter-long) great aisled hall with ribbed vaults prioritizes connecting with God, while what might have been deemed science and medicine came in a distant second in the treatment and healing process.

The largest and most notorious hospital of the Middle Ages was the Hôtel-Dieu in Paris. Close to Notre-Dame Cathedral and completed in 1260, the hospital had 450 beds. Each bed housed between three and eight patients daily. Patients with different illnesses were all mixed together, which contributed to an average yearly mortality rate of 2,000 people at this hospital alone. Occasionally, severe outbreaks of disease in this complex killed over 5,000 people. Being confined to the Hôtel-Dieu brought with it the prospect of almost certain death – a clear change in philosophy from the time of the ancient Greeks, when health care was associated with wellness.

Care of the Sick (c. 1440) by Domenico Di Bartolo.

The long, single-aisle design of the medieval hospital became cruciform in fifteenth-century Italy, with the altar located at the intersection of the two arms of the cross. Interestingly, this form has lived on in some inpatient pod design, but the altar has been replaced by the nursing station and medication closets.

The Renaissance
With the birth of the Renaissance and a renewed interest in all things classical, hospital design shifted away from the monastery model to that of a classical palace. One of the most important hospitals of the Renaissance was the Ospedale Maggiore in Milan, founded by Duke Francesco I Sforza in 1456. Some 1,000 feet (305 meters) long, it was divided into three parts: a central court with a chapel and two wings that both contained four wards laid out like a crucifix. Each wing had a central altar and domed ceiling, and each ward contained sixty beds. The ground floor also had an open colonnade in which the sick could walk and convalesce during the day.

The Ospedale Maggiore advanced the concept of mechanical systems in care facilities by introducing running water for the lavatories. Access to lavatories was through trap doors between beds that led to a level below, creating the first "en suite" bathrooms in hospital design. As a result, a degree of civility returned to the hospital environment for patients. After several centuries, the hospital was once more considered a place where patients had some hope of recovery.

The Renaissance also saw the introduction of a small dresser, chest, and writing table at each bed for the patient's comfort and use. Each bed had its own window nearby with a seat and a pleasant view to the exterior or a courtyard. The infinitely cruel practice of packing up to eight patients into one bed came to an end as hospitals moved toward the concept of one patient per bed.

Today, the Ospedale Maggiore is still Milan's main public district hospital, but its original building is now part of the Policlinico di Milano, the city's main university campus.

The Arrival of Scientific Thought
With the arrival of scientific thought in the late sixteenth and early seventeenth centuries, medical professionals began to focus on the lack of natural ventilation as a major contributor to high mortality rates in hospitals. Architects started to design wards as a series of small pavilions that were separated, yet connected, by arcades around a courtyard, usually with a church as the central focus. The Royal Hospital for Seamen at Greenwich, England, designed by Sir Christopher Wren in 1694, and the Royal Naval Hospital in Plymouth, designed by Alexander Rovehead in the 1750s, represent this next transformation of hospital design away from the cruciform shape to a series of pavilions containing wards connected by a common arcade. This design would continue for hundreds of years, and the Royal Naval Hospital in Plymouth didn't close until 1995, at which point it became a gated residential complex.

In 1786, the first specialized hospital appeared in London – the London Lock Hospital – which treated patients with venereal diseases. During the nineteenth century, other specialized hospitals were established in London that focused, for example, on eyes, ears, lungs, and joints. While individual hospitals had already existed in the past to house the insane, orphans, and single, pregnant mothers, the arrival of specialized hospitals showed that scientific and medical discoveries were beginning to lay the groundwork for modern Western medical practice and the way society would care for the sick.

The Birth of Modern Western Health-Care Planning Principles
The roots of modern Western hospital planning can be found in the principles developed by Florence Nightingale in the 1800s. A daughter of a well-to-do English country gentleman, Nightingale is considered the founder of modern nursing for her work during the Crimean War, when she both managed and trained nurses and cared for wounded soldiers herself. She prioritized function over form long before the modern phrase was coined. At the height of the Crimean War, the rate of death in field hospitals due to cholera and unsanitary conditions was 42 percent. Through her efforts, which included the introduction of handwashing, improving ventilation, and other hygiene practices, she brought it down to just 2 percent in the war hospital where she worked.

After the war, Nightingale returned to England to reform the hospital system and establish the first secular nursing school at St. Thomas' Hospital in London in 1860. She also published influential books and essays, including *Notes on Nursing: What It Is, and What It Is Not* (1859) and *Notes on Hospitals* (c. 1860). In these writings, Nightingale specified the proportions of wards and the number and size of windows, as well as their placement in relationship to beds, to best support health. She also emphasized the role of ambiance, ventilation, heating, building materials, and color in the process of healing. To her, bright white paint and shiny wood floors and doors, as well as natural light from two sides, were fundamental design features of the new hospital environments, in contrast to the dark, cramped wards typical of the period. Nightingale's principles remained entrenched in hospital design until the end of the Second World War.

The Early Twentieth Century
In the early twentieth century, medical practice gradually saw the widespread introduction of antiseptics, which would fundamentally change medicine and hospital design forever. The recognition and development of the science of bacteriology finally killed the pavilion model. With the arrival of widely available and effective antibiotics, such as penicillin in 1928, the use of cross ventilation and natural light from two sides of a room to contain the spread of disease no longer seemed as important. Medical science was now considered more relevant than the physical environment of hospitals in healing patients.

Florence Nightingale in the Military Hospital at Scutari (1855), by Joseph Austin Benwell.

From Pavilions to Large Floor Plates
The widespread introduction of electricity and the advent of mechanical ventilation systems compounded this trend, as they obviated the need for access to daylight and natural ventilation. The invention of the elevator also presented the opportunity to introduce multi-floored structures into hospital design. This meant the hospital could now return to the dense core of the city, where land was precious and height a necessity. Large, compact, multi-level floor plates emerged from the new emphasis on mechanical systems solutions to building design issues. A new concern for efficiency, including in staffing, was also promoted by the new high-rise hospital model. With this, the mega hospital was born and would flourish as the design solution of choice for several decades.

Modernism and the International Style, with its streamlined look and projection of power, was the perfect architectural symbol for the new age of hospitals that focused on high-tech medical treatments. The hospital became a machine for delivering medicine, with little regard for human scale and humane physical environments. This new emphasis on technology made the medical profession more prone to look beyond – or through – the person and their physiological and psychological needs to just the disease itself. It was as if the person were merely the container of the illness.

Post-War: The Mega Hospital
After the Second World War, a population explosion led to a massive rebuilding of the health-care system, based on the machine-for-healing model. But the effects

on the social, physical, and psychological well-being of the patients and staff of these mega hospitals now started to be questioned. These machines for delivering medicine, with their large floor plates and no daylight, were the opposite of the Nightingale model and became symbols for all that was wrong with hospital design.

In many ways, the "health-care machine" hospital design had become nothing but a container for an ever-exploding array of new technologies. It was believed that any new medical facility had to be designed with maximum consideration for the rapid changes technology brought to the delivery of medicine. If a facility could not constantly adapt and change, it was feared that it would quickly be rendered obsolete.

Interstitial Space and Maximum Flexibility

The concept of large, well-serviced, regular-use floors separated by interstitial floors was first seen at Louis Kahn's Salk Institute (1962) in La Jolla, California. The idea was to provide an intermediate service space between each pair of occupied floors to house the mechanical systems of the hospital. The number of columns on interstitial floors was reduced by using long-span trusses, thus providing maximum capacity to rearrange mechanical systems whenever the technology was updated. The first acute care hospital to employ this concept to its fullest was W.E. Tatton Brown's Greenwich District Hospital (1969) in London, England, followed by Eberhard Zeidler's much celebrated, flexible, and light-filled McMaster University Health Sciences Centre (1972) in Hamilton, Ontario, Canada, which the World Hospital Congress then described as "obsolescence-proof."

However, by the 1980s, the interstitial space design had been discredited, as clients gradually saw that the initial capital costs were too high and the projected savings through flexibility were not fully realized. Additionally, people began to question the prioritizing of technology, or the image of technology, over the patients it was supposed to serve. Being a patient in a hospital, or treating someone who is sick or injured, is a deeply personal, emotional, and often awkward human experience, but awe of technology and its resulting representation in hospital design resulted in a cool and perceptually sterile instead of warm and caring environment. A growing chorus of staff, patients, and administrators criticized the high-tech mega hospitals as enormous, inhumane zones of windowless space with little human scale that valued efficiency above all else. Health-care design had reached another crossroads – the idea of the health-care factory was on life support, awaiting a rethinking of the fundamental principles of health-care delivery.

McMaster University Health Sciences Centre, Zeidler Architects.

Credit Valley Hospital radiation therapy waiting area, Farrow Partners.

Postmodernism

The rising popularity of postmodern architecture, which rejected the austerity and formality of Modernism and the International Style, also began to find its way into hospital design. Hospitals put a new emphasis on patient-centered care and design solutions and began to imagine themselves as a collection of neighborhoods, with a renewed emphasis on daylight and a residential vernacular or hotel-like feel.

Lobbies introduced meandering routes and changing levels to create variety and interest, while materials such as brick, wood, and carpet helped to humanize the hospital. By the late 1980s, the atrium design had become dominant in hospitals, most notably in a number of Eberhard Zeidler's internationally-celebrated designs, as it introduced daylight into the heart of the facility and gave it a sense of exhilaration along with greater ease of spatial orientation.

Humanizing the Hospital

In addition to the neighborhood, the shopping mall or retail district also became an inspiration for how to humanize the hospital and make it more familiar to the population it served. Beyond the atrium, or "central square," enclosed "main streets" with "storefronts" and waiting areas for each department were ways of creating a community of health care on a pedestrian scale. In addition, "secondary streets" (circulation corridors) and "neighborhoods" (departmental areas) were interspersed with courtyards and access to daylight. Over the years, connection to daylight, views to nature, and a more natural environment became ever more important elements in hospital design, as people better understood their contribution to the healing process for patients and the well-being of staff.

Contextualism and New Regionalism

By the end of the twentieth century, the concept of the machine for healing was dead. Postmodernism prioritized the contextualism of buildings in their surrounding environment over buildings that looked like they had landed there from outer space. Furthermore, movements like New Residentialism and Critical Regionalism also began to influence the design of health-care facilities, with their emphasis on making hospitals relate to the communities they served. Where just twenty-five years earlier you could walk into a hospital in one city and feel like it could be located anywhere in world, now hospitals were designed to be unique to each individual community. The ubiquitous International Style had been replaced by democratic pluralism in the planning and design of health centers.

The Future Hospital?

Now more than ever, both in government policy and architectural circles, people are searching for the "hospital of the future."

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer

Helmsley Cancer Center, Farrow Partners and Rubinstein Ofer.

Post-pandemic, various forces are pushing the design of medical centers in many different potential directions. Should the hospital be more high tech, as a plug and play machine for healing, or more high-touch, friendly, and familiar, like a hotel or shopping center? Should it be a monolithic structure of centralized health-care services, or broken up and dispersed throughout the community into malls and high street retail spaces that have been hollowed out by online shopping, thereby bringing people back to our urban cores as a healthy side effect? Can hospitals become safer and more effective by following the lean design principles of the automotive sector, creating procedures and workflows that are repetitive and akin to robotic actions? Can we emulate scientific, evidence-based processes with evidenced-based design tactics to future-proof our hospitals?

Big Tech and Health

Big Tech has also turned its attention to health care and, more interestingly, to health. Certain apps now have a higher rate of accurately identifying diseases or ailments than seasoned doctors due to the successful incorporation of artificial intelligence. We are witnessing a shift in attitudes away from the Western, pathogenic, evidence-based model that has dominated our approach to health for so long, and back toward a more comprehensive and holistic approach that links physical, spiritual, and mind health with social well-being, and that promotes a continuum of health in which the body and spirit are nurtured even when no illness is present.

The COVID-19 pandemic forced us to turn our attention to the many problems that long existed on the periphery of our collective vision, but which we were able to ignore as long as we had no pressing reason to address them. These include big issues around equity, inclusion, the environment, energy and food security, mind health, how we care for our elders, housing, education, and basic values about how we should interact with one another. What ties all of these together is the question of how we define health. What is health versus health care? What causes health in our societies? What is the role of architecture in causing – in *constructing* – health through what and how we design and build?

Eradicating Hospitals as Presently Conceived

I have designed a few hospitals that have garnered international recognition for their thinking in this area. However, I believe (though it may seem counterintuitive, professionally) that there are two questions we should collectively be asking. First, what would we need to do to "eradicate" hospitals as they are presently conceived, beyond the episodic events in life in which they are necessary, such as breaking an arm or the treatment of major illnesses? Second, what would we need to change in how our societies are structured and how they operate to enable this to occur?

I believe we must move away from the idea of hospitals as "Centers of Excellence" in pathogenic health care to of the idea of hospitals as salutogenic "Centers of Influence" that cause optimal health and well-being.

In the structures of our present governments, health, what causes health, and the health-care system are all siloed. We have ministries or departments of municipal affairs, housing, education, economic development, social services, and "health," yet optimal health results from the combined influence of where we live, work, learn, heal, and play; our forms of transportation; what we eat; our social habits and interactions with others; and our natural and built environments. This siloing must change if we are to create a transformational revolution instead of small, incremental improvements. We must not just work on preventive health strategies, such as immunization, antibiotics, and proactive screening tactics that keep bad things from occurring, but fundamentally move our gaze further upstream and turn our focus to what actively causes optimal health.

Saluto-systemic Health

In chapter 10, the Venice Archipelago Project and the Market Bridge and Brick-Bridge Park Precinct Project illustrated in tangible ways how a saluto-systemic approach that involves multiple circular, interlinking systems of health – physical, mental, social, cultural, ecological, economic, and spatial – enhances human health and well-being. Our Health Promoting Lifestyle Center, which won an international design competition for South Africa's National Department of Health, offers a way forward, albeit on a smaller scale, for a new interpretation of what a community health center could be as we move toward a salutogenic position on health and well-being.

Center of Influence: South Africa's Health Promoting Lifestyle Center, rural location. Farrow Partners, Clark Nexsen, and Ngonyama Okpanum and Associates.

The Health Promoting Lifestyle Centers
The goal of the Health Promoting Lifestyle Center (HPLC) was to demonstrate how a saluto-systemic approach can promote health innovation. The HPLC offers an alluring yet practical alternative model that minimizes dependence on traditional, curative-focused health services and transforms behavior from supporting an illness-focused society to a health-promoting society, post-pandemic. As a health typology, it is designed to be adaptable to fit the context of each of South Africa's nine provinces, as well as different rural, urban, and suburban locations.

Centers of Influence versus Centers of Excellence
One of the core concepts of the HPLC is for it to be a "Center of Influence." Whereas the well-established concept of the hospital-based "Center of Excellence" provides outstanding downstream illness care, this South African–centric innovation will set a standard for promoting the full range of upstream causes of health and fundamentally change how people think about their lives.

The HPLC is designed to be appealing, understandable, and widely accessible, and to attract and empower those who work, learn, play, and visit there. Its design embodies the beliefs that a community health center cannot be an island within its surroundings, nor can it succeed merely by fusing a primary health-care facility with a community center.

Guided and inspired by nature, the HPLC leverages salutogenic design principles to advance the physical, mental, social, and spiritual dimensions of community health. In addition to direct public health benefits, the HPLC's design also takes a salutogenic approach to improving the economy by freeing people to pursue their full potential while reducing lost productivity due to sickness.

Like the Venice Archipelago Project, which proposes multi-use instead of single-use infrastructure, the HPLC offers a model that could accelerate a shift to infrastructure that promotes health and prosperity. In the words of former British National Health Services Chief Executive Lord Nigel Crisp, "There is a much more radical change underway. A dislocation. A shift in power and control. Health professionals don't create our health. We do. All of us as individuals have responsibilities for our own health and often for the health of our families … and employers, educators, architects, businesses and community leaders, as well as government, also have a responsibility to create the conditions that allow us to live healthy lives."[1]

Hippocrates, considered the father of modern medicine, is believed to have once said that "the function of protecting and developing health must rank even above that of restoring it when it is impaired." The design of the HPLC creates a place that will be a catalyst for improving life in South Africa's cities, townships, and rural areas. Its salutogenic and biomimetic design qualities will help change what people expect from their infrastructure and tangibly reduce the burden of disease.

Health and Hope
This is why the architectural form of the HPLC is inspired by a local expression of health, hope, and economic vibrancy. We have already considered the importance of a salutogenic sense of coherence and how individuals who are compromised by stress are significantly more vulnerable to disease. When each of the three elements of a sense of coherence – comprehensibility, manageability, and meaningfulness – is incorporated into the design of a building, it reduces stress, increases well-being, and empowers those who occupy it.

The Protea
The metaphor for both the design and function of the HPLC is the protea, South Africa's national flower, which is known for its wide variety of forms and colors. You will remember that its name is derived from the Greek god Proteus, who could change his form at will. Its image and varied forms represent the adaptive, responsive, and transformative nature of the HPLC, and of an individual's health. Furthermore, the protea flower has meaning as a symbol of national hope, beauty, and the aspiration for harmony between South Africa's many cultures. It evokes the flowering of a nation and its ability to grow robustly by allowing the unique talents of its people to blossom through expression in theater, arts, music, sport, and education.

In post-apartheid South Africa, most new public buildings have intentionally shifted their architectural and urban vocabulary away from the classical, monumental style that dominated the apartheid period to contextual, vernacular, modest, almost domestic building forms that meld into the surroundings. However, we conceived of the HPLC's central sculptural flower-like community space as an important symbol on the skyline of the cities, townships, and rural areas they serve of a new salutogenic view of community and individual health and well-being.

Biomimicry
The design of the HPLC incorporates strategies that nature uses to create conditions conducive to life. It will become a living part of the site, contributing to its regenerative capacity through diverse environmental strategies, such as the application of biomimicry, which emulates the functions of nature rather than simply

South Africa's Health Promoting Lifestyle Center, township location, Farrow Partners, Clark Nexsen and Ngonyama Okpanum and Associates.

copying natural forms. Like flowers that attract bees and other pollinators, the protea-like shape of the HPLC will attract people to it, in particular the outpatient clinic, through its gentle and convivial bio-inspired design.

Health Education
As a catalyst for shifting from a curative to an educational perspective and model, the HPLC project will reimagine the concept of health education as a continuous, lifelong learning process rather than as a series of discrete events and interventions. When this "cause health" view is integrated into everyday life, it empowers people to shape their own destinies.

The programmatic elements within these easily accessible HPLC community buildings are primarily aimed at the most vulnerable populations (the poor, women, children under five, and youth) in urban, township, and rural areas. Services provided include primary care, maternal health care, HIV/AIDS treatment and prevention education, anti-violence against women education, vocational training, water and sanitation, income security, access to technology, food security, obesity and nutritional counseling, sustainable farming practices, environmental sustainability, sports, fitness and recreation, music, and performing arts. Programs are selected and tailored to suit the needs of people in each geographic region and at each level (urban, township, rural), making them active participants and creators of a more holistic health process.

Health Skills Training
For example, in shanty town environments, employment opportunities for women tend to be very limited, so many women are lured into working in the sex trade to survive and provide for their families. This often results in very dangerous circumstances for women and leads to accelerated rates of HIV/AIDS. An HPLC in this environment would offer vocational training programs for women, such as hairdressing, tailoring, and other business skills to help them find alternative means of earning a living and thus mitigating the risks to women and reducing the spread of HIV/AIDS. In more rural settings, training programs targeted to farmers, such as instruction in sustainable farming techniques that allow families to earn a more profitable living while preserving the natural resources required to support farming in the longer term, will be offered. This, in turn, allows for a higher quality of life, greater access to nutritional food, and better and more affordable housing options.

Flexible Pavilions
Radiating outward from the central core, a network of separate yet interconnected pavilions supports the rich and diverse range of programs and services that are conducive to life and well-being for each community. Organic in their form, the pavilions also mimic processes that occur in nature by directing wind, providing shade, harnessing the sun, and collecting rainwater. Overhead, the blossom-like roof structure, consisting of polytetrafluoroethylene (PTFE) fabric leaves, gives the HPLC a translucent glow while also allowing light to filter directly into the buildings below. Additionally, the roof lifts to allow the natural flow of

South Africa's Health Promoting Lifestyle Center, urban location, Farrow Partners, Clark Nexsen and Ngonyama Okpanum and Associates.

air through the interior spaces below, rendering the building multifunctional in its ability to adjust to changing environmental conditions.

The HPLC not only evokes images of nature but actually functions as part of nature. Extending beyond its walls, a collection of peripheral spaces, including vocational training workshops, a library, teaching gardens, learning kitchens, and an outdoor theater, helps it transcend typical models for healing. Its comprehensive, salutogenic design elevates it to become a place for health innovation and an embodiment of the Center of Influence model.

Hospitals as Accelerators of Optimal health
Like South Africa's Health Promoting Lifestyle Centers, our own hospitals, and the systems they are a part of, must deliver health and well-being for the community that uses them – patients, caregivers, visitors, staff, and researchers. I was part of an international team of health professionals that explored how our hospitals could be judged by their capacity to cause total health, not simply prevent physical harm. We defined this as the ability to address the holistic needs of patients in order to actively promote their recovery, deliver better outcomes, and promote individual agency. In addition, we discussed and shared evidence of our growing understanding of the experienced effects of hospital design on healing – the neurological, physiological, and psychological implications of medical spaces on human health. I present some of the results of our collective thinking here.

In earlier chapters, we explored how a saluto-systemic approach to designing cities – one which embraces a wider concept of health as containing multiple circular, interlinking systems of healthy action (physical/mental, social, sociocultural, ecological, economic, and spatial) – can enhance human health and well-being. A complex system such as a hospital has similar characteristics to a city and, similarly, has the potential to make its occupants (patients, staff, and visitors) flourish. Like city design, transformative hospital design requires a saluto-systemic approach to both the process of design and formal architectural ideas in order to promote transformative narratives that lead to healthy habits and behaviors.

Building Healthy Relationships, Person-to-Place
Recall that the qualities and values of enriching person-to-person relationships are similar to those of salutogenic person-to-place relationships. Whether a place is salutogenic depends on how we remember and interpret our experiences of it through our bodily actions and senses. From the moment we walk in the front door to the time we return home, many hospitals fail to build a supportive and generous person-to-place relationship through what the building communicates as a result of its massing, detail, and the qualities that influence our senses.

Medical staff, patients, visitors, and other users need environments that support them in what are often challenging circumstances. The needs of staff must be comprehensively met so that they,

too, feel safe, cared for, and valued and are therefore better able to meaningfully interact with and care for others. If we desire a change in outcomes – clinical and experiential – the culture of health care needs to undergo a major shift. This is particularly vital because of the ways in which health-care environments can inadvertently cause anxiety in both patients and staff, damaging their psychological health and contributing to the growing problems of staff burnout and patient dissatisfaction.

Design Principles and Cultural Norms
We can no longer consider hospitals as factories for simply diagnosing and treating illness; rather, we must see them as structures that actively cause health by supporting healthy, user-based behaviors and experiences. To create the conditions under which users feel a sense of agency and can develop constructive relationships with their health facilities, we need to change the design, culture, and behaviors that underlie them. This involves identifying and rewriting many of the current design principles, cultural norms, and other practices that dictate how hospitals operate, and how patients and staff experience them.

Co-creation
To drive change in the system, we need effective processes for saluto-systemic co-creation of designs – and the development of a true understanding of what patients, staff, and communities value – that continue beyond the completion of the hospital building itself. A saluto-systemic co-creation process, sometimes referred to as inclusive, participatory, and user-centered, enables the identification of key design principles relating to, among other things, privacy, art, light, nature, sound, temperature and ventilation control, signage, layout, cleanliness, and how sensorially welcoming the environment seems. Through the co-creation of objectives, new design principles, and ambition for change, combined with a well-developed body of research on these issues, we can create a rich picture of a health-creating and health-promoting environment that addresses people's lifestyle, emotional, and experiential needs. To succeed, each design idea needs to achieve the three key aims of Antonovsky's concept of sense of coherence – comprehensibility, manageability, and meaningfulness – as follows:

Comprehensibility: The different components of the buildings, operating model, and culture must be coherent and consistent. This encourages a sense of trust and positive predictability. Medical environments that are age friendly and easy to understand and navigate reduce anxiety and increase feelings of safety because they reduce cognitive burden, wasted time and motion, and opportunities for error.

Manageability: Hospital designs must help patients and staff cope with challenges and exercise control over the environment. They should remove barriers and distractions by creating environments that are safe, comfortable, and accessible for all users, regardless of any preexisting impairments. They need to promote patient-centeredness, agency, psychological safety, and a focus on learning and improvement. This can be achieved through several strategies, including a combination of aesthetics, natural light, natural environments, visual stimuli, and ergonomics.

Meaningfulness: All users of a hospital and its services need to feel a sense of belonging and respect. Environments that are inspiring, engaging, restoring, challenging, and cognitively rich support this. Fostering a strong sense of belonging is even more important for the culture of the organization. Helping staff deal with stress and trauma, moral injury, and similar challenges creates meaning and purpose and is vital for restoration and recovery.

Absorbing Our Surroundings
Our built surroundings inform a number of our psychological and physical responses, which in turn influence our behaviors and emotions. Humans adapt to the conditions in which they are placed, an evolutionary trait that continues to serve us well today. When it is bright, our pupils contract; when it is too loud, we distance ourselves from the noise; and when a material is uncomfortable, we avoid contact with it. However, when we experience prolonged exposure to environmental stressors, we are forced to find ways to cope. This creates an unease, which has immediate and long-term effects on health.

To better understand our conscious and unconscious responses to our built environment and its resulting effects on human health, it is important to contextualize the mechanisms of human perception and experience within the spaces we occupy. As we have seen, this is dependent on the neural mechanisms involved in the analysis of experiential information – the ways we perceive and experience our environment. Preconceived and sensory information allow the mind to create reality, which is a combination of our perceptions, expectations, imagination, and memory. According to the theory of constructed emotion, what we call "reality" is really just our personal gaze and interpretation of inputs from the external world. As such, mental representations of architecture are conscious and unconscious interpretations of space framed by that same personal gaze, a unique lens through which we view and respond to spatial layouts, materials, and building typologies.

Architecture with empathic qualities: Helmsley Cancer Center, Farrow Partners and Rubinstein Ofer.

Architecture, Empathy, and Nonverbal Clues
Architecture with empathic qualities – that is, qualities that actively engage and support an occupant's emotional capacity – creates conscious and unconscious recognitions of emotional equality. When occupants participate in nonverbal communication with their health-care spaces via their thoughts, behaviors, and actions, they experience empathy.

We have already discussed how the ways we interact with buildings is analogous to the ways we create relationships with other people. In hospital settings, we need to create positive person-to-place relationships, just as we would with person-to-person relationships, by fostering mutual respect and offering emotional support and a sense of security, generosity, intimacy, and comfort.

Occupant Well-Being
The design of most medical institutions prioritizes the absence of illness at the heart of the healing experience, thus creating facilities that reflect clinical values and standards but do not offer spaces with the flexibility to diverge, improvise, or collaborate.

The physical places where patients can heal, visitors can share their compassion, and hospital employees can thrive are all subject to this inflexibility. It is important to ask what the toll of these impersonal and inflexible spaces is on mind health. How does the perception of these spaces influence occupant well-being?

Authenticity
Inauthentic spaces within our hospital designs are very commonplace these days. Too often, health-care institutions negate the diverse realities of the human experience that make living environments enjoyable, enriching, and encouraging. Without these considerations, we end up with spaces lacking in human spirit, lived intelligence, and communal engagement – factors that are crucial in supporting comprehensibility, manageability, meaningfullness, and creating health.

Health-care environments have both immediate and long-term effects on occupant well-being and lived experience. The quality of spaces and how program elements are assembled is significant in building the capacity for patients, visitors, and staff to thrive in all areas of their lives. Places that cultivate positive ideations of self and support opportunities to develop fulfilling relationships with others and the natural world are essential in creating successful healing environments, yet they are not always available. This creates an opportunity for hospitals to foster well-being and equality (including inclusive, accessible, and universal design strategies) through purposeful design and material interventions.

Constructing Health
How can we design health-care facilities that have a positive impact on the mental, physical, and mind health of patients, visitors, and staff? We can do this by focusing on the elements of enriching environments. This includes creating
• generous spaces that communicate a higher purpose and a legacy, and that make us more empathetic to those around us;
• spaces that offer a sense of vitality and variety and stimulate our ability to heal;
• natural environments that are appropriately stimulating and physiologically rewarding;
• authentic and rooted spaces that communicate a place and point in time;
• spaces for stillness and intimacy that allow us to slow down and listen to our own being; and
• healing environments that offer hope when we are feeling fearful or uncertain.

We will now further explore these concepts through a selection of my own health-care buildings, both fully constructed and under design, that explore a saluto-systemic approach to healthcare environments.

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

Generosity

The Helmsley Cancer Center

A building communicates clues about the type of relationship it will form with us individually – the affordances it will offer. Hospitals are often transactional in their function and form and therefore far from health-giving to the patients, visitors, and staff that use them. When we go through a difficult time in our lives, such as being treated for cancer, one of the most important characteristics a health center can communicate is generosity.

The Helmsley Cancer Center is part of one of Israel's most prominent health sciences organizations, the Shaare Zedek Medical Center. As the flagship center for cancer treatment in the country, Helmsley is part of the first phase of a master plan we undertook to expand the campus from 1 million square feet (93,000 square meters) to 6.5 million square feet (604,000 square meters), with a total of 2,200 beds.

Today's medical spaces need to be designed to surpass mere technical medical treatments in order to enhance the entire human experience. From the start of the design process of the Helmsley Cancer Center in 2013, our team combined several fields of knowledge to create an enhanced and enriched health-care environment that would leverage scientifically grounded, multisensory, neuro-wellness interventions to improve the clinical human experience.

We explored how to develop an ongoing dialogue between place and user through connections between inner and outer worlds, how to personalize place, and how enriched environments can promote vitality and instill hopefulness. We were determined to design a building that would boost the brain's immune system by improving interactions and synaptic connectivity, which is a scientifically proven integrative approach for creating longer, healthier aging and enhancing the entire

Birdseye view, Helmsley Cancer Center, Farrow Partners and Rubinstein Ofer.

medical experience for human beings. Employing a co-creation process, we overlaid the functional stacking and arrangement of programs and how they tied back to the main hospital building with these concepts. We also examined how and what values the center should communicate to people coming for treatment as well as to the medical staff that work there every day.

The primary metaphor for the building that emerged from this process is that of the butterfly, a fragile yet extraordinarily beautiful creature that undergoes a metamorphosis from caterpillar to fully formed butterfly. The process of metamorphosis is inherent in the experience of cancer treatment, which is a transition from one state of health to another. Depending on whether one takes a salutogenic or pathogenic approach to the journey, it can also transform one's state of mind.

An old and well-known Jewish fable called "The Wiseman and the Cynic" became the inspiration for the project. We developed an illustrated cartoon storyboard to tell it to the user group, which resulted in the cancer center's beloved nickname, "The Butterfly." The fable goes as follows:

> Once there was a Wiseman who had a special power. He could answer any question posed to him, and people from far would come with questions, which he always answered. The Cynic heard of the Wiseman's gift and was surprised how he would answer each question correctly, concisely, and with clarity.
>
> The Cynic resolved that he would think of a question that would stump the Wiseman. He had an idea; he would run to a meadow where butterflies frolicked, catch one within his hands, and hold it so gently within. Then he would run back into town to pose his question to stump the Wiseman.
>
> "I have a question!" he called to the Wiseman, barely containing his excitement. "Wiseman, tell me, I have a butterfly in my hands – is it alive, or is it dead?"
>
> The Cynic smiled as he looked at the Wiseman. He had finally done it, he thought. If the Wiseman says "dead," he

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

would open his hands, and the butterfly would fly free. If he says “alive,” he would crush the butterfly in his hands. No more butterfly, and the Cynic would win.

The Wiseman looked at the Cynic for a moment, and then smiled at him and said, “Hakol byadecha,” which translated means, “It is all in your hand.”

The Cynic instantly realized the Wiseman’s greater lesson: the butterfly’s life rested in his own hands, and there was a lot more at stake – his attitude, his approach, and his tone. Though it may not always feel like we have a butterfly’s life weighing in the mix, choice is always before us, in action and in perspective.

The exterior of the Helmsley Cancer Center consists of a four-storey timber structure that bends gently up and outward, engineered from European larch and in collaboration with WIEHAG, one of the world’s leading timber fabricators. In a 5,000-year-old city built primarily of stone, wood may seem to be an unusual choice, particularly given that Israeli building codes do not recognize mass timber. For centuries, limestone has been Jerusalem’s main building material for many reasons, including its defensive strength, its local abundance, and the fact that the Temple of Solomon (also known as the First Temple) and its foundations (the present Western Wall) were built from it. Ever since the British Mandate for Palestine (1920), municipal laws have required that all buildings in Jerusalem be clad with Jerusalem limestone.

However, wood and trees play an important role in many Torah stories, including the Tree of Life, the Tree of Knowledge in the Garden of Eden, the olive tree that grew after the Great Flood, and the Burning Bush where God spoke to Moses. Jewish culture celebrates an entire holiday dedicated to trees, Tu BiShvat, which is considered the “new year” for trees because it is believed to be the day that sap rises. The tree-shaped menorah, lit during Hanukkah, references the Creation story of Genesis and expresses life and growth. Therefore, the choice to use wood was embraced by the hospital, despite building regulatory issues, as it reinforced the organization’s narrative of the growth, life, and transformation that the material evokes in Jewish cultural and religious traditions.

The two sides, or “wings,” of the building consist of 715 individual and different European larch glulam beams and columns, as well as 6,200 square feet (560 square meters) of spruce cross-laminated timber (CLT) roof panels, all tied together by 2,700 concealed steel connectors. The entire structure and its components were designed, engineered, and fabricated by teams in six countries on three continents. WIEHAG, a 175-year-old Austrian timber engineering and fabrication company, joined the team in a design assist role to execute what is one of the most intricate global timber structures.

The two wings are asymmetrical in design, communicating the lightness, fragility, and beauty of life as well as a sense of motion. This is very unlike many hospitals around the world, whose designs communicate strength and permanence. Between the wings is a 17-ton (15,422-kilogram), 79-foot-long (24-meter-long) central steel skylight, consisting of individual curved and triangular components that let light into several terraced interior courtyard gardens cascading through the building. Beneath the skylight, a curved staircase that stretches gently from the outpatient clinics to the main entrance level connects the different levels in the central area. The typology of the building resembles traditional courtyard houses and neighborhoods of Jerusalem and the surrounding region. A typical private house might have a small garden and fountain at its center, surrounded by ceremonial and private rooms. In other cases, individuals and families shared their private living quarters with other families around a common courtyard space. Similarly, late-nineteenth and early-twentieth-century Jewish courtyard neighborhoods in Tel Aviv and Jerusalem were made of inward-facing, easily defensible housing for extended families and close but unrelated community members. Individual apartments were generally modest in size, with the large communal components, such as sitting areas, gardens, a cistern, a laundry area, and a large oven for Shabbat meals in the courtyard.

The Butterfly’s interior courtyard is layered with rhythmically positioned wood elements that “grow” vertically from a 1,750-square-foot (165-square-meter) elliptical garden at the lowest level entrance to the radiation treatment rooms and then bend and cloak the ceiling, like stratus and cumulus “timber” clouds rising in the sky. The wood members are set at different densities and depths, creating flowing, wave-like planes of wood along the south section of the courtyard. While the exterior structure reaches outward and upward, offering hope and generosity, the interior is shaped to create a sense of embrace, stillness, solidity, and silence for people undergoing treatment. The interior courtyard is also a moody and emotional space because the light and shadow conditions constantly change as light flows through the central and secondary skylight above the elliptical garden and onto the layered timber. From morning to night, and through the seasons, the space communicates and reinforces the message that we are alive and that life is full of hope, despite the current obstacles in front of us.

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

South wing of the Helmsley Cancer Center, Farrow Partners and Rubinstein Ofer.

The concept of environmental enrichment has shown us how one's physical environment impacts mental and physical well-being by altering the biochemistry and neuroanatomical structure of the brain. In addition, embreathment, or the representation of one's physiological breath in immersive experiences to enhance presence and body awareness, is a relatively new concept and tool in embodied cognition that can improve well-being. Embreathment may be experienced, for example, by watching a video of a peaceful landscape that expands and contracts with the rhythm of one's own breath, or by consciously becoming aware of one's breath in exercises such as body scan meditation and progressive muscle relaxation.

Embreathment can be used to reduce claustrophobia, anxiety, and associated negative cognitions by enhancing a sense of agency, sustained hopefulness, and interoception in situations where one's ability to act is restricted. In cancer centers, for example, some patients experience intense claustrophobia in MRI or CT machines, which presents a significant psychological challenge in delivering optimal treatment. However, embreathment techniques have been proven to increase patients' sense of mental and physical control and decrease their sense of claustrophobia.

The Helmsley Cancer Center builds on such principles and treatments with additional neuro-wellness interventions based on pioneering research in multisensory integration by our collaborator, internationally acclaimed Israeli brain scientist Amir Amedi.

Recent neuroscientific breakthroughs have uncovered new insights into the senses and the bidirectional effect of the mind on the body (top-down) and the body on the mind (bottom-up), including the perception of pain. Historically, doctors prescribed analgesics for pain, yet acute and chronic pain are complex phenomena, with a highly subjective veneer. Different people can experience the same physical nociceptive (i.e., relating to the perception or sensation of pain) stimulus yet report very different levels of pain. Moreover, all of our senses – not just touch – influence our perception of pain.

Amedi's lab at Reichman University's Baruch Ivcher Institute for Brain, Cognition and Technology has shown clear overlaps between body representations and areas of the brain related to high-order mental and emotional functions. He and his colleagues demonstrated that sensory information, such as pain, or pleasure, can be conveyed by alternative sensory modalities through sensory substitution, meaning that immersive experiences can reprogram the brain to bring about desired top-down influences. For example, the use of multisensory feedback immersive systems that react to one's breath in real time induce mind-body sensory substitutions that modify one's internal awareness and result in less pain, claustrophobia, and anxiety.

At the Helmsley Cancer Center, the CT simulator room explores these multisensory neuro-wellness treatment options. The room was designed with maximal sensory programming capabilities, enabling multisensory integration of auditory, visual, and tactile cues, including a curved LED display surrounding the CT scan machine, with ambient lights extending the display's effects to the whole room; a unique nine-speaker ambisonic audio system, which allows for algorithms to localize sounds in space; and haptic interfaces along the surface of the CT machine's bed.

Finally, integrated sensors create interactive experiences, enabling a personalized user experience through dynamic interaction with the patient's own physiological signals. This embreathment experience uses localized sounds and images to reduce the patient's anxiety and enhances their sense of control and body awareness through representations of their breath. This guides the patient to the desired calmer breathing pattern, resulting in, among other things, a sense of hopefulness and agency.

Projecting into the future, we are now beginning to explore similar implementations that would be constructed using human responsive technology, reactive lighting, and interactive kinetic architectural elements in treatment rooms, waiting areas, and staff lounges.

Eventually, they would be applied to the entire range of the patient experience, beginning with parking areas, through the main lobby, and along all circulation routes. By the time a person reaches the radiation treatment room, their sense of agency and hopefulness, not to mention their healing – achieved through an environmentally enriched journey – would be well underway.

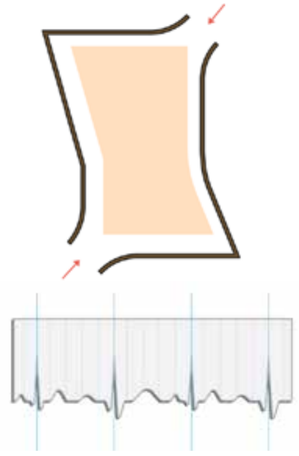
Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

Kaplan Medical Center, main entrance, Farrow Partners.

Kaplan Medical Center, main entrance, Farrow Partners.

National Oncology Center, Farrow Partners.

Generosity and Legacy



Above and right: Facade pulse, Kaplan Cardiology Center, Farrow Partners.

Kaplan Medical Center
Designed earlier than Shaare Zedek's Helmsey Cancer Center, the Kaplan Medical Center in Rehovot, a city just south of Tel Aviv, communicates a recurring message found in many of our health center designs about the beauty and fragility of life. When you approach the main entrance building, you arrive in a park-like setting where sweet oranges grow. The design of the main entrance was inspired by the shape of orange blossoms, asymmetrically composed of three petal-like roof planes made of timber and supported by semicircular timber arches.

This provides an authentic and generous welcome for a large health-care campus with otherwise generic buildings. Inside the main entrance, your view connects back to the park's central lawn and eucalyptus grove beyond.

We were also retained by the Kaplan Medical Center to develop a comprehensive master plan for their 58 acre (23 hectare) site. The Kaplan Cardiology Center is the first phase of this and the largest cardiology center in the Middle East. Its terracotta facade communicates the beating of the heart, and the fluid design of the building's interior also references the workings of the heart, with circulatory systems (corridors) and chambers (departments). The graphic rhythm recorded by an electrocardiogram influenced the design of the elevations, in the form of an exterior sunshade system made of terracotta vertical bands. The plan takes the shape of a simple shifted rectangle, with two primary entrances in opposite corners and at different levels: one facing the parking area, and the other oriented toward the center of the hospital campus. At the entrances, the sunshade facade is raised and appears to open, simulating a convivial embrace.

National Oncology Centre
The National Oncology Centre in Port of Spain, Trinidad, is a three-storey structure with four radiation treatment bunkers, linked to an existing hospital via walkways and landscaping. While it predates the Kaplan Medical Center's main entrance building, it shows similar intent. The wing-like design of the building communicates shelter and protection but also, again, the fragility and beauty of life. An overlap between spaces of enclosure and exposure, indoor and outdoor, supports a range of activities and emotional states for those who use the building. The gently sloping lines of the main lobby ceiling and sprawling therapy gardens create a gathering place for cancer patients and their families.

Thunder Bay Regional Health Sciences Centre, main entrance, Farrow Partners and Salter Pilon.

Variety and Vitality

Thunder Bay Regional Health Sciences Centre

The first time our office used wood extensively in a health facility was in our design of the Thunder Bay Regional Health Sciences Centre (TBRHSC). It foregrounds the distinctive culture and heritage of the forestry and pulp and paper industries, which, at the time, were the region's main employers. The choice of wood was also a nod to the historical importance of the railway to Thunder Bay.

In the past, timber was the major structural element of the long railway trestle bridges that spanned deep river gorges and connected this northern Ontario community to the rest of Canada. These bridges and, more specifically, the curved wood train trestle bridge are ingrained in the collective memory of people in the region. At the time of construction, local building codes did not permit the use of wood in hospitals, so we had to undergo extensive negotiations with building officials to gain approval for the material's use.

When the TBRHSC was designed, the prevailing question in hospital architecture was, somewhat perversely, whether to make a hospital feel more like a hotel or an academic campus. We rejected both options and chose instead to consider the real human feelings that would be experienced here. As a result, we decided that the design needed to exude self-confidence and a sense of abundance. It should also offer hope and be engaging and health-centric.

The plan is organized in a simple T-shape, with the bottom of the T facing south. Thunder Bay is in a northern location with very limited daylight in the winter months, so we gently curved the main east–west circulation route to follow the path of the sun. This ensures that all public areas are bathed in natural light, no matter the season. We deliberately designed the building to open to the outside – to the natural environment, gardens, terraces, walking paths, and a larger park system that connects to the nearby river – for a local population that very much embraces an outdoor lifestyle.

The facility's design explores concepts of variety and vitality, among others, by offering people a range of experiences and a sense of discovery. It stimulates positive emotions and background bodily feelings of seeking and curiosity as one arrives and moves through the central, gently curved, light-filled, wood-framed main circulation concourse. By leading one forward in this way, the concourse becomes a place that naturally brings people together for events and informal social interaction.

The Thunder Bay Regional Health Sciences Centre was described by Dr. Alan Dilani, founder and director of the International Academy for Design and Health, as "one of the most architecturally advanced hospitals in the world." It was also recognized by Online Masters in Public Health as one of the "30 most architecturally impressive hospitals in the world."[2]

Thunder Bay Regional Health Sciences Centre, exterior and interior views of the main public corridor, Farrow Partners and Salter Pilon.

Colchester East Hants Health Center, main entrance, Farrow Partners and WHR Architects.

Variety and Vitality

Colchester East Hants Health Centre
Colchester East Hants Health Centre, in Truro, Nova Scotia, is a new 124-bed hospital that supports medical, surgical, palliative, mental health, critical, emergency, and ambulatory care. Like TBRHSC, its design explores similar concepts of variety, vitality, and curiosity. Instead of a traditional main lobby, it has a linear central circulation route that links, edges, and bisects a number of exterior courtyards, like beads along a necklace. As people move through the hospital, they remain constantly connected to the nature of the province of Nova Scotia through these landscaped courtyards and gardens.

Colchester East Hants Health Center, main public corridor, Farrow Partners and WHR Architects.

Credit Valley Hospital, main lobby, Farrow Partners.

Credit Valley Hospital, main lobby, Farrow Partners.

Credit Valley Hospital, main lobby concept model, Farrow Partners.

Nature

Credit Valley Hospital
The design for Credit Valley Hospital in Mississauga, Ontario, Canada, draws on a range of elements and concepts from nature. Recognizing that people are at their most emotionally vulnerable in hospitals, we explored questions such as, “What are the most basic needs when patients are worried or feeling vulnerable?” and, “Do we have the courage to advocate for human-centric places that truly provide healing and hope?” When we asked cancer patients what is important to them, they invariably responded with variations of, “Cancer can be a devastating illness. The space we come to for treatment should give us hope.” When asked what gives them hope, and a sense of coherence, they said, “Something that is alive.”

When you walk in the front door of the hospital, you encounter broad, tree-like shapes that elicit feelings of both protection and encouragement. These “trees” are in fact structural wood columns that divide and divide again into smaller curved columns and radial cantilevered beams that support the roof. Credit Valley Hospital was the precursor to the Toronto Montessori School (TMS) Upper School, where we began exploring the concept of positive ambiguity through the pairing and mixing of circular and triangular forms (see chapter 12). It was also one of the early designs where we began investigating natural ranges of fractal dimension, or density, through extensive physical models to assess how the pupils of our eyes search and understand patterns, first scanning larger elements like the column trunks, then shifting to the finer diagonal beams that support the ceiling. This was, however, still before we discovered Richard Taylor’s research on the rhythm, pattern, shape, light, and shadow effects of midrange dimensional complexity and how they resonate with us emotionally.

Like a walk in a tree-lined courtyard, the main lobby of Credit Valley Hospital offers places of canopied refuge as well as open spaces that provide visual orientation.

Clustered seating areas promote social interaction in natural sanctuaries, with openings to a larger field of vision. The plan is both organic and a very clear and logical triangular arrangement of space.

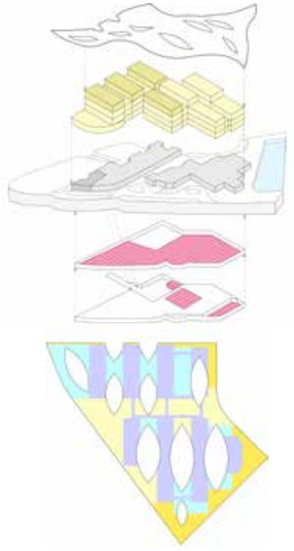
Credit Valley Hospital, main lobby, Farrow Partners.

Mater Private Hospital, main entrance, Farrow Partners and MCA Architects.

Mater Private Hospital, main entrance, Farrow Partners and MCA Architects.

Alexandria Hospital, sectional model, Farrow Partners.

Nature



Alexandria Hospital, building organization with leaf-like roof canopy, Farrow Partners.

Mater Private Hospital
Ireland's leading private hospital, located in Dublin, offers specialized cancer, cardiac, and spinal care. Designed after the TMS and Credit Valley projects, Mater Private Hospital continues to explore concepts of nature, life, and hope in an urban environment. The hospital is located on a prominent street with a Grade I listed church two blocks away, while a well-preserved block of significant Georgian townhouses sits opposite the property, crisp in their massing and detailing. The Mater Private Hospital includes several new vertical and horizontal building additions, along with a variety of complex renovations. However, our main urban intervention is an exterior colonnade along the front of the existing building and main entrance, like a relative of the columned entry portico of the nearby church. While our colonnade echoes the church's portico, the columns of our structure are more natural, creating the equivalent of a tree-lined street of whitewashed mass timber, intentionally not attempting to mimic the historically-listed Georgian houses across the street. The colonnade is also a generous gesture, as it offers the public a covered area for walking, gathering, and sitting that protects against the occasionally rainy Irish weather.

Alexandra Hospital
The design for this new hospital in Queenstown, Singapore, further explores the role of nature, as it is anchored in the principle of "a hospital within a garden, a garden within a hospital." Situated next to a lake in a mature residential neighborhood, Alexandra Hospital marries a distinctive organic, mountain-like form with operational effectiveness. The hospital is thus a place to go not just for medical treatments but for an evening stroll, a meal by the lake, or physical activity as well.

While we drew many design details from Singapore's unique culture and architectural style, the hospital consists of five standardized 30-by-30-foot (9-by-9-meter) structural grid buildings oriented toward the lake, each separated by a garden courtyard. The entire complex is sheltered by a gently undulating canopy, with leaf-like openings above the courtyards providing shade in the subtropical environment.

Alexandria Hospital, section model, Farrow Partners.

Themes and symbols connect Indigenous physical and spiritual worlds and convey reassuring stories of a coherent life, where illness and healing and the afterlife are part of a natural process. Sechelt Hospital, Farrow Partners and Perkins + Will.

Authenticity

Sechelt Hospital
One of the oft-stated goals in hospital design is to make a facility “feel like home.” The reality is that each individual’s idea of what a home should look and feel like differs greatly depending on their broad social and cultural experiences (learned) and their own past experiences (remembered). To create a place that will cause health, we must therefore look at the intent behind the desire for “home-like” design and, more importantly, a sense of familiarity to each person’s individual experiences and background.

In a health-care setting, people want to be reassured by design elements that are personally meaningful. The former St. Mary’s Hospital, was conceived as a long-term asset to the Sechelt community in terms of both resource sustainability and therapeutic effect.

Located on the Sunshine Coast, northwest of Vancouver, British Columbia, Canada, the hospital land was donated by the Sechelt First Nation more than fifty years ago. Once a site of great hardship, abuse, and trauma caused by Canadian government policies that devastated the Sechelt people, the hospital is now a part of the Truth and Reconciliation process between Indigenous people and settlers.

Members of the Sechelt First Nation played a key role in the design process through extensive consultation on how to incorporate the most meaningful and enduring elements of their culture and traditions into the hospital. The shape of the building was inspired by the cedar bentwood box, which is unique to Coastal First Nations. In this concept, the bentwood box holds our most precious possession: our health.

Themes and symbols connect Indigenous physical and spiritual worlds and convey reassuring stories of a coherent life, where illness and healing, but also death and the afterlife, are part of a natural process. Major Sechelt works of art, such as the three totem poles that mark the main entrance, tell stories and depict well-known cultural symbols. The entrance is further animated by a mural by First Nations artist Shain Jackson that spans the 70-foot (21-meter) length of the transparent main lobby, visible to the wider community from beyond the property line.

At the time of its opening in 2013, Sechelt Hospital was recognized by multiple bodies as one of the most sustainable hospitals in North America. Designed to be carbon neutral, as climate change mitigation has health co-benefits, in addition to a high-performance building envelope, the hospital includes 125 boreholes, each 250 feet (76 meters) deep, to provide zero-carbon energy for the building’s heating and cooling, distributed through radiant slabs. A 19-kilowatt photovoltaic array provides electricity, and passive design strategies, such as a green roof, solar shading, and operable windows, reduce solar heat gain. We defined sustainability not just in ecological terms, however, but also in terms of cultural authenticity, which is why the incorporation of so many elements of Sechelt design, tradition, and ways of thinking was critical and has been recognized as one of the hospital’s most notable qualities.

Sechelt Hospital, main lobby. Mural by Shain Jackson.

Thunder Bay Regional Health Sciences Centre, cancer radiation treatment room, Farrow Partners and Salter Pilon.

Silence and Stillness

TBRHSC Cancer Radiation Treatment Rooms

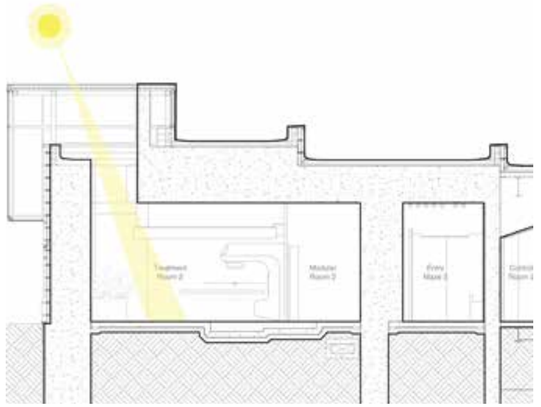
The cancer radiation treatment rooms of Thunder Bay Regional Health Sciences Centre were the first of their type in Canada. Typically, cancer radiation treatment rooms (also known, in war-like jargon, as cancer “bunkers”) are quite gloomy places with no natural light, but our treatment room design brings in direct sunlight from a carefully modeled skylight. While designing the rooms to control the radiation was technically challenging and had to meet the strict requirements of Atomic Energy of Canada, the impact on the psychological well-being of patients and health-care workers is enormous.

Radiation dissipates its energy, and as a result its harmful properties, exponentially. Therefore, in cancer bunker design, we can limit its spread by manipulating the distance it travels and the shape of the route it must bounce through. Additionally, when a patient receives treatment, the radiation machine focuses laser lights on pre-painted marks on the body that allow for the required precision treatment of the cancer. This requires a very low light level to ensure the lasers are visible.

To meet these requirements, we began to study art gallery designs that allow the penetration of natural light, in focused ways, on paintings that should be viewed in natural light but are also highly susceptible to damage from it. The team arrived at an authentic solution that brings the north light straight down, in a focused way, along a modeled wall that grabs the light as it penetrates the room, to illuminate a naturally planted garden below. This way, the light raises and lowers in intensity with changing times of day, weather, and seasons while keeping the daylight focused at the foot of the treatment bed, where patients undergoing radiation therapy can see it.

Usually, when you enter a radiation treatment room, you move through an entry maze that dissipates the radiation. Typically, when you reach the end of this maze, you turn a corner and find yourself looking directly at the seemingly overscaled treatment machine, which can be a deflating experience.

In the radiation treatment rooms at TBRHSC, however, we flipped the machine around, so that when you enter you look past the machine to the sun-lit garden beyond, a simple but notable design breakthrough in cancer bunker design for the way it provides a sense of stillness, intimacy, and hope for patients and staff.



Section through the radiation treatment room showing the skylight, Thunder Bay Regional Health Sciences Centre, Farrow Partners and Salter Pilon.

Entry corridor to the radiation treatment room, Thunder Bay Regional Health Sciences Centre, Farrow Partners and Salter Pilon.

View of clerestory window above COVID-19 ICU, Farrow Partners.

View from patient bed to clerestory window, COVID-19 ICU, Farrow Partners.

View of clerestory window above COVID-19 ICU, Farrow Partners.

Hope

Solace Rapid Assembly – High-Performance COVID-19 Intensive Care Units

To increase the chances of a better health outcome, medical staff enrich the oxygen levels for COVID-19 patients, which allows their lungs to function at a higher level than would be possible without oxygen enrichment. Likewise, our design strategy for rapid assembly COVID-19 intensive care units (ICU) explored the ability to both "enrich" a typical ICU in order to achieve better outcomes for patients, and to help medical staff do their best work at a time when they are laboring incessantly under some of the worst medical conditions imaginable.

Solace, from the Latin verb solare, is the comforting, calming, and soothing of grief – such as through listening to music or being in the company of good friends. How could the physical space of a COVID-19 ICU ward achieve solace for those caring or healing under very difficult conditions? Building on our work for THRHSC's cancer radiation treatment rooms, where we applied daylight in treatment areas, we designed something similar as an accelerant for health and wellness outcomes.

The high-performance Solace COVID-19 ICU is a simple rectangular form with twelve single-patient rooms on three sides of the floor plate and staff support areas on the fourth. The center of the rectangle contains the medical staff care zone. Above this central area, we raised the ceiling to create a four-sided clerestory, window-lined lantern, allowing daylight to illuminate staff work areas – a rare condition in most ICUs.

For patients that need to face into the care zone for observation, windows at the back or side of their rooms would not provide much daylight and no view. However, the raised lantern provides direct views for ventilated patients lying in their beds; they can see out the windows above the care station, allowing them to feel part of the changing day/night cycles, seasons, and weather conditions.

Even for patients who may be unconscious at first, this contributes to improved outcomes. The effects of improved health through participation in the regular circadian rhythms of daylight have been well documented with premature babies in neonatal ICUs.[3] The salutary effects of proximity to a window and natural day/night light are similar for COVID-19 patients, as they move from unconsciousness to semi-consciousness and finally consciousness again. Being able to sense or see the changing light conditions of a passing cloud, a sudden rainstorm, the warm afternoon sun, gentle moonlight, or a dawn sunrise, gives a sense of life, time, coherence, and hope.

Changing light conditions throughout the day and night, COVID-19 ICU, Farrow Partners.

Herzog Medical Center, main level common areas overlooking the Jerusalem Forest Valley, Farrow Partners.

Hope

Herzog Medical Center
The Herzog Medical Center is our third major medical campus design in Israel and the country's foremost center for psychological trauma, mental health, geriatric care, and respiratory medicine. Our expansion of the campus will double the number of inpatient beds to 1,200 across three new buildings, expand and rejuvenate eight existing buildings, and add a vibrant outpatient community health center as well as conference facilities and a hotel, making it the new heart of the surrounding emergent, mixed-use neighborhood.

The 15-acre (6-hectare) site overlooks the Jerusalem Forest valley in the ancient city and hosts an important archeological site – a 2,500-year-old Roman road and guardhouse, which was the ancient entrance to Jerusalem.

The hillside site plays a crucial role in the campus, with community recreation areas, parks, gardens, paths, restaurants, and community health facilities all engaging the edge of the valley. New inpatient beds are positioned on the crest of the hill and cascade down the slope, while the two-storey main level hosts communal public functions and a public promenade with exceptional valley views.

The design is conceived as a green hand, palm resting in the forested valley with finger-like parks extending up, through, and over the hillside. These green spaces define four new state-of-the-art medical and research buildings and extend through to the municipal lands to the north, tying together the district as it is reimagined into a new high-tech center for Jerusalem.

Serving complex patient populations that require longer stays – not just elderly patients, but also young and psychiatric patients – the intent of the campus is to radiate hope and generosity. The Herzog Medical Center is a new hub for a transforming neighborhood that expresses common purpose, promotes well-being, and enhances our self-belief and ability to create both individual and societal change.

Herzog Medical Center, aerial view, overlooking the Jerusalem Forest Valley, Farrow Partners.

Herzog Medical Center, main entry lobby,
Farrow Partners.

Bethany Lodge, evening light in the solarium, Farrow Partners.

Enriched Environments and the Aging Brain: Creating Long-Term Care-Health Centers

An increase in life expectancy has placed new and growing demands on our health-care facilities, creating a need for improved design strategies for our aging communities. Long-term care (LTC) facilities are one of the primary sources of care for some of our elders with specific health challenges, but they face serious tests of overcrowding, institutional and unwelcoming design, high staff turnover and burnout levels, and a lack of services that promote well-being. Many of these facilities cause boredom, dis-ease, and depression because of how they are designed and where they are sited and located. Elders often need to leave their own communities to access long-term care, which is cruel as it uproots and separates them from family and friends. This presents an opportunity – indeed, a moral imperative – to reevaluate how the design of LTC facilities can better support the needs of residents, staff, and their families and friends by focusing on the therapeutic effects – indeed, as a noninvasive therapeutic treatment – our buildings can have on human health and well-being and, more specifically, the aging human brain.

Wood and Well-Being

Two of the most impactful decisions we can make in design are scale, as it relates to our bodies, and the intentional selection and application of building materials. As we know, integrating nature and natural elements, such as mass timber and wood, into the built environment creates access to their spiritual, physiological, and psychological benefits and helps connect occupants to their greater surroundings. Wood has several material and immaterial benefits: it is hypoallergenic and has antimicrobial properties, excellent sound absorption, and reduced off-gassing emissions, all of which collectively enhance salutogenic physiological effects on occupants. Emotionally, wood structures and interiors reinforce our personal narratives about growth, perseverance, and change, and they promote what some would call a spiritual connection to nature and positive ideations of self. On a neurobiological level, wood buildings also support the theory of environmental enrichment, which considers the role that sense perception (olfactory, tactile, visual, and auditory) has on our cognitive and physical health. For example, even just the scent of environments built of wood, which changes with the season, temperature, and humidity, makes us more aware that we are alive and connected to the natural world around us.

Cultures around the world practice immersion in nature for its revitalizing and spiritual benefits. The practice of incorporating nature into the psychological treatment of the elderly has shown that when older adults identify with natural environments, it creates a sense of agency and acceptance about the transitional nature of life.[5] As a result, interest in the health benefits of nature and natural materials in the design of medical facilities has grown steadily in the past decade.

Neurogenesis

Contrary to the assumption that brain networks are fixed or cannot change after a certain age, our brains are, in fact, permanently plastic and can grow, heal, and change throughout our lives. As we have discovered, several factors contribute to this, including our environment, which affects our capacity to strengthen our neural networks through neurogenesis. This process allows us to create new neurons, contributing to our ability to learn and adapt, and is possibly most beneficial in vulnerable groups facing chronic disease and neurodegeneration.

Enhancing Cognitive Reserves

How do buildings create health for vulnerable communities? In what ways can the built environment participate as not only a preventive measure against illness but as an accelerant for health? How might the use of natural materials create environments that make aging communities more resilient to neurodegeneration? Many LTC facilities operating today are the opposite of enriching environments and actually exacerbate the effects of age-related decline. During the COVID-19 pandemic, many even contributed to higher mortality rates due to their design and staffing practices.

Furthermore, we know that impoverished spaces – those without appropriate sensory stimulation – intensify brain atrophy and slow down the recovery process of brain lesions in stroke victims.[6] Enriched environments, however, support cognitive reserve – that is, the brain's ability to improvise and find alternative ways of getting things done when faced with the challenges of life. This occurs because enriched environments strengthen synaptic health and promote the growth of new neurons. As a result, people with greater cognitive reserve have greater resilience within neural networks and are better able to cope with neurodegeneration and illness.[7]

This research is supported by a Norwegian study on health-care workers' preferred levels of wood finishes in medical facilities. The study showed that they preferred intermediate levels of wood finishes,

Wellesley Central Place, courtyard, Farrow Partners.

around 50 percent of the surface area, in inpatient room settings,[8] which I believe ties back to the earlier concept of positive ambiguity, whereby our minds prefer to compare and contrast over being in uniform sensory environments. This research points to the therapeutic power of natural materials on sensory perception and their potential application for improved well-being in LTC facilities.

There is also a growing body of research that demonstrates the health benefits of nature and natural elements in the psychiatric well-being of aging communities. A study on the life satisfaction and longevity of elderly women in rural areas versus those in urban areas revealed that a greater connection to nature was a dominant factor in the ability of rural women to cope with the challenges of aging.[9] The study also suggested that place attachment theory (the concept of emotional bonds between people and place) and attention restoration theory (the concept that spending time in nature relieves mental fatigue) positively shaped the identities of these women.

A Sense of Agency That Fosters Positive Ideations

Such studies can have a significant benefit in the creation of living facilities for the elderly. A common psychological challenge for elderly people involves creating a sense of agency that fosters positive ideations of self, family, and community.[10] According to the "narrative approach" in psychiatry, dominant narratives frame our perspective, and so if you change your narrative, you can change your perspective on life. Research by Israeli therapist Ronen Berger on incorporating nature into the therapy of older adults suggests that making connections between personal narrative and natural cycles expands patient perspectives, creates a sense of strength, and fosters acceptance of the concept of transition in life.[11] In addition, wood structures in LTC facilities inspire hope, as demonstrated in the aforementioned Finnish study that recorded residents' subjective experience of their exposed wood beam facility.[12]

The use of wood in medical facilities also increases well-being and improves patient recovery. The oft-referenced work by influential health-care design researcher Roger Ulrich on the power of nature and healing found that when patients had views of nature from their rooms, their recovery times were faster and their chances of postoperative complications were reduced.[13] Incidentally, the restorative effects of wood can also be seen in the very young: neonatal units with wood finishes have been shown to improve sleeping habits of newborns by 20 percent.

It is also important to note that wood buildings make employees happier. In LEED-certified and green buildings, particularly those with wood structures and finishes, there is greater employee retention, reduced burnout, and higher recorded levels of workplace satisfaction and well-being.[14] When health-care workers feel good, they are more present and better able to have constructive and meaningful interactions with their patients. Finding ways to incorporate wood elements into LTC facilities brings together the spiritual, physiological, and psychological healing properties of wood.

Accelerates for Health in Vulnerable Communities

Answering the question of how buildings can create health for vulnerable communities requires that we use holistic and accelerative interventions that accelerate health. Consideration of the health-related benefits that LTC facilities might provide to their residents begins with creating competent strategies that support human well-being.

Built environments should reflect values that support and strengthen our aging communities. Wood gives the impression of timelessness and has qualities of generosity and hope, allowing us to connect to something greater than ourselves. Every piece of wood is unique and authentic – qualities that support enriching environments. Additionally, wood conveys a sense of realness and rootedness, sincerity, and authenticity.

It is evident that the purposeful application of natural materials, including wood, can greatly advance strategies that support and accelerate health, reduce stress, create a sense of agency, uplift us, and make us feel whole. For example, our study of the benefits of mass timber in LTC settings for Vancouver Coastal Health in British Columbia, Canada, presents a resident in a room with approximately 30 percent wood finishes. The ceiling over the resident's bed is fitted with 10-foot-wide (3-meter-wide) exposed CLT panels, as is the wall next to the exterior wall. This use of wood frames views to the exterior, strengthens the connection to outdoor ecologies, and increases overall exposure to nature and natural materials.

In the end, how we design LTC environments has a significant impact not only on the mental, physical, and spiritual health of the elderly of our communities but also on those who work with and visit them, as the buildings can communicate important message about the values that are important in how we value the vulnerable in our communities.

The Residence in Mission, aerial view, Farrow Partners and KMBR.

The Residence in Mission, courtyard, Farrow Partners and KMBR.

The Residence in Mission, aerial view, Farrow Partners and KMBR.

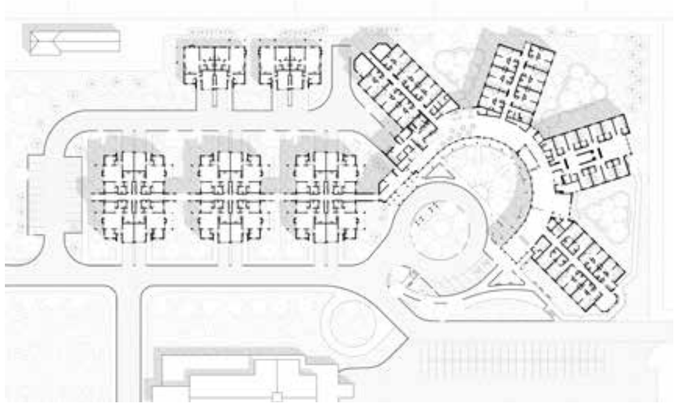
The Residence in Mission
Located in the city of Mission in the lower mainland of the province of British Columbia, Canada, the Residence in Mission, a new complex continuing care center, is part of a 130,000-square-foot (12,000-square-meter) campus of care for seniors that includes 200 residential beds for people with complex health-care needs, a day program for older adults, and a community health center. The project's plan gives a nod to the traditional Haida sun crest form. The slender, semicircular central part of the complex houses the main living areas, while arms containing secondary bedroom areas radiate out from it and edge triangular landscaped courtyards containing walking paths and sitting areas. All living areas receive daylight on two sides, from both the central courtyard and the secondary courtyards between the bedroom wings.

The courtyard facade is clad with a range of panels that gradually transition from a warm color range on one side of the building to a cooler range on the other side. The colors were inspired by the circadian rhythms and natural colors of the forest that are cooler in the morning and warmer later in the day.

Many complex care facilities for seniors are mind numbing in their repetitive design, insipid colors, long, straight corridors, and deep floor plans, with few or no opportunities to connect to the outside and the changing light and weather conditions though the days and seasons. We have already seen that lack of sensory stimulation intensifies brain atrophy, unlike the stimulation the brain receives in enriched environments, which support improved cognitive reserve by enhancing synaptic health and encouraging the development of new neurons. The gently curved corridors and public areas of the Residence in Mission, however, offer variety and vitality, stimulating the mind with ever-changing visual and spatial prospects as residents and employees move through them. The views of the many different garden courtyards support a narrative and perspective in which our connection to nature generates a sense of strength and acceptance about the progression of life.

The Residence in Mission, main entrance and floor plan, Farrow Partners and KMBR.

Netherlands Norwich Community
This is a master planned community we created for the Netherlands Reformed Congregation of Norwich, a town near London, Ontario, Canada. Netherlands Norwich builds on concepts similar to those underpinning The Residence in Mission project, with a variety of housing types for the elderly that range from independent living, to assisted living, to complex care living. We combined independent living homes in several fourplex suites, which are linked back to the assisted living building. Like The Residence in Mission, the assisted living building is semicircular, with a view that opens to the community's church. Also like Mission, the common and living areas surround a central garden. Other private areas are housed in wings that radiate outward and surround semiprivate garden and activity areas.



Netherlands Norwich Community, site plan showing a range of seniors housing types, Farrow Partners.

Netherlands Norwich Community, central courtyard, Farrow Partners.

Netherlands Norwich Community, complex care wing, Farrow Partners.

Netherlands Norwich Community, complex care wing, Farrow Partners

Wellesley Central Place,
Farrow Partners.

Wellesley Central Place
Wellesley Central Place is a 150-bed, 100,000-square-foot (9,300-square-meter) LTC and outpatient facility located in the heart of downtown Toronto.

One of our early LTC designs, it resembles a small urban neighborhood, with a central garden commons, an active high street, and quieter residential clusters. Its narrow floor plate sections and wrapping rectilinear courtyards later evolved into the semicircular typologies we designed for the Mission and Norwich buildings.

While Toronto's urban plan is dominated by a city block grid, the south edge of the Wellesley Central Place property faces an infrequent-in-Toronto gently curved street, which we used to create a generous, four-storey-high front porch off the main public areas of the building. The north side of the common areas overlooks a central garden courtyard, edged by a single-loaded corridor on all sides, which allows daylight and views to the garden terrace. The south side of the facility engages with the busy street life, while the courtyard offers a more intimate experience.

Situated on the corner of the city block, the north and west sides of the building create an L-shape that faces a treed square, shared as a common amenity with several other residential building on the block. Like the Mission and Norwich projects, Wellesley Central Place explores how LTC buildings in communities can activate optimal health for aging people by employing the tools of environmental enrichment. LTC conceived as a noninvasive therapeutic treatment to enhance health and well-being, specifically, for the aging brain.

Wellesley Central Place, central courtyard, Farrow Partners.

Living Bridge, Toronto,
Farrow Partners.

14

Constructing Health and Human Performance: A Way Forward

"Holding out a line. Casting and recasting it. Waiting patiently, watching the river, the waves, the light, sinking into the circle of life. Until suddenly you feel it; a series of nibbles, then tugs, and then slowly something coalesces there on the end of your line. Lines of thought agglutinate. They weave themselves together and take shape, gaining felt sense and even power."

– Perry Zurn and Dani S. Bassett, Curious Minds: The Power of Connecting[1]

Helmsley Cancer Center,
Farrow Partners and Rubinstein Ofer.

This book has been an attempt to make sense.

To make sense of how our minds work in our bodies and extend out into the world, something we are not taught in school.

To make sense of how what we construct can create the conditions in which we flourish – where we live, work, learn, heal, and play.

To make sense of society's views of health and well-being, which of late have been dominated by a pathogenic (preventing illness) perspective versus a salutogenic (causing health) one that has existed for more than 5,000 years of human history.

To make sense of how what we build can be fundamentally rooted in generosity – how buildings can provide us with affordances that help us in what we do in our daily lives instead of being merely transactional in what they offer.

To make sense of how our minds construct person-to-place relationships with our environments in a similar way to how we construct our most cherished person-to-person bonds.

To make sense of how our minds interact with enriched environments, which, like nutrient-rich, architectural superfoods, create the conditions for optimal health.

And finally, to make sense of what I do every day as an architect. (This might be most motivating for me.)

I am not a scientist. I do not follow a scientific process wherein hypotheses are tested and variables eliminated through experiments, yet I do actively conduct research through design.

In architecture, it is precisely the variables that create the most enduring and enchanting results, the *Stimmung* that moves us.

In my work as an architect, I do what Tim Ingold describes as "thinking through making, as opposed to the making through thinking that, in institutions of higher education, has tended to place theorists and practitioners on opposite sides of the academic fence."[2]

As Sarah Robinson observes, the word building "is both a noun and a verb,"[3] both a place and an action. The very acts of designing and building, over many years, have led me to formulate my theory of how we can and must use enriched environments to construct health.

Midway through my career, I am only now beginning to comprehend the questions that I posed at the beginning of this book. While running a fruitful practice, I went back to university to complete a Master of Neuroscience Applied to Architectural Design at Iuav University of Venice as a fly-in student. I became the first Canadian architect to receive this degree in what is now an emerging area of inquiry. The more I research and build, the more I feel like a bather walking into the ocean – the further in I stride, the deeper the water grows.

However, I clearly know that we must be committed to causing health – *constructing* health – in every public space and every building. As architects, we must help people open their eyes to the potential their built and natural environments have in activating optimal health and stop tolerating design that causes boredom, dis-ease, and depression.

We must help people see that there is no such thing as neutral space, and that what we build affects how we experience the world and therefore either causes or undermines health. We must do our utmost to build high-performance – and human performance –environments that are accelerants for optimal health.

This means we need to begin identifying the thousands of causes of health or symptoms of wellness that lead to a healthier society, not just the diagnoses or symptoms of disease. Only then can we pursue salutogenic design that actively incites health and create enriched environments with qualities and values of generosity, variety and vitality, authenticity, hope, nature, and silence, stillness, solidity, and intimacy in order to stimulate enriched person-to-person experiences.

By exploring the role our environments play in encouraging, enhancing, and causing ecological, physical, societal, and mind health, we can understand how our surroundings make us feel – and how they can make us feel better.

We can construct health.

Kaplan Medical Center Planning Charrette Workshop

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About the Author

Working at the intersection of architecture and neuroscience, Tye Farrow is a world-recognized pioneer in architecture that gives or causes health. With award-winning projects around the globe that enact salutogenic design – design that actively incites health – he is the first Canadian architect to have earned a Master of Neuroscience Applied to Architectural Design (Iuav University of Venice). He also has a Master of Architecture in Urban Design (Harvard University) and a Bachelor of Architecture (University of Toronto).

Tye is a sought-after speaker who has presented to respected organizations and universities in over forty cities on six continents, including at the Salk Institute for Biological Studies, the Johns Hopkins University School of Medicine, the Mayo Clinic, and the Cleveland Clinic. He has been called a global leader who is making "a significant contribution to health and humanity through the medium of architecture" (World Congress on Design and Health) and "one of the world's most prominent practitioners of, and advocates for, human-built environments that enrich our lives through neuroarts choices" (Susan Magsamen, International Arts + Mind Lab, Johns Hopkins University School of Medical).

Tye has designed a wide range of projects, including a proposal for a new mixed-use archipelago park inspired by Vivaldi's *The Four Seasons* to address rising sea levels in Venice, a new cancer center in Jerusalem that communicates life's beauty and fragility through a butterfly-like wood structure, a private hospital in Dublin that is inspired by Celtic mythology, a Montessori School campus in Toronto that is embedded with tree-like natural affordances, and a hospital in Sechelt, British Columbia, that reflects Indigenous notions of generosity. *Hospitality Design* has described him as "one of nineteen global earth champions and wellness visionaries who are changing what it means to do good."

Tye is a Fellow of the Royal Architectural Institute of Canada, a registered architect with the Ontario Association of Architects and the Architectural Institute of British Columbia, and a faculty member of the Iuav University of Venice's Master of Neuroscience Applied to Architectural Design program. His past community volunteering activities include having served as president of the Board of Governors of the University of Toronto Alumni Association; chair of the Committee on Equity, Diversity and Inclusion, University of Toronto Alumni Association; vice-chair of the College of Electors, University of Toronto; Boundless cabinet member, John H. Daniels Faculty of Architecture, Landscape, and Design at the University of Toronto; alumni faculty representative of the Faculty Council, John H. Daniels Faculty of Architecture, Landscape, and Design at the University of Toronto; first vice-president of the Board of Governors, Architectural Conservancy of Ontario; and chair of the Board of Governors, Royal St. George's College.

Glossary of Terms

Action potential: Our perception of what actions a building or object affords us, based on our individual physical capabilities.

Active Design Guidelines: A set of guidelines published by the City of New York that offer a range of tools to reduce obesity and diabetes through design strategies that promote walking. These include the convenient placement of comfortable stairs, protective canopies, or an activated street front at the base of a building as well as facilities that support exercise through pedestrian-friendly exteriors.

Affordances: The opportunities the environment provides or furnishes to the animal (and, by extension, to the human being); coined by James J. Gibson.

Aletheic gaze: Similar to peripheral vision, the aletheic gaze, as defined by David Michael Levin tends to be pluralistic, contextual, inclusionary, and caring.

Assertoric gaze: Similar to focused vision, the assertoric gazed is defined by David Michael Levin as narrow, dogmatic, inflexible, and unmoved.

Attention restoration theory: Explores how our ability to concentrate improves after we spend time in nature, linked to two types of focus: voluntary and involuntary.

Attunement: Defined by Alberto Pérez-Gómez as how certain places have a "voice" that speaks to us, where we feel connected – attuned – as inhabitants of a specific location; a multisensorial "communicative" setting that links human health and self-understanding.
Basal ganglia: Located near the thalamus, the basal ganglia is a group of subcortical nuclei responsible for learned cognition; motor learning and control; evaluating goals, prospects, and risks; and developing incentives and motivations.

Biophilia: The term was first used by German psychologist and philosopher Erich Fromm to describe an innate attraction to the natural world. American biologist and Pulitzer Prize–winning author Edward O. Wilson further developed Fromm's hypothesis in his 1984 book Biophilia, in which he defines it as "the innate tendency to focus on life and life-like processes," or the subconscious human urge to seek connection with nature and other forms of life.

Bodily affordances: Opportunities for an environment or object to communicate messages through implicit suggestions of movement, actions, and behaviors.

Center of Influence: An alternative to the well-established concept of the hospital as a "Center of Excellence," which provides downstream illness care, a Centre of Influence promotes a full range of upstream causes of health within a community.

Cerebral cortex: A blanket-like covering of billions of neurons that wraps around the cerebral hemisphere. When we think of what a brain looks like, with its folds, peaks, and valleys all scrunched together, we are picturing the cerebral cortex.

Cognitive psychology: The science of the mind.
Cognitive schema: Patterns of thought and behavior that organize categories of information and the relationship between them. For example, a bicycle and a bus are both forms of transportation, yet they are different in terms of their shape, size, capacity, and what propels them.

Compassion fatigue: Refers to the emotional cost, or pain, of caring for others, when one begins to internalize the traumas of others.

Comprehensibility: According to Aaron Antonovsky, comprehensibility is "the cognitive dimension, [and it] refers to the extent to which one perceives internal and external stimuli as rationally understandable, and as information that is orderly, coherent, clear, structured. To understand one's context and one's own part in it."

Continuum of health: The concept in which the body and spirit are nurtured even when no illness is present.

Distributed cognition: An approach to cognitive science, formulated by cognitive anthropologist Edwin Hutchins, whereby mental representations in our brains are distributed outward into our sociocultural systems that we then use to perceive and make sense of our surrounding world. In other words, knowledge lies not just within the individual but in our social and physical environments.

Eidetic memories: Hyperreal reminiscences of both physical and emotional imprints in the mind.

Emotions: The communications the interoceptive (internal) body sends to the mind on the present state of things. They are bottom-up communications – that is, physiological changes to the body, such as a pounding heart, sweating, trembling, muscle tension – sent to the cerebral cortex in response to the changing environment.

Environmental enrichment: A field of study first identified by Donald O. Hebb through his experiments with lab mice, where he discovered that mice in enriched environments lived longer, had fewer behavioral issues, were physically healthier, and performed better on cognitive tests than mice in regular cages. The field of study looks at the health-generating capacities of the built environment.

Environmental neuroscience: Combines environmental psychology and social and cognitive psychology with social, cognitive, and behavioral neuroscience to investigate how the natural and built environments pair with social structures to affect behavior.

Environmental psychology: How we individually connect and interact with space.

Epistemology: A branch of philosophy that explores "the sense of knowing" and investigates how we know and how we make knowing possible.

Eudaimonia: Emerging out of Hellenistic philosophy and commonly translated to mean "happiness," or "human flourishing."

Eudaimonic well-being: Developed by the Greek philosopher Aristotle and achieved through personal growth, fulfillment, and experiences of meaning and purpose.

Experimental psychology and cognitive neuroscience: The analysis of visual patterns and our responses to them, positive or negative.

Extended mind thesis: Developed by Andy Clark and David Chalmers, that the mind does not live solely in the brain, or even just the body, but stretches out into the world around us. Their thesis was further developed by researchers in embodied cognition, which explores the role of our body in thinking, known as extended cognition.

Exteroceptive: Signals from outside the body.

Feelings: The conscious experience of emotions that takes place after the body's physiological response. They are top-down reactions to the internal emotions the body sends to the mind that result in an action.

Focused vision: Provides detailed, conscious information, such as when we are reading the words on a page.

Forebrain and cerebral hemispheres: Located above and enveloping the hindbrain and the midbrain is the forebrain, which consists of the right and left cerebral hemispheres. While very similar in how they coordinate our cognition, perception, and actions, the right and left cerebral hemispheres each do so in unique ways. Our right hemisphere deals with more of what we typically deem the creative sides of things, such as language and information, while the left side focuses more on the analytical aspects of the information it receives and responds to. The two hemispheres are further divided into four lobes: the frontal lobe, the parietal lobe, the temporal lobe, and the occipital lobe.

Frontal lobe: Located just behind the forehead, the frontal lobe deals with the primary functions of the organizing and planning of muscles and movements, reasoning, and intensity of emotions.

Gestalt theory: From the German word for shape, form, or figure, Gestalt theory emphasizes that the whole is greater than its individual parts in how we perceive an object, place, person, or thing. Each part influences the reading or perception of each other part, thereby creating the larger meaning.

Health: Defined by the World Health Organization as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."

Health Arena: A concept introduced by the World Health Organization that recognizes the role of where we work, live, learn, and play in promoting and enhancing human health.

Hedonic well-being: Relates to a multisensorial consciousness or sensations that give us pleasure and happiness, which we anticipate and seek out, and which are often associated with pleasures of the flesh and gastronomic delight.

Hindbrain: Includes most of the brainstem and the cerebellum and coordinates breathing, motor activity, sleep, and wakefulness.

Home: Refers to the interconnections between material and immaterial qualities of domestic place – the architectural atmosphere, or Stimmung. Home is where we perform our intimate rituals – the social and material practices of family traditions, expectations, customs, and beliefs – that

develop out of our understandings and interpretations of our surroundings based on cultural/social experiences (learned), past experiences (remembered), and layered cultural iconography.

Homeostasis: The primary internal, self-regulating process by which an organism maintains stability while adapting to surrounding circumstances in order to preserve its existence.

Hospital: From the Latin word hospes, meaning guest, visitor, or host, a hospital was originally a resting place for travelers and later a place that cared for people who were too sick, poor, or old to look after themselves. Today, hospitals have evolved into often large complexes where people who are ill or injured are given medical and surgical treatment and care, either through inpatient or outpatient services.

House: A physical Cartesian spatial measurement, along with the programmatic elements that are needed for its residents, such as living, dining, and sleeping spaces. A house provides shelter.

Human factor psychology: How our surroundings create meaning and metaphors through perception.

Hypothalamus: Located under the thalamus, this area produces hormones that manage essential bodily operations, including pulse and heart rate, body temperature, appetite, and weight.

Interoceptive: Signals from within the body, such as your heart beat, respiration, and the autonomic nervous system

Involuntary attention: Attention that is diverted toward something without conscious effort, such as happens when we are in nature, natural settings, or an environment rich in natural materials and forms. Involuntary attention is very important for human health, because when the mind is in this mode, it restores and reinvigorates a person's ability to engage their voluntary attention.

Isovist: Clifford Tandy's concept of the volume of space that is visible from a given point of known location in space by an individual. This approach can be used to describe spatial properties from a beholder-centered perspective.

Long-term potentiation (LTP): The learning process that stems from the strengthening of neural networks that result from repeated behaviors, thoughts, and actions.

Manageability: According to Aaron Antonovsky, manageability is "the instrumental or behavioral dimension, defined as the degree to which one feels that there are resources at one's disposal that can be used to meet the requirements of the stimuli one is bombarded by."

Meaningfulness: According to Aaron Antonovsky, meaningfulness "expresses the motivational dimension, [and] refers to the extent to which one feels that life has an emotional meaning."

Mental health: As defined by the World Health Organization (WHO), "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively is able to make a contribution to his or her community. However, the term mental health is also often associated with mental illness and a deficit-based view of health, which results from the pathogenic medical lens through which we view many things in society today.

Metaphoric affordance: A type of affordance that does not result in an immediate physical action but rather the imagined perception of action, such as a lofty dome that communicates an upward motion but doesn't result in an immediate action beyond drawing our eyes and head up toward it.

Midbrain: Located just above the hindbrain, the midbrain is a very small area that helps us process visual and auditory signals and is tied to our how our eyes move, our attention and focus, and the perception of reward.

Mind health: An asset-based view of health, rooted in the idea of salutogenesis, or that which actively causes health.

Moods: The experience of feelings over a long period of time. While our feelings are usually more powerful responses that last quite briefly and result from an emotional stimulus, moods are a state of being that is not as concentrated, is not provoked by an environmental stimulus or event, and can last for days, weeks, or months on end.

Motor affordance: A type of affordance that offers clues as to how we should interact with objects, such as a door handle that suggests how the hand should push, pull, or turn it.

Natural affordance: A type of affordance naturally occurring in the environment that reveals a possible function or use, such as the canopy of a tree providing shade and shelter, or a low branch that allows a person to climb higher to safety or to see a view over the horizon.

Neural mirroring: Developed by Vittorio Gallese and Giacomo Rizzolatti, neural mirroring identifies how we model, or feel into, the same behavior or feeling we observe in others. For example, when someone smiles, we are wired to reflect or mirror that same action back.

Neuroaesthetics: Combines the study of art with cognitive psychology and the neurobiology of perception, emotion, and empathy.

Neuroarts: The study of how the arts and aesthetic experiences measurably change the body, brain, and behavior, including our thoughts, feelings, and emotions, and how this knowledge is translated into specific practices that advance health and well-being.

Neurodiversity and sensory impact: Expands on conventional notions of inclusive building design by addressing sensory design considerations, such as lighting, acoustics, flooring, and aesthetics, which can cause human neurological ailments, ranging from serious diagnoses to milder but common complaints, such as unsteadiness, migraines, or stress.

Neurons: The core data transmission elements of nervous tissue that perceive sensory signals and communicate messages of action to the body. The brain contains around 86 billion neurons, which are connected to each other by synapses.

Neurophenomenology: The study of how experience, the mind, and consciousness are related through the embodied mind, where the mind extends throughout the body and beyond to the surrounding environment.

Neuroplasticity: The brain's ability to learn and adapt due to the ever-changing character of the connections between neurons; also known as brain plasticity. Elizabeth Gould's research shows that not all aspects of the brain are fixed or destined to deteriorate over time, as was previously assumed, but that the brain is changeable or "plastic" throughout adulthood, with the potential to create new neural networks under enriched conditions, including the places we inhabit.

Neuroscience: The science of the brain.

Neurourbanism: Based on transdisciplinary research between the urban environment and mental health, investigating how different elements of urban environments influence people psychologically and physiologically.

Neuro wellness: Explores the integrated and inseparable interconnection between the brain and the body relating to cognitive function, emotional regulation, and overall health through complementary techniques that include encouraging mindfulness and social connection, and physical, nutritional, and cognitive stimulation.

Noncommunicable diseases: Diseases, such as heart disease, cancer, and diabetes, that tend to be of long duration and are often tied to environmental conditions and a person's surroundings; identified by the UN General Assembly as a major socioeconomic challenge facing society.

Occipital lobe: Located in the back and bottom of our cerebral cortex and wrapped by the other lobes, the occipital lobe is where we process visual signals from our eyes.

Occupational psychology: How we shape our working environments and how that impacts and enhances productivity.

One Health: Acknowledges how human health is interwoven with animal, plant, and environmental health, and is an increasingly useful approach in addressing zoonotic diseases, antimicrobial resistance, food safety and security, and environmental contamination, which affect the entire planet.

Parietal lobe: Located toward the back of the skull, the parietal lobe contains the somatosensory cortex, which is responsible for shaping our understanding of and attention to the surrounding environment and our body in it. This includes alerting us to and processing the sense of touch or temperature on our skin, sensory integration, and language processing.

Pathogenic: Causing disease.

Place: The phenomenological experience of space, in which the perception of objects in relationship to each other, and to one's own body, is continuously in flux due to ever-changing conditions. Place is informed by human learning, memory, emotional experience, and our personal interpretations.

Place attachment theory: The concept of emotional bonds between people and place.

Planetary health: The health of human civilization and the state of the natural

systems on which it depends. Planetary health shifts the focus of public health from just human populations to one that also incorporates natural ecosystems and recognizes the interdependence between the natural and human-made system.

Peripheral vision: What we see on the edges of our vision. Peripheral vision communicates unconscious aspects of mood and atmospheric qualities of a place.

Positive ambiguity: As defined by Tye Farrow, buildings, art, music, or environments that we find mesmerizing as a result of a positive tension of seemingly incompatible components that allows for different interpretations, such as Rubin's vase, where we see the shape of a vase as well as two faces looking at one another. What is in front of us doesn't change, but our interpretation of the sensory information does.

Positive ideation: As it relates to the built environment, positive ideation includes places that support healthy personal development, cultivate coherent ideations of self, encourage curiosity and learning, and help to develop fulfilling relationships with others.

Primary affordance: A type of affordance that communicates how objects or architecture should be used.

Proprioceptive: Signals at the surface of the body and from its kinetic movement in space.

Qualities of enriched environments: As defined by Tye Farrow, the qualities of enriched environments are not prescriptive devices used to achieve exact or identical outcomes in every situation but more analogous to spices, which have specific and distinct qualities and characteristics that are generally universal, but which people employ differently according to learned and remembered psychological and physiological experiences and cultural norms. The qualities of enriched environments include generosity; variety and vitality; authenticity; hope; nature; and silence, stillness, solidity, and intimacy.

Salutogenesis: The central concept that illustrates the shift from a deficit-based view of health to an asset-based view of health. The term was coined by Israeli-American medical sociologist Aaron Antonovsky in his 1979 book, *Health, Stress, and Coping,* where he begins to unravel, in his words, "one of the greatest mysteries in the study of people: How do we manage to stay healthy?" The term is derived from *salus*, the Latin word for health, and *genesis*, the Greek word for origin. Thus, salutogenesis focuses on the origins of human health and well-being as opposed to the origins of disease (pathogenesis). It reframes health as the positive force of health-generating practices rather than disease mitigation, and it emphasizes the ways in which we can build the resources to optimize health.

Saluto-systemic approach: A salute-systemic approach embraces a broader concept of health, in which multiple circular, interlinking systems of healthy action – physical, mental, social, sociocultural, ecological, economic, and spatial – all flourish in the support of human health and well-being. This approach refers both to the formal ideas in architectural design that cause health, and to a healthy process of designing. At its core, it is a co-creative, collaborative, participatory community process that promotes transformative narratives, which in turn lead to healthy habits and behaviors.

Sense of coherence: Aaron Antonovsky's concept of salutogenesis defines a sense of coherence as "a global orientation that expresses the extent to which one has a pervasive, enduring, though dynamic feeling of confidence that one's internal and external environments are predictable and that there is a high probability that things will work out as well as can reasonably be expected." A sense of coherence consists of three elements: comprehensibility, manageability, and meaningfulness.

Senses: The human senses include sight, scent, sound, touch, taste, and the two lesser-known senses of proprioception and the vestibular system.

Sensory integration theory: Developed by Dr. Jean Ayres, an American occupational therapist and psychologist, in the late 1960s and 1970s. It examines how our brains receive, process, and integrate sensory signals from our bodies and environments, which makes it possible for us to live our daily lives through spatial and social interactions in a meaningful way.

Signifier: A perceivable clue or suggestion about what you can do with an object. Social prescribing: A form of therapy in which the patient engages with museums, art, music, or nature through physical or sensory events as a way of enhancing health.

Space: A Descartian concept based on mapping Cartesian coordinates of objects in space, in which the relationship of one object to another never changes but is fixed and defined. It is locational and geographic. Space exists independent of us.

***Stimmung*:** A concept expressed by the German word meaning mood, attunement, and atmosphere, all of which "speak to us." The roots of the word are from the German noun *Stimme*, meaning "voice." The word is associated with human mood as well as with music and the tuning of an instrument.

Stress recovery theory: Assesses the impact of stress on a person facing a demanding situation or one that threatens their well-being, particularly in an urban environment. Stress recovery theory was developed by Roger Ulrich, who argues that after being in a stressful space, individuals experience an almost automatic biological compulsion to leave that space and seek out a natural environment, which regulates the physiological effects of the stressful state, and produces positive emotional change.

Sustainable Development Goals (SDGs): The UN General Assembly's collection of seventeen interconnected global goals designed to be a "blueprint to achieve a better and more sustainable future for all." Each goal contributes, directly or indirectly, to positive health outcomes.

Synapses: Cellular connectors that reach outwards from the body of a neuron toward other neurons, creating an incredibly complex constellation of cells that help disseminate information across the neuronal network.

Temporal lobe: Beside the occipital lobe and at the bottom of the cerebral cortex is the temporal lobe, our home for hearing, language, and reading, as well as the storage and retrieval of memory and the processing and managing of emotions. The experience and memory of emotion in the temporal lobe results from its connection to five other areas buried within the middle bottom of the brain: the hippocampus, the amygdala (found in both the right and left sides of the brain), the striatum, the thalamus, and the hypothalamus.

Thalamus: The area where sensory perceptions (excluding what we smell) enter the brain. The thalamus also has specialized areas for vision.

Theory of constructed emotion: Developed by Lisa Feldman Barrett to explain how we experience and perceive emotion, based on how the human mind uses preexisting concepts to stimulate the interbody systems, such as heart rate and breathing, while also interpreting the body's external sensory input. We therefore base our reality and emotions on our interpretations of these sensory inputs, which we filter through our broad social and cultural experiences (learned) and our own past experiences (remembered), resulting in an action.

Voluntary attention: Attention that is deliberately applied, such as when staring at a computer screen or reading a book.

Wellness (or well-being): The Global Wellness Institute defines wellness as "the active pursuit of activities, choices, and lifestyles that lead to a state of holistic health." It emphasizes a holistic, active, embodied physical engagement that leads to mind and body health.

Fifty Recommended Books to Read

The Aesthetic Brain: How We Evolved to Desire Beauty and Enjoy Art, by Anjan Chatterjee (New York: Oxford University Press, 2014).

The Age of Insight: The Quest to Understand the Unconscious in Art, Mind and Brain, from Vienna 1900 to Present, by Eric R. Kandel (New York: Random House, 2012).

The Archaeology of the Mind: Neuroevolutionary Origins of Human Emotion, by Jaak Panksepp and Lucy Biven (New York: W.W. Norton, 2012).

The Architect's Brain: Neuroscience, Creativity and Architecture, by Harry Francis Mallgrave (Oxford: Wiley-Blackwell, 2011).

Architecture and the Crisis of Modern Science, by Alberto Pérez-Gómez (Cambridge, MA: MIT Press, 1985).

Architecture Is a Verb, by Sarah Robinson (New York: Routledge, 2021).

Atmospheres: Architectural Environments, Surrounding Objects, by Peter Zumthor (Basel: Birkhäuser, 2006).

Attunement: Architectural Meaning after the Crisis of Modern Science, by Alberto Pérez-Gómez (Cambridge, MA: MIT Press, 2016).

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Body, Memory, and Architecture, by Kent C. Bloomer and Charles W. Moore (New Haven, CT: Yale University Press, 1977).

The Brain: The Story of You, by David Eagleman (New York: Pantheon Books, 2015).

City of Well-Being: A Radical Guide to Planning, by Hugh Barton (London: Routledge, 2017).

Descartes' Error: Emotion, Reason, and the Human Body, by Antonio Damasio (New York: Penguin, 1994).

Designing Mind-Friendly Environments: Architecture and Design for Everyone, by Steve Maslin (London: Jessica Kingsley Publishers, 2022).

Dwelling, Seeing, and Designing: Toward a Phenomenological Ecology, edited by David Seamon (Albany: State University of New York Press, 1993).

The Dynamics of Architectural Form, by Rudolf Arnheim (Berkeley: University of California Press, 1977).

Ecological and Salutogenic Design for a Sustainable Healthy Global Society, edited by Ken Yeang and Alan Dilani (Newcastle upon Tyne: Cambridge Scholars Publishing, 2021).

The Embodied Mind: Cognitive Science and Human Experiences, by Francisco J. Varela, Evan Thompson, and Eleanor Rosch (Cambridge, MA: MIT Press, 1991).

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The Eyes of the Skin: Architecture and the Senses, by Juhani Pallasmaa (Hoboken, NJ: John Wiley & Sons, 2012).

Feeling and Knowing: Making Minds Conscious, by Antonio Damasio (New York: Pantheon Books, 2021).

The Feeling Body: Affective Science Meets the Enactive Mind, by Giovanna Colombetti (Cambridge, MA: MIT Press, 2014).

From Object to Experience: The New Culture of Architectural Design, by Harry Francis Mallgrave (London: Bloomsbury Visual Arts, 2018).

Generosity and Architecture, edited by Mhairi McVicar, Stephen Kite, and Charles Drożyński (New York: Routledge, 2022).

Health Is Made at Home, Hospitals Are for Repairs: Building a Healthy and Health-Creating Society, by Nigel Crisp (Billericay, UK: Salus, 2020).

Health, Stress, and Coping, by Aaron Antonovsky (San Francisco: Jossey-Bass, 1979).

Healthy Buildings: How Indoor Spaces Drive Performance and Productivity, by Joseph G. Allen and John D. Macomber (Cambridge, MA: Harvard University Press, 2020).

Healthy Environments, Healing Spaces: Practices and Directions in Health, Planning and Design, edited by Timothy Beatley, Carla Jones, and Reuben M. Rainey (Charlottesville: University of Virginia Press, 2018).

How Emotions Are Made: The Secret Life of the Brain, by Lisa Feldman Barrett (Boston: Houghton Mifflin Harcourt, 2017).

Imagining for Real: Essays on Creation, Attention, and Correspondence, by Tim Ingold (New York: Routledge, 2021).

Inseminations: Seeds for Architectural Thought, by Juhani Pallasmaa and Matteo Zambelli (Hoboken, NJ: John Wiley & Sons, 2020).

Livewired: The Inside Story of the Ever-Changing Brain, by David Eagleman (Toronto: Doubleday, 2020).

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The World of Perception, by Maurice Merleau-Ponty (London: Routledge, 2004).

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Endnotes

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Netherlands Norwich Community, complex care wing, p. 235 (Bottom Right)

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Wellesley Central Place, p. 236 (Full Page)

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Wellesley Central Place, central courtyard, p. 237 (Bottom Left and Right)

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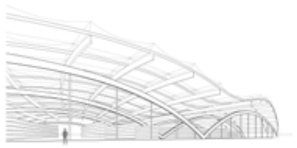
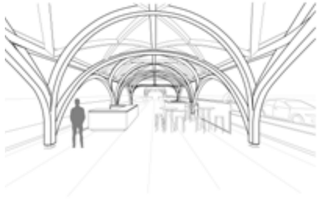
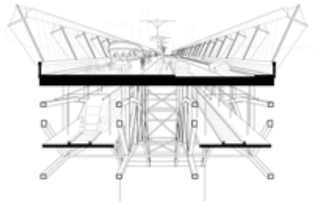
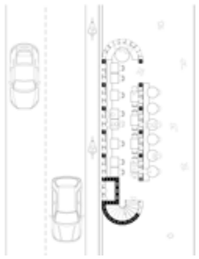






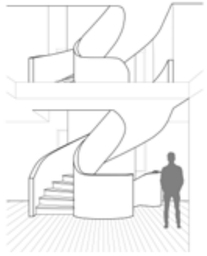


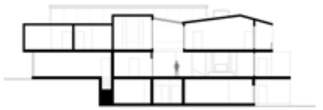
Project: Venice Aqua-emerald Archipelago
Architects: Farrow Partners
Location: Venice, Italy

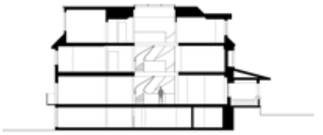
Project: Market Bridge at the Prince Edward Viaduct
Architects: Farrow Partners
Location: Toronto, Canada

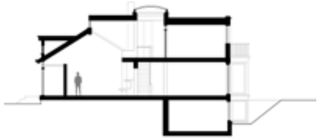
Project: Yonge Street Pavilions
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

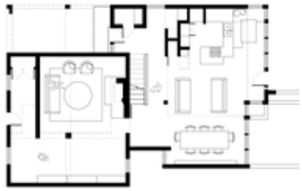
Index of Projects







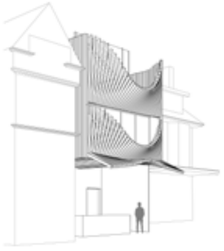


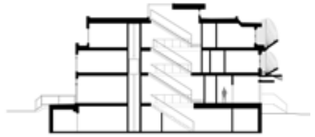


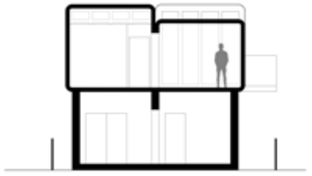
Project: Millbank House
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

Project: Roxborough House
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

Project: MacPherson House
Architects: Farrow Partners
Location: Toronto, Ontario, Canada



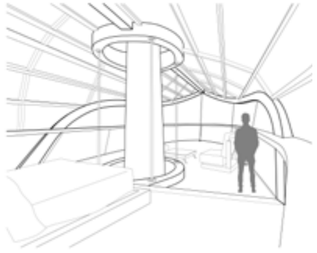
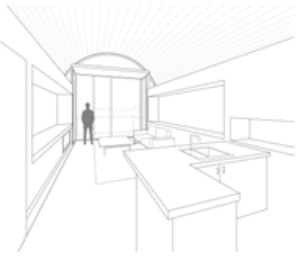






Project: Boswell House
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

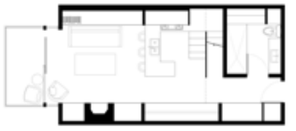
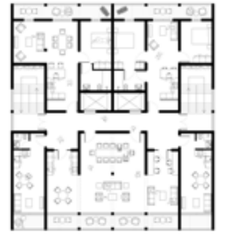
Project: The King City Guest Houses
Architects: Farrow Partners
Location: Canada

Project: R-Hauz V2 Laneway Houses
Architects: Farrow Partners
Location: Toronto, Ontario, Canada



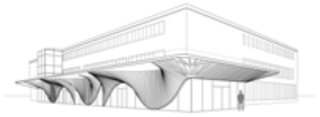


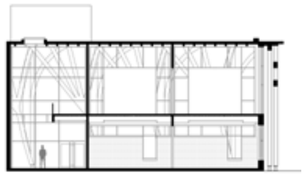



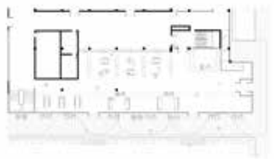
Project: E'Terra Samara Resort
Architects: Farrow Partners
Location: Grand Bend, Ontario, Canada

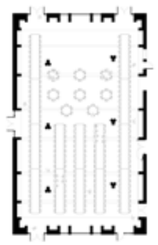
Project: The Living Bridge
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

Project: The Treehouse Multigenerational Living Building
Architects: Farrow Partners
Location: Canada





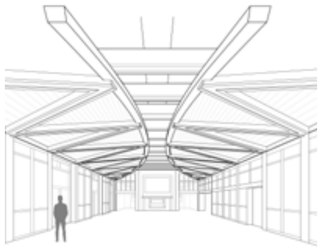


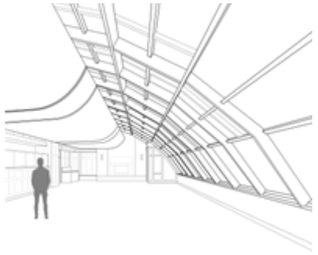


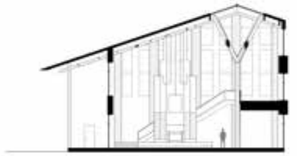
Project: Holy Name of Mary College School
Architects: Farrow Partners,
Location: Mississauga, Ontario, Canada

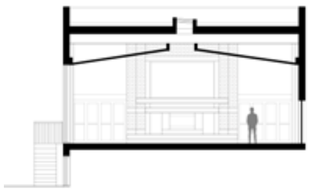
Project: TMS Upper School (Elgin Mills Campus)
Architects: Farrow Partners
Location: Richmond Hill, Ontario, Canada

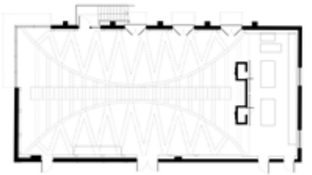
Project: TMS Middle School (Elgin Mills Campus)
Architects: Farrow Partners
Location: Richmond Hill, Ontario, Canada

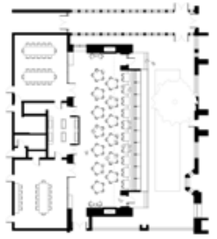








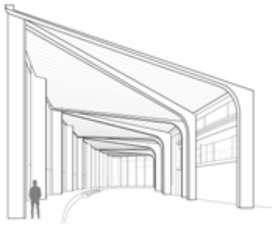
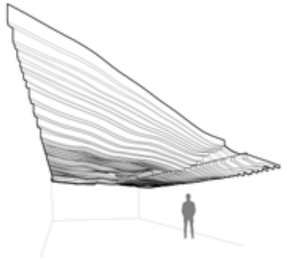
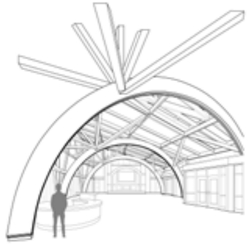


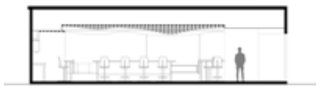
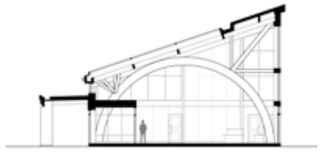
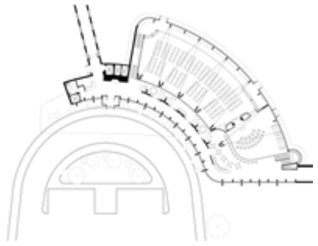


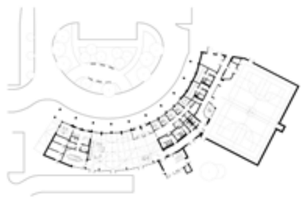
Project: The Country Day School
Architects: Farrow Partners
Location: King City, Ontario, Canada

Project: Royal St. George's College
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

Project: The Bishop Strachan School Student Centre
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

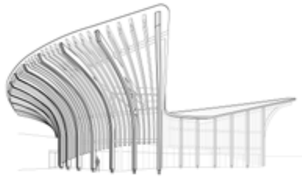
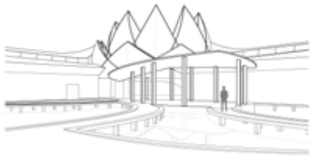
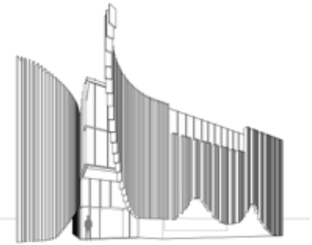
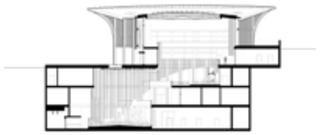




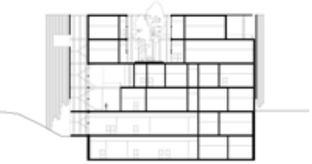


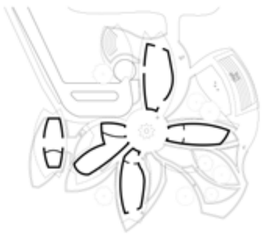
Project: Elmwood School
Architects: Farrow Partners
Location: Ottawa, Ontario, Canada

Project: The York School Wellness Centre
Architects: Farrow Partners
Location: Toronto, Ontario, Canada

Project: TMS Lower School (Bayview Campus)
Architects: Farrow Partners
Location: Richmond Hill, Ontario, Canada



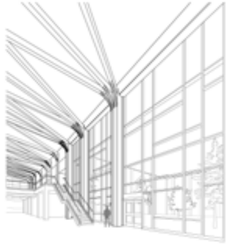
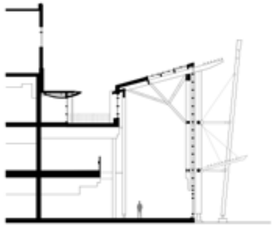
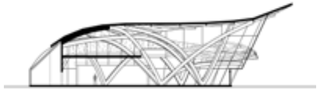
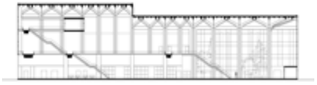


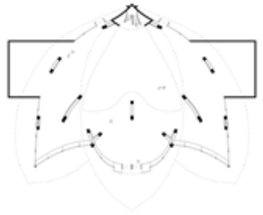

Project: Helmsley Cancer Centre
Architects: Farrow Partners & Rubinstein Ofer
Location: Jerusalem, Israel

Project: The Health Promoting Lifestyle Centres
Architects: Farrow Partners, Clark Nexsen and Ngonyama Okpanum & Associates
Location: South Africa

Project: Kaplan Cardiology Center
Architects: Farrow Partners
Location: Rehovot, Israel



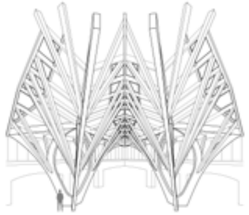





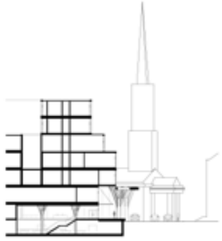
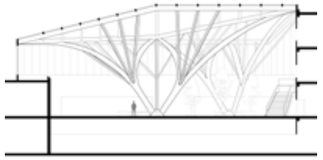


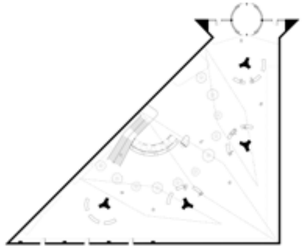
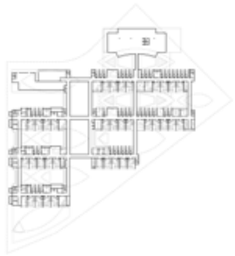

Project: Thunder Bay Regional Health Sciences Centre
Architects: Farrow Partners
Location: Thunder Bay, Canada

Project: Kaplan Medical Centre
Architects: Farrow Partners
Location: Port-of-Spain, Trinidad

Project: Colchester East Hants Health Centre
Architects: Farrow Partners and WHR
Location: Truro, Canada

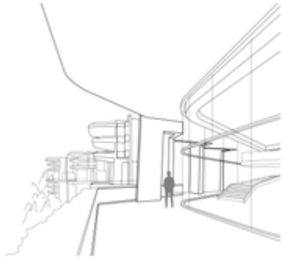



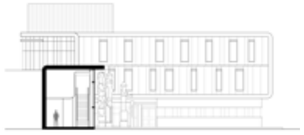




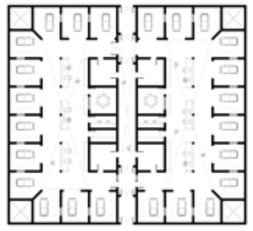
Project: Mater Private Hospital
Architects: Farrow Partners and MCA
Location: Dublin, Ireland

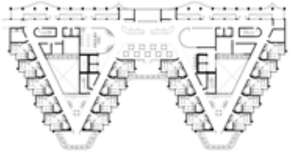
Project: Credit Valley Hospital
Architects: Farrow Partners
Location: Mississauga, Canada

Project: Alexandria Hospital
Architects: Farrow Partners
Location: Singapore





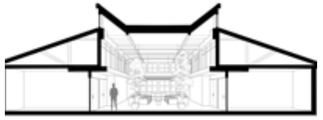


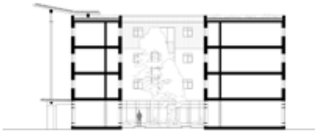


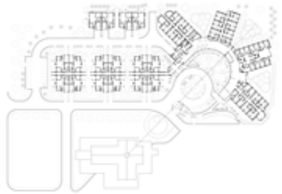
Project: St. Mary's Hospital
Architects: Farrow Partners & Perkins Will
Location: Sechelt, Canada

Project: Solace Rapid Assembly - Covid-19 Intensive Care Inpatient Units
Architects: Farrow Partners
Location: Thunder Bay, Canada

Project: Herzog Medical Centre
Architects : Farrow Partners
Location: Jerusalem, Israel







Project: The Mission Complex Continuing Care Centre
Architects: Farrow Partners and KMBR
Location: Mission, Canada

Project: Netherlands Norwich Community
Architects: Farrow Partners
Location: Norwich, Canada

Project: Wellesley Central Place
Architects: Farrow Partners
Location: Toronto, Canada

Early on, I began to understand the interrelationship between the environments we create and their ability to enhance optimal health in various ways – that is, how they could actually cause health. Optimal health is like a tabletop, supported by four legs. Each leg represents one of the different ways design impacts – or enhances – optimal health.

The first leg is design's impact on the natural environment and our ability to enhance ecological health. Second is design's bearing on our physical bodies and the design decisions that can boost physiological health. Third is design's bearing on our communities and the places we create that naturally improve societal health. The fourth leg represents how the environments we create make us feel – and how they can make us feel better – by the way they enrich mind health.

The four legs are all tightly connected; remove one leg, and optimal health quickly becomes unstable and comes crashing down.

We know that the landscape architect Frederick Law Olmsted designed New York's Central Park, the Boston Common, and numerous emerald necklace park systems throughout the United States, but what isn't commonly known is that he also founded the United States Sanitary Commission, a predecessor of the Red Cross.

In fact, Olmstead was an early public health figure who used the design of immersive natural park networks as, in his words, "sanitary institutions" to enhance ecological, physical, societal, and mind health. Parks became saluto-systemic urban health accelerators.

The pandemic made us keenly aware of the interrelationship between our environments and mind health. We saw how some places we inhabited over long periods caused tremendous loneliness, boredom, disease, and depression, while others, both built and natural, encouraged us to come together and were reinvigorating, engaging, and refreshing due to their ability to reinforce and encourage social and community bonds.

If we view placemaking as a non-invasive treatment, building and city making once again become acts of public health, using the environment to bring people together and to enjoy being together once again.

We often don't intentionally focus on how environments make us feel, but they do so consciously, subconsciously, and pre-consciously (that is, before we are aware of the feeling).

The German word *Stimmung* refers to both the mood attunement of an individual's mental state and the atmosphere of a specific place and how it communicates to us through multisensorial stimulations affecting sight, scent, sound, touch, taste, and the two lesser-known senses of proprioception and that of the vestibular system.

These communicate to us if the places that surround us are pathogenic – places we move through quickly to escape – or salutogenic – health-giving places where we want to linger, stay, and explore.

For most of human history, our view of health has been salutogenic – focused on how we can cause ecological, physical, societal, and mind health, with architecture used as a scaffolding to support these aims.

In the last 100 years, however, medicine has focused on “doing no harm,” and public health has championed “preventative” health measures. As a result, the aspiration of building design and city making seems to have slid toward straight functionalism, employing a transactional approach toward our resulting health and well-being. In many ways this approach is analogous to a lake into which people keep falling and drowning. The reactive response is to put up a fence to stop people from falling in, but really we should be teaching people how to swim in order to create the conditions in which people can flourish – to cause health – instead of just trying to prevent bad things from happening.

Compelling research in the fields of medical therapeutics and social services has identified how the spaces we occupy can cause various diseases, but comparatively little research has been devoted to determining how the environments we create can actively better our health.

We need to know not just how buildings influence our human actions but also how buildings influence our biological, psychological, sociological, and spiritual states: the architectural equivalent of nutrient-rich super foods, such as blueberries, which are packed with minerals (like iron, calcium, and magnesium) and vitamins (like vitamin A, B, C, and D) that help to enhance memory, oxygenate our blood cells, and nourish our nervous and immune systems, our muscles, bones, teeth, skin, eyes, connective tissues, and heart.

We need an architecture that isn't full of "empty calories," but one that stimulates learning and memory and enhances creativity, perception, empathy, emotions, and meaningful social interactions.

We are now aware of how our mind constructs person-to-place relationships in a way similar to how we form person-to-person relationships. We need to assess our building designs to understand if they offer the equivalent of person-to-person relationships that are generous, open, animated, engaging, optimistic, natural, full of variety and vitality, authentic, honest, and caring – or, if they offer the equivalent of classroom learning of days past: rigid, repetitive, dismissive, contemptuous, and scornful – pedagogies that have long gone out of favor.

We must look to design solutions that stimulate enriched experiences based on human qualities – those where we feel present, that offer hope, that are natural, that offer variety and vitality, that have authenticity and are solid, silent, still, and intimate, and, most important, those that are generous.

Intentionally generous architecture allows people, regardless of their individual backgrounds, to see and experience the many affordances a place offers. It is an architecture that allows us to sense ourselves and our surroundings, like the changing cycles of the days and seasons.

Generous design is immersive, with qualities that make us realize we are human and allow us to feel the rapture of being alive. Generous design, and a generous saluto-systemic design process, causes health.

One more thing.

We have explored (1) what affordances our built environments can offer and (2) how they can be intentionally generous by design. Environments in which we can sense ourselves – as a result of what our surroundings have to offer – are generous, multisensorial, immersive, and allow us to feel the rapture of being alive. Intentionally generous architecture allows a person to see and experience the offerings of their world, regardless of their individual abilities.

This leads us to a third concept, which we haven't covered, but which springs from the first two: the concept of dignity.

We often view dignity through a deficit-based lens – for example, the multiple indignities faced by underprivileged segments of our society during the pandemic, the environments our elders endure, or the everyday environments encountered by people with varying levels of ability that fail to offer affordances, accessibility, generosity, or dignity.

I would suggest that we need to look harder at the places around us to find new ways they can provide dignity. In schools where children and teenagers are often struggling to see a place for themselves. In cities where loneliness is at an all-time high for adults of all ages, despite our hyper-connected digital world.

Asset-based qualities of human dignity – and architecture – represent possibilities for allowing and creating the conditions in which each of us individually have honor and worth. This means not just removing barriers in our environments, but creating accelerants.

Yet, I am getting ahead of myself, as this exploration might be the beginning of another book…

Credit Valley Hospital, Farrow Partners.

Constructing Health

Credit Valley Hospital, Farrow Partners