This is Your Brain on Architecture: An Exploration in Designing a Neurologically Healthy Mental Wellness Center

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Abstract

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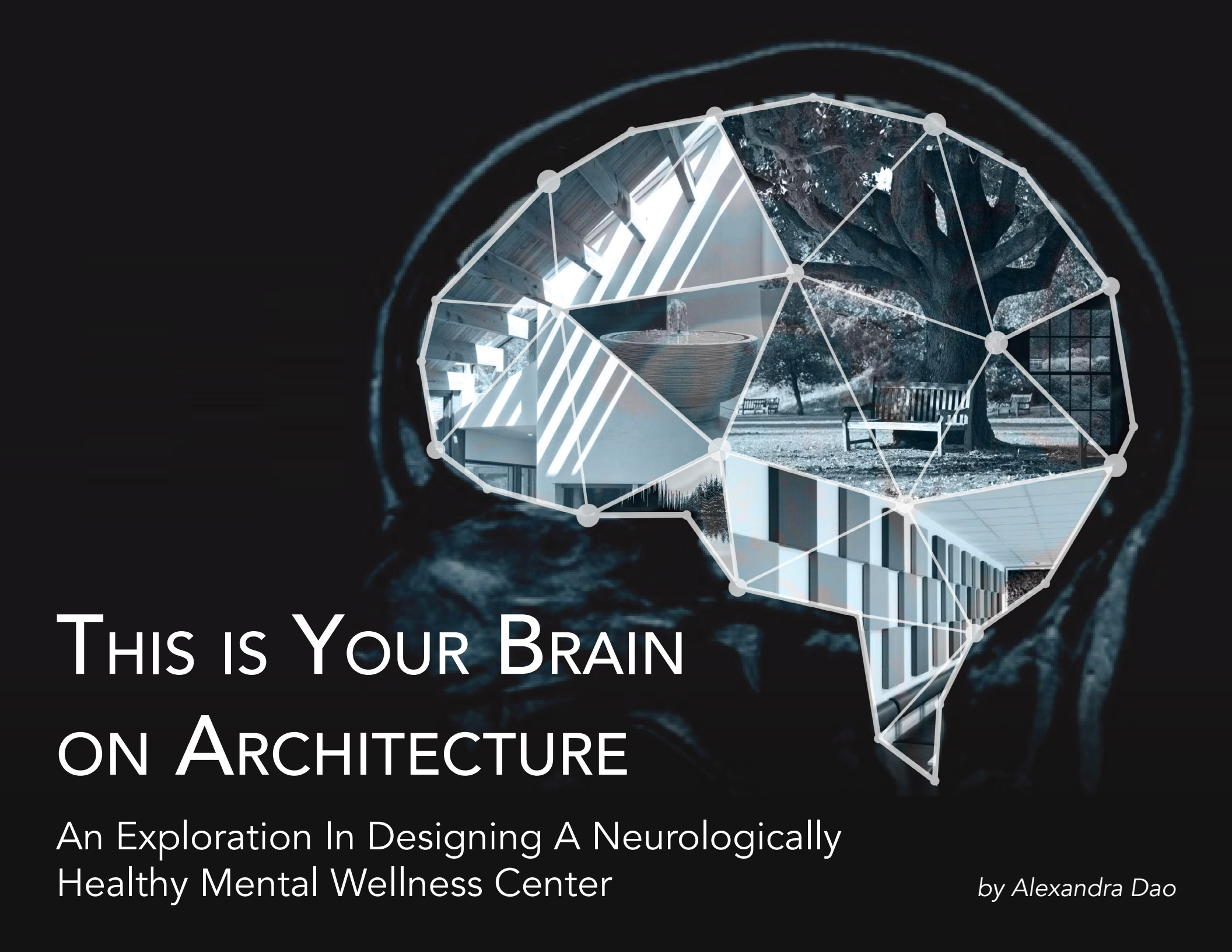
Many buildings today fail to acknowledge the growing concern for health-centric design. By neglecting our neurological needs and desires, some spaces can come to have a detrimental effect on the well-being of their inhabitants. This thesis asserts that, by designing environments that focus on neuro-sensory concerns, buildings can more effectively support the overall health and well-being of their inhabitants. The particular neuro-sensory design factors investigated in this thesis are environmental lighting, color and pattern, exterior views, soundscapes, and provision of green spaces. This thesis is tested through the design of a mental health clinic and wellness center, exploring how architecture can improve health and well-being for those recovering from mood or emotional disorders and/or looking to improve their mental wellness.



This is Your Brain on Architecture

An Exploration In Designing A Neurologically Healthy Mental Wellness Center

by Alexandra Dao

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This is Your Brain on Architecture

Part I
INTRODUCTION

CHAPTER 1: OVERVIEW

"We shape our buildings, and afterwards our buildings shape us."

– Winston Churchill[1]

1.1 PROBLEM STATEMENT

A growing body of evidence has emerged over the last half century that supports the critical role that architecture plays in occupant health, especially healing environments. But many buildings today continue to neglect the issue of health-centric design. The built environment has the unique ability to exert a direct effect on the way people think and feel. By neglecting neurological needs and desires, some spaces can come to have a detrimental effect on the well-being of their inhabitants. Therefore, the need for consideration of people's sensory and experiential needs in architectural design cannot be overstated.

Today, the issue of neurological-based design is emerging as one of the foremost concerns of progressive and health-conscious designers, neuroscientists, and educators. This topic has recently become the focus of several emerging research groups, including the new Academy of Neuroscience for Architecture, founded in 2003.[2] However, while interest has been growing over the past decade, the strategies in health-centric design are scattered between disciplines and have largely failed to infiltrate mainstream design. Neurologically healthy design needs to be fully integrated into architectural design concepts and processes in order to improve the neurological health of the building inhabitants.

1 "We Shape Our Buildings," Famous Quotes and Stories, International Churchill Society, spoken at the House of Commons October 28, 1943, https://www.winstonchurchill.org/resources/quotes/famous-quotations-and-stories/.

2 "ANFA History," Academy of Neuroscience for Architecture, accessed June 12, 2017, http://www.anfarch.org/history.

1.2 CLAIM

This thesis asserts that designers should begin to address the health of buildings and their inhabitants by a more systematic consideration of the neurological factors of architectural design. By designing environments that focus on neuro-sensory concerns, these environments can more effectively support the overall health and well-being of their inhabitants. While spaces dedicated to healing tend to best illustrate this argument, the design principles that emerge from this research are applicable to many building types.

For the purposes of this thesis, neuro-sensory design factors are defined as those design elements that affect neurophysiological or psychological health by stimulating any of the five senses – sight, hearing, taste, smell, and touch. The particular neuro-sensory design factors investigated in this thesis are lighting, color and pattern, exterior views, soundscapes, and provision of green spaces.

1.3 DEMONSTRATION

This thesis, while applicable to the built environment in general, will be tested through the design of a healthcare environment. Because the effects of the neuro-sensory design factors are most clearly seen in spaces that involve neurological recovery, a mental health clinic and wellness center is one of the best options to demonstrate this thesis. This facility, located in the Fremont neighborhood of Seattle, will explore how architecture can affect and improve health and well-being for those recovering from mood or emotional disorders and/or looking to improve their mental wellness.

1.4 METHODOLOGY

This thesis begins with the formation of a significant research base, which includes in-depth investigations into each of the neuro-sensory design factors. A selection of case studies is further analyzed for their particular healing qualities. Finally, a design framework is created by drawing out the major conclusions from this research, which then becomes a design guide for neurologically healthy spaces. After introduction of the mental wellness center typology, typical requirements and recommendations for the site and program of the facility design will be developed based on this research. The design framework can then begin to be used to create the set of necessary design requirements for this particular project and will ultimately demonstrate how architecture can play a central role in promoting health and well-being.

Part II
HEALTH DESIGN RESEARCH

CHAPTER 2: NEURO-SENSORY ARCHITECTURAL FACTORS

Neurological health is influenced by various external stimuli, including architectural features. Certain architectural design factors have been proven to be instrumental in affecting people's health and well-being, specifically through the stimulation of the senses. There are five neuro-sensory stimuli investigated in this chapter. These factors are lighting, color and pattern, exterior views, soundscapes, and green space. Each of these functions through one or more means of human perception, and several are of particular importance in healthcare environments. Additionally, each of these factors possess architectural or design implications and can have a profound impact on our neurological systems.

Major progress in this field of study first made its mark on modern research in the 1960s but was largely confined to the fields of biology in the sciences and phenomenology in philosophy. Around 40 years ago, there was a surge of interest in this type of study, with more fields joining the research, including psychology, sociology, and even interior design. In the last twenty years, this research has expanded to include newly specified fields such as photobiology and neuroarchitecture. At the same time, certain healthcare systems began to incorporate some of this research into new design models that focus on the healing and health-centric properties of environmental design.

Figure 1 | Logo for the Academy of Neuroscience for Architecture (ANFA), founded in 2003 in San Diego, California.
[Source: Academy of Neuroscience for Architecture]

Their mission statement is "to promote and advance knowledge that links neuroscience research to a growing understanding of human responses to the built environment."

2.1 LIGHTING AND HEALTH

2.1.1 THE CIRCADIAN SYSTEM

The effects that light have on health have been subject to a new explosion of studies in the past few years. Researchers are consistently learning more about how much of human health is influenced by the amount, timing, intensity, and type of lighting people are exposed to. This new surge of interest in studying lighting for health began decades ago but was significantly spurred by the 2002 discovery of a third type of photoreceptor in the retina of the human eye. These are called intrinsically photosensitive retinal ganglion cells (ipRGCs) and explain how the circadian rhythms of the human body are regulated by light.[3]

Circadian rhythms are the body's daily sleep-wake cycles. The process of maintaining these cycles is directly tied to the rhythmic production of certain hormones, namely melatonin and cortisol. Cortisol, a stress hormone, works to increase our alertness, and its production peaks in the first few hours after waking. If the circadian rhythms are aligned with the typical day-night cycle, melatonin production will spike in the late afternoon or early evening, resulting in decreased alertness in preparation for sleep. The external stimulus that controls the production and suppression of these hormones is light, more specifically the qualities of type, color, timing, and duration. When an individual's circadian rhythm becomes irregular or misaligned with the natural day-night cycle, such as with night-shift workers or people exposed to blue-light screens late at night, the regulatory hormones get out of balance and various negative health effects can occur.[4] Much of the research on the effects of light on human health falls into three main categories: physiological, psychological, and performance.

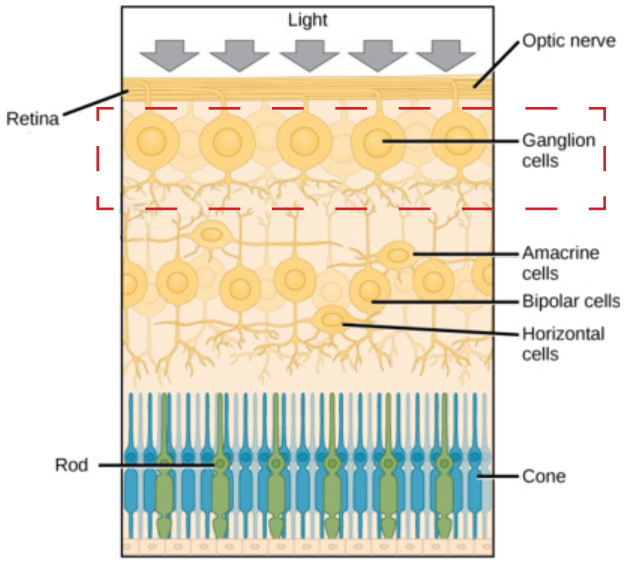

Figure 2 | The anatomy of the human retina, highlighting the area of ganglion cells, including intrinsically photosensitive retinal ganglion cells (ipRGCs)
[Source: Lumen Learning]

3 Teresa Goodman, David Gibbs, and Geoff Cook, *Better Lighting for Improved Human Performance, Health and Well-Being, and Increased Energy Efficiency* (National Physical Laboratory Middlesex: Crown, 2006), 39-40.

4 Goodman, Gibbs, and Cook, *Better Lighting*, 43-49.

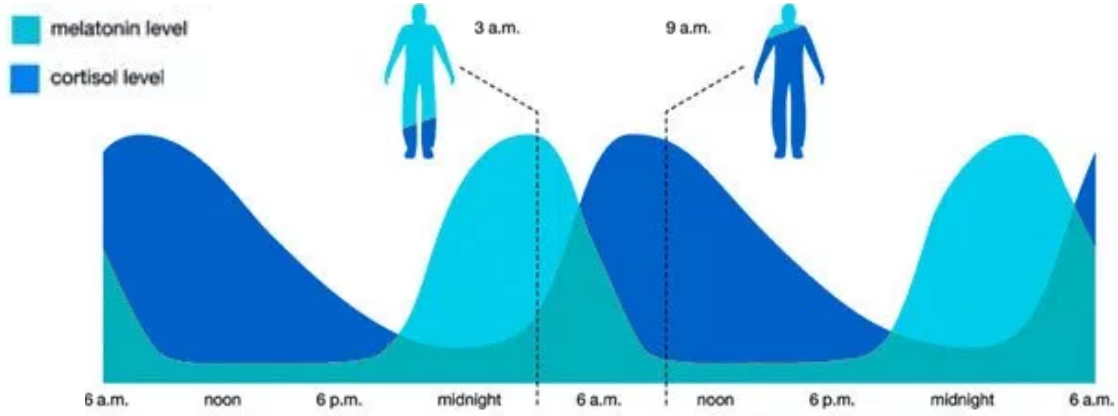

Figure 3 | Bodily hormone levels, specifically melatonin and cortisol, are affected by daylight and affect our neurological conditions throughout the day [Source: Alex Fergus]

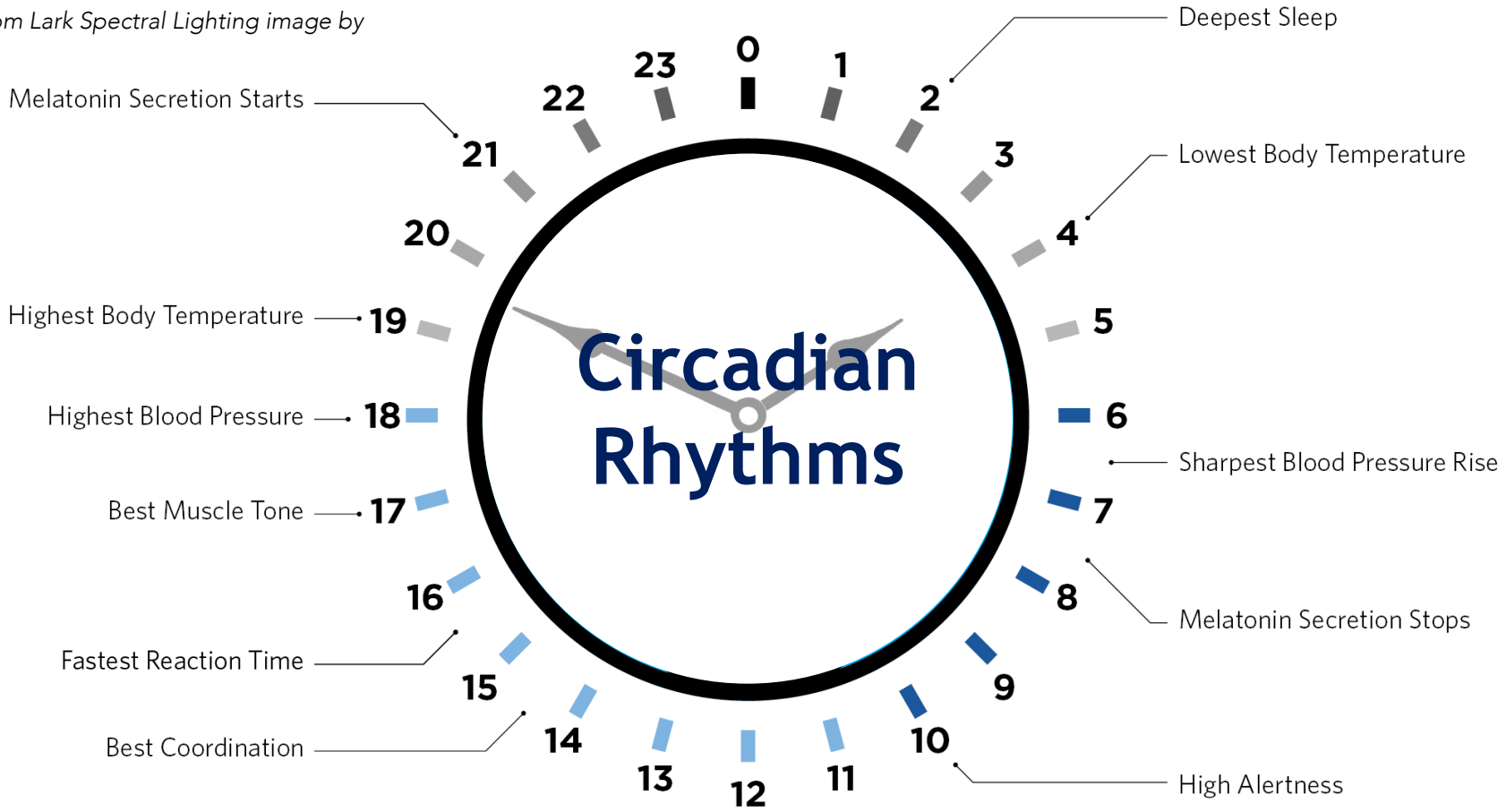

Figure 4 | The features and timings of circadian rhythms tend to line up with the 24-hour day-night cycle and are regulated by light [Source: adapted from Lark Spectral Lighting image by ZGF Architects]

2.1.2 PHYSIOLOGICAL HEALTH EFFECTS

Most of the physiological health effects related to lighting stem from circadian rhythm disruption and/or the resulting misalignment in melatonin production. Numerous studies have indicated an increased risk of breast cancer, especially in women and especially in night-shift workers.[5,6,7] Some studies have also shown an increased risk of prostate cancer associated with misalignment of circadian rhythms.[8] The link between misalignment of the circadian rhythm and these cancers, especially breast cancer in women, has been thoroughly documented both in anecdotal and extensive survey-based studies.[9,10] While there is still more research to be done to firmly establish a causal relationship, the correlation is nevertheless strong.

Two other physiological conditions strongly correlated with light-related factors are high blood pressure and cardiovascular disease.[11,12,13] Similar studies also found an important

5 Rebecca Veitch, Shay Bracha, and Patrick Everett Chappell, "Circadian Dysregulation Is Associated with a Loss of Estrogen Receptor Expression in Mammary Tissue: Implications for an Etiology of Breast Cancer," In *Hormone Dependent Cancers: Mechanisms and Biomarkers* (Endocrine Society, 2010), 23-24.

6 Sarah E. Bauer et al., "A case-referent study: light at night and breast cancer risk in Georgia," *International Journal of Health Geographics* 12 (2013): 23.

7 Susan Hurley et al., "Light at night and breast cancer risk among California teachers," *Epidemiology* 25 (2014): 697.

8 Itai Kloog et al., "Global Co-Distribution of Light at Night (LAN) and Cancers of Prostate, Colon, and Lung in Men," *Chronobiology* 26 (2009): 108-125.

9 Itai Kloog et al., "Light at night co-distributes with incident breast but not lung cancer in the female population of Israel," Chronobiology 25 (2008): 65-81.

10 Itai Kloog et al., "Nighttime light level co-distributes with breast cancer incidence worldwide," *Cancer Causes & Control* 21 (2010): 2059-2068.

11 Masako Kohsaka et al., "Effects of bright light exposure on heart rate variability during sleep in young women," *Psychiatry and Clinical Neurosciences* 55 (2001): 283-284.

12 Melanie Rüger et al., "Time-of-day-dependent effects of bright light exposure on human psychophysiology: comparison of daytime and nighttime exposure," *American Journal of Physiology* 290 (2006): 1413-1420.

13 Kenji Obayashi et al., "Association between light exposure at night and nighttime blood pressure in the elderly independent of nocturnal urinary melatonin excretion," *Chronobiology* 31, (2014): 779-786.

link between circadian rhythms and weight regulation, with correlations to conditions such as obesity and diabetes.[14,15] Furthermore, certain inflammatory issues, such as asthma, can also be affected by circadian disorders.[16]

Poorly designed LED lighting is a constantly physiological risk to many people. Like a common issue with some older fluorescent lights, they can flicker at certain frequencies that cause a host of physiological and neurological issues. Many of these potential negative consequences of flicker are backed up by various forms of evidence, ranging from anecdotal to scientific studies as recently as 2006.[17]

However, the physiological relationship between light and health can be used positively as well. Several studies have noted the trend that people who are exposed to more light during the day, and thus have better aligned circadian rhythms and melatonin levels, tend to participate in more physical activity and have better overall sleep quality.[18] Additionally, chronotherapy is a distinctly effective means of treatment that has evolved out of this line of study. It involves the administering of certain medications or procedures at specific times of day, resulting in improved effectiveness and reduced negative side effects.[19]

14 Tracy A. Bedrosian, Laura K. Fonken, and Randy J. Nelson, "Endocrine Effects of Circadian Disruption," *Annual Review of Physiology* 78 (2016): 109-131.

15 Emily McFadden et al., "The Relationship Between Obesity and Exposure to Light at Night: Cross-sectional analyses of over 100,000 women in the breakthrough generations study," *American Journal of Epidemiology* 180 (2014): 245-250.

16 Bedrosian, Fonken, and Nelson, "Endocrine Effects," 117-118.

17 Arnold Wilkins, Jennifer Veitch, and Brad Lehman, "LED Lighting Flicker and Potential Health Concerns: IEEE standard PAR1789 update," In *Energy Conversion Congress and Exposition* (IEEE, 2010), 171-178.

18 Mohamed Boubekri et al., "Impact of Windows and Daylight Exposure on Overall Health and Sleep Quality of Office Workers: A case-control pilot study," *Journal of Clinical Sleep Medicine* 10 (2014): 603.

19 Bedrosian, Fonken, and Nelson, "Endocrine Effects," 117-118.

2.1.3 PSYCHOLOGICAL HEALTH EFFECTS

Quality of lighting is also a major determinant of people's psychological states, especially when it comes to sleep disorders. Overexposure to artificial light at night has been known to result in increased clinical insomnia, increased sleep onset latency, poor sleep quality, and fatigue during the day.[20,21,22] For teenagers, these conditions can result in aggravated cases of Delayed Sleep Phase Disorder (DSPD).[23] In general, those most susceptible to sleep disorders can benefit the most from the right dose of artificial light at the right time. This is the basis of light therapy, commonly prescribed to individuals with various sleep or mood disorders.

Lighting conditions misaligned with circadian rhythms also correlate directly to clinical depression, especially in adults, the elderly, and hospitalized patients.[24,25] The circadian disruption resulting from too much artificial light at night or a lack of enough light during the day has also been linked to other severe mood disorders, such as manic-depressive disorder and seasonal affective disorder (SAD).[26] Seasonal mood changes and environmental lighting discomfort are further correlated to poor sleep quality.[27]

Figure 5 | A typical light box, commonly used as a form of light therapy
[Source: The Light Therapy Lamp]

20 Jeanne Sophie Martin et al., "Relationship of Chronotype to Sleep, Light Exposure, And Work-Related Fatigue in Student Workers," *Chronobiology* 29 (2012): 295-304.

21 Kenji Obayashi et al., "Effect of Exposure to Evening Light on Sleep Initiation in the Elderly: A longitudinal analysis for repeated measurements in home settings," *Chronobiology* 31 (2014): 461-467.

22 Kenji Obayashi, Keigo Saeki, and Norio Kurumatani, "Association Between Light Exposure at Night and Insomnia in the General Elderly Population: the HEIJO-KYO cohort," *Chronobiology* 31 (2014): 976-982.

23 R. Robert Auger et al., "Light Exposure Among Adolescents with Delayed Sleep Phase Disorder: A prospective cohort study." *Chronobiology* 28 (2011): 911-920.

24 Obayashi et al., "Light Exposure at Night and Nighttime Blood Pressure in the Elderly," 779-786.

25 Anders West et al., "The Effect of Circadian Light on Depressive Mood in Post Stroke Patient During Admission for Rehabilitation," *Stroke* 48 (2017): A13.

26 Bedrosian, Fonken, and Nelson, "Endocrine Effects," 118-120.

27 M. B. C. Aries, J. A. Veitch, and G. R. Newsham, "Physical and Psychological Discomfort in the Office Environment" (paper presented at the Light and Health Research Foundation Conference, SOLG Symposium, Eindhoven, the Netherlands, 2007).

Studies have revealed a simple, direct connection between well-being and satisfaction in the interior environment. The more positive a person is about their environment, the less physiological and psychological discomfort they tend to report. In terms of lighting, people located farther from windows do not tend to report any more discomfort, likely because of the lesser chance for direct sunlight causing glare and thermal problems. However, people who rated the lighting quality as higher did distinctly tend to report lower levels of discomfort.[28] Furthermore, additional studies showed that people consider daylight much more "natural" than artificial light and prefer natural light in most circumstances.[29]

2.1.4 PERFORMANCE HEALTH EFFECTS

Lighting can have a large impact on task performance. First and foremost, sleep performance is the most obviously inhibited activity when nighttime lighting is overly bright. Studies have shown that too much artificial light in the evening and at night prevents deep sleep and leads to poor sleep quality. This can cause more fatigue, decrease alertness, and consequently lower performance of daytime tasks.[30,31,32] Conversely, employees that are regularly exposed to light during the day, and therefore have better aligned circadian rhythms, have reportedly lower rates of role limitation in the workplace due to physical problems. These issues were significantly worse with employees who work in windowless environments.[33]

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28 Aries, Veitch, and Newsham, "Physical and Psychological Discomfort."

29 Antal Haans, "The Natural Preference in People's Appraisal of Light," *Journal of Environmental Psychology* 39 (2014): 51-61.

30 A. Daurat et al., "Bright Light During Nighttime: Effects on the circadian regulation of alertness and performance," *Neurosignals* 9 (2000): 309-318.

31 Anne-Marie Chang et al., "Human Responses to Bright Light of Different Durations," *The Journal of Physiology* 590 (2012): 3103-3112.

32 Anne-Marie Chang et al., "Direct Effects of Light on Alertness, Vigilance, and the Waking Electroencephalogram in Humans Depend on Prior Light History," *Sleep* 36 (2013): 1239-1246.

33 Boubekri et al., "Impact of Windows and Daylight Exposure," 603.

Exposure to blue light during the day has been proven to decrease both melatonin concentration and sleepiness while raising alertness.[34,35,36,37] While this can increase daytime task performance, it can have negative effects when exposed too close to nighttime. Blue light has also been shown to affect typical sleep patterns in individuals trying to sleep while failing to improve performance of tasks at night.[38,39] Alternatively, a new 2014 study now suggests exposing individuals to red light during the day elicits an alert response without the resulting suppression of melatonin production that blue light traditionally causes.[40]

A field investigation into the benefits of well-lit offices revealed that workstation-specific lighting with individual controls was better than traditional recessed luminaires.[41] Employees who judged the lighting as better or more comfortable also reported the room was more attractive and claimed to be in a better mood, leading to higher environmental satisfaction and a better performance.

34 Jeanne F. Duffy and Charles A. Czeisler, "Effect of Light on Human Circadian Physiology," *Sleep Medicine Clinics* 4 (2009): 165-177.

35 Jo Phipps-Nelson et al., "Blue Light Exposure Reduces Objective Measures of Sleepiness During Prolonged Nighttime Performance Testing," *Chronobiology* 26 (2009): 891-912.

36 Nayantara Santhi et al., "The Spectral Composition of Evening Light and Individual Differences in The Suppression of Melatonin and Delay of Sleep in Humans," *Journal of Pineal Research* 53 (2012): 47-59.

37 Amely Wahnschaffe et al., "Out of the Lab and into the Bathroom: Evening short-term exposure to conventional light suppresses melatonin and increases alertness perception," *International Journal of Molecular Sciences* 14 (2013): 2573-2589.

38 Stéphanie van der Lely et al., "Blue Blocker Glasses as A Countermeasure for Alerting Effects of Evening Light-Emitting Diode Screen Exposure in Male Teenagers," *Journal of Adolescent Health* 56 (2015): 113-119.

39 Mariana G. Figueiro and Mark S. Rea, "Short-Wavelength Light Enhances Cortisol Awakening Response in Sleep-Restricted Adolescents," *International Journal of Endocrinology* 2012 (2012).

40 Levent Sahin et al., "Daytime Light Exposure: Effects on biomarkers, measures of alertness, and performance," *Behavioural Brain Research* 274 (2014): 176-185.

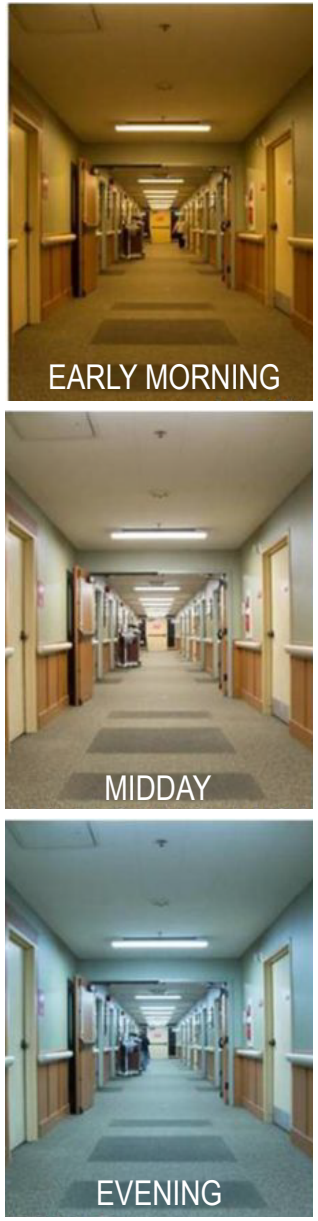
41 J. A. Veitch et al., "High-Quality Lighting: Energy-efficiency that enhances employee well-being," (2010): 197-204.

2.1.5 SUMMARY AND DESIGN CONCLUSIONS

The neuro-sensory impact of light is one of the most well-documented and thoroughly researched topics in current healthcare design. The evidence confirms that varying amounts, durations, and qualities light have profound effects on human bodily systems, such as circadian rhythms and melatonin release cycles. Lighting has been shown to have the ability to drastically improve health, in terms of physiology, psychology, and performance. In terms of physiological issues, improper lighting exposure has been linked to conditions such as cardiovascular disease, obesity, high blood pressure, and certain cancers. Psychologically, light has been shown to impact sleep disorders (i.e. insomnia, sleep onset latency, fatigue, delayed sleep phase disorder) as well as emotional or mood disorders (i.e. depression, manic-depressive disorder, seasonal affective disorder). Lastly, in terms of performance, studies have shown that various lighting conditions can affect alertness or sleepiness during tasks and impact environmental satisfaction, both of which contribute to overall performance.

The resulting design recommendation regarding architectural lighting is to connect the lighting of the interior as much as possible with natural light conditions in order to maintain healthy circadian rhythms. This goal may have to be mitigated by other design factors in certain specific situations, such as extreme latitudes or conditions for night-shift workers. However, this can often be accomplished through an abundance of natural light wherever possible as well as circadian-supporting artificial lighting in places where sunlight does not penetrate. Circadian lighting is an electrical lighting scheme whereby the lighting dims or brightens as it shifts from redder to bluer throughout the day, mimicking natural light. Light levels for specific spaces should also be consistently appropriate to the tasks designed to be accomplished therein, avoiding the eye strain of under-lighting or the glare of over-lighting. Lastly, many functions benefit from certain lighting amenities, such as personal task lights to boost performance as well as light therapy boxes or rooms to support emotional health and alertness.

Figure 6 | An example of circadian lighting being used in a hallway where natural light cannot reach: the lights shift from redder in the early morning to bluer in the evening and show a corresponding change brightness throughout the day [Source: AIA Central Valley]



2.2 COLOR & PATTERN AND HEALTH

2.2.1 COLOR MEANING AS CULTURAL CONSTRUCT

There exists a phenomenon of biological imperatives known as the symbol vs. signal response; this response is inherently important to our perception of color.[42] Color, as perceived by the brain, is either interpreted as an innate and instantly understandable signal or as a symbol to which a cultural meaning has been attached. Color as a signal might be seen for example as the color of the sunrise indicating the approaching day, while color as a symbol could be the associations of the color red and green with stopping and proceeding, respectively. Most of our responses to color and meaning in the environment come from culturally ingrained sources, making them symbolic of a deeper cultural meaning. However, despite not being true "signals," this type of sensory perception still often results in physiological effects and almost always results in psychological effects.[43] Therefore, color design is not something that should be ignored, especially in healing environments.

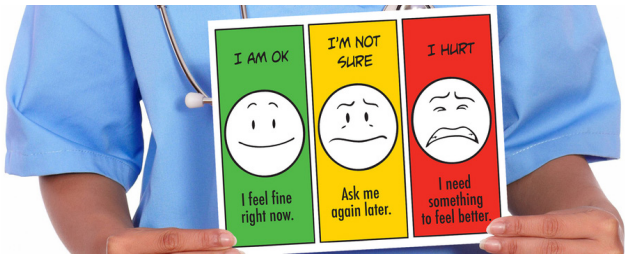


Figure 7 | A green-yellow-red pain scale used in hospitals draws upon our understanding of colors as "symbols" for additional meanings
[Source: Stoplight Pain Scale, developed by Amy Drendel, DO and Booster Shot Media]

2.2.2 COLOR AND LIGHT

Colored light has been an area of research that has received significant attention in recent years. Much of this attention has been on physiological effects, as discussed in the previous lighting section, whereas fewer studies have been done on the psychological effects. While most psychological research on light and color has focused on aesthetic preference and comfort, there is some evidence to link it to health and behavior.

42 Barbara K. Wise and James A. Wise, "The Human Factors of Color in Environmental Design: A critical review" (report prepared for National Aeronautics and Space Administration, Ames Research Center, Moffett Field, California, August 1988).

43 Wise and Wise, "The Human Factors of Color."

In terms of preferences, people tend to prefer incandescent light to fluorescent light, and they prefer daylight to any kind of artificial light. In terms of health and behavior, the red end of the spectrum has been shown to increase brain activity, which would suggest higher mental arousal. There is also some evidence linking red- and blue-shifted light to various states of mind. More red lights have been linked to greater dominance and competitiveness, but decreased mental flexibility in cognitive tasks like creativity. This is in contrast to bluer lights, which have been related to improved performances in creative and reasoning tasks.[44]

As a result of this kind of research, light therapy has begun to be integrated into certain healing therapy regimens. One of these is color therapy, or ocular color light therapy, where individuals are exposed to colored lights.[45] The supposed benefits of this form of treatment are enhanced brain energy, improved intellectual capacity, and increased neural pathways. These benefits have yet to be proven, and are therefore not considered reliable treatments in clinical settings. However, light therapy is used as an elective treatment for patients to try and improve their own mood or to help alleviate the symptoms of stress, anxiety, or depression.

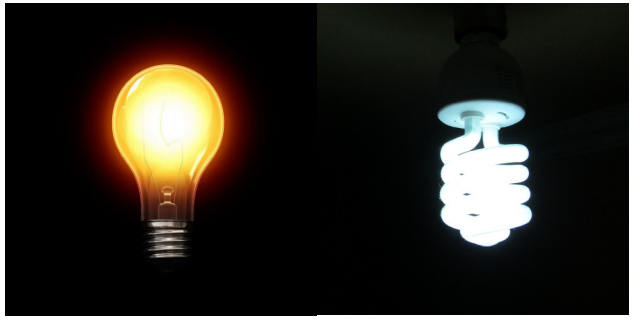


Figure 8 | Warmer incandescent (left) vs. cooler fluorescent (right) light bulbs
[Source: Great American Things]

Figure 9 | Sensory comfort rooms often allow for color light therapy, providing spaces where people can manipulate their environment to aid in their treatment
[Source: Swedish Behavioral Health & Psychiatry]

2.2.3 COLOR AND ENVIRONMENTAL ELEMENTS

Various studies have been done on the color of interior walls and surfaces in healthcare environments. Overall, several consistencies for effective color treatment have emerged. The results indicate that using warmer and brighter colors helps depressed patients, but cooler blues and greens are better for patients with anxiety or stress disorders. Because of the tendency for bluer tones to have soothing effects, they are seen as more beneficial for the most

44 Howard Frumkin, *Environmental Health: From global to local* (John Wiley & Sons, 2016).

45 Marc Schweitzer, Laura Gilpin, and Susan Frampton, "Healing Spaces: Elements of environmental design that make an impact on health." *Journal of Alternative & Complementary Medicine* 10 (2004).

calming spaces.[46] Additionally, there tends to be positive associations with the color green, likely from the connection to nature, whereas orange may elicit feelings of excitement or distress.[47,48,49]

Wall color also has the ability to change how a space feels, providing the opportunity to mitigate the institutional atmosphere.[50,51] This can be most successfully accomplished by using a coordinated scheme that uses color to differentiate the various areas of the facility, and perhaps most importantly, avoiding the over-prevalence of white.[52] Studies have shown that the typical choice of white or grey walls can be disturbing and overwhelming for certain people, especially those with mental or attentional disorders.[53,54]

2.2.4 COLOR AND OBJECTS

Similar to wall surfaces, the colors of interior objects can have a distinct impact on health and well-being. Purposeful color choice can be inserted into a healthcare environment through colorful artwork, comfortable furnishings, or stimulating room surfaces. Artwork tends to be most healthful when it is of restful nature scenes, especially in rooms without exterior windows.

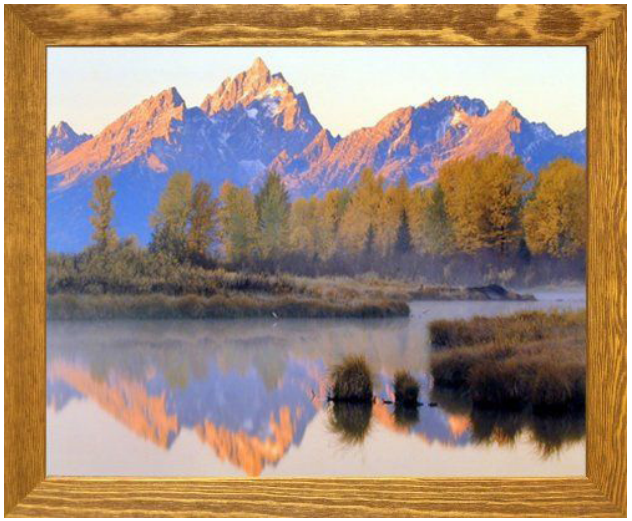


Figure 10 | A painting of a calm natural scene, particularly useful as a colorful focal point in areas that do not have exterior windows or too many [Source: Impact Posters Gallery]

46 Bradley E. Karlin and Robert A. Zeiss, "Best Practices: Environmental and therapeutic issues in psychiatric hospital design: toward best practices," *Psychiatric Services* 57 (2006): 1376-1378.

47 Karin Dijkstra, Marcel E. Pieterse, and A. Th H. Pruyn, "Individual Differences in Reactions Towards Color in Simulated Healthcare Environments: The role of stimulus screening ability," *Journal of Environmental Psychology* 28 (2008): 268-277.

48 Helen H. Epps and Naz Kaya, "Color Matching from Memory" (paper presented at the Interim Meeting of the International Color Association, AIC 2004 Color and Paints, Porto Alegre, Brazil, November 3-5, 2004)

49 Lois B Wexner, "The Degree to Which Colors (Hues) Are Associated with Mood-Tones." *Journal of Applied Psychology* 38 (1954): 432.

50 B. Cooper, A. Mohide, and S. Gilbert, "Testing the Use of Color in a Long-Term Care Setting," *Dimensions in Health Service* 66 (1989): 22-24.

51 Dijkstra, Pieterse, and Pruyn, "Individual Differences in Reactions Towards Color," 268-277.

52 Karlin and Zeiss, "Best Practices," 1376-1378.

53 N. Kwallek et al., "Impact of Three Interior Color Schemes on Worker Mood and Performance Relative to Individual Environmental Sensitivity," *Color Research and Application* 22 (1997): 121-132.

54 Dijkstra, Pieterse, and Pruyn, "Individual Differences in Reactions Towards Color," 268-277.

Also, color patterns should not be able to be misperceived as threatening or confusing in any way – such as bugs, animals, or figures – by medicated or distressed patients.[55]

2.2.5 SUMMARY AND DESIGN CONCLUSIONS

The quality of color, while somewhat related to the quality of light, shows its health effects much more prominently in the psychological rather than the physiological realm. Additionally, many, if not most, of color's psychological effects are cultural constructs that result in particular mood associations. This means that color can be an essential tool in improving well-being and state of mind, especially for patients in healthcare environments. Color-conscious design can begin to improve neurological states through the use of colored light, interior walls, and objects. Light therapy rooms have begun to appear in clinical environments, especially where patients may suffer from mental or mood disorders. Certain tones of wall colors have been linked to different psychological states. For example, brighter colors are more recommended for patients with depression, while cooler colors are recommended more for patients with anxiety, and an over-prevalence of the color white is strongly discouraged.

The rules of designing with color are often based on cultural constructs, so there are fewer concrete and universal design recommendations to follow. However, obvious socially constructed meanings within color choices should definitely be integrated into the design. Additionally, some general rules for color-based health design are to use consistent and complimentary color palettes, use cooler blues and greens for a calming effect, and use brighter or warmer reds and oranges for stimulating effects. In clinical environments specifically, color-conscious design also includes avoiding an overabundance of the color white, avoiding easily misunderstood patterns, and utilizing colored light therapy rooms to increase sensory comfort.

55 Jaynelle F. Stichler, "Creating Healing Environments in Critical Care Units," *Critical Care Nursing Quarterly* 24 (2001): 1-20.

2.3 EXTERIOR VIEWS AND HEALTH

2.3.1 NATURAL VIEWS

In 1984, a landmark study largely credited with generating interest in the relationship between health and views was completed by Roger S. Ulrich, a now renowned professor in health and environmental design. This simple study investigated the relationship between patient post-operative health and their view from a hospital room window. There were two groups: those whose room faced a natural scene and those who faced a brick wall. The patients who had the natural view experienced shorter hospital stays, received fewer negative comments from the nurses, and requested less pain medication than similar patients in the brick-view rooms.[56] According to much of the research done on this topic since Ulrich's 1984 study, natural views promote positive benefits such as faster healing, lower stress levels, better attention and focus, and improved mood. And as noted in studies from 2008 and 2017, the longer individuals were exposed to or focused on the view, the more pronounced these benefits became.[57,58]

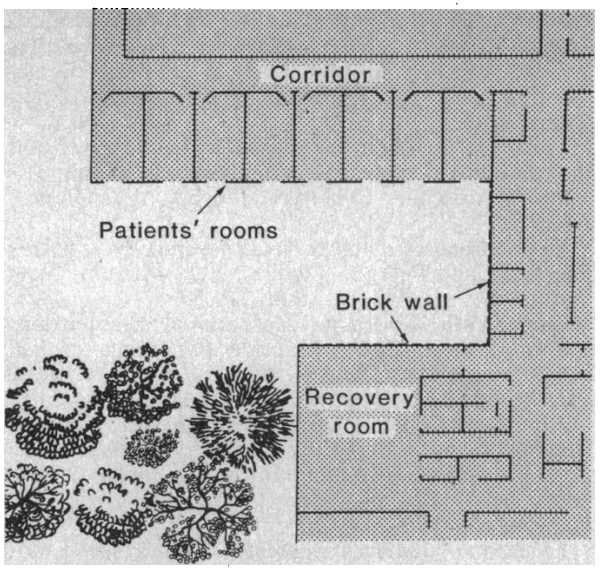


Figure 11 | A plan of the hospital wing used for Roger Ulrich's 1984 landmark study [Source: Roger Ulrich]

2.3.2 URBAN VIEWS

These studies that espouse the virtues of natural views are often done within the context of comparing natural views and urban views, the results of which seem to show the former as consistently superior. However, several factors have been proposed as possible explanations for this. If the "urban" scene in question is static and uninteresting, such as a brick wall, or stressful and unpleasant, such as a car accident or high traffic, it may make sense that natural

56 Roger Ulrich, "View Through a Window May Influence Recovery," *Science* 224 (1984): 224-225.

57 Peter H. Kahn et al., "A Plasma Display Window? — The shifting baseline problem in a technologically mediated natural world," *Journal of Environmental Psychology* 28 (2008): 192-199.

58 Silvia Collado et al., "Restorative Environments and Health," in *Handbook of Environmental Psychology and Quality of Life Research*, ed. Ghozlane Fleury-Bahi, Enric Pol, and Oscar Navarro (Springer International Publishing, 2017) 127-148.

views would be preferred and have more benefits. However, Ulrich commented on the fact that, in some cases, it may be more beneficial for people, especially those who are bedridden, to look out onto an interesting urban scene than a banal landscape.[59,60] Therefore, while generally nature views appear to offer more benefits than urban ones, certain urban views have the potential to be positive as well.

2.3.3 THE PRESENCE OF REAL VIEWS

A study from 2008 examined the difference between real windows looking out onto real natural scenes and fake "plasma" windows looking out onto televised, real-time natural scenes. It was observed that none of the positive effects of looking out of the real window were replicated in the participants who sat in front of the fake windows. The results from the fake windows were not statistically different from individuals who sat in front of blank walls.[61] This experiment confirmed that real windows with legitimate views are preferred and that providing an exterior view creates certain positive effects that cannot be replicated in spaces visually isolated from the outside environment.

2.3.4 SUMMARY AND DESIGN CONCLUSIONS

Through various studies done on the topic, exterior views in interior environments are almost universally shown to increase health, well-being, and performance of occupants. Most notably, a landmark 1984 study indicated that natural views promoted faster recovery and less pain-associated symptoms than urban views. Some additional benefits of natural views

59 Ulrich, "View Through a Window," 224-225.

60 Roger S. Ulrich et al., "Stress Recovery During Exposure to Natural and Urban Environments," *Journal of Environmental Psychology* 11 (1991): 201-230.

61 Kahn et al., "A Plasma Display Window," 192-199.

are lower stress levels, better attention and focus, improved knowledge retention, and better mood. In some studies, the longer individuals were exposed or focused on the view, the more pronounced the benefits became. However, it is not just natural scenes that can create these kinds of health improvements. In some cases, studies postulate that certain peaceful urban scenes, such as simple people-watching, may be more simulating and provide more wellness benefits than under-stimulating natural scenes.

The main conclusion that comes out of this body of research is that designers should integrate as many windows into interior spaces as possible, given lighting, spatial organization, and program restrictions. The research indicates that organizing a building with views of nature, or even the constructed nature of a courtyard, tends to have more beneficial effects than views of urban scenes. Therefore, these types of views should be prioritized. However, views looking out on urban environments that are not typically anxiety-inducing can be an alternative to natural scenes, especially where a higher degree of connection to the urban fabric may be desired. In cases where an external window absolutely cannot be provided, design efforts should have a focus on wall color or wall art.

2.4 SOUNDSCAPE AND HEALTH

2.4.1 NOISE

Over the last 50 years, sound levels in clinical settings have been steadily increasing.[62] This increase has been generally shown to negatively affect the health of recovering patients, especially those in psychiatric facilities. In numerous studies, excess or unwanted noise has been linked to various negative health effects. Some of these consequences are elevated stress, disturbed sleep, impeded recovery, increased heart rate, blood pressure, respiration rate, and cholesterol, reduced weight gain, and hormonal imbalances.[63,64,65] Specifically, positive effects were obtained both by reducing overall noise levels and replacing disturbing, inappropriate, or apprehensive noises with nature sounds. These changes mainly resulted in decreased stress, a slower heart rate, faster healing, and decreased aggression in psychiatric patients.[66,67,68] Suggestions for controlling the soundscape of clinical environments include controlling all noise at the source, allowing provisions for it to be turned down at night, and allowing patients to individually access music and sounds through headphones or comfort/sensory rooms. Additionally, quiet spaces like patient rooms should be located far away from noisier spaces like

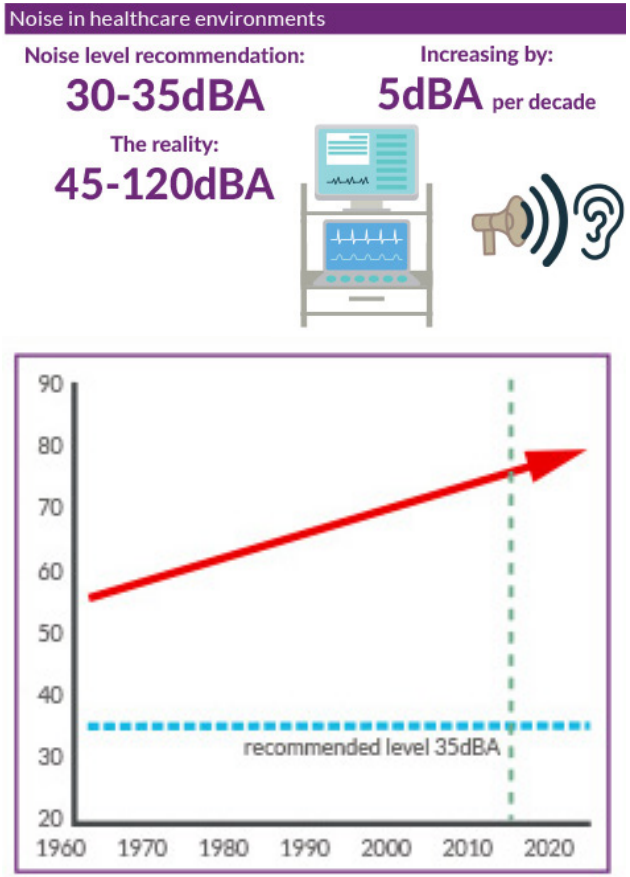


Figure 12 | Noise levels in healthcare environments have been increasing over the last five decades and have reached volumes much higher than the recommended 35dBA
[Source: Evidence Space]

62 Brian Brown, Peter Rutherford, and Paul Crawford, "The Role of Noise in Clinical Environments with Particular Reference to Mental Health Care: A narrative review," *International Journal of Nursing Studies* 52 (2015): 1514-1524.

63 Roger S. Ulrich, Robert F. Simons, and Mark A. Miles, "Effects of Environmental Simulations and Television on Blood Donor Stress," *Journal of Architectural and Planning Research* (2003): 38-47.

64 Vania Blomkvist et al., "Acoustics and Psychosocial Environment in Intensive Coronary Care," *Occupational and Environmental Medicine* 62 (2005): e1.

65 Brown, Rutherford, and Crawford, "The Role of Noise in Clinical Environments," 1514-1524.

66 Ulrich, Simons, and Miles, "Effects of Environmental Simulations and Television," 38-47.

67 Blomkvist et al., "Acoustics and Psychosocial Environment," *Occupational and Environmental Medicine* 62 (2005): e1.

68 Brown, Rutherford, and Crawford, "The Role of Noise in Clinical Environments," 1514-1524.

dining halls and busy streets, and closer to courtyards or other spaces that encourage soothing, relaxing natural sounds such as running water, rain, breezes, and songbirds.[69]

2.4.2 MUSIC

Another positive use of noise in healing environments has been shown through the use of music. Several studies have examined the use of music in healing, especially in relation to mental health. One study concluded that patients, even when lightly sedated, typically appreciated listening to music and claimed it made them feel more relaxed, safer, and even made the environment seem more pleasant.[70,71] Another study investigated music's role in the mental state of relaxation, confirming the link between music and neurophysiological and emotional relaxation responses.[72] These studies indicate that listening to music has many similar positive responses that listening to nature sounds and decreasing unwanted noise has on patients in clinical environments.

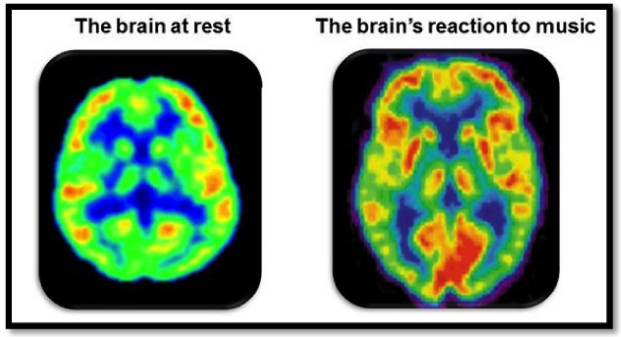


Figure 13 | Brain stimulation response while listening to music
[Source: The Healing Place of Wake County]

2.4.3 ACOUSTIC COMFORT

In areas other than hospitals and clinics, acoustic comfort is typically still a very important, if often overlooked, factor to consider. The type and source of sounds are significant characteristics that can determine acoustic comfort. Other qualities that influence this subjective sense of comfort are duration of stay, activities, and typical acoustic condition, which is used

Figure 14 | Like this waterfall, even loud sounds are often acceptable if emitting from pleasant sources
[Source: Tamae Ishii]

69 Brown, Rutherford, and Crawford, "The Role of Noise in Clinical Environments," 1514-1524.

70 Bitten Thorgaard et al., "Specially Selected Music in the Cardiac Laboratory—An important tool for improvement of the wellbeing of patients," *European Journal of Cardiovascular Nursing* 3 (2004): 21-26.

71 Ann-Charlotte Fredriksson, Leif Hellström, and Ulrica Nilsson, "Patients' Perception of Music Versus Ordinary Sound in a Postanaesthesia Care Unit: A randomised crossover trial," *Intensive and Critical Care Nursing* 25 (2009): 208-213.

72 Robert E. Krout, "Music Listening to Facilitate Relaxation and Promote Wellness," *The Arts in Psychotherapy* 34 (2007).

to establish a baseline.[73] Interestingly, people tend to generally disapprove of louder public environments, yet they show more tolerance to louder sounds if they are considered pleasant. This illustrates that pleasant sounds can distinctly improve acoustic comfort, even if the sound level is relatively high.[74]

2.4.4 MATERIALS

The design of a suitable acoustic environment for a space requires appropriate materials. With current architectural trends towards the smoother surfaces of concrete and glass, using proper sound-absorbing materials has become even more important. Mid to high frequency sound absorption is often already accomplished by furniture, carpets, and bodies in a room. Low frequency absorption is harder and typically requires the installation of specially fabricated panels.[75] During the design phase, it is important to consider the sound transmission and absorption coefficients of objects, as well as the orientation and location of spaces in the building relative to noise sources.[76]

2.4.5 SUMMARY AND DESIGN CONCLUSIONS

The soundscape of clinical environments have been steadily rising over the last 50 years. This has led to hospitals and other healing spaces becoming notoriously noisy environments: a condition that is not compatible with health improvements. Unwelcome, loud, or disturbing noises have been linked to negative effects including longer recovery times in patients, elevated

Figure 15 | Modern architecture's distinct trend towards using harder materials, such as concrete and glass
[Source: ArchDaily]

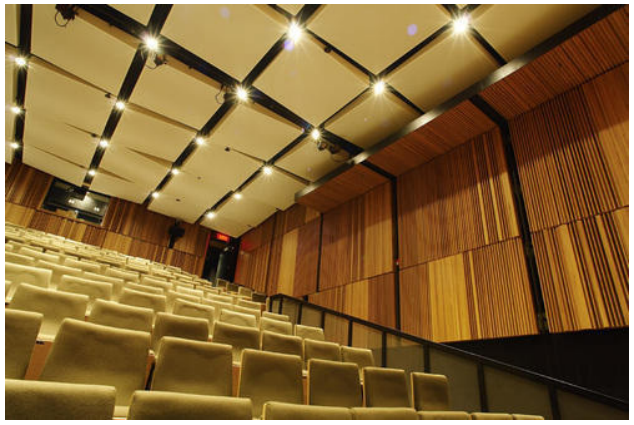


Figure 16 | Specially fabricated sound-absorbing panels, often used in acoustically-controlled environments such as auditoria
[Source: WSC Building Materials]

73 Bing Chen and Jian Kang, "Acoustic Comfort in Shopping Mall Atrium Spaces—A case study in Sheffield Meadowhall," *Architectural Science Review* 47 (2004): 107-114.

74 Wei Yang and Jian Kang, "Acoustic Comfort Evaluation in Urban Open Public Spaces," *Applied Acoustics* 66 (2005): 211-229.

75 H. Drotleff, and X. Zhou, "Attractive Room Acoustic Design for Multi-Purpose Halls," *Acta Acustica United* 87 (2001): 500-504.

76 Gül Koçlar Oral, Alpin Köknel Yener, and Nurgün Tamer Bayazit, "Building Envelope Design with The Objective to Ensure Thermal, Visual and Acoustic Comfort Conditions," *Building and Environment* 39 (2004): 281-287.

stress, disturbed sleep, increased heart rate, and hormonal imbalances. Using appropriate acoustic-based design practices, such as turning down volumes at night and locating patient rooms near courtyards with natural sounds, have noted positive effects on health. Specifically, these benefits can include decreased stress, slower heart rates, and decreased agitation. In addition to the use of nature sounds, providing patients with the option to listen to calming music at appropriate times has also been proven to have many of the same health benefits.

As briefly mentioned above, there are a few acoustic-based strategies for health design that can be integrated into architectural designs. For one, many healthcare buildings use intercoms or other loud sound-based paging systems. It has been recommended that these sounds be turned down at night and/or completely replaced with silent visual paging systems. Another strategy is audio-based programming, whereby program adjacencies are established based on the particular sound levels and requirements of the individual spaces. In clinical environments for example, this could range from locating loud dining halls far from quiet patient rooms or even organizing patient rooms around a quieter, nature-filled courtyard. Lastly, a kind of sound-based sensory comfort room could be made available for people to listen to soothing sounds or music if desired, similar to the previously mentioned light therapy rooms.

Figure 17 | A "Yacker Tracker" being introduced at a hospital as a new part of the effort to lower overall sound levels
[Source: NewsOK]

Figure 18 | A standard visual paging system using numbers; newer systems can also use colors, words, or even simple images in place of numbers
[Source: SenSource]

2.5 GREEN SPACE AND HEALTH

2.5.1 A MULTI-SENSORY, HEALING EXPERIENCE

Green spaces are the most evident and heavily researched example of multi-sensory neurologically-affective experiences. Different from the previous neuro-sensory design factors mentioned, green spaces are multi-sensory in nature because they act as stimuli for various senses, including sight, sound, smell, and touch. Studies done on the effects of green spaces or nature on health have ranged from small-scale interventions such as interior potted plants to large-scale parks in a neighborhood. The data concludes that these types of spaces support both our physical as well as our mental health. According to various studies and reports, higher quality, healthy green spaces regularly correlate to better health patterns.[77,78,79]

Healing gardens, a specific kind of green space, are often utilized in hospital designs and other clinical environments to aid in patient recovery. In these healthcare environments, green spaces have been well-known for centuries for their apparent healing properties. This has resulted in a proliferation of healing gardens designed as integral parts of hospitals and other clinical environments.

2.5.2 INTERIOR PLANTS

While most studies on nature and health are done on the outdoors, a few studies have been done to examine the effects that interior plants have on people's health. The results of

77 Jolanda Maas et al., "Green Space, Urbanity, And Health: How strong is the relation?" *Journal of Epidemiology and Community Health* 60 (2006): 587-592.

78 Richard Mitchell and Frank Popham. "Greenspace, Urbanity and Health: Relationships in England." *Journal of Epidemiology and Community Health* 61 (2007): 681-683.

79 Jacinta Francis et al., "Quality or Quantity? Exploring the relationship between Public Open Space attributes and mental health in Perth, Western Australia," *Social Science & Medicine* 74 (2012): 1570-1577.

these experiments have generally been positive, showing a statistically significant correlation between the presence of the plants and improved health metrics. Specifically, improved productivity, increased attentiveness, lowered stress levels, and decreased physical discomfort have all been recorded in the presence of interior plants.[80,81]

2.5.3 PHYSICAL EFFECTS AND "GREEN EXERCISE"

Studies in health and design have concluded that green space, especially in urban contexts, improves general health. According to a 2003 cross-sectional analysis of several studies, living and spending considerable time in greener environments appears to lead to fewer symptoms of poor health and a higher perceived general health.[82] Other surveys that specifically studied health issues in certain populations found that access to a garden or other nearby green space is associated with lower rates of obesity and better physical activity.[83,84]

Additional studies have been done on the specific effects of "green exercise" on mental health. Green exercise is physical activity done in green spaces or outdoor environments, such as walking, running, biking, canoeing, or horseback riding. Special care is taken in these studies to isolate the specific benefits of physical activity in a green environment from the benefits of the activity itself. Studies in this area showed that green exercise programs led to significant improvements in self-esteem and mood regardless of the type, intensity, or even type of

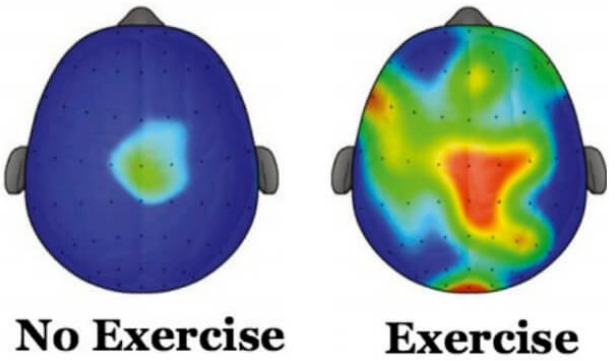


Figure 19 | Brain stimulation patterns while exercising
[Source: Business Insider]

80 Virginia I. Lohr, Caroline H. Pearson-Mims, and Georgia K. Goodwin, "Interior Plants May Improve Worker Productivity and Reduce Stress in a Windowless Environment," *Journal of Environmental Horticulture* 14 (1996): 97-100.

81 Virginia I. Lohr and Caroline H. Pearson-Mims, "Physical Discomfort May Be Reduced in the Presence of Interior Plants," *HortTechnology* 10 (2000): 53-58.

82 Sjerp De Vries et al., "Natural Environments—Healthy Environments?" *Environment and Planning* 35 (2003): 1717-1731.

83 Thomas Sick Nielsen and Karsten Bruun Hansen, "Do Green Areas Affect Health" *Health & Place* 13 (2007): 839-850.

84 Emma Coombes, Andrew P. Jones, and Melvyn Hillsdon, "The Relationship of Physical Activity and Overweight to Objectively Measured Green Space Accessibility and Use," *Social Science & Medicine* 70 (2010): 816-822.

green environment.[85] It was also suggested that these benefits were reflected over very short durations, with diminishing but still positive returns as the activity continued. Furthermore, while every green environment studied showed benefits, the presence of water demonstrated additional, greater improvements in both mood and self-esteem. Those with pre-existing mental issues showed the greatest improvements in their psychological states.[86] Additionally, all kinds of exercise have been shown to stimulate neural connections and improve brain activity, improving both body and mind simultaneously. The evidence results in a compelling argument for designing spaces that support green exercise programs.

Figure 20 | A water feature can help increase the health benefits of green spaces
[Source: Green Lake Seattle neighborhood website]

2.5.4 PRIMARY PSYCHOLOGICAL EFFECTS

Further psychological studies have shown or suggested that green spaces have many benefits for health and well-being. Primarily, multiple studies have shown nature to have mitigating effect on stress and anxiety or mood disorders.[87,88,89,90,91] One study even suggests that visiting the parks and green spaces is not necessary to gain the de-stressing effects; casually walking past a park or living in a greener area provides a certain degree of emotional

85 Jules Pretty et al., "Green Exercise in the UK Countryside: Effects on health and psychological well-being, and implications for policy and planning," *Journal of Environmental Planning and Management* 50 (2007): 211-231.

86 Jo Barton and Jules Pretty, "What is the best dose of nature and green exercise for improving mental health? A multi-study analysis," *Environmental Science & Technology* 44 (2010): 3947-3955.

87 Anna Chiesura, "The Role of Urban Parks for the Sustainable City," *Landscape and Urban Planning* 68 (2004): 129-138.

88 Nielsen and Hansen, "Do Green Areas Affect Health?" 839-850.

89 Agnes E. Van den Berg et al., "Green Space as a Buffer Between Stressful Life Events and Health," *Social Science & Medicine* 70 (2010): 1203-1210.

90 Francis et al., "Quality or Quantity?" 1570-1577.

91 D. Nutsford, A. L. Pearson, and S. Kingham, "An Ecological Study Investigating the Association Between Access to Urban Green Space and Mental Health," *Public Health* 127 (2013): 1005-1011.

support to better deal with stressful situations.[92] A second study supported this assertion by finding the same results irrespective of whether or not the subjects actually used the green space.[93] In terms of anxiety and mood disorders, it is likely that the types of green spaces most responsible for improving mental health in these situations are small spaces within the immediate vicinity, rather than large neighborhood spaces.[94]

However, while greener areas have the ability to improve mental well-being, moving to areas with fewer or lower-quality green spaces does not necessarily reverse that trend. A longitudinal study completed in 2013 showed that, while individuals who moved to greener areas did indeed show a sustained improvement in their mental health, those who move to less green areas initially showed a decrease but then rebounded back to their original baseline.[95] This could indicate that, while the presence of green space is certainly beneficial, the lack of abundant nature may not be seriously detrimental to already healthy individuals.

2.5.5 HEALING GARDENS

The healing properties of green spaces have been recognized for centuries, with nature and its apparent restorative and therapeutic effects as one of the earliest forms of therapy. However, with advances in medication and pathogen theories that changed healthcare in the 20th century, the connection between healing and nature became diminished.[96] Hospitals became sealed, isolated environments, trusting fully in the power of sterilization and medicine.

92 Nielsen and Hansen, "Do Green Areas Affect Health?" 839-850.

93 Francis et al., "Quality or Quantity?" 1570-1577.

94 Nutsford, Pearson, and Kingham, "Access to Urban Green Space and Mental Health," 1005-1011.

95 Ian Alcock et al., "Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas," *Environmental Science & Technology* 48 (2014): 1247-1255.

96 Clare Cooper Marcus and Marni Barnes, "Introduction: Historic and Cultural Overview," in *Healing Gardens: Therapeutic Benefits and Design Recommendations*, ed. Clare Cooper Marcus and Marni Barnes (Canada: John Wiley & Sons, 1999), 4-14.

In the last two decades, healing gardens have begun to return to the healthcare scene, with green spaces showing up in or near hospitals, clinics, and other related places.

A healing garden can be any green space with the ability to produce therapeutic effects, such stress reduction. Excess stress, a major problem in healthcare settings, has been shown countless times to hinder recovery efforts and decrease overall health.[97,98] The healing garden is the epitome of a multi-sensory neurological healing factor. It incorporates concern for sight in its aesthetic appeal, promoting the benefits of looking at nature, such as decreased stress and pain levels. An attractive outdoor space also encourages exercise, proven to aid in mental tasks like memory and cognition and to decrease the likelihood of depression. There is a concern for natural sounds via elements like rustling leaves, running water, and birds chirping and for smells from elements like flowers and trees. All of these have been proven to have calming and anxiety-reducing effects. The sensation of touch and temperature is effected by the natural breeze and direct rays of sunshine that often accompany a healing garden, which have been linked to positive sensations, lowered stress levels, and an increased sense of well-being.

Figure 21 | A hospital healing garden incorporating a calming water feature
[Source: ZGF Architects online portfolio]

2.5.6 SUMMARY AND DESIGN CONCLUSIONS

Several studies have observed the positive health effects that come from having access to natural spaces. These effects have shown to be both physiological as well as psychological. In terms of physiological health, various studies have linked access to green spaces, especially in urban settings, to improved general health. This can take the form of fewer symptoms of illness, lower rates of obesity, and a higher likelihood of meeting physical activity standards. However, most benefits of green spaces are found in positive changes to psychological states, such as

97 Roger S. Ulrich, "Effects of Gardens on Health Outcomes: Theory and Research," in *Healing Gardens: Therapeutic Benefits and Design Recommendations*, ed. Clare Cooper Marcus and Marni Barnes (Canada: John Wiley & Sons, 1999), 31-33.

98 Aaron Antonovsky, *Health, Stress, and Coping*, (University of Michigan, 1979).

improvements in self-esteem and mood, decreased stress and anxiety, and mitigated mood and emotional disorders. Many of these health effects have also been exhibited through the simple implementation of indoor plants, specifically improved productivity, increased attentiveness, lowered stress levels, and decreased physical discomfort.

On an urban planning scale, it is clearly beneficial to incorporate as much high-quality, healthy green space into a neighborhood as possible, especially in urban neighborhoods. On a smaller, architectural scale, providing interior potted plants, some on-site green space, or a landscaped courtyard are the most beneficial options. If providing exterior natural space, certain additional design elements that should be considered are movable furniture, a water feature (appealing both aesthetically and acoustically), and specifically chosen tree and plant species. The most notable uses of trees are to provide shade or as attractive homes for songbirds. This kind of green space should be overall wholly attractive and provide walking paths, encouraging people to participate in physical exercise.

Further design recommendations can help healing gardens to reduce stress and enhance the therapeutic benefits in healthcare environments. From an architectural perspective, these design considerations are easy access and simple wayfinding from the interior to the garden. In terms of landscaping, additional opportunities for exercise should be provided, such as clear walking paths or other amenities. Plants should be organized in a park-like or savanna-like way, meaning open grassy spaces with scattered trees and incorporating features like leafy plants, flowers, and still or slow-moving water features. However, the design of these spaces should avoid an abundance of hardscape (like concrete), abstract sculptures or art pieces (which can increase stress in anxious patients), and loud sounds from traffic or other urban sources.[99]

99 Ulrich, "Effects of Gardens on Health Outcomes: Theory and Research," 71-75.

CHAPTER 3: PRECEDENT ANALYSIS

3.1 PAIMIO SANATORIUM, *ALVAR AALTO*

Alvar Aalto's Paimio Sanatorium was one of the first buildings of the modern era to take the concepts of patient-centric and health-centric environmental design seriously. The building is still in use today and is internationally recognized as a key example of modern, health-oriented architecture and design. In early 2004, Paimio Sanatorium was submitted to the UNESCO Tentative List of Finland, the first step towards becoming an official UNESCO World Heritage Site.[100]

The Paimio Sanatorium was designed and built between 1928 and 1933 originally as a countryside tuberculosis hospital in southwest Finland. A significant pulmonary tuberculosis outbreak occurred at the beginning of the 20th century, a condition for which there was yet no medication. The only course of treatment was a long-term relocation to an isolated sanatorium that included lots of rest, a restrictive diet, monitored green exercise, occasional surgery, and hope. Paimio was just one of the 16 different sanatoria built in Finland between 1930 and 1935.[101] By 1971, it had stopped catering solely to tuberculosis patients but continued to operate as a hospital.

Sanatoria of the age were typically designed according to the current health-related understandings of tuberculosis. Paimio was no exception, meaning the building had to be located in the countryside and needed access to fresh air and natural sunlight.[102] Because of these expectations, sanatoria were already set up to be more health-centric environments

Figure 22 | Paimio Sanatorium today
[Source: ArchDaily]

Figure 23 | The green environment surrounding the sanatorium
[Source: Panoramio]

100 "Paimio Hospital (formerly Paimio Sanatorium)," Tentative Lists, UNESCO World Heritage Convention, submitted January 28, 2004, accessed August 7, 2017, http://whc.unesco.org/en/tentativelists/1864/.

101 Marianna Heikinheimo, "Paimio Sanatorium" (article initially written for the Alvar Aalto Foundation's monograph series, September 8, 2014): 3-4.

102 Heikinheimo, "Paimio Sanatorium," 2, 12, 19.

than other projects of its time. Despite the anecdotal evidence behind their design principles, sanatoria often ended up exhibiting many design factors that would go on to be proven health-promoting factors, such as the exposure to daylight and the prevalence of outdoor space.

However, unlike typical sanatoria of the time, Aalto paid special attention to the holistic design of patient-occupied spaces. He emphasized the creation of standards for human biological needs that every element should follow, believing in a design methodology rooted in scientific analysis and evidence-based design.[103,104] He further insisted that hospitals should be comfortable, believing as he did that patient rooms were akin to small dwellings.[105] In this way, the design reflected both an inherent concern for health as well as the comfort and well-being of the patients. In the spirit of this consideration, he carefully planned out the patient rooms, down to the specific colors of the surfaces and materials of the objects, designed to be calming, quiet, and functionally efficient. Aalto also created specific lighting fixtures and pieces of furniture intended to both work with the architecture and aid the patients' in recovery. The furniture was specifically intended to support hygiene and breathing, with often movable seating options.

The seating choices did not stop at movable furniture but extended to Aalto's creative use of views, sunlight, shadow, and color. Dining areas, lounges, and other common spaces were intentionally planned to face different directions, look out on different views, and use different bold colors intermittently. This creates a variety of communal environments throughout the sanatorium, providing patients with an additional level of choice when deciding where to

Figure 24 | One of the original patient rooms, made for two patients
[Source: Atlas of Interiors]

Figure 25 | The Paimio chair, a comfortable and movable chair, intended to ease the breathing difficulties of tuberculosis patients
[Source: Architect Magazine online]

103 Ellis Woodman, "Revisiting Aalto's Paimio," *Architectural Review* 240 (November 2016): 109-116.

104 Heikinheimo, "Paimio Sanatorium," 20.

105 Heikinheimo, "Paimio Sanatorium," 25-29.

spend time.[106] The small gesture of providing patient choice works positively to give patients back some small sense of control over their treatment and their lives in an environment where they would otherwise surrender that control to specified doctors' orders. This strategy has been proven to decrease stress and generally improve health of hospitalized patients.[107,108]

The healing elements of the Paimio Sanatorium have now been at work in this building for over 80 years. It was one of the first modern healthcare environments to focus on evidence-based, health-centric design, directly integrating the health-promoting factors of sunlight, fresh air, attractive outdoor space, bright colors, muted sounds, and sound hygiene practices. However, there are two important aspects of this design that are still rarely seen in similar environments today – the holistic, patient-focused concepts and the belief that hospitals should be comfortable, health-promoting environments. Using the patient as inspiration, Aalto based all design decisions around the human body and its needs. Paimio even included the innovative concept of patient choice in its variety of communal spaces and movable furniture, giving the patients a small sense of control back over their lives.

Figure 26 | Rooftop sun porch, facing the gardens, providing both sunny and shady spots
[Source: The Architectural Review]

Figure 27 | Patients' dining room, showing the abundance of views looking out and the controlled sunlight coming in
[Source: Sami Heikinheimo]

106 Diana Anderson, "Humanizing the Hospital: Design Lessons from a Finnish Sanatorium," *Canadian Medical Association Journal* 182 (Aug 10, 2010): E535-7.

107 Ulrich, "Effects of Gardens on Health Outcomes: Theory and Research," 37-42.

108 University of Detroit School of Architecture, *An Analysis of Environment for Mental Therapy* (Detroit: University of Detroit, 1966), 63.

3.2 MAGGIE'S CENTRES, *VARIOUS ARCHITECTS*

Like the Paimio Sanatorium, Maggie's Centres were founded on the idea of providing a healing environment to those who need it most. However, unlike sanatoria and hospitals, these are not institutional or clinical spaces but are spaces dedicated to caring for and supporting people with cancer. Maggie's Centres are drop-in centers for cancer patients and their loved ones, providing amenities and support services such as information, intimate kitchens, therapy sessions, yoga/meditation, or just a pleasant space to wait for the next appointment.

Maggie Keswick Jencks, along with her husband Charles, founded the Maggie's Centres organization. They both believed in the ability of buildings to help heal and uplift people. While battling terminal cancer in the early 1990s, Maggie Jencks observed firsthand the depressing and intimidating nature of the unwelcoming hospital interiors. With their lack of windows, too-bright lighting, sterile surfaces, and stiff seating, "patients who arrive relatively hopeful soon start to wilt."[109] She felt that there needed to be a place where people could go to decompress from the harsh lights and the clinical smell of the hospital. Through her own experiences, she learned how important it was to provide a space where patients could be treated like people, get a cup of tea, and find answers to the questions they didn't even know to ask. Through her observations, she came to feel that pleasant, well-designed spaces could inspire hope and imagination and could help improve the health, both mental and physical, of cancer patients.[110]

Maggie Jencks died in June of 1995. One year later, the first Maggie's Centre opened in Edinburgh. Today there are more than twenty Centres throughout the world. Each follows a very specific set of design instructions, in order to ensure they retain the healing environmental qualities they strive for. Each center has a different design that responds to its context, but the

Figure 28 | The first Maggie's Centre, designed by Richard Murphy Architects, which opened in Edinburgh, Scotland in 1996
[Source: Maggie's Centres online]

109 Maggie Keswick Jencks, *A View From the Front Line* (London, 1995), 21.

110 Jencks, *A View From the Front Line*, 9-26.

key guiding points remain the same. The official architectural and design brief states that the entrance should be obvious and approachable, especially in contrast to the oft-intimidating hospital environment. Yet, at the same time, it should not be too cozy as to seem dismissive to what the visitors are going through.[111] The design is described as having a domestic theme, with no front desk, a central kitchen and kitchen table, and clarity of function without signage. Casual informational and educational spaces, such as a small library, a couple computer stations, and a subtle yet visible notice board, are present. The structures are also designed with a collection of rooms of various sizes and transparencies, programmed as sitting rooms, consultation rooms, meditation rooms, and retreat/relaxation rooms.[112] These spaces are lit by as much natural daylight as possible, with large windows and extensive, abundant views of carefully cultivated nature.[113] The furnishings are flexible, with the ability to move seating and sit outside on a nice day or to make yourself tea in the kitchen.[114] As one visitor said, "'The atmosphere is hard to pin down, but it is far more coffee morning than cancer ward.'"[115]

Today, there are 22 Maggie's Centres throughout the UK and abroad, with even more in development. While operating as a separate entity, the buildings are always paired with a cancer treatment facility or hospital oncology department. Numerous well-known architects have taken up the challenge of designing these facilities, including Frank Gehry, Zaha Hadid, and Rem Koolhaas. Today the buildings continue to serve their original purpose, a testament to the quality of architecture and space, for those who work in them as well as those who visit

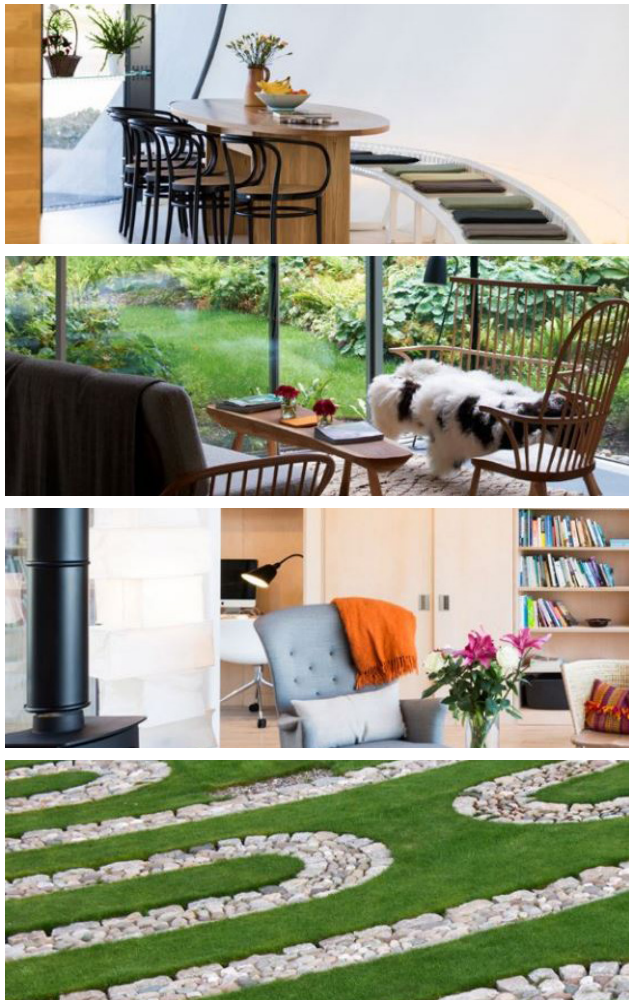


Figure 29 | Some of the architectural requirements from the Maggie's Centre design brief: A central kitchen table (first), A variety of comfortable seating (second), Activities such as books or computers (third), and Activated green space (fourth) [Source: Maggie's Centres online]

111 Maggie's Keswick Jencks Cancer Caring Trust, *Maggie's Architecture and Landscape Brief* (publication created for Maggie's Centres designers, 2015), 3.

112 Maggie's Keswick Jencks Cancer Caring Trust, *Maggie's Architecture and Landscape Brief*, 8-9.

113 Maggie's Keswick Jencks Cancer Caring Trust, *Maggie's Architecture and Landscape Brief*, 7-8.

114 Maggie's Keswick Jencks Cancer Caring Trust, *Maggie's Architecture and Landscape Brief*, 4.

115 Marcia Blakenham, "Maggie's Centres: Marching On," In *A View From the Front Line*, Maggie Keswick Jencks and Marcia Blakenham (2007), 27-28.

them.[116] People who visit these centers report feeling profoundly grateful and deeply affected by the quality and care.[117] This is a level of thought and care in the design that should be implemented in many more projects, especially spaces that focus on health and recovery.

This precedent exemplifies the importance of architecture, and specifically non-institutional environments, in the healing process. Maggie's Centres do not try to replace the clinical environment of cancer treatment, but rather serve as an important complement to hospital oncology departments. They change the traditional hospital waiting room into a more familial "living room." Open to anyone whose lives have been touched by cancer, patients can continue to find comfort in the presence of their friends and family, and the network of awareness can grow. Through their welcoming entrances, residential character, casual programming, and light-filled interiors, Maggie's Centres use their design to become the much-needed spaces of healing and hope for cancer patients.

Figure 30 | Various Maggie's Centres, each with a different kind of welcoming exterior aesthetic: Maggie's Aberdeen (top), Maggie's Lanarkshire (middle), Maggie's Oxford Centre (bottom) [Source: Maggie's Centres online]

116 Edwin Heathcote, "Maggie's Centres," *British Medical Journal* 333 (2006): 1304-305.

117 Heathcote, "Maggie's Centres," 1304-305.

CHAPTER 4: HEALTH DESIGN FRAMEWORKS

THE FRAMEWORK

Ultimately, the primary objective of this thesis is to create an understanding of how architectural design factors can influence neurological health and well-being. This is investigated through the establishment of certain health design factors – which include the neuro-sensory factors of lighting, color and pattern, exterior views, soundscapes, and green spaces – as well as certain design elements gleaned from successful precedent analyses. Combining the lessons learned from the neuro-sensory design research and the precedent analyses creates a design framework, intended to be applicable to most program types. This framework forms a set of suggested guidelines which, if followed, would aid in designing neurologically healthy spaces.

THE FRAMEWORK APPLICATION

For the most effective application of this framework, appropriate design elements would be chosen from this set after a program is specified. Occupant health is maximized and optimized by combining the particular design recommendations with the health-based needs of the particular program.

Therefore, to illustrate to utility of this framework, it will be applied to a specified program. Although nearly any program type would be possible here, it is more directly illustrative for the purposes of this thesis to choose a healthcare-related program where the benefits of health-based design will be more apparent. Among healthcare environments, those that emphasize mental and psychological well-being will be well-equipped to show the beneficial effects of these interventions. For these reasons, the program that will be used to illustrate these neurological health design factors is a mental health clinic and wellness center.

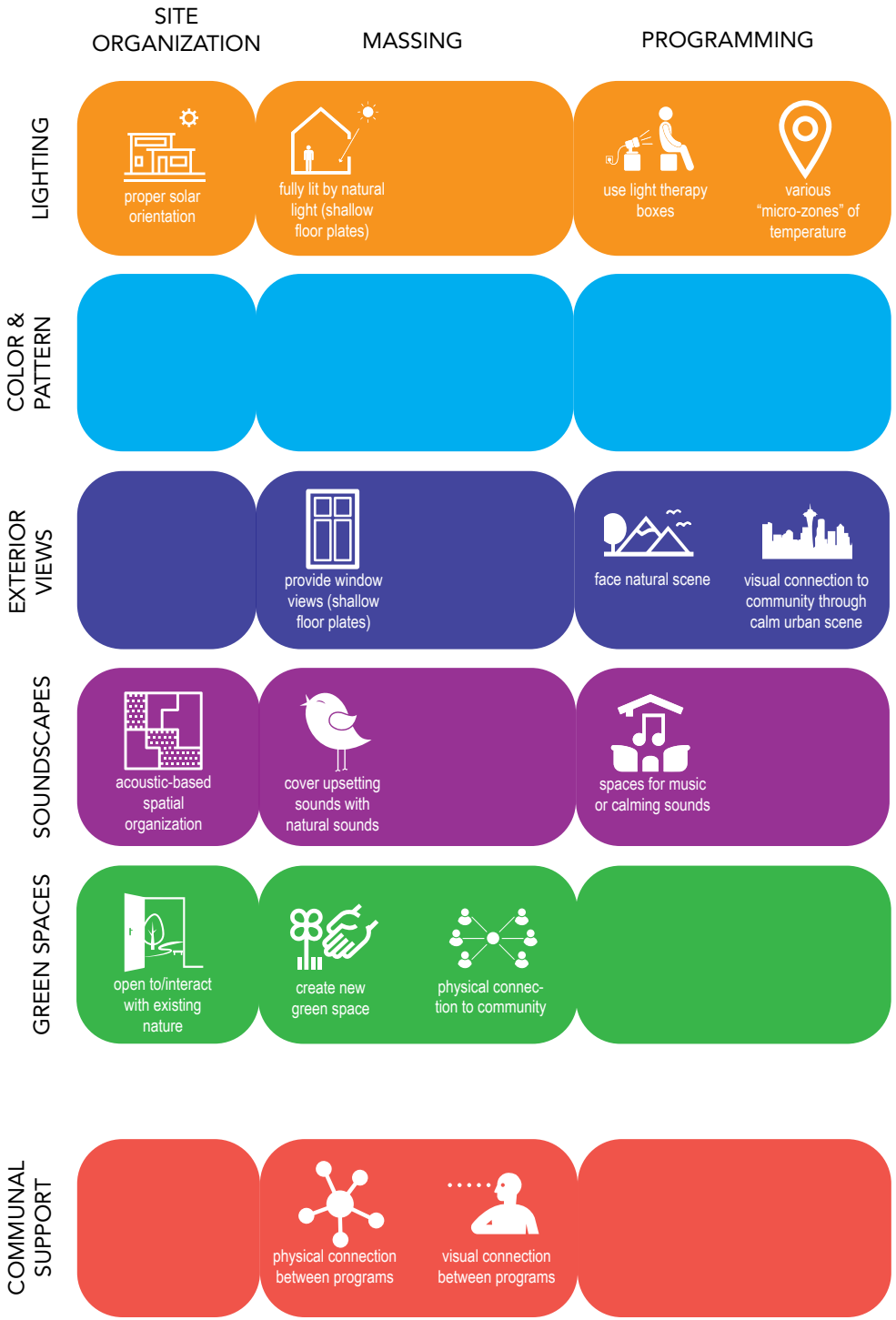
Figure 31 | The Framework, the culmination of all the preliminary research done for this thesis, formed into a matrix organized by health design factors and architectural scale of intervention

This Framework is organized by architectural scale in order to be useful in the design process. From largest to most detailed, the scales are: Site Organization, Massing, Programming, Environmental Strategies, and Design Details.

In the other direction, the six topics are comprised of the five investigated neuro-sensory factors as well as one additional topic, here named Communal Support. This topic contains additional important health design considerations, largely picked up from the precedent studies, that do not fit into a neuro-sensory category and often relate more specifically to the design itself.

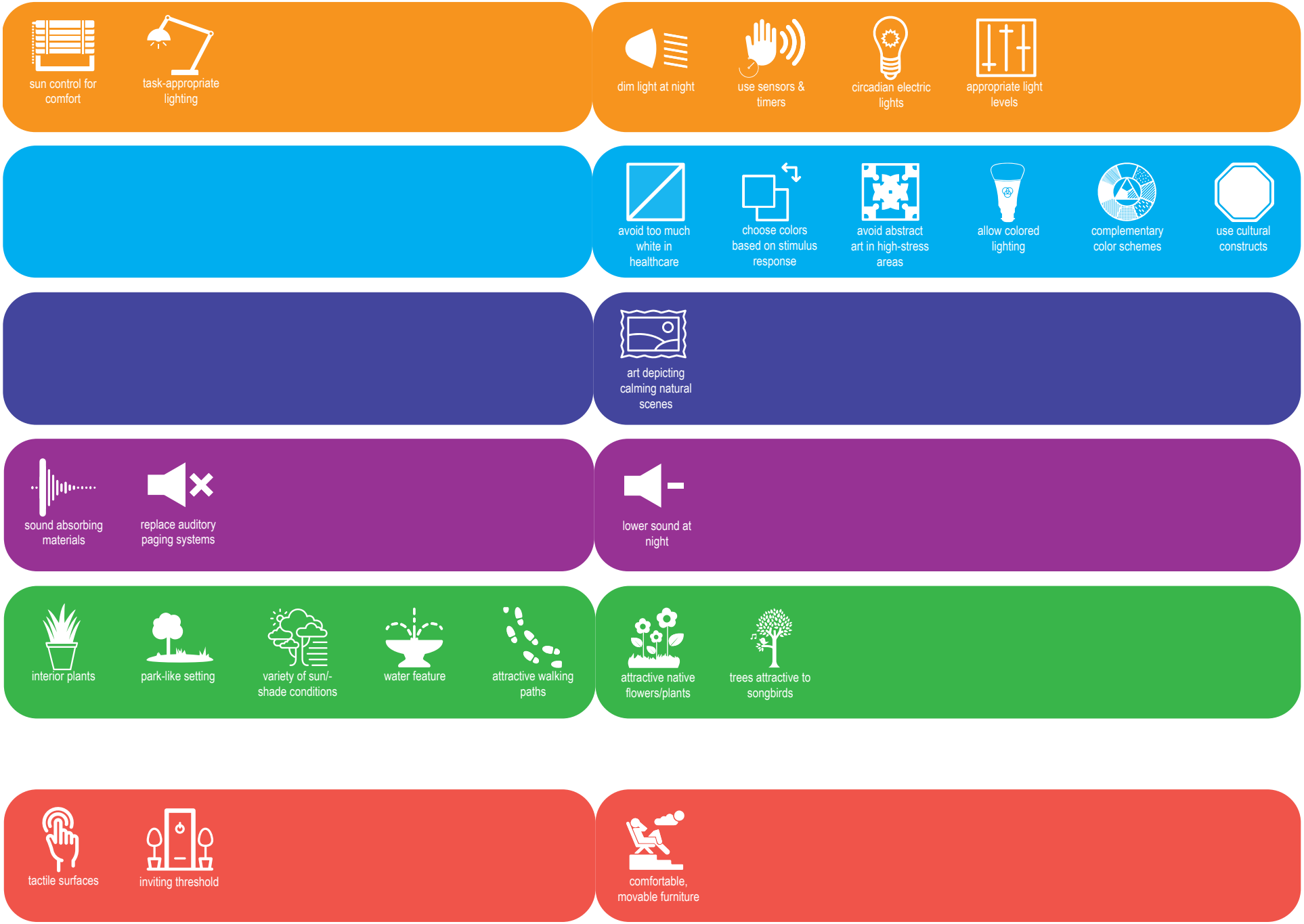
Each icon shown here is representative of one specific design recommendation drawn from the large amount of preliminary research conducted. They are organized in their respective locations in the matrix according to two factors: (1) which topic they fall under and (2) the point in the design process at which they should be considered.

This Framework guides design by providing certain recommendations at each step of the process. For example, the considerations that fall under the Site Organization scale should be considered in the very early stages of project development. However, the Design Details scale does not have to be considered until much farther along, after many other decisions have been finalized. The Framework was applied to the mental health clinic and wellness center design project in this way.



ENVIRONMENTAL STRATEGIES

DESIGN DETAILS



Part III
APPLICATION

CHAPTER 5: DESIGNING A MENTAL HEALTH FACILITY

5.1 MODERN SPATIAL REQUIREMENTS

The proposed design for a mental health and wellness center seeks to provide several core functions right from the start. The overall environment of each of these spaces should be non-institutional and therapeutic in nature, suggesting a more residential rather than institutional character. There are several types of spaces that must be present in this particular type of facility, and each can be improved or added to using appropriate neuro-sensory design principles.[118] These spaces fall into three main categories: outpatient recovery services, inpatient rehabilitation services, and general support services.

5.1.1 OUTPATIENT RECOVERY

The outpatient recovery section mainly focuses on the required therapy spaces. This includes reception functions such as check-in and waiting areas, as well as individual therapy rooms. While there are no particular requirements for reception areas aside from legibility, therapy and consultation rooms must be no smaller than 60 square feet and should service a wide range of therapy types. The therapy department may also include an on-site pharmacy.[119]

Also in this category is space for administrative tasks. This includes front-end tasks such as meeting with patients regarding insurance concerns or appointment scheduling as well as back-end functions like storage for patient records and other supplies. The administrative spaces should also support the facility staff through the allocation of either general or individual offices, accessible staff restrooms, at least one conference or multi-purpose room, and staff lockers and a lounge.

118 The American Institute of Architects, *Metal Health Facilities* (Washington DC: American Institute of Architects Press, 1993).

119 The American Institute of Architects, *Metal Health Facilities,* 4-5.

5.1.2 INPATIENT REHABILITATION

Inpatient rehabilitation requires much of the same spaces as the outpatient recovery types mentioned above, but also requires several additional services. The most obvious and necessary are patient rooms, which should be at least 100 square feet.[120] Inpatient zones should also provide within their organization access to washrooms and toilets as well as spaces to meet with guests and interact with other patients. This is supported by an admissions area addition to the administrative services mentioned in the outpatient recovery section.

Other required elements to support inpatient care are dietary facilities and linen services. Dietary facilities must include kitchen areas and a dining hall and may also include a café for guests. Linen services should include a receiving and sorting room, a washing room, and nearby storage for laundry supplies.

5.1.3 GENERAL SUPPORT SERVICES

Required elements regarding the general functioning of the mental health facility are few. The main ones are a general storage area and an engineering service and equipment area, but a radiology suite and/or a laboratory suite may also be included, especially if they are not located nearby in the community.[121] These are not required elements, but may be suggested depending on what portion of the continuum of care the facility focuses on. Because this center will focus on outpatient counseling and voluntary inpatient services only, with an emphasis on mood, emotional, and anxiety disorders, neither of these services are particularly needed.

120 The American Institute of Architects, *Metal Health Facilities,* 13-16.

121 The American Institute of Architects, *Metal Health Facilities,* 2-4.

5.2 DESIGN RECOMMENDATIONS

Studies on individuals recovering from mental illnesses have shown that other program and design considerations may lead to a more complete state of recovery. In terms of design, the more common siting of the facility in a remote area, with expansive grounds all around it, only serves to keep the community out and the patients in. Architectural researchers have noted that "the absence of traffic and activities common to ordinary communities such as shopping, holidays, meal-getting and 'living' activities of all kinds" can impede the recovery process by taking away those familiar acts of daily life.[122] Therefore, it is important to retain a visual connection to parts of the community from within the facility. In addition, housing large numbers of patients in a single building or ward can further hinder mental recovery by inhibiting their abilities to express themselves as individuals. Therefore, in-patient groupings should be relatively small.[123]

For mental health clinics in particular, it is especially important that the facility deviate from the design aesthetic of the typical hospital industry standard. There should be more of a comforting and/or residential sensibility than a sterile or clinical environment.[124] This can be done with very basic design principles, such as the use of various, non-white colors for walls and for prominent surfaces as well as dynamic and variable lighting plans. Colors should follow an overall scheme, but still vary in hue according to the program associated with the space. Lighting plans should incorporate various levels, such as ambient lighting in conjunction with task lighting. They should also allow in natural light as much as possible and use circadian lighting wherever natural light has to be supplemented by electric, especially in those spaces where patients spend most of their time.

Figure 32 | Retained community connections can help keep patients in touch with daily life, even while staying at a facility
[Source: 123RF Photo]

Figure 33 | Circadian lighting: it should be focused on patient lounges where they spend the most time
[Source: Ario Lighting]

122 University of Detroit School of Architecture, *Environment for Mental Therapy*, 51-52.

123 University of Detroit School of Architecture, *Environment for Mental Therapy*, 51-61.

124 The American Institute of Architects, *Metal Health Facilities*.

In terms of programmatic improvements, some additional amenities that are not specifically required for mental health facilities should be provided. An exercise space or workout room has been shown to improve both the body and mind. These rooms should be intentionally designed for either for individuals, pairs, or groups of people.[125] In a similar vein, dedicated rooms for yoga, meditation, tai chi, or other calm and relaxing group activities can be beneficial.[126] In addition to rooms for physical therapy, it is also important to provide sensory comfort rooms, or spaces where distressed patients can go to experience more calming environments. They can listen to calming sounds or change the colored lights in the room to whatever might help comfort them.[127]

Lastly, the facility should emphasize continuous well-being by supporting much of the continuum of care.[128] It should offer a range of support services, from inpatient to outpatient, pharmaceutical to psychotherapies. Spaces for group therapy sessions are particularly important to provide, as it has been shown that people tend to follow up more reliably on their aftercare and remain in healthier states when they share their trials and successes in a common group setting.[129] In this way, through the various therapies and treatments available, the patients would hopefully arrive at lasting solutions that can keep them well for a long time to come.

Figure 34 | Health and recovery amenities for patients: exercise equipment and spaces (left) and sensory comfort rooms (right)
[Source: BackCare Resources – Multi Sensory]

Figure 35 | Providing group therapy options is one way to emphasize continuous well-being and one point on the continuum of care
[Source: Everyday Health]

125 Tammy Felker, Meeting with Tammy Felker, Registered Nurse and Architect, May 10, 2017.

126 University of Detroit School of Architecture, *Environment for Mental Therapy*, 25-26.

127 "Swedish Ballard Behavioral Health Unit," Behavioral Health & Psychiatry, Swedish Medical Center, accessed April 20, 2017, https://www.swedish.org/services/behavioral-health.

128 Felker, meeting, May 10, 2017.

129 University of Detroit School of Architecture, *Environment for Mental Therapy*, 25-26.

CHAPTER 6: PROGRAM

Having established the specific requirements and outlined the design recommendations specific to a mental health facility, a detailed program can now be developed. Following this detailed program, the core set of frameworks specific to this project will be identified.

Overall, the facility is approximately 30,000 square feet of interior space spread between 2-3 stories. The design is broken up into three programmatic levels that each represent a different function of this mental wellness center. The levels correspond to the varying depths of interaction with the center. They further represent a consideration for the continuum of care and the healing process, providing various spaces for general wellness, outpatient therapy, and inpatient services. As shown in the following diagram, each of the three levels are defined by the distinct type of activity that occurs within them. The public wellness level is the level of engagement, the outpatient level is concerned with recovery, and the rehabilitation level is representative of rehabilitation.

6.1 PROGRAM LEVELS

6.1.1 ENGAGEMENT

The first level is the most public and corresponds to the central "Living Room" space and those public functions coming off of it. It is intended for use by anyone in the community suffering from mental health issues, their friends and family, or anyone who wants to learn more, be more conscious about, or improve their own mental wellness. This level is heavily influenced by the Maggie's Centre concept. It includes a large, central living room space with a small education center as well as the additional program elements of yoga/meditation rooms, exercise/workout rooms, and an aromatic tea shop. It also includes flexible space for community classes on well-being and classes for families and friends of individuals with mental disorders.

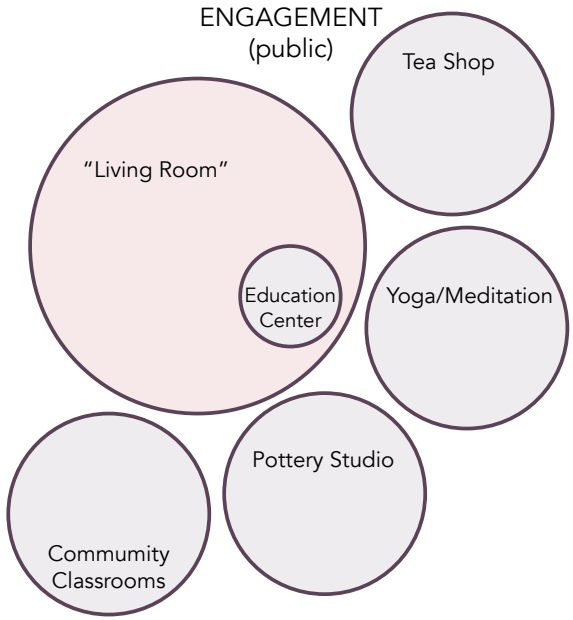


Figure 36 | The Engagement level of the facility, containing various public functions, remains open to anyone wishing to learn more about or improve their own mental wellness

These features promote the general wellness of the neighborhood through engagement with the various mind-positive amenities all located in a health-promoting environment.

6.1.2 RECOVERY

The second level is for outpatient consultation and therapy services. It is designed for people who need or want help from specialists on an outpatient basis or are looking to schedule regular wellness exams. The main concept behind this level is that of recovery, providing safe spaces where individuals can get help in developing their personal coping methods. The main features of this space are the consultation and treatment rooms, which can include various types such as typical talk therapy, light therapy, and even pet therapy. Other programmatic features of this level are group therapy rooms, administrative functions and offices, and a pharmacy.

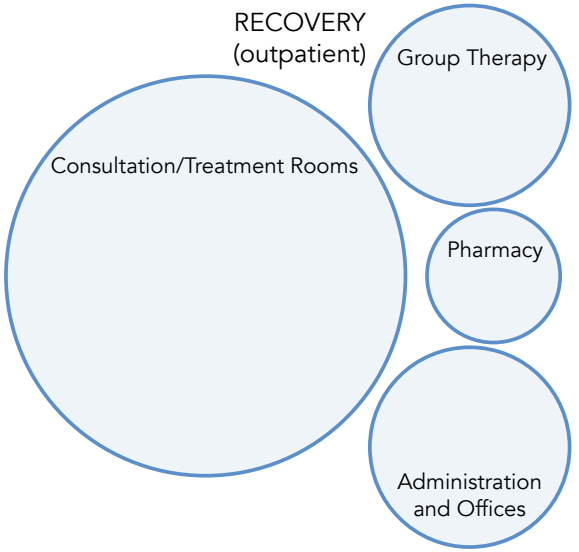


Figure 37 | The Recovery level is mainly for outpatient services, but can occasionally share spaces with the inpatient level

6.1.3 REHABILITATION

The third and most invasive level is for inpatient treatment services. The inpatient level is specifically geared towards those with mood or emotional disorders, on a short-term and voluntary stay basis. A typical stay here could be anywhere from overnight to two weeks. The patient group is comprised of those who are looking for extra help beyond what outpatient services can provide or individuals transferring from more intensive inpatient programs on their way to recovery. Many of the design principles of this level will follow from the lessons of the Paimio Sanatorium. Like the sanatorium and hospitals of today, the concept of complete rehabilitation guides this level. Programmatically, it includes patient rooms and lounges, rehabilitation therapy and treatment rooms, as well as dining and linen services.

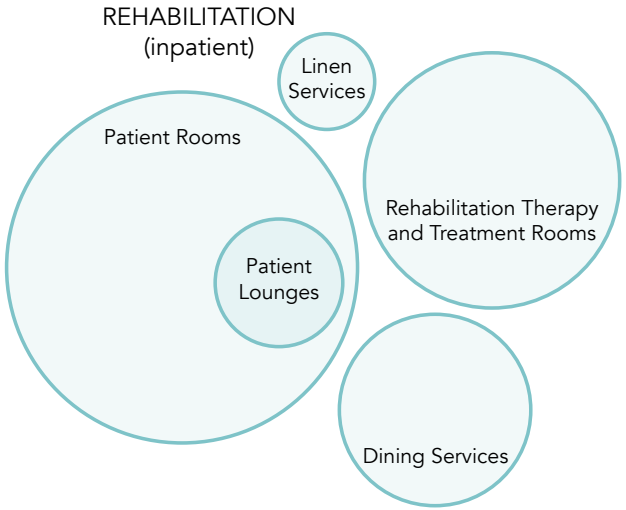


Figure 38 | The Rehabilitation level focuses solely on inpatient services for those desiring more intensive care. These individuals stay at the facility overnight or for other short-term stays while getting the help they need

6.2 INTERACTION BETWEEN LEVELS

Based on these three programmatic levels, there would be three main types of visitors to the center: typical member of the public, outpatient with an appointment, and an inpatient coming to stay for anywhere from one night to two weeks. The public visitors would be coming to the site for any of the three main public amenities: the yoga studio, pottery shop, or tea room. From there, they may be enticed to visit the central Living Room or the garden spaces. The outpatients would be coming for individual counseling, therapy, or treatment appointments. They may be referred to the center's services or they may stumble upon them as a member of the public and decide to make an appointment. The inpatient visitors have all set up appointed stay dates and durations, or they are considering doing so. There may be around a dozen inpatient visitors staying in the facility at one time, and their daily activities would keep them busy all over the complex. A typical day could take them from their inpatient rooms to the shared therapy and counseling services, from the public functions to the Living Room, and back again. (Figure 39)

When the earlier design framework is reconsidered through the lens of these program divisions, the conditions that make the most important considerations for each space are highlighted. (Figure 40) Functionally, the public level also splits into two groups based on the assortment of design recommendations. The protected-yet-public programs of the Living Room and garden spaces have a different set of design considerations from the three most public programs of the Yoga Studio, Tea Room, and Pottery Shop. These will be important functional and design recommendation conditions to consider going forward.

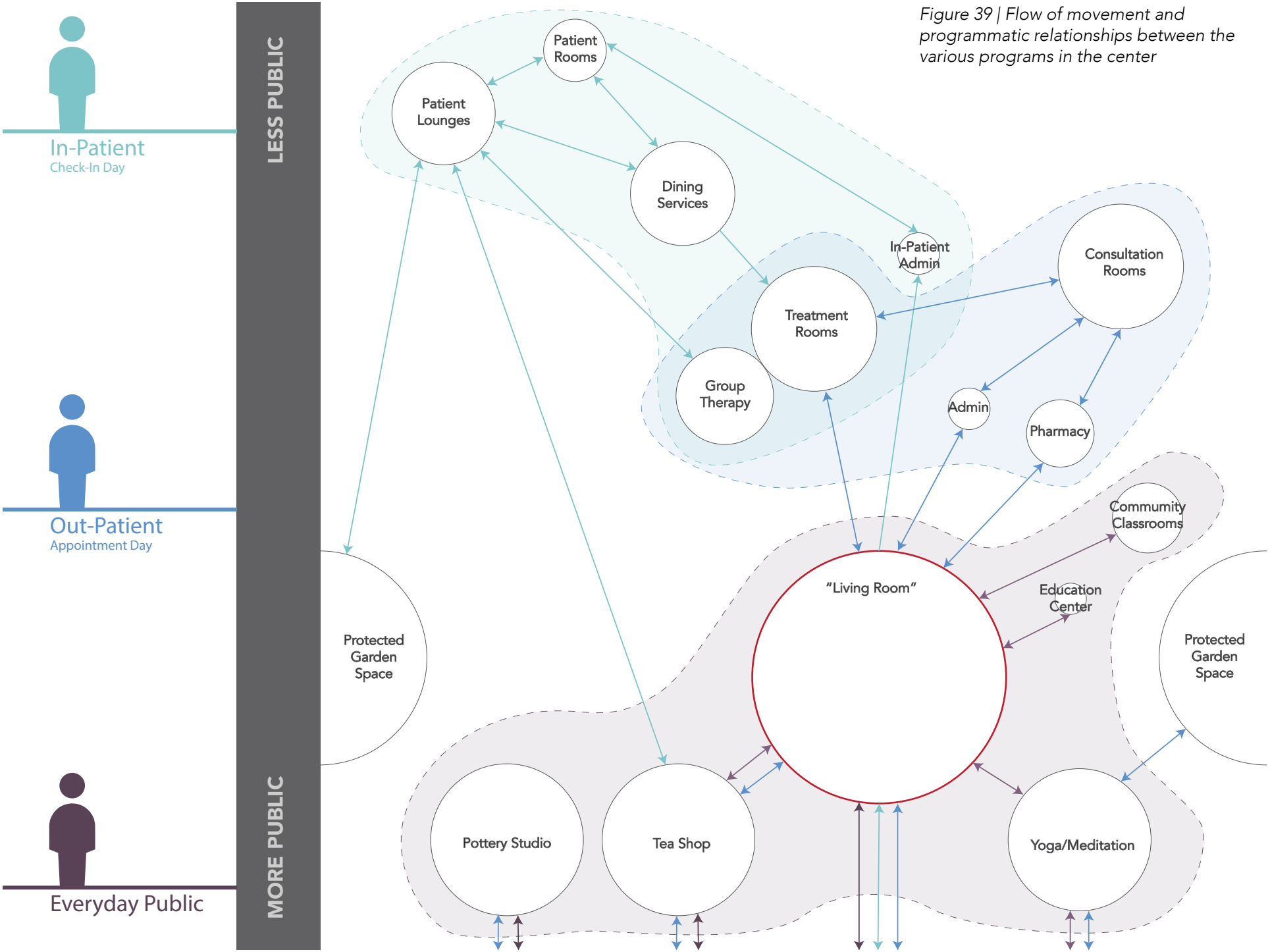


Figure 39 | Flow of movement and programmatic relationships between the various programs in the center

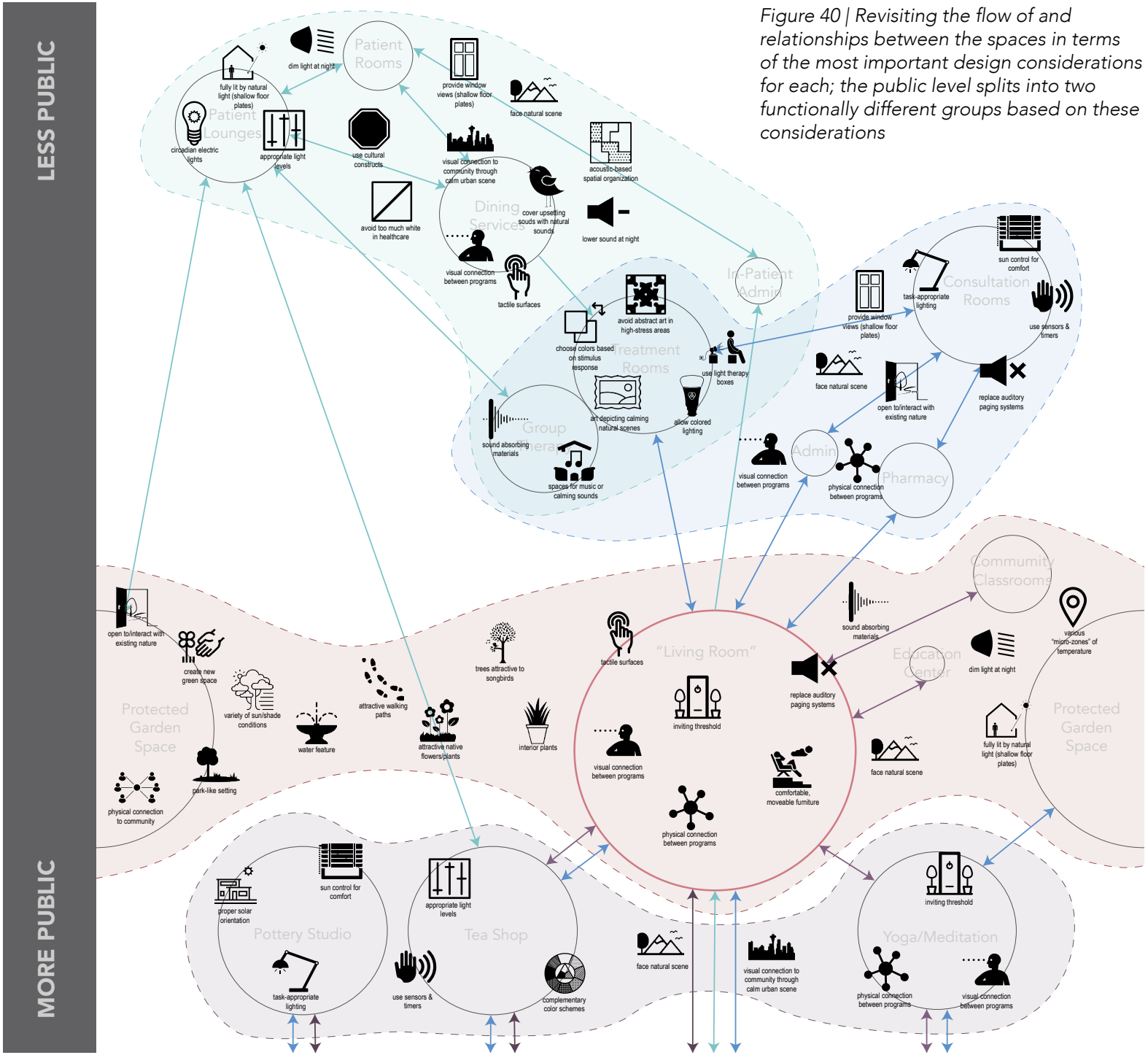


Figure 40 | Revisiting the flow of and relationships between the spaces in terms of the most important design considerations for each; the public level splits into two functionally different groups based on these considerations

CHAPTER 7: SITE

7.1 WHY SEATTLE

The center is located in an urban neighborhood of Seattle, Washington, which has a unique set of psychological and neurological issues. These issues are mainly considerations of latitude and climate as well as regional attitude. The particular climactic conditions of regions like the Pacific Northwest result in a higher concern for certain mood disorders such as SAD (Seasonal Affective Disorder).[130] Seattle is also home to a number of jobs with a high-stress working culture, namely the tech industry. Companies like Amazon and Microsoft, as well as a large number of start-ups, call the Seattle area home and typically represent a working culture of high expectations and high-stress performance. Additionally, siting it in this urban environment flies in the face of traditional mental health facility design. The goals behind this decision are twofold: (1) to reach a larger local community, and (2) to encourage regular use and to regularize the treatment of mental illness through increased visibility and access.

Neighborhood Requirements
fit scale of 30,000 sf, 2-3 story building
not too busy/built-up
yet not too quiet/residential
near identified high-stress jobs

Site Requirements
near public green space
opportunity to add more green space to lot
near water
not directly north of any building over 5 stories
consider proximity to main arterials

Figure 41 | These goals for choosing a neighborhood and site will inform the ultimate site selection as closely as possible

130 Steven Duncan, "The Architecture of Light: An Evidence Based Design Approach to Treating Winter Depression in Seattle" (Masters thesis, University of Washington, 2011), 25-27.

7.2 NEIGHBORHOOD AND SITE, SELECTION AND ANALYSIS

With the general location decided on, the next concern becomes selecting the specific site. A number of neighborhood and site requirements are laid out and treated as goals in the search for a site. To choose an appropriate location for the case study, the neighborhood needed to find a good balance regarding scale and usage, and the specific site goals included several requirements regarding various physical features.

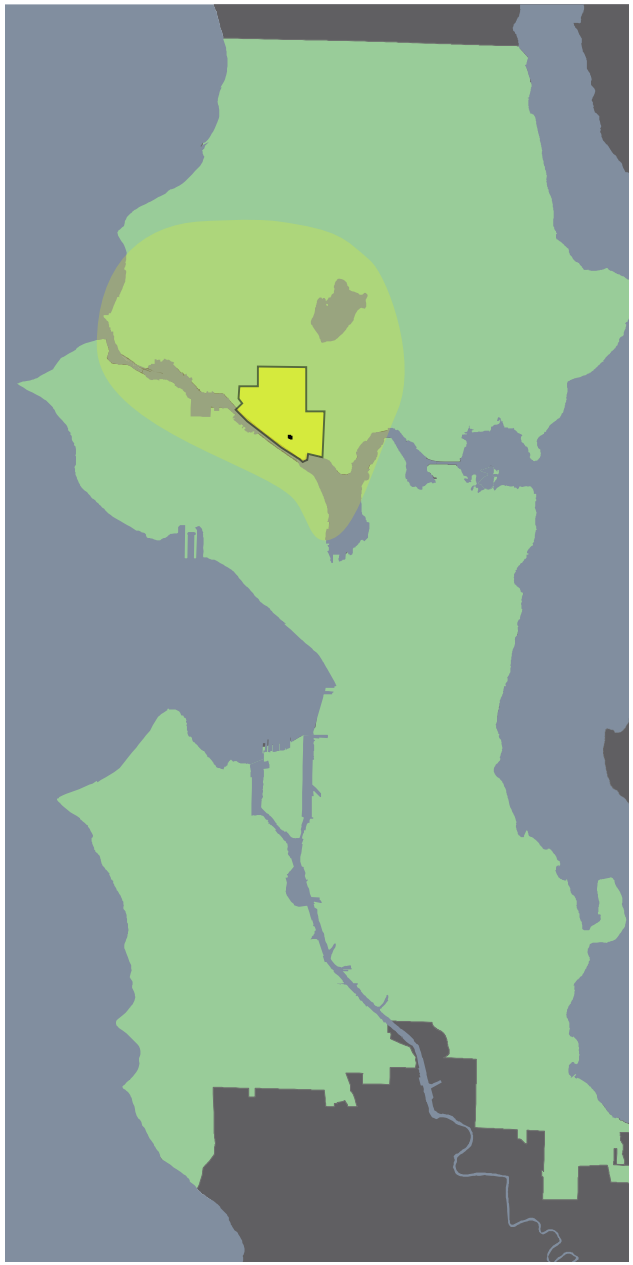
Given these requirements, the chosen neighborhood is Fremont, since it matches each of the major neighborhood goals for the project and allows for the site goals to be met as well. It is near a major waterway, known as the Fremont Cut, and is fairly close to both the Chittenden Locks in Ballard to the west and Lake Union to the east. It contains several major arterials to other popular neighborhoods throughout the city, such as the heavily-traveled Burke-Gilman Trail which runs along the water. Yet it also has a strong residential and small business presence. This provides the opportunity to find an ideal balance between attracting people as they pass by on a busy street and still providing pockets of quieter, more intimate space.

Even though no facility like this proposed center currently exists in the Seattle area, Fremont and it's surrounding area also lacks any kind of community mental health center beyond single-practitioner outpatient offices. The area of effect for this proposed center could serve the neighborhood of Fremont as well as surrounding neighborhoods, such as Ballard and Wallingford. Additionally, Fremont's vitality, color, and appreciation for experimentalism make this neighborhood uniquely suited for a new kind of community-focused center like this.

7.2.1 OVERALL FREMONT

Fremont has a lively commercial core, the desired tech industry presence and recreational waterfront access to the south, and a large residential zone in the northern half of the neighborhood. The residential zone follows up slope from the more commercial areas

Figure 42 | Overall Seattle city, showing Fremont's shape and location as well as the potential Area of Effect for the proposed facility



and is mainly comprised of low-density single-family and a few multi-family dwellings. The neighborhood's main arterial follows Leary Way NW, N 36th Street, Fremont Place N, and N 35th Street. The portion of the neighborhood along N 36th and 35th Streets comprises the commercial core. The tech zone is to the south of the commercial core, along the waterfront, and features well-known companies such as Google, Tableau, and Adobe, among others. The waterfront area, with its various forms of recreation, runs along the south end of the neighborhood, as does the Burke-Gilman Trail. There are also several green spaces nearby, such as Ernst, Gas Works, and Fremont Canal Parks. And its many landmarks – such as the Fremont Troll, oft flamboyant Lenin Statue, and not-so-subtle "Center of the Universe" paraphernalia – have helped forge its identity as artsy, quirky, and not afraid to be different. It also acts as a transition to other nearby neighborhoods, such as Ballard, Wallingford, Phinney Ridge, and Green Lake. All of these qualities combine to make it a unique combination of a heavily trafficked, yet small-scale neighborhood ripe with opportunity.[131]

7.2.2 SITE AND SITE AREA

Given the specific site requirements, the chosen site is located at 508 N 36th Street. It is ideally positioned on the north side of the busy 36th Street main arterial, between two quieter roads. One of these roads, Evanston Avenue N, connects to the waterfront by a 5-minute walk from the site. The other is Dayton Avenue N, a much less trafficked, neighborhood street. The surrounding commercial core features several nearby functions that draw the public to this area and contribute to the vibrancy and success of a facility like this. Some of these functions are restaurants, cafes, bars, fitness clubs, spas, salons, and galleries. The chosen site sits right at the seam between this commercial core and the residential zone to the north. This location allows

131 b9 Architects, "Neighborhood Analysis," in 3616 Evanston Ave. N Streamlined Design Review Packet (2015), 8.

Figure 43 | Fremont's regions, zones, and key features, showing things like the commercial core, tech zone, waterfront, arterials, and the chosen site

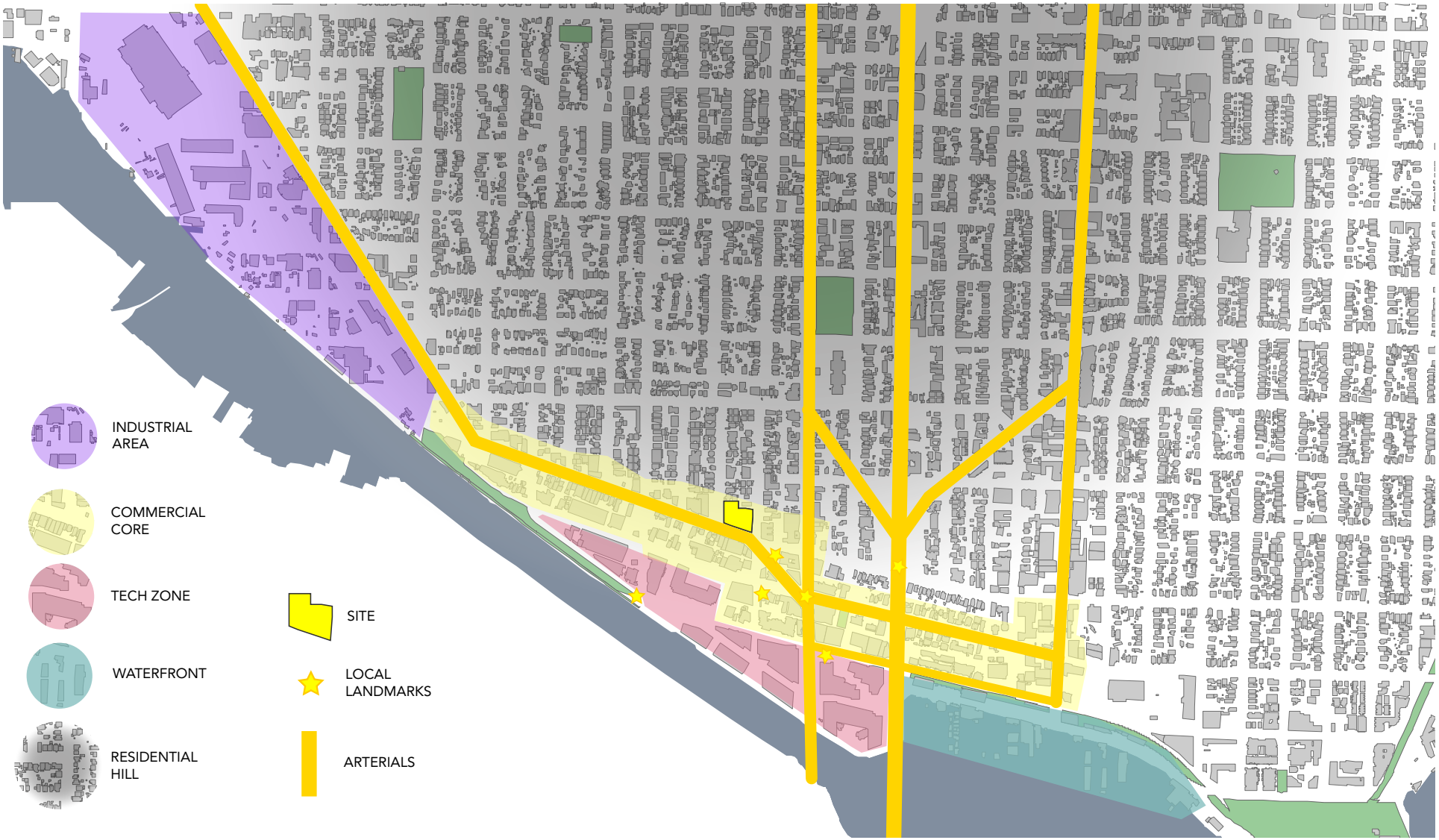


Figure 44 | The chosen site and its immediate surroundings, highlighting the nearby streets, building functions, landmarks, and trees

the facility to fit the desired balance between providing some very public spaces off of a busy, main arterial, while also providing the opportunity to craft some more intimate space on the residential side.

This area of Fremont gets a large part of its personality from its landmarks, contributing to wayfinding and placemaking. This site is located just across the street from the Lenin Statue as well as fairly close to the Fremont Rocket and Center of the Universe sign. It's also only a 5-minute walk down N 36th Street from the famous Fremont troll. Additionally, the site is a short trip to the waterfront, green spaces, and other various amenities that Fremont and the neighboring areas have to offer.

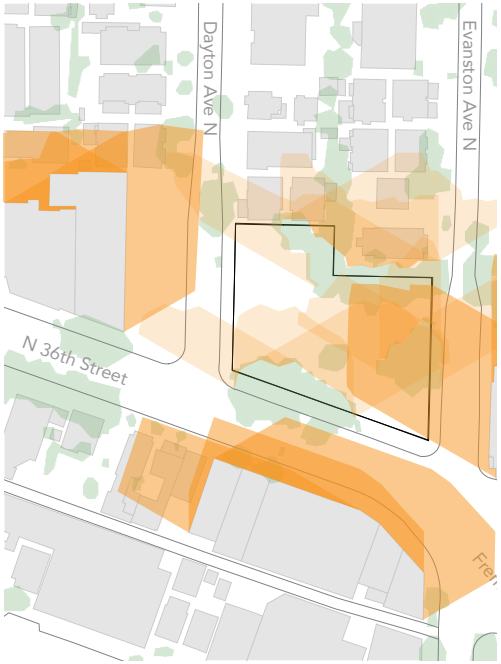
At over 30,000 square feet, the chosen site at 508 N 36th Street is a large lot and has several mature, full-canopied trees on the property and along the street. The large size of the lot is another condition that further aids in the goal to create both a designated street presence as well as a more private rear section adjacent to the residences. It also allows for the creation of protected garden space on the property, a crucial component of the neuro-sensory design recommendations. All of this ensures the site is not an isolated or out-of-the-way destination and provides a decent exposure to transit and pedestrian traffic, while still maintaining a semblance of privacy at the back of the expansive and shaded lot.

7.2.3 SITE ANALYSIS

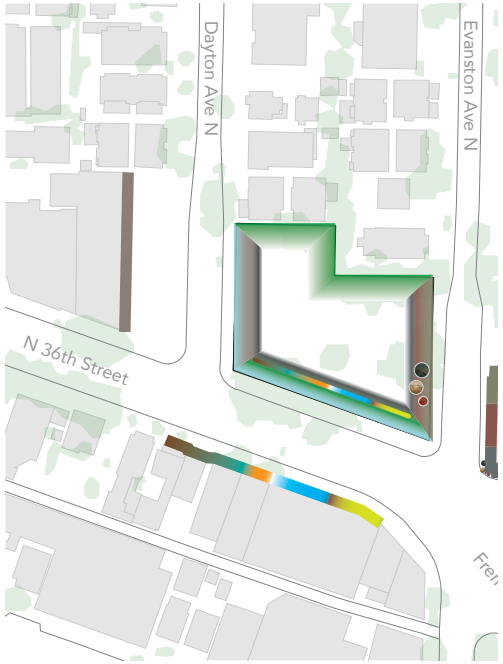
Bringing back the earlier design framework, the chosen site could be analyzed in relation to the five neuro-sensory factors identified earlier: lighting, color and pattern, views, sound, and green spaces. In the Lighting analysis, site access to sun and shade throughout the year were examined. (Figure 45-1) The diagram shows the solar shading conditions from nearby buildings and large trees on the day with the most extreme solar angle each year (the Winter Solstice, December 21). The shadows of the surrounding buildings, with the exception of the eastern

Figure 45 | Series of site analysis vignettes that investigate the chosen site through the lens of the five previously determined neuro-sensory factors

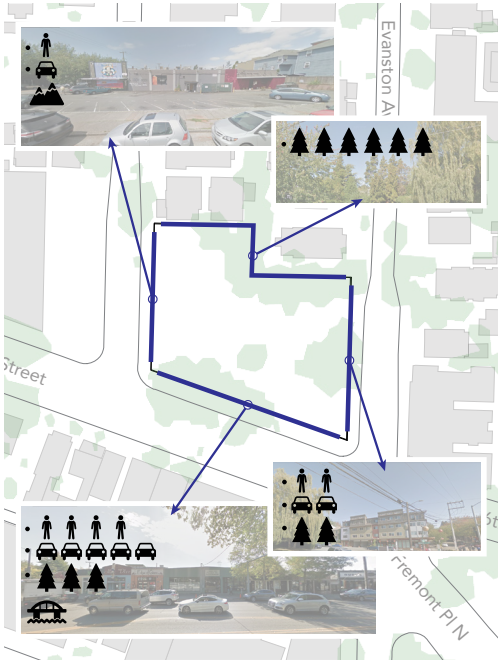
1 Light
2 Color & Pattern
3 Views
4 Sound
5 Green Spaces



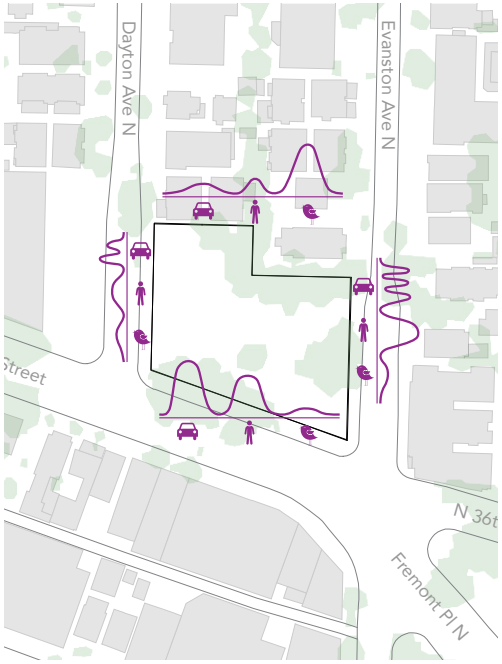
1 LIGHT



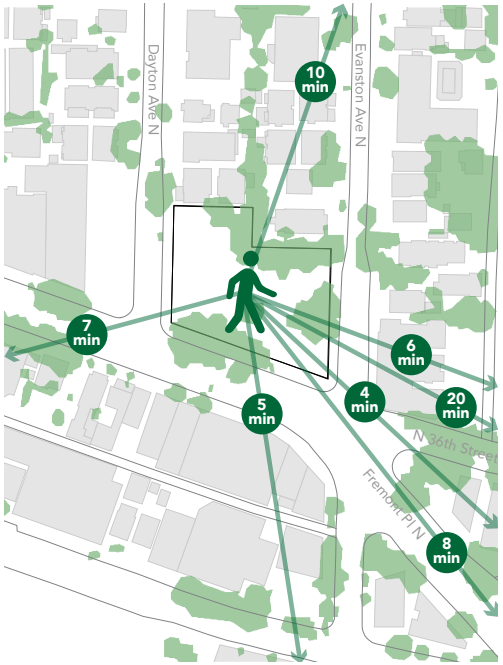
2 COLOR & PATTERN



3 VIEWS



4 SOUND



5 GREEN SPACES

neighbor at one key point during the year, will not impact the site. The elements creating the most shadows on the site are the large trees.

The Color and Pattern analysis visualizes the various colors and colorful street artifacts prominently visible from each of the four main sides of the site. (Figure 45-2) Similarly, the View analysis investigated the particular prominent view elements visible from each of these four main side. (Figure 45-3) The view with the most variety, color, and activity is the view toward the south, which sees the most amount of vehicles and pedestrians as well as a few trees. The Aurora Bridge and Fremont Bridge may also be visible in this direction from the top floor of the facility. The view with the least activity and variety is the opposing side to the north, whose only major view element is its many evergreen trees. The views out to the east and west of the site are similar, with the eastern view being busier with slightly more people and vehicle traffic and the western view including glimpses of the sky and possibly the Olympic Mountains from the top floor on clear days.

The Sound analysis illustrates the amount and type of sounds that can be expected from each direction around the site. (Figure 45-4) The highest vehicular sound comes from the busy N 36th Street to the south, and the highest natural sounds come from the prevalence of trees to the north. Sounds to the east and west are similar, but the east would have significantly higher sounds from pedestrians and more individual sound peaks from cars driving by.

The Green Space analysis shows the overall green character of the area, including the existing mature trees on and surrounding the site as well as the walking proximity to the nearest public green spaces, such as parks, playgrounds, trails, and outdoor gathering spots. (Figure 45-5) It shows that there are public green spaces as close as a four-minute walk away (Ernst Park), but none in the immediate vicinity. This suggests that creating a more public kind of green space on this site could be a well-received community amenity.

CHAPTER 8: THE DESIGN

8.1 DESIGN DEVELOPMENT

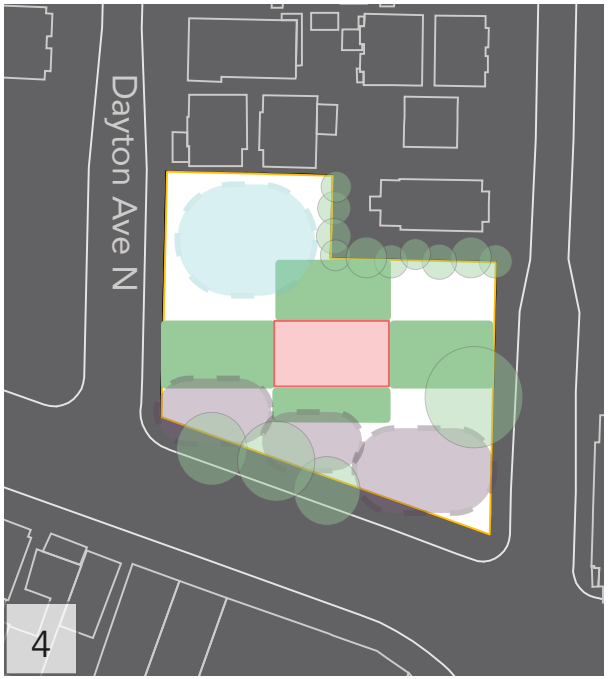
The primary design development method for this facility consists of an initial scheme development process followed by the development of the gardens and ground-level building footprints. The overall scheme development begins with the basic site boundaries and ends with its evolution into the core idea behind the design, shown in the parti diagram in Figure 47. The development of the gardens and ground level plan begins nearly where the scheme evolution left off – at a slightly more realized version of the parti. Then, the this process continues through each of the four garden spaces and investigates how that space actively shapes and is being shaped by the nearby building components. In this way, the garden spaces drive the initial design creation, at least for the ground level. During the entirety of both design processes, the recommendations from the design framework and conclusions from the previous site analysis are constantly considered.

8.1.1 OVERALL SCHEME DEVELOPMENT

The spatial scheme was developed through a series of design development steps. The first step is to note the existing site conditions. (Figure 46-1) North 36th Street is a major, busy arterial to the south that creates a lot of vehicular and pedestrian activity and noise. Evanston Avenue N sits to the east of the site and is a less public street with waterfront connection. And Dayton Avenue N is a quiet neighborhood street to the west. Lastly, there ares several large, mature trees on the site that are important to keep and work with. In this way, the garden design will not be starting from scratch. There are three large, public trees along N 36th Street, an even larger willow tree to the east along Evanston Ave N, and several evergreen trees of various sizes along the back of the lot.

Figure 46 | Overall scheme development series, showing the evolution from existing conditions to parti diagram

1 Establish existing conditions on site
2 Site major program components
3 Determine approximate area and location
4 Add unique garden conditions branching off from each side of Living Room



The next step was to site the major program components. (Figure 46-2) A more public kind of green space or park could be created to the east, on a side that is prominent but not too overwhelmed with activity. It was also important to site to louder, public functions to the south along the busy street and keep the quieter, more private inpatient functions to the north along the residences. Finally, the Living Room, as the central idea of this facility, would occupy the central space. In this way, the Living Room can become a very public space relative to the rest of the complex, but it is shielded from the outside activity on the surrounding streets.

The third step is twofold. The first part was to outline the approximate required area for each of the previously determined ground-level programs. The second part was to split up the public zone into the three distinct programs of the pottery shop, tea room, and yoga studio that together hold the streetline. (Figure 46-3) With these three programs holding the streetline, a kind of protection along the street is formed, shielding the interior of the complex from any overwhelming street activity.

The last step in the scheme development process determines the core idea in its simplest terms, or the *parti* of the project. The Living Room, as the heart of the facility, would have four unique garden conditions branching out from each side. (Figure 46-4) Each garden would have different personalities or characters, which will go on to inform the design of the surrounding built spaces.

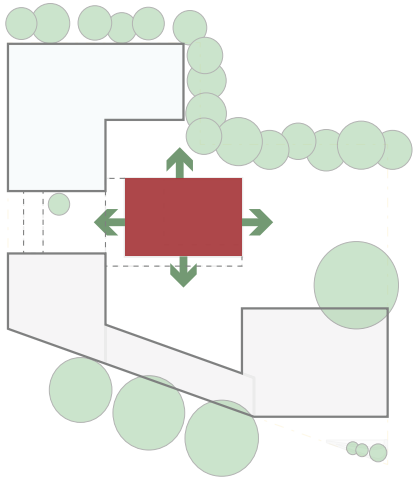


Figure 47 | The resulting parti diagram, showing the central Living Room as the key built space with the surrounding four gardens branching out from it

8.1.2 GARDEN+BUILDING FOOTPRINT DEVELOPMENT

The previous scheme development process leads to the specific development of the garden spaces and building footprints. This series of steps begins with the simple idea of a basic Living Room block in the center with four garden conditions coming off of it, three adjacent public programs holding the streetline to the south, and a large inpatient block to the north. (Figure 48-1)

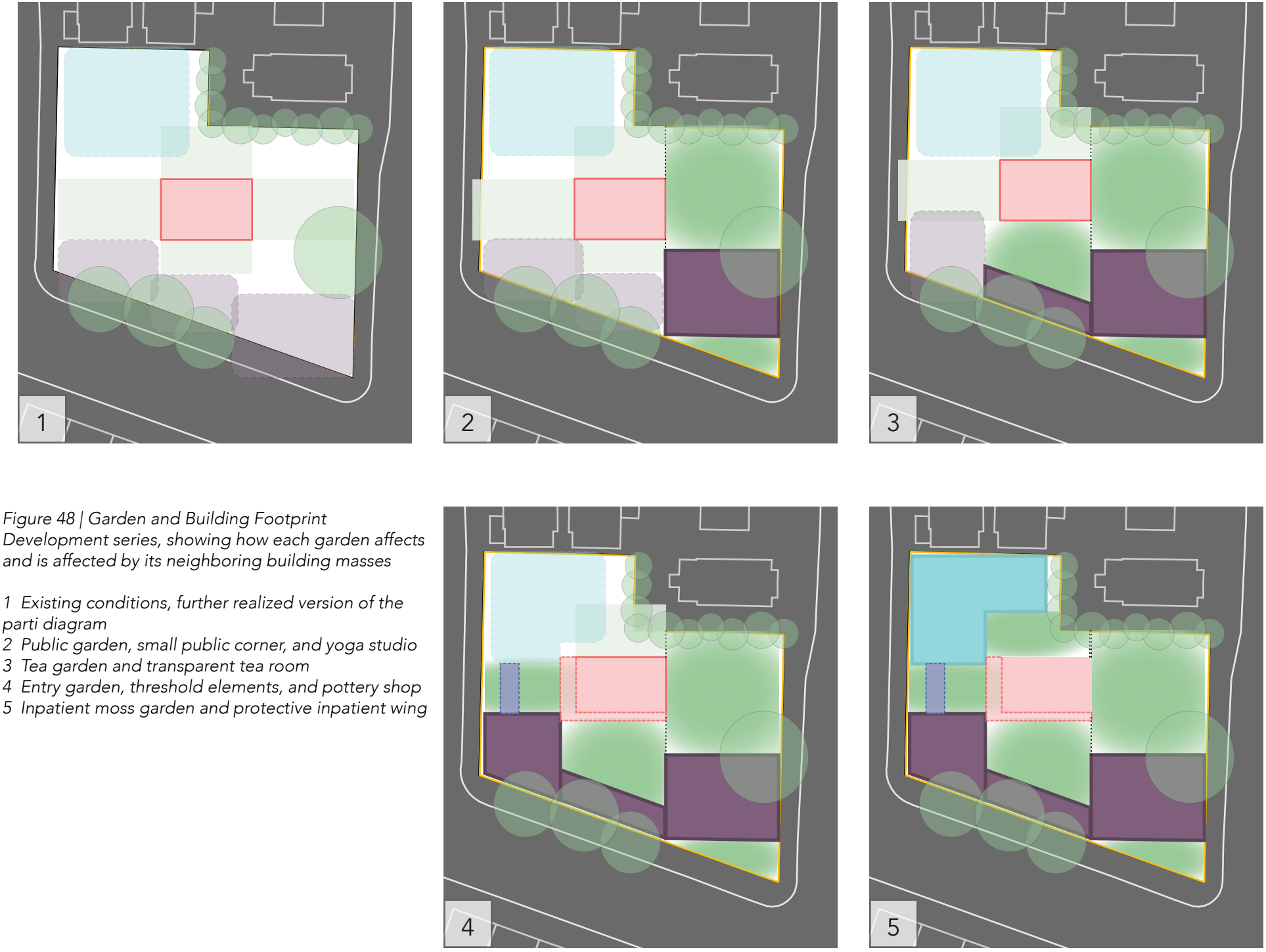


Figure 48 | Garden and Building Footprint Development series, showing how each garden affects and is affected by its neighboring building masses

1 Existing conditions, further realized version of the parti diagram
2 Public garden, small public corner, and yoga studio
3 Tea garden and transparent tea room
4 Entry garden, threshold elements, and pottery shop
5 Inpatient moss garden and protective inpatient wing

Moving forward in the development, a large public garden and small public corner on the east side help to place and shape the yoga studio between them, facilitating interaction between the two programs. This move also softens the site's hard southeast corner, helping to draw people in. (Figure 48-2) The next garden is shaped by a long, thin, and transparent tea room that provides a visual connection between the street and the sunny tea garden beyond. (Figure 48-3) The facility entry garden is the main entrance for patients to the facility off the quietest street to the west. Here, the buildings respond to create a defined entryway, complete with a bridge on the second level to create a real threshold for clear legibility. (Figure 48-4) Last is the intimate inpatient moss or Zen garden north of the Living Room, which is protected by an L-shaped inpatient wing. (Figure 48-5)

Figure 49 | The zonal floor plans that result from the design development processes

This result is a complex of three floors. Included in the center at this point are the following spaces and design choices:

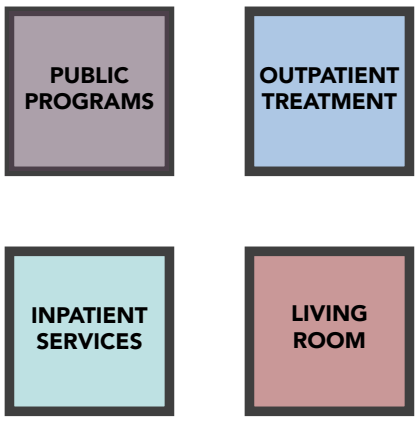
- the three public functions in a line along the main road

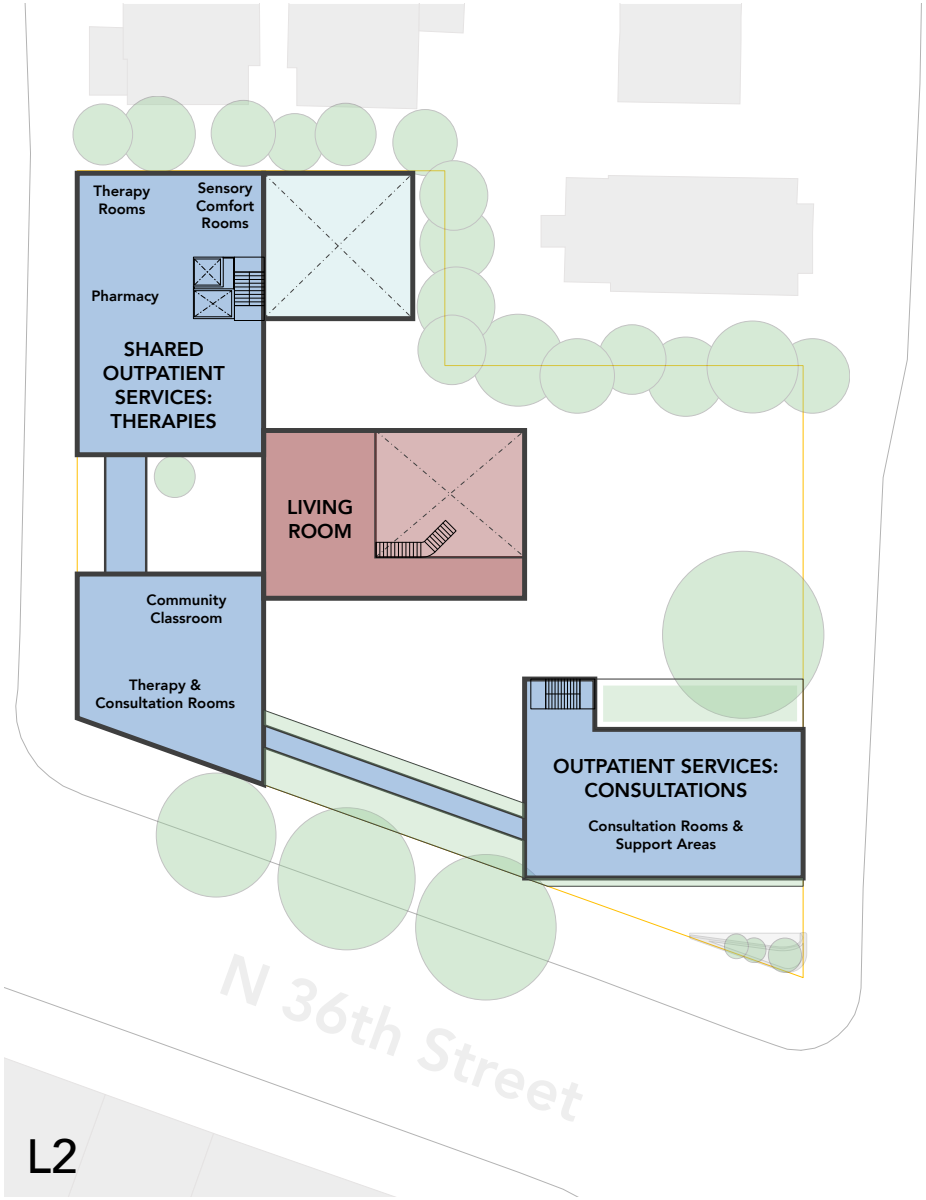
- the inpatient functions in an L-shape at the rear

- a 2-story Living Room pavilion in the center

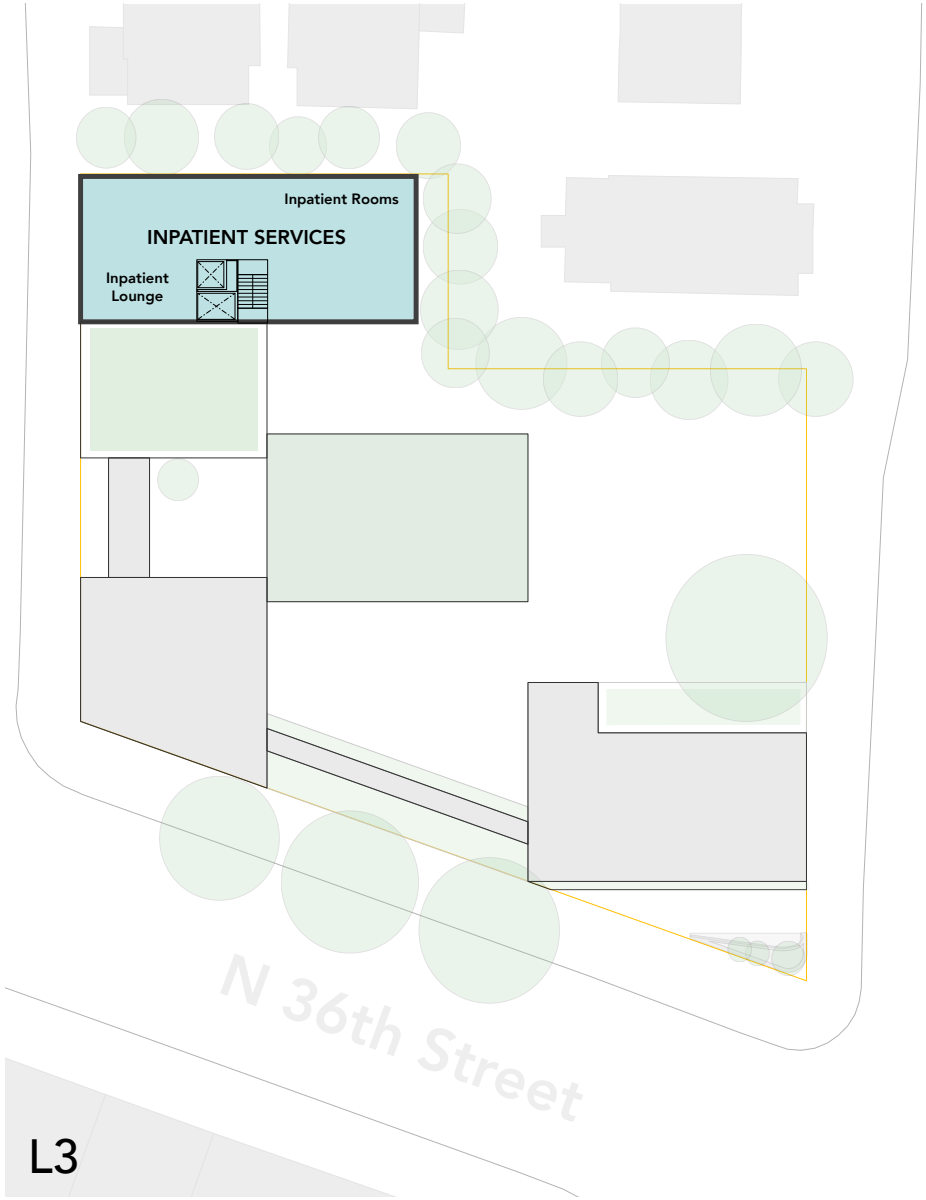
- a second-story outpatient bar that wraps around the perimeter of the site, containing: (1) typical consultation rooms and a community classroom at the front, and (2) shared therapy services at the back

- the third floor as reserved for the most private program: the inpatient rooms and lounges




Therapy Rooms
Sensory Comfort Rooms
Pharmacy
SHARED OUTPATIENT SERVICES: THERAPIES
LIVING ROOM
Community Classroom
Therapy & Consultation Rooms
OUTPATIENT SERVICES: CONSULTATIONS
Consultation Rooms & Support Areas
N 36th Street

L2


Inpatient Rooms
INPATIENT SERVICES
Inpatient Lounge
N 36th Street

L3

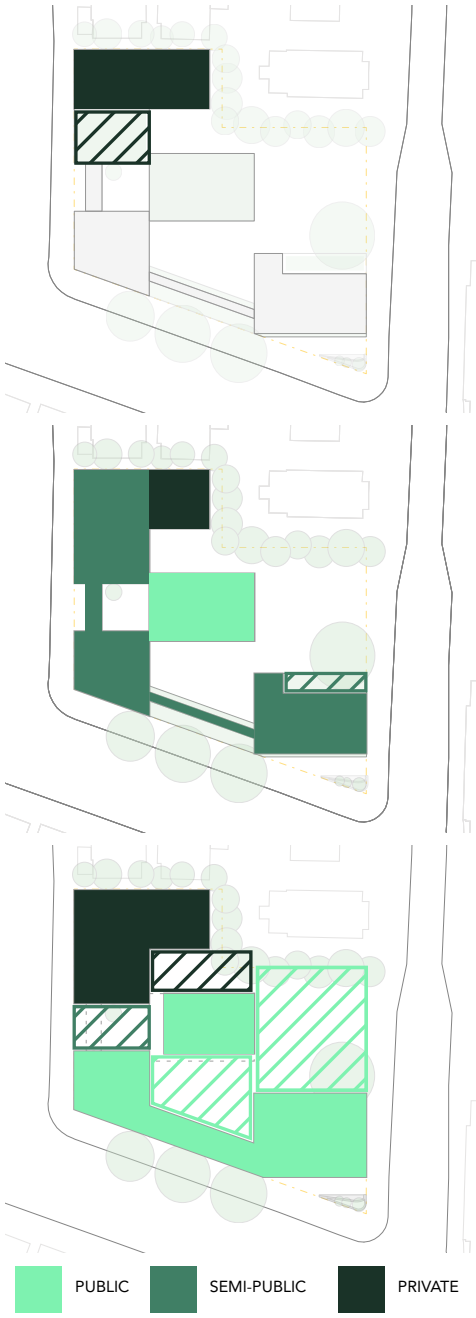
8.2 DESIGN PERMEABILITY

With a design as complicated and multi-layered as this facility, certain particular qualities need to be understood in order to make sense of how the overall site would function as a single complete whole. The intended permeability of this design, and the lack of permeability in certain areas, helps to define and refine the overall organization, zoning, and movement through the site. This permeability can best be explained through two methods: (1) the spectrum of public to semi-public to private spaces and (2) the different levels of circulation through the site.

8.2.1 PUBLIC/PRIVATE SPACE

The scheme that results from the previous development series also creates distinct patterns of public, semi-public, and private space. (Figure 50) The public spaces are defined as those spaces where the public may and would typically venture on a regular basis. These are the three built public spaces along the street and both floors of the Living Room in the center. The public park-style garden on the east and the tea garden between the tea room and Living Room are also included in the public areas. The semi-public spaces are those areas where the public may visit but typically are only used by those with a private appointment or other similar reason. The areas included in this definition are the facility entry garden and the entire outpatient section on the second level, including the outpatients' outdoor deck. And lastly, the truly private spaces are defined as those where any typical member of the public cannot access, although there may be a visual connection. The areas that fit this quality are all related to the inpatient functions. They include the intimate moss garden north of the Living Room, the inpatient wing's entire first floor (including the double-height dining space), and the inpatient wing's entire third floor with the inpatients' outdoor deck.

Figure 50 | Diagrams noting the public, semi-public, and private building masses



8.2.2 CIRCULATION PATTERNS

This further creates three distinct patterns of circulation. Most public visitors are coming to the site for the public park or any one of the three public functions, from which they can then visit the central Living Room space if they choose to. (Figure 51-1) Outpatients might approach the site from one of two main directions. They could enter from the western facility entrance, if for example, it's their first time visiting, and they're unfamiliar with the environment. Or they may enter from the eastern public entrance, if perhaps they've been there before and maybe arrived early to enjoy the park or spend some time relaxing in the Living Room before their appointments. Then, they would be off towards any one of the three main therapy or consultation appointment blocks on the second level. (Figure 51-2) Inpatients would likely enter through the main facility entrance garden to the west, the more formal entrance and close to the inpatient wing. From there, they would spend their day filled with activities that bring them all over the complex and back, such as yoga sessions, therapy appointments, pottery classes, or even some down time in the Living Room. (Figure 51-3)

Figure 51 | Circulation diagrams, broken down by typical user type

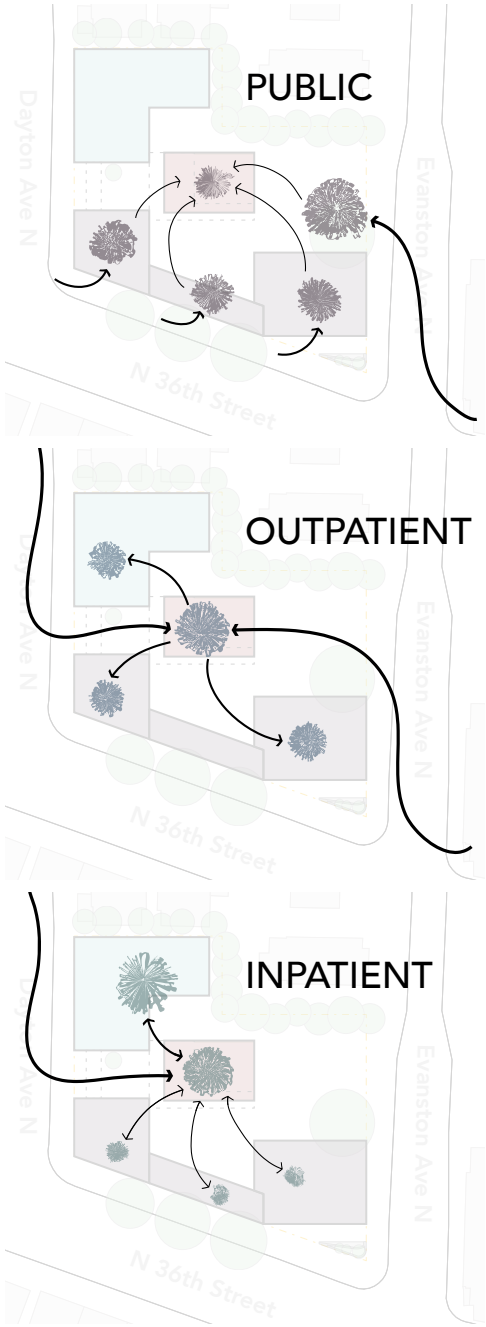
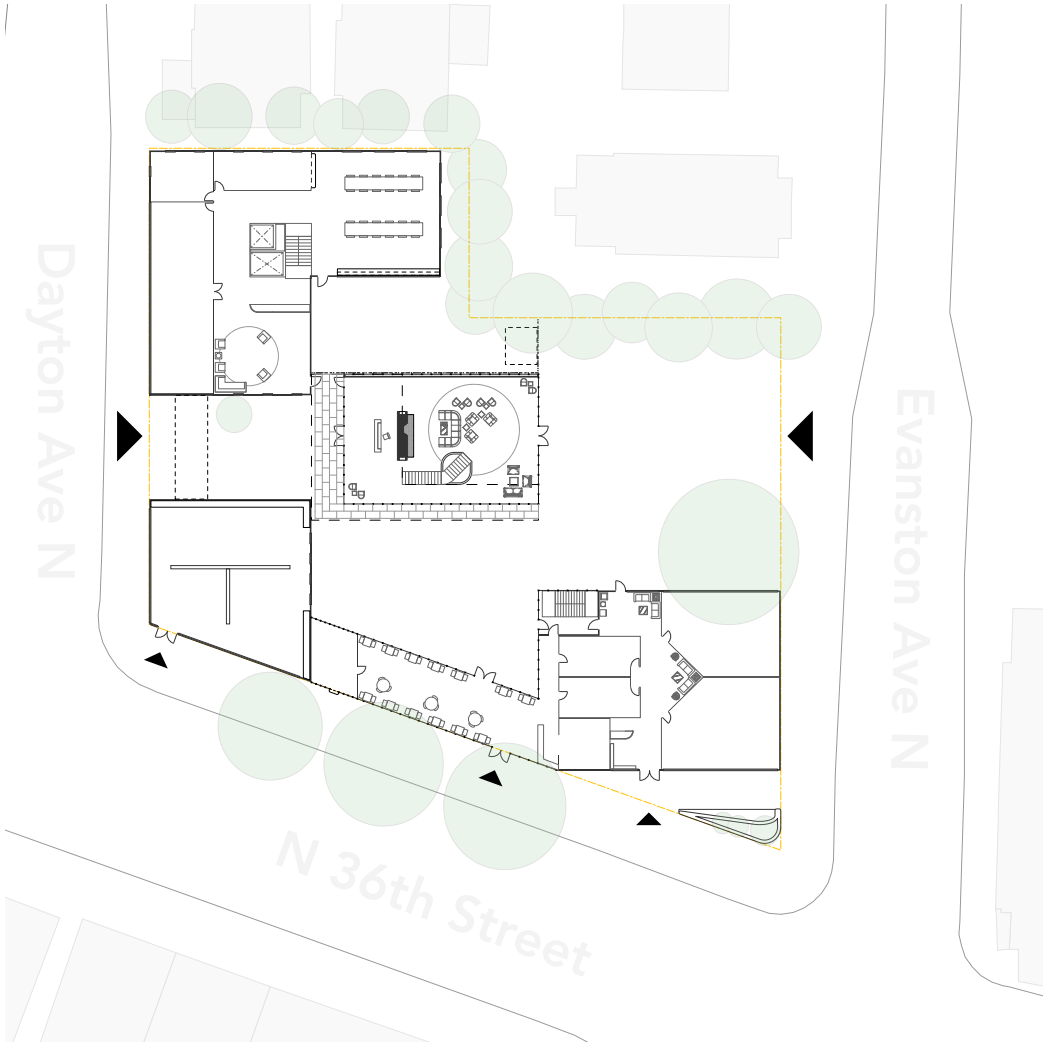


Figure 52 | Facility floor plans, showing more extensive details on each of the three levels; these new plans highlight the following:

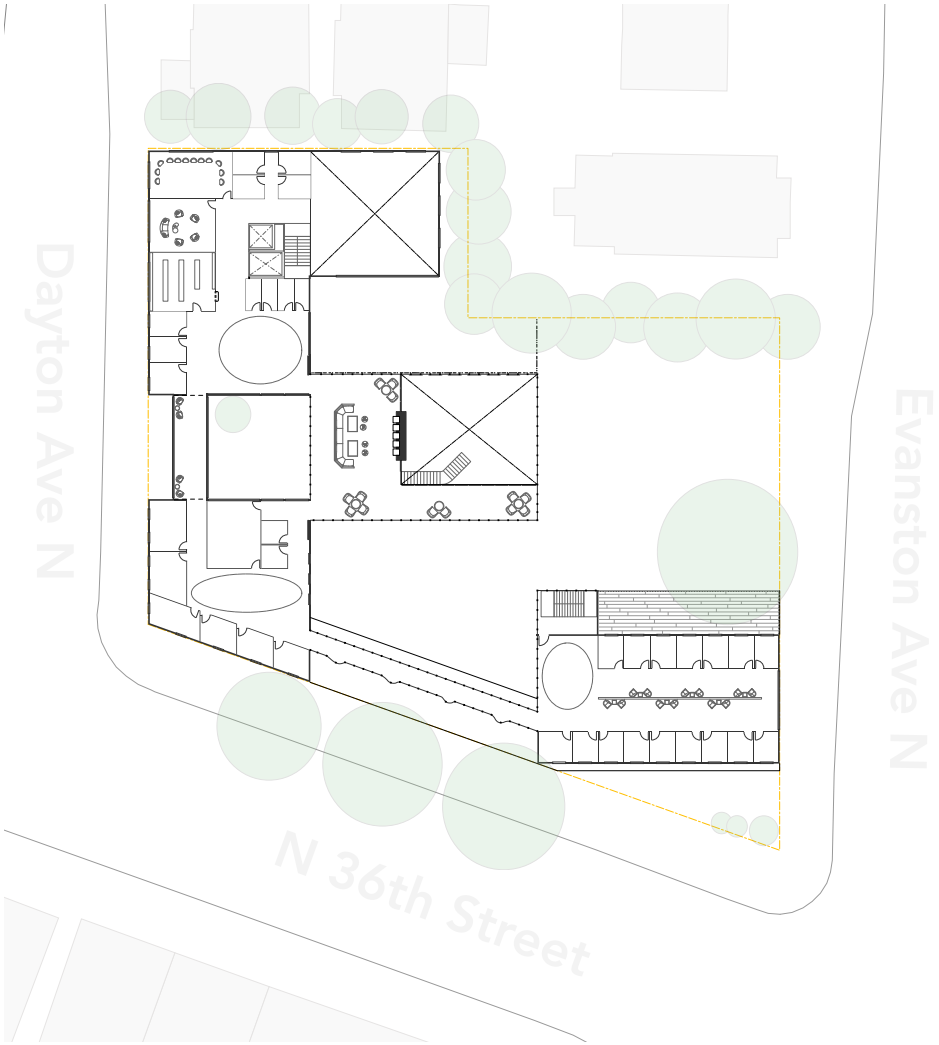
First floor:
- two main entry sides along with the three smaller entries to the public functions along 36th Street
- heightened visibility through the thin tea shop
- ground floor of the Living Room, with its openness and central fireplace feature wall

Second floor
- different sizes and types of therapy spaces in the outpatient section
- connectivity to the Living Room's second level

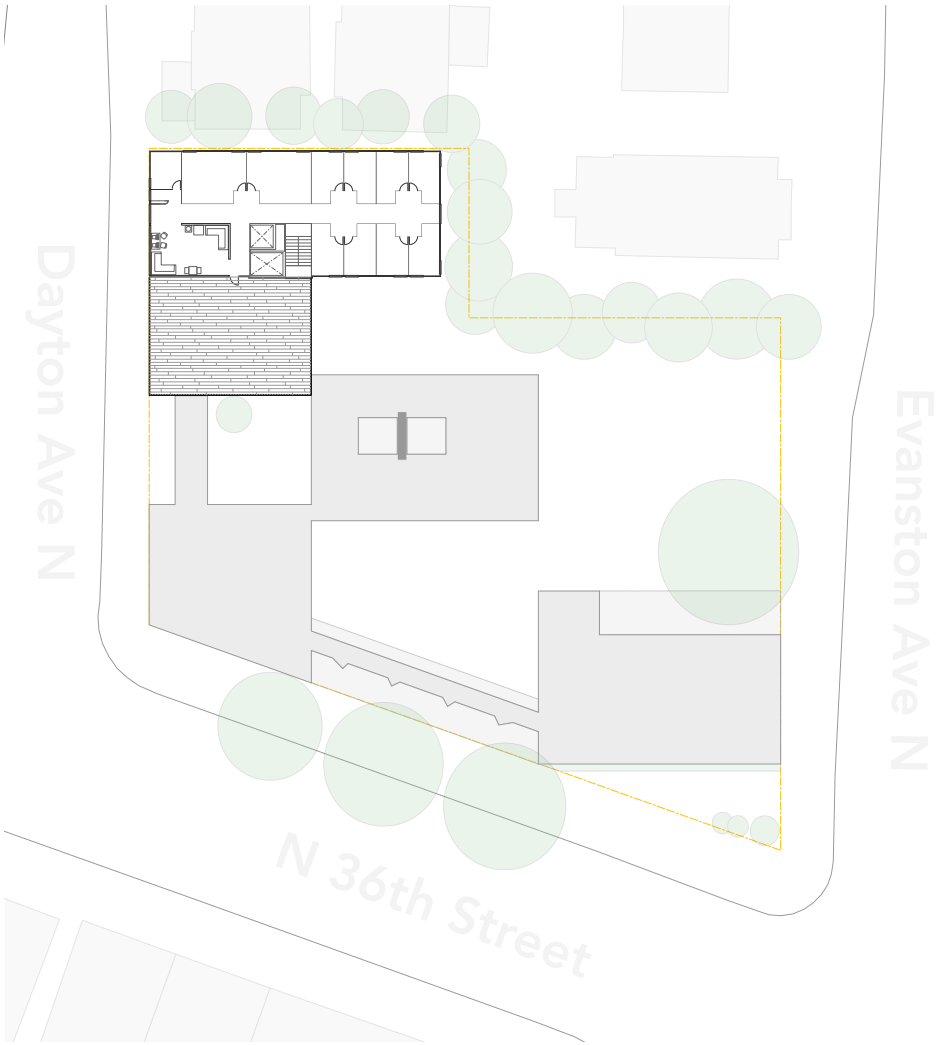
Third floor
- remains just for the most private inpatient functions, containing:
- 10 rooms that house a total of 12 people at one time
- a lounge
- a small nurse's station
- an extensive outdoor deck



L1


Dayton Ave N
Evanston Ave N
N 36th Street

L2


Dayton Ave N
Evanston Ave N
N 36th Street

L3

Figure 53 | Site plan highlighting the various garden characters at work in the design:

- welcoming Facility Entry Garden to the west
- active, park-like Public Garden to the east
- sunny, open Tea Garden to the south
- protected, intimate Moss Garden to the north

8.3 THE CENTER DESIGN

8.3.1 SPACES

OVERALL

The overall design of the center is vaguely reminiscent of a cloister with a glass pavilion in the center. Despite the outward focus and street presence of the three main public functions, the facility as a whole is inwardly focused. The outer buildings form a permeable, protective barrier around the complex. The heavy block massing of the ground level buildings helps to enforce its introverted nature by creating a strong delineation between the complex interior and exterior, while also providing distinct thresholds of both physical and visual access. The second floor outpatient bar wraps around the perimeter of the entire complex, further solidifying this idea of an inward-facing facility. This bar simultaneously acts as a connective element for all parts of the facility. It connects to the public functions via stairs and hallways. It connects to the inpatient functions where it cuts into the inpatient wing, sharing much of the second floor. It connects to the mezzanine level of the Living Room via the cantilevered overhang of the central pavilion. And it creates visual connections to each of the garden spaces in the complex. The third and highest level occurs in only one place and is reserved for the most private functions: the inpatient rooms and lounge. All of these spaces are organized around the "shining jewel" in the center of the project, the 2-story glass pavilion of the Living Room.

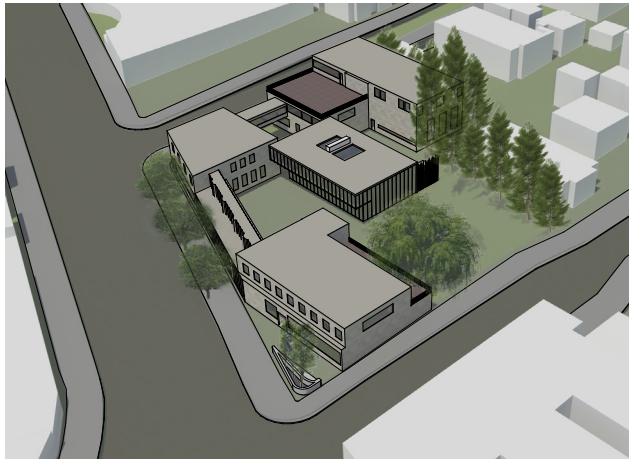


Figure 54 | Aerial view of complex, simplified to show only the massing components, rather than actual specified architectural expression

SPATIAL SPECIFICS

The Facility Entry Garden (visualized in Figure 55) is off the quiet neighborhood street to the west, Dayton Avenue N, and acts as the main entry point for anyone coming here for a specific service. It leads between the public function of the pottery studio and the private inpatient wing, directly into the Living Room. This entry leads under the second-level skybridge,

Figure 55 | Facility entry garden (west), where many outpatients and most inpatients will enter

creating a defined threshold entryway, clad with a warm and welcoming wood exterior. The entry to the Living Room space would also be a defined threshold, as it sits under the cantilevered portion of the building. Through the glass facade of the Living Room, an inviting space and welcome desk would be visible to new arrivals, who would most likely be coming in this way for either specific appointments or inpatient stays. Up on the second level, new arrivals may see other guests engaging in conversation or games. The garden would have plenty of vegetation lining the sides as well as a sufficient amount of central pavement to further suggest to visitors that this garden is a space of progression, helping move them forward into the Living Room for check-in or direction services.

If the guest is a new inpatient, checking in for their stay, they would be sent out the door at the northwest corner of the Living Room, across the small, covered gap, and into the reception area on the First Floor of the Inpatient Wing. On future visits, family members and friends can go straight to this inpatient entrance for visitation. In addition to reception, this first level of the inpatient wing also features a large space for administrative offices, a small space for laundry and other utility functions, a kitchen, a double-height dining room, and vertical circulation in the form of two elevators and a stairway.

After entering the facility and checking in, inpatients who've come in through the facility entry garden and checked in with reception would likely be sent up to the Inpatient Wing's Third Floor. Here they can find their assigned room for the duration of their stay, along with a lounge, a small nurse's station, and an expansive outdoor deck. There are 10 rooms that house a total of 12 guests at one time, with eight single rooms and two doubles. Each room would contain its own bathroom, one or two twin beds, dressers, nightstands, and desks. The rooms are organized in groupings of 4 patients to aid in creating a sense of close-knit community support. The nurse's station is small and all the way at the western end of the hall. It contains a medicine/equipment room and a desk, but the nurses are expected to be walking around, interacting with

patients most of the time. The outdoor deck is just across from the nurse's station, and features comfortable seating options, a couple computer stations, games, books, and a small area for water and snacks. This area is provided so that inpatients will always have the ability to leave their rooms and socialize with others, which one of the important design features of mental health clinics.

For inpatients who desire more of an intimate outdoor experience, they can find a protected Moss Garden (visualized in Figure 56) at the north end of the site. It is easily viewable from the outdoor deck on the top floor of the inpatient wing, and directly accessible, although not easily viewable, from the dining space on the first floor. The garden has a central water feature, an important design recommendation, as well as some fixed and some movable seating. There is also a small garden that inpatient visitors can tend to as part of their treatments, along with several existing evergreen trees. Also visible, but not directly accessible, would be both the public garden and the entry garden, which retains a kind of connection to community that is important in environments like this. All visual connectivity between the garden and other spaces on the first floor is hindered in some way, in order to provide an extra sense of privacy to the garden occupants. The visibility between the garden and the dining room is limited by the low height of the window and the placement of cabinets over it. The visibility between the garden and the Living Room is limited by two things: (1) the tall bamboo screen that wraps around from the public garden on the east to the facility entry garden to the west, and (2) a series of translucent display screens fixed to the interior of the northern Living Room wall, intended to display information. Each of these interventions continue to provide light from these direction into these interior spaces as well as slight glimpses into the gardens, while still retaining a sense of privacy.

Those outside the inpatient community might enter through the Public Garden (visualized in Figure 57), which can serve as a gathering space as well as a main entrance to

Figure 56 | Intimate moss garden (north), a more private and thoughtful garden reserved for the inpatients

Figure 57 | Public garden (east), showing the high level of public use and activity, the direct connection to the tea garden, and the Living Room entry

the complex. There would be an open flow from this space into the tea garden south of the Living Room and a slight visual connection through a bamboo screen to the northern moss garden. This garden also contains the only other direct entrance to the Living Room, aside from the facility entry garden. It is the largest of the outdoor spaces throughout the complex, and provides plenty of spaces for visitors engage in various activities such as light sports, relaxing in the sun, and outdoor yoga or meditation sessions under the big willow tree. The hope here is that visitors to the park may become intrigued enough by the adjacent Living Room to stop in, experience the space, and maybe learn something about mental health and/or self care.

Once inside the main space of the Living Room (visualized in Figure 58), the feeling of a glass pavilion becomes apparent. Each of the garden spaces are visible from this interior space, albeit to varying degrees. There is a large, tactile fireplace feature wall in the center and a large skylight on either side of this feature, washing both sides of the wall with natural light. There is also a central stair leading up to a second-story mezzanine level. The particular design choices inside the Living Room work together to create a sense of reception, learning, and quiet contemplation on the lower level with group engagement happening on the upper level. The fireplace wall becomes a centralizing part of this, as it has several features buried within it. Its long bench provides prime seating for solitary activities such as reading or relaxing, and its carved-out shelves on each of the shorter sides can be used for books. And its hearth creates a cozy ambiance for the quieter ground floor. Upstairs, as in opposition to the book shelves on the ground floor, built-in storage boxes pop out of the long side of the wall and contain board games and group activities. The lower level also has a few interior plants as well as an "Education Center" along the north wall. This Education Center takes the form of several translucent displays, fixed to the mullions, that both create a kind of screen between the Living Room interior and the private inpatient moss garden as well as teach mental health facts and self-care techniques. While both levels have comfortable, oft-movable furniture, the lower level

Figure 58 | Living Room interior, where anyone can come to relax, read, or engage with others

furniture is designed to be more solitary or couple-focused, while the upper level furniture is organized into small groups to facilitate more conversation and interaction. The movable furniture further allows for the center to host movie nights or other community events, either open to the public for exclusively for those inpatients staying at the facility.

The upper level of the Living Room also is also where the connection points to the Outpatient Level are located. The outpatient level is organized into three main blocks, connected to each other via long hallways or bridges and accessed through either the two Living Room entry points or the two moments of vertical circulation within the blocks. The shape of the level follows the perimeter of the site, helping to simultaneously connect all the programs to each other and to create an extra layer of protection for the internal gardens and Living Room. The general organization tends to find the typical consultation rooms nearer to the front, or south, of the complex while the shared therapy services are grouped closer to the back, within the mass of the inpatient wing. The frontmost block, found at the southeastern corner of the site and sitting just above the yoga studio, contains the consultation rooms. These are rooms for typical one-on-one meetings with counselors or licensed psychologists, often used for talking through issues, certain kinds of therapy, or going over further treatment options. Each of these rooms face at least a partially-natural view, with the south-facing rooms looking through a vegetative screen at tree foliage and street activity and the north-facing rooms looking towards the public garden and large willow tree. The north-facing rooms additionally have access to a large deck, shaded by the willow, that patients can use for their appointments. The second block is located in the southwest corner of the site and is connected to the first through a long, glass hall with small bump-outs for casual seating. It features a few larger flexible therapy rooms, support spaces for the therapists, and a community classroom. The south-facing consultation rooms here face the same foliage and street activity as the first block, while the north-facing community classroom faces the facility entry garden. The third and last block contains the

primary therapy spaces, including but not limited to sensory comfort rooms, two different group/flex therapy rooms, a pharmacy, and both individual and group light therapy areas. Each of the three outpatient blocks contains a small amount of waiting space, for those who might feel more comfortable waiting for their appointment just outside their assigned room. And each of these waiting areas look out onto a garden. The rear block looks out onto the inpatient moss garden, while the waiting areas of the other two blocks are focused on the tea garden.

In addition to the views from the second-level outpatient blocks, the Tea Garden also connects to the vertical circulation from the southeast consultation/yoga block as well as directly connects to the public garden. There is also a distinct direct visual connection through the shallow tea room along the main street to the south. In this way the tea garden can be understood as a very central, and very visible, kind of space. It pairs well with the adjacent Living Room in this respect, reflecting its nature as an outdoor version of this interior space. It is planted with a few large and colorful trees and furnished with an assortment of small outdoor tables and comfortable chairs. It also receives some of the most variable light conditions throughout the day and year, experiencing very bright and sunny weather in the summer while remaining in the shade for much of the winter. The intent here is that anyone visiting the tea room might, on a nice day, want to bring their tea outside and enjoy this garden space. Then, any passersby on the street could catch a glimpse of the garden and the Living Room beyond through the glass-clad tea room (visualized in Figure 59), which might even interest and entice them enough to stop in and experience the space for themselves.

This street front of the complex contains the previously-mentioned Tea Room, nestled between the Yoga Studio and the Pottery Shop. The Tea Room is long, thin, and largely transparent, in order to facilitate the view of the tea garden and Living Room behind it. In addition to the main preparation, ordering, and seating areas, there is also a tea window located on the side closest to the pottery shop. Here, pedestrians can stroll up to the window

Figure 59 | Street front view of pedestrian space along 36th Street, highlighting the transparency through the tea room to the tea garden and Living Room beyond

and order a cup of tea to-go, without ever having to slow down or go inside. This has the potential of bring a lot more visitors to the site, passing by the transparent tea room to gaze upon the inner workings and possible pique an interest in mental health. The Pottery Shop adjacent to this tea window is a simple space, with a lot of storage along the walls for the many necessary pieces of equipment, one area for checking in, an two activity areas of different sizes. Due to its proximity to the inpatient wing and the therapeutic nature of pottery work, some inpatients may be able to work here as part of their treatment plans. Lastly, the Yoga Studio on the other side of the Tea Room is the largest of the public programs on the street. It contains a set of restrooms/changing rooms, two waiting spaces, and storage cubbyholes. It also contains two rooms that can be used for either yoga or meditation sessions, which can hold anywhere from twelve to twenty people per class. Although most of the interior walls of these spaces are sheathed with mirrors, each room has a window that helps create a particular quality. One room faces and helps to activate the small public corner. The other room looks out to the public garden to the north, with its view facing the shady area just under the large willow tree. Additionally, there is a back door on the north end of the yoga block that can help facilitate interaction between the yoga classes and the visitors hanging out in the public garden. And on nice days, entire classes can be held just outside the back door, under the willow tree.

8.3.2 APPLICATION OF DESIGN FRAMEWORK

As mentioned throughout the previous spatial description, numerous architectural recommendations from the design framework were incorporated into this facility. As per the original intent of the framework, these recommendations were able to be used in the design process at certain key stages. Considerations about the first two layers of the design framework, Site Organization and Massing, are visible in the conceptual massing phase. (Figures 60 & 61) Design elements visible at this scale are things like acoustic-based spatial programming

between the public and inpatient functions, the incorporation of existing nature into the rear moss garden, and the frequent access to window views throughout the complex. The next two scales of the design framework are Programming and Environmental Strategies, and they can be seen implemented at the point where more detail in the design of spaces and user groups begins to be defined. (Figures 62 & 63) Some examples of design tactics represented at this scale are the creation of specifically-natural views, the use of interior plants, a variety of sun/shade conditions, the presence of a water feature, and tactile surfaces. The final layer in the design framework, Design Details, would appear at or near the final design phase, once all the overarching design decisions have been finalized. It contains the most specific level of recommendations such as what kind of flowers to plant and what colors to paint the walls.

Figure 60 | West-facing section showing how the massing components relate to each other and how the defined garden spaces are created within them

Figure 61 | Design framework is brought back, showing how the first two layers (Site Organization and Massing) are applied

Figure 62 | West-facing section perspective view highlighting the wide distribution of potential visitors, from the typical public to the inpatient crowd, mixed throughout much of the permeable complex

Figure 63 | Design framework is brought back to show two levels (Programming and Environmental Strategies) as applied

Part IV
CONCLUSION

CHAPTER 9: RECOMMENDATIONS AND CONCLUSIONS

9.1 RECOMMENDATIONS FOR FURTHER RESEARCH

Further research can always be done on this topic, as thousands of additional studies currently exist and more are constantly being completed or needed. Further research could be done on each topic, research could be conducted on additional topics, and the research base could be opened up to include other factors beyond neuro-sensory elements.

Further investigations could be done into each of the five neuro-sensory factors mentioned, especially lighting, color, and green space. For lighting, there exists much more research than was able to be covered in a broad research thesis like this, making lighting an area where a deeper dive into existing research could pay off significantly. In terms of color and green space, the existing research is largely softer or more qualitative, which often results in fewer solid conclusions. Further research studies could be done in these areas to expand the existing knowledge base for applicability to design and other related fields.

Similarly, the overall investigation could be expanded to include research on additional neuro-sensory topics, such as thermal comfort, air quality, or particular scents. Each of these potential factors has an additional entire body of research behind it that was not strong enough or not int he correct vein of design work for this thesis, but should not be overlooked.

As a last recommendation, the list of researched design factors can be opened up to include additional types of factors, other than neuro-sensory, that could contribute to neurological health or overall well-being. This would involve an expansion on the last line of the framework created within this thesis, referred to as design strategies for “Communal Support” in this context. The ideas in this category that arose from the research conducted during this thesis tend to be more focused on human movement and experience, such as encouraging people to use the stairs as much as possible to stimulate brain development and healing.

9.2 RECOMMENDATIONS FOR FURTHER PROJECT DEVELOPMENT

If the research application portion of this project were to be carried forward, there are a few additional qualities that could be considered and further designed. The design of the inpatient rooms could be further investigated, the exterior coloring and materiality could be further researched and intentionally designed, and the elevations of the perimeter buildings could be redesigned, likely according to further lighting research.

The scale of the inpatient rooms, while intentionally not thoroughly designed for this thesis project, could be taken a step further. Detailed design and visualization of these spaces was intentionally avoided due to both the time and scope constraints of this thesis as well as the idea that other spaces were more integral. In a facility like this mental wellness center, inpatients are encouraged to spend as little time as possible in their own rooms. Due to this and to safety concerns, the rooms are typically very simple. However, if moving forward with this design, it would be beneficial to more closely examine and design this scale of spaces, as they are still an important part of the inpatient experience.

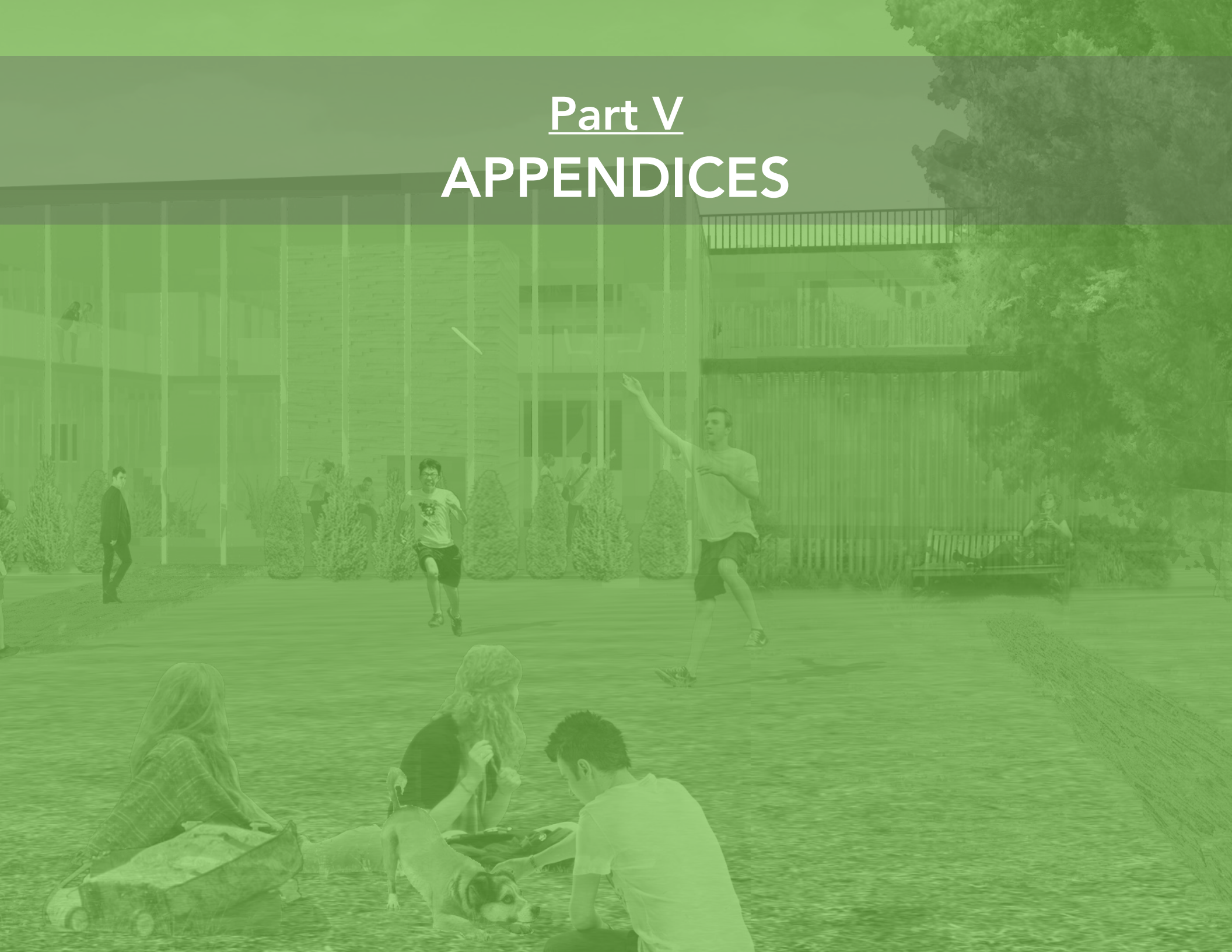
Additionally, further development on this project could include more intensive design of the exterior color and materiality of the perimeter buildings. The current choices were made based partially on aesthetics, but mostly on seeking a neural and non-white cladding option that would fit into its surroundings while not detracting from the main design points of the rest of the center. If further developed, this exterior cladding could become a main design point. This would require further research into the color and pattern set of design recommendations.

Similarly, the elevations of each of the perimeter buildings could be redesigned, likely according to additional lighting research. The existing elevations are based on allowing as much natural light in as possible while responding aesthetically do the different interior functions. Further development would allow for these elevations to become an additional main design point of this facility, based on further lighting research and requirements of the specific spaces.

9.3 OVERALL CONCLUSIONS

This thesis presents an argument for why neuro-sensory design factors should be considered in architectural design and how this can begin to happen. The ultimate goal is to establish a baseline from which further research on neurological design in architecture can be done in the future. To arrive at this baseline, the thesis process intends to first identify the strongest neuro-sensory design factors that possess architectural or design implications and that also have a profound impact on our neurological health. The research then goes on to discover each of their most notable conclusions and create a framework of design recommendations that architects can begin to consider in the design process. The resulting design of a mental health clinic and wellness center shows one way in which neuro-sensory design factors can be used to inform the design of neurologically healthy spaces and to help improve the well-being of an entire community.

Research in this area has exploded over the last two decades, but there continues to be additional research to be done. This thesis successfully and strongly completes its goal of setting up a broad baseline from which further or more in-depth research in neuroscience for architecture can occur. As the research presented in this thesis illustrates, neuro-sensory design factors can have a notable impact on architectural design, and this design can play a large part in our neurological health.



Part V
APPENDICES

APPENDIX A | OTHER NEURO-SENSORY FACTORS: THERMAL COMFORT AND HEALTH

This discussion of thermal comfort was intentionally omitted from the main body of the text. Despite the fact that thermal qualities possess some neurological effects, there was not enough existing research directly illustrative of these effects. Additionally, the research here did not add sufficient depth to the conceptual-level design thinking as produced in this thesis. For these reasons, thermal comfort was not included in the list of neuro-sensory health factors investigated in this thesis.

A.1 THERMAL ADAPTATION

Aside from the significant health risks that come from being subjected to extreme temperatures, the thermal environment has been shown to have numerous influences over people's perceived health and well-being. The element most directly relatable to neurological design is the presence of thermally adaptive features. Adaptable environmental qualities have been shown to make people feel better both physiologically and psychologically. The ability to adjust the thermal aspects of the environment, either through operable windows or a thermostat, shows a significant improvement in behavioral health and perception of comfort.[132] Additionally, individuals using the operable window method of thermal adaptation tend to report feeling more comfortable in their environments than in buildings with a typical central HVAC system. As well, different degrees of control manifest themselves in various levels of comfort.[133]

132 Gail S. Brager and Richard J. De Dear, "Thermal Adaptation in the Built Environment: A literature review," *Energy and Buildings 27 (1998): 83-96.*

133 Gail Brager, Gwelen Paliaga, and Richard De Dear, "Operable Windows, Personal Control and Occupant Comfort," *Center for the Built Environment, ASHRAE Transactions 110 (2004): 17-35.*

Buildings that have improper thermal environments may result in instances of Sick Building Syndrome (SBS), as evidenced in a 1987 study. Results showed that temperature was one of the most important factors in determining the perception of indoor air quality, directly influencing reports of SBS symptoms. A distinct increase in symptoms was reported when the indoor environment was considered to be too warm or too cold. In accordance with the previously noted observation, when individuals were able to control the room temperature, the reported SBS symptoms decreased.[134]

A.2 MENTAL PERFORMANCE AND PRODUCTIVITY

The interior thermal environment has also been shown to affect mental performance and productivity. In a study on cognition and heat stress, it was observed that mental performance decreased after only a couple degrees. Recognition was best at 26°C and was negatively affected above or below this value, and multiplication tasks were significantly hindered at any temperatures above 27°C. Comprehension for all tasks studied was significantly reduced above 27°C. This study concluded that moderate heat stress decreases mental arousal without conscious effort.[135] Another study focused specifically on productivity in the workplace and documented an average task performance decrease of 2% per degree for temperatures above 25°C. Further results showed a strong correlation between temperatures below typical room temperature and decreased performance of manual tasks, likely due to decreased blood flow.[136]

134 Jouni JK Jaakkola, Olli P. Heinonen, and O. Seppänen, "Sick Building Syndrome, Sensation of Dryness and Thermal Comfort in Relation to Room Temperature in an Office Building: Need for individual control of temperature," *Environment International 15 (1989): 163-168.*

135 David P. Wyon, I. B. Andersen, and Gunnar R. Lundqvist, "The Effects of Moderate Heat Stress on Mental Performance," *Scandinavian Journal of Work, Environment & Health (1979): 352-361.*

136 Olli Seppanen, William J. Fisk, and David Faulkner, *Control of Temperature for Health and Productivity in Offices* (Berkeley: Lawrence Berkeley National Laboratory, 2004).

A.3 SUMMARY AND DESIGN CONCLUSIONS

The neuro-sensory factor of thermal control thus encompasses both qualities of temperature as well as the ability to change those qualities to suit the particular occupants. Aside from the significant health risks from extreme temperatures, the major health effects of thermal comfort are related to perceived comfort, Sick Building Syndrome, and mental performance and productivity. The ability to adapt to the thermal environment, such as through an operable window, is one quality that universally makes people feel more comfortable in a space and improves mental health. These benefits are present whether or not the mitigating device is actually used; just having an operable window produces these beneficial effects. However, reflecting the negative power of the thermal environment, improperly set temperature and high humidity can result in a prevalence of Sick Building Syndrome symptoms. Lastly, thermal comfort has been linked to mental performance and productivity, affecting cognitive task performance, comprehension, recognition, and overall mental arousal.

The most obvious design recommendation regarding thermal comfort is to insure an efficient and effective means of heating, cooling, and ventilation in a space in order to avoid dangerous temperature extremes. Another best practice is to provide a means for occupants to feel a sense of control over their thermal environment. This can be done in simple ways such as by using operable windows, providing openly accessible thermostats, or creating frequent opportunities for people to sit in different micro-thermal zones (i.e. outside on a balcony, in the shade, in direct sunlight, etc.). Simply providing these kinds of opportunities increases people's apparent health, well-being, and overall positivity.

APPENDIX B | BACKGROUND ON MENTAL HEALTH

B.1 HISTORY OF FACILITIES AND TREATMENTS

Mental health facilities have a storied and relatively infamous past. Throughout history, individuals who were unfortunate enough to suffer from mental health disorders were often forced into brutal insane asylums, where the public could sometimes pay to be entertained by the "lunatics."[137] Families were often convinced that commitment to these institutions was the only option to cure their loved one. Yet, these institutions often saw it in their best financial interests to maintain a full bed count, and were therefore often criticized as to their true motivations behind the supposed "cures" they espoused.[138,139] Those with less obvious mental issues often learned to keep quiet and suffer in silence.

Institutional treatments were frequently torturous and harsh, based either on pseudoscience or on no science at all. Doctors treated patients as criminals, animals, and occasionally test subjects for the often ignorant and extreme "treatments" forced upon them.[140] Those more violently disturbed people often ended up either in prisons or the subjects of experimental surgeries that sometimes left them permanently vegetative. In large part, the various misconceptions about mental illness fueled these cruel mistreatments of the time. Living conditions were too often deplorable as well, with general housing being in small, windowless rooms, where patients slept on little more than straw-stuffed sacks.[141] The concept of the mental

137 Carla Yanni, *The Architecture of Madness: Insane Asylums in the United States* (Minneapolis: University of Minnesota Press, 2007), 17-30.

138 Yanni, *Architecture of Madness*, 5-7.

139 Jeffrey Geller, "A History of Private Psychiatric Hospitals in the USA: From Start to Almost Finished." *Psychiatric Quarterly 77 (2006): 1.*

140 University of Detroit School of Architecture, *Environment for Mental Therapy*, 3.

141 University of Detroit School of Architecture, *Environment for Mental Therapy*, 3.

health facility had far to go to evolve from the dark, painful, and stigmatized Bedlam that came before it.[142]

Moral attitudes finally began to change by the start of the 19th century, but actual progress was slow.[143] By the early 20th century, as standards for treating the mentally ill were established and statistics on illnesses and treatments became available for the first time, true evidence-based treatments took off.[144] A few decades later, reforms finally began to take effect. Finally, as the understanding of mental disorders began to develop out of legitimate science, the concepts behind the treatments evolved in similar ways. One valuable concept that eventually emerged from this new line of thought is the importance of the environment in the treatment of mental illnesses.[145,146]

142 Yanni, *Architecture of Madness*, 19.

143 Yanni, *Architecture of Madness*, 5-13, 24-40.

144 University of Detroit School of Architecture, *Environment for Mental Therapy*, 3.

145 Yanni, *Architecture of Madness*, 8-9, 27-29, 38-41.

146 University of Detroit School of Architecture, *Environment for Mental Therapy*, 4.

B.2 UNDERSTANDING MENTAL WELLNESS

B.2.1 WHAT IS MENTAL HEALTH?

Nowadays, the culture around mental wellbeing has changed drastically. It is important to understand that mental wellness is a constant, lifelong endeavor that many people struggle with. It is similar to physical wellness in that some individuals are generally healthy and may only need to visit a healthcare provider when sick or injured, yet others may struggle with lifelong chronic issues that require medication or therapy to solve.

Ultimately, mental health is concerned on an everyday basis with how one individual interacts with other individuals, with the world, and with himself or herself.[147] It is more than just the absence of any particular mental illness. No one person can be in an ideal mental state all of the time. Even healthy people must work to maintain a healthy mental well-being.

B.2.2 TREATMENTS

Mental illness can take many different forms, but there are some general commonalities. Most patients that are traditionally considered mentally ill tend not to exhibit extreme behaviors. Typically, they are quiet and unexcited, and they are rarely violent.[148] Ill individuals can almost always benefit from hospital treatment, therapy, or at least some form of consultations. At the very least, trained professionals can often tell if a person is truly mentally ill and/or if they're going to get worse and suffer a breakdown.[149]

There are various types of treatments and therapies designed to help people who suffer from mood, emotional, or anxiety disorders. A list of the common types of therapies can

147 University of Detroit School of Architecture, *Environment for Mental Therapy*, 8-9.

148 University of Detroit School of Architecture, *Environment for Mental Therapy*, 11.

149 University of Detroit School of Architecture, *Environment for Mental Therapy*, 11.

be found below. Most of these, like cognitive behavioral therapy and exposure therapy, can be performed in typical consultation rooms on an outpatient basis. Some treatments, such as phototherapy, can be performed as outpatient services but require a particular room setup. Another subset of treatments can only be performed on inpatient bases, such as sleep hygiene studies or brain stimulation therapies. Medication comprises a kind of pharmaceutical therapy that may be suggested for inpatients as well as outpatients. Lastly, there are several activities that are seen as complementary to certain treatment methods. Some of the most successful and well-known are stress-management and mindfulness techniques, yoga and meditation, regular exercise, healthy nutrition, adequate sleep, and a high level of community involvement.[150]

150 SAMHSA, "Treatments for Mental Disorders," last modified April 5, 2017, https://www.samhsa.gov/treatment/mental-disorders.

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