Neural Networks and Neighborhood Inclusion: A Paradigm Shift in Senior Housing

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Abstract

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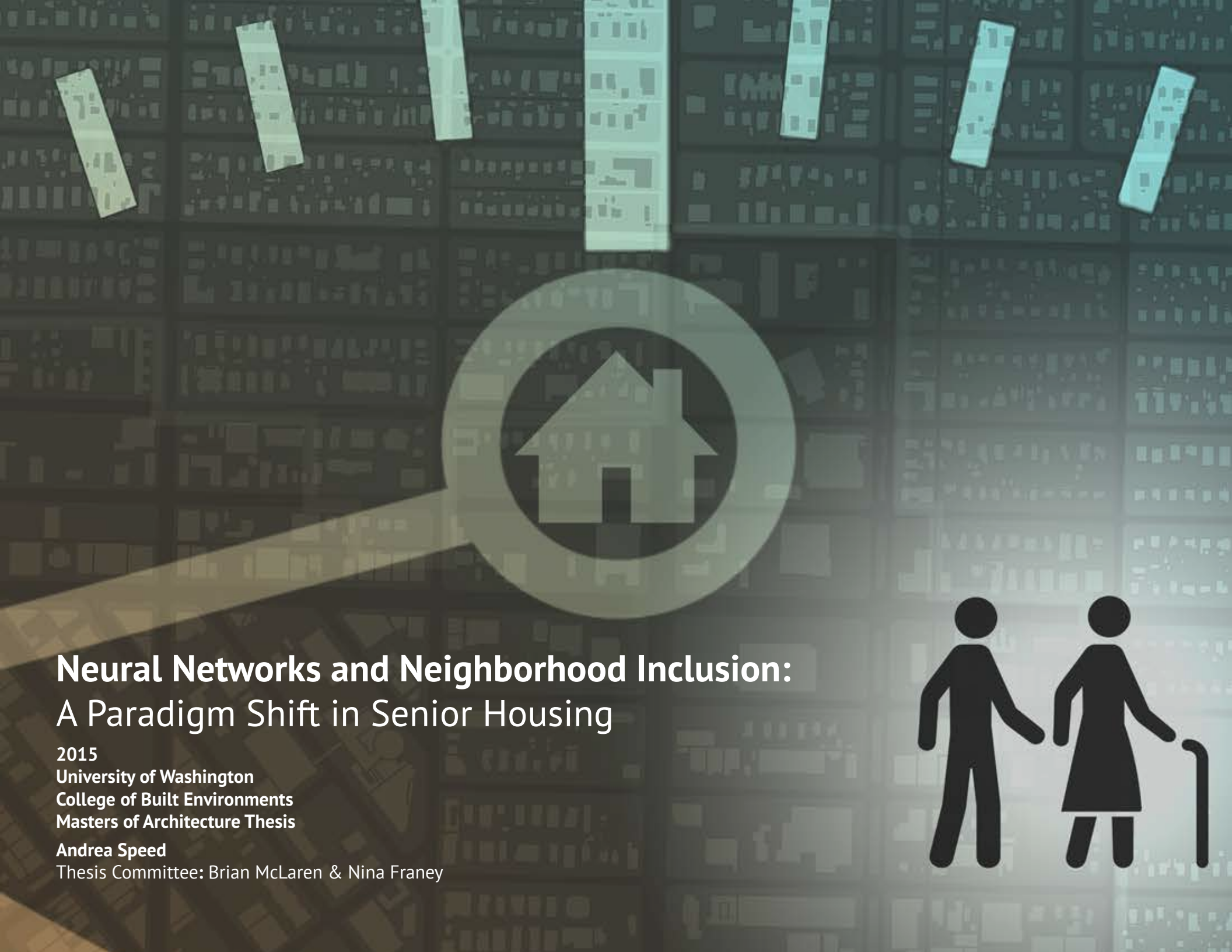
Given that seniors today are more active, living longer, and have a wider variety of needs, the composition of a senior living residence should likewise evolve. This thesis proposes a network of smaller scale facilities that allow for greater personal autonomy, yet engage with the neighborhood through public space and programs. The building proposes a program of senior housing combined with a public education component in the context of a music school. Concurrently, the building scheme is based around maximizing lighting according to natural circadian rhythms in order to reinforce daily cycles, aid cognitive function, and instigate neurogenesis.



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Masters of Architecture Thesis

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Thesis Committee: Brian McLaren & Nina Franey

Special thanks
to my mom
to my brother
and to Pamanee Chaiwat
for their continual support and inspiration

In memory of Edward E. Francisco Jr. and Edward E. Speed

CONTENTS

CHAPTER 1. **Effects of an Aging Population**

The current paradigm of senior living facilities is a large-scale complex where all of the users' needs are met within the boundaries of the building envelope. These facilities are designed for safety and efficiency, with a focus on pragmatic functional issues. Regrettably, the equally important mental, emotional and social interactions of users have not received the same level of attention. By crafting space according to the biological clocks and circadian rhythms of the users, the spaces will be more apt to expand the minds and moods, creating a more dynamic use of space. Also, by choosing a site that is integrated within a walkable neighborhood close to daily amenities there is an increased degree of social interaction which benefits both the user and the neighborhood.

One of the most significant changes in our world today is the shift in population demographics. In the 1700s only two percent of the population was over the age of 60 (Abbott 9). Current projections for

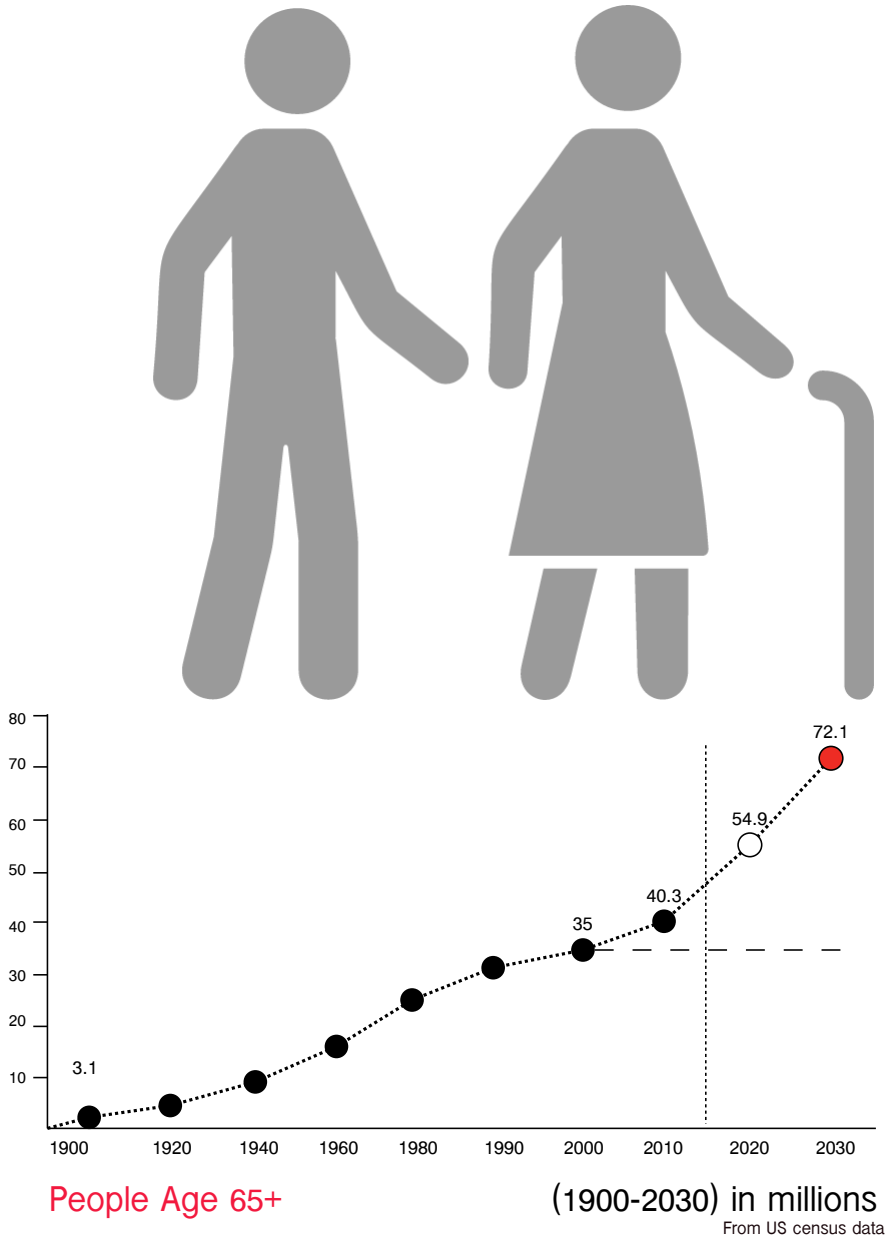
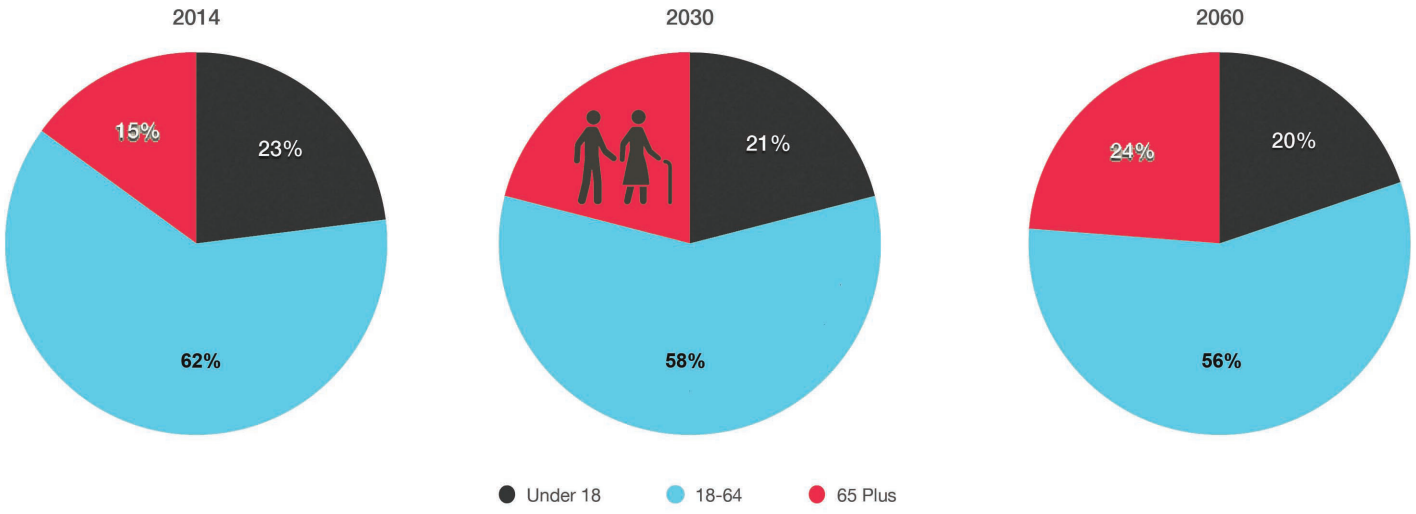


Figure 1.1 : An aging population- current and future projections of people age 65+

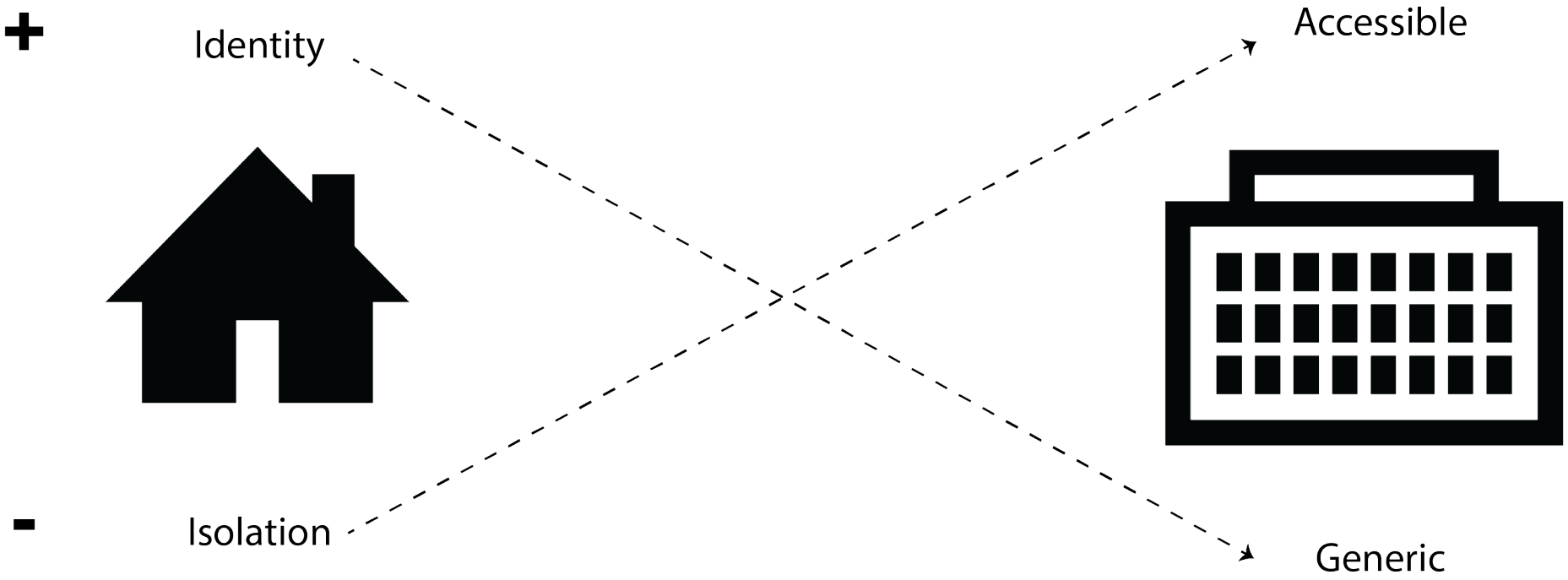
Figure 1.2: Shifting demographics of the elderly U.S. population

"Between 2014 and 2060, the U.S. population is projected to increase from 319 million to 417 million, reaching 400 million in 2051." (Colby 1)



the the United States show that by 2030 that one in five Americans will be 65 years and over(Prikl). This is partly because of the baby boomer generation, which will significantly enlarge this user group, but it is happening on a global scale as well; the people of the world are getting older. In 2000, there were 600 million people aged 60 and over; there will be 1.2 billion by 2025 and 2 billion by 2050. By 2050, the number of older persons in the world will exceed the number of young for the first time in history (Feddersen 2009, 9). The need for senior living facilities as an architectural typology has arisen out of a changing cultural and urban context. The elder members of the family no longer reside in the same house as the rest of the family, but they often resist and fear moving

Figure 1.3: Pros and cons of single family homes versus larger institutions



into a larger assisted-living facility, because doing so is a drastic change; it means relinquishing a certain degree of independence and it means living in a homogenous environment surrounded only by other seniors. Often, the move into a senior living facility has psychological repercussions from the physical loss of personal memorabilia, reduction of private space, and separation from a familiar neighborhood with its network of amenities and multigenerational neighbors. The sense of identity and personal space can be quickly lost amid the repetitive and institutional aspect of the senior living "home". The loss of material objects can result in decreased memory recall and less mental stimulation (Eberhard 2008).

Large-scale facilities that encompass all of the users' needs are often isolated from the surrounding neighborhood and will not meet the expectations of the baby boomer generation. Wid Chapman (2011) corroborates this point noting that "traditional senior housing, especially long-term care facilities, is isolated from the surrounding community, and boomers find that unacceptable"(10). Robert H McNulty, JD (2009) President of Partners for Livable Communities in Washington DC notes that boomers, "will work longer, live longer, have greater means, and be more civically and recreationally engaged. As a result, they will demand an entirely different type of 'aging' strategy" (Abbott xvi). The wealth of knowledge and experience becomes siloed and the potential for educating younger generations is a missed opportunity. Internalized senior living facilities negatively impact the neighborhood in terms of street life because there is a lack of public presence and uses that are open to the community.

Similarly, Keith Wardrip (2010) from the AARP Public Policy Institute notes the reluctance of seniors to move away from home. He notes that "in fact, 85 percent of older adults agree that if they can no longer live in their homes, they would at least like to remain in their local community for as long as possible" (24). Leaving the neighborhood would mean losing access to familiar neighbors, friends, relatives, doctors, restaurants, parks, and services. This underscores how the desire to stay within the same neighborhood is connected to the social aspect of living within a community.

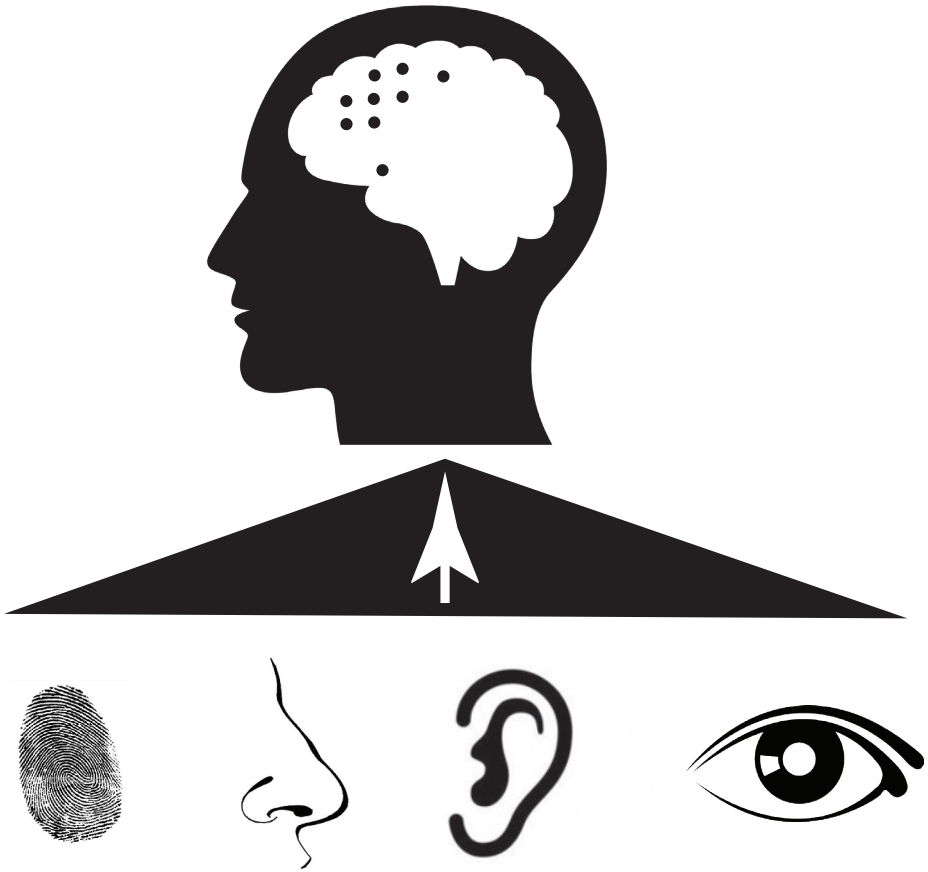
Senior housing, in view of this thesis, should be a vibrant part of the community, contribute not only to the individuals' physical health needs but also to their mental, emotional and social needs, while providing a cultural amenity to the neighborhood and being economically viable. It envisions small-scale facilities that operate within a network based on how they reciprocate to the

neighborhood. A network of senior living options is important because how " a community promotes choice is by providing a range of housing options for its residents" (Wardrip 42) Choice is vital for seniors in terms of maintaining their identity and personal power.

Activities that would engage seniors and their neighbors alike could include storytelling, art classes, music lessons, and gardening with the older generations taking on a mentor role to neighborhood youth. The young at heart could also engage in social activities or workshops taught by young adults in areas such as dance, technology and cooking. Incorporating such activities within the senior living facilities helps to make it an economic feasibility and serves the social and mental needs of the underlying neural agenda to keep the seniors healthy and active. These facilities should also incorporate areas stillness to reflect, recall, and remember encouraging contemplative architecture to activate the brain through involuntary attention.

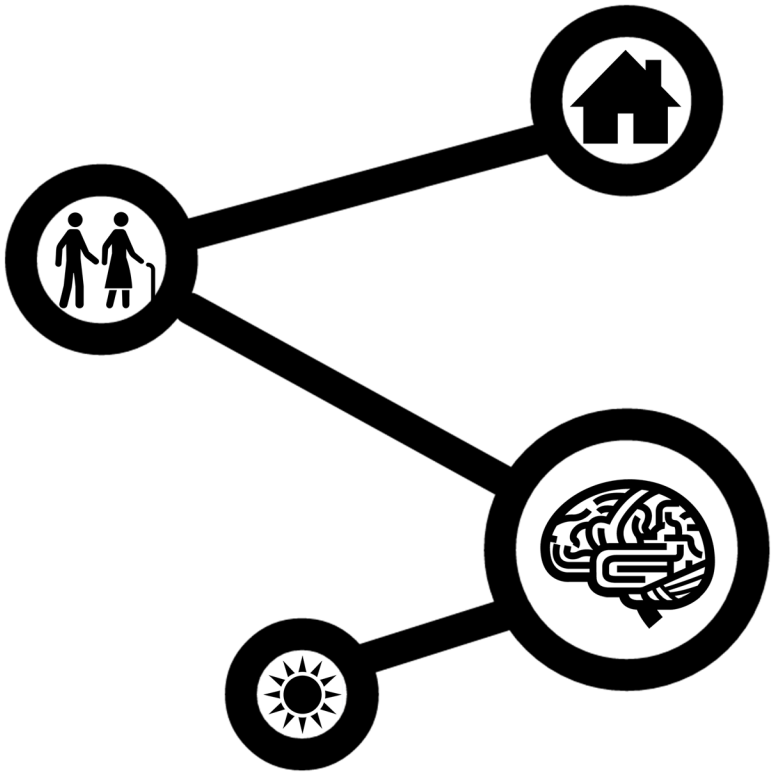
Figure 1.4: Senior mentorship activities

Figure 1.5: Sensory stimulation diagram



Seniors deserve the best quality of life and by optimizing spaces to receive sunlight as specific times of day in accordance with their natural circadian rhythms they will reap neurological health benefits. Recent developments in neuroscience have shown that the brain does not stop developing in a person's early twenties as was previously thought. Instead the brain has a much more flexible structure that continues to develop in response to its environment. While large senior facilities are equipped to keep resident's bodies functioning, they do not seem to pay attention to environmental factors on how the buildings orientation and design impact the mental state of the residents. This is not to say that architecture can solve degenerative brain processes involved with disease's such as Alzheimer's disease, but it can possibly promote ways to maintain a healthy brain for a longer period of time. Through exposure to a more engaging environment that encourages physical mobility, mental curiosity, and social activity, the brain can be stimulated.

Figure 1.6: Thesis dimensions



Specifically, this thesis will draw on neuroscience research to create a healthier living environment for seniors. It proposes that by tailoring spaces to engage seniors via appropriate lighting levels combined with physical exercise and social interaction with other residents and the neighborhood the individual's mental health and quality of life will also be improved.

One facility could improve the quality of life to a certain level, but by providing a network of mixed use senior living facilities there would be an exponentially increased benefit to the individuals and the community. In a network of diverse functions, each senior living complex will provide greater user satisfaction through specialization, addressing the needs of a diverse group of users and encourage pedestrian activity. In addition, the thesis asserts that residents in the surrounding neighborhood will benefit from the shared knowledge and history of the elderly residents who are engaging in teaching or mentorship roles.

CHAPTER 2. **Theoretical Framework**

John P. Eberhard, the founding president of the Academy of Neuroscience for Architecture, has written a series of hypotheses about the aging brain. He also delves into the ways the human brain processes visual information, as well as ideas about how neuroscientists and architects could begin to have a more research-based collaborative relationship. Eberhard comes from an architecture background and is encouraging neuroscientists to pursue the implications of architectural impact studies on the brain, so much of what is being used to support this thesis is still in the early stages of neurological research and relies on larger concepts about programming space.

Juhani Pallasmaa is another architect that has taken an interest in neuroscience. While he is a noted architect for his written work The *Eyes of the Skin,* which discusses the qualitative sensory aspects of architecture, he believes that neuroscience could begin to identify

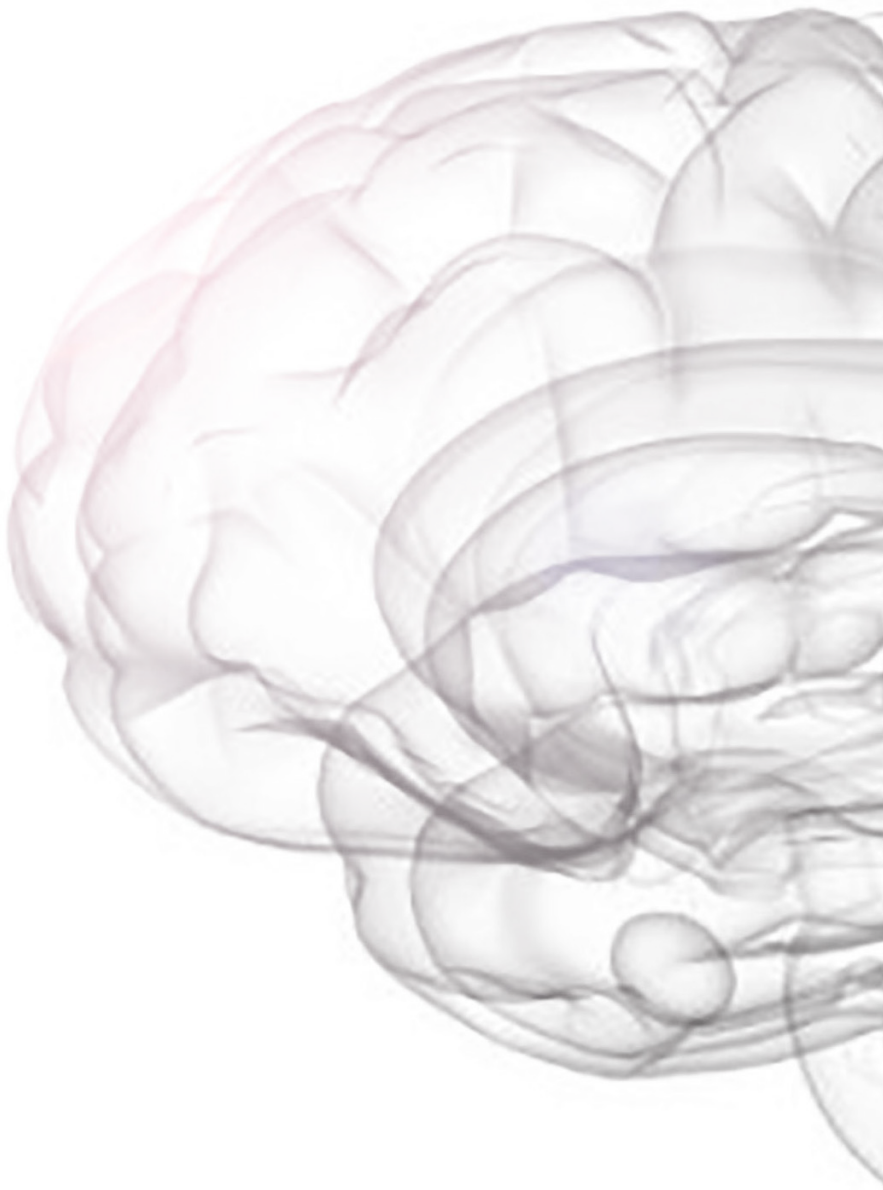


Figure 2.1: Theoretical brain

why people react to spatial constructs in particular ways. He notes that recent scientific discoveries, " challenge the traditional and still prevailing visual understanding of architecture and suggest that the most significant architectural experiences arise from existential encounters rather than retinal percepts, intelligence and aesthetics of the new" (Pallasmaa 5). He believes that neuroscience research will bring relevance to design and arts that are in danger of being disregarded because of their "uselessness" and apparent subjectivity.

The Salk Institute is an example of a scientist, Jonas Salk, working with architect Louis Kahn, in 1960, to create a building which redefines how researchers collaborate and view the world. The institute is located in La Jolla, California, where the idealized site is the home to an independent, nonprofit, scientific research laboratory employing more than 850 researchers and staff. "The institute has 58 labs and focuses its research in three areas: molecular biology and genetics, neuroscience, and plant biology. Research

Figure 2.2: Salk Institute Photograph
source: Bruce Levenstein

topics include cancer, diabetes, birth defects, Alzheimer's disease, Parkinson's disease, and AIDS" (Eberhard 142). The design departs from traditional laboratory spaces by providing an uninterrupted view to the landscape from the work space; using views to nature to change how people think. The labs at the Salk Institute are organized in such a way to provide interaction between the different fields of study. Instead isolating groups that function independently the cross-contamination of ideas around break out spaces and meal areas allows for ground breaking research. While the Salk Institute was successful in making a productive work environment it is not the ideal housing typology. What is applicable to the senior housing is how the institute frames views to nature, allowing for the conscious mind to linger and enter a state of involuntary attention.

Figure 2.3: Bioscleave House interior
photographer: Eric Striffler

It is valuable to look at existing senior housing as case studies in terms of arranging public and private spaces and transition between these privacy zones.

"My house is my refuge, an emotional piece of architecture, not a cold piece of convenience."

~Architect *Luis Barragan*

Figure 2.4: Altenmarkt Senior Residence
photographer: Angelo Kaunat

Figure 2.5: Altenmarkt Senior Residence Plan
source: Archdaily

A senior housing precedent is Senior Citizens Residence in Altenmarkt, Austria by the architecture firm Kadawittfeldarchitektur. Completed in 2007, the 5,100 sqm (55,000sf) project provides senior housing as well as a senior activities center which functions as an interface with the neighborhood. The two program components are divided into two distinct building masses that share a courtyard space. The courtyard is used as a semi-public space where events can take place without the sense of intruding on the private senior living space. The housing portion is characterized by a double loaded corridor with private bathrooms for each unit.

In Berlin, Germany the Beguinage designed by architect Barbara Barkenhoff, is a communal living project containing 53 apartments and two guest apartments completed in 2007. The design incorporates common balconies on alternating floors creating shared social space. The urban nature of the project means that there is an economy of space and defined front of house condition.

“Three different groups of floor plan typologies were developed with sizes ranging from 56 to 105sqm” (Fedderson 149).

Another noteworthy project is Miss Sargfabrik by BKK-3 Architects in Vienna, Austria. The 2,820 sqm residence houses 39 apartments which is designed to accommodate social diversity as an intergenerational housing model.

> The residential functions are complemented by diverse communicative spaces for communal use: a club room, a library, reading and media room that resembles a walk-in spatial installation as well as a joint kitchen with dining area and washroom (Fedderson 93).

The seven story building plan conforms to the site boundaries on the street edge, but the back side is a small courtyard. The living units are divided by angular walls and oriented along a single corridor, creating a unique and modern interior.

Lessons from each of these cases studies, including courtyard orientation, variable unit size, and common balcony spaces will be

Figure 2.6: Miss Sargfabrik facade
source: Bkk-3

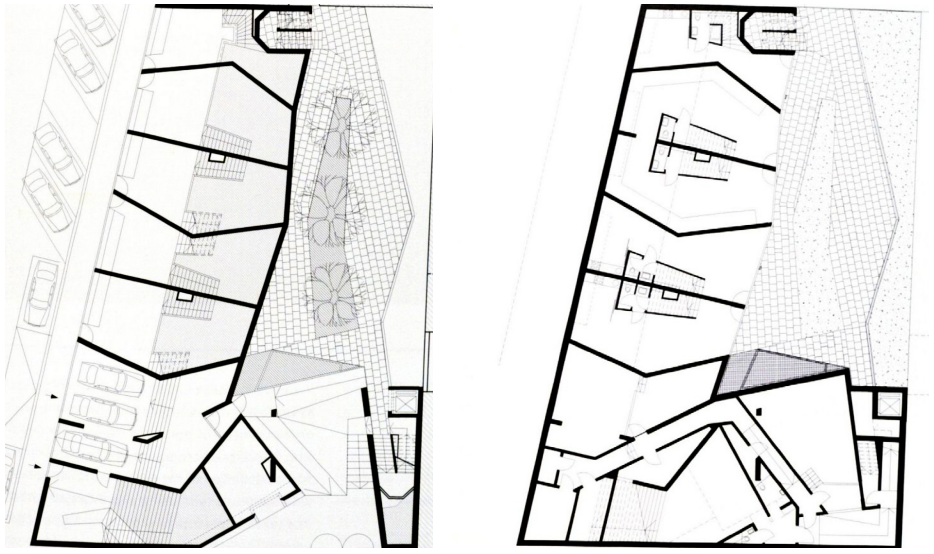
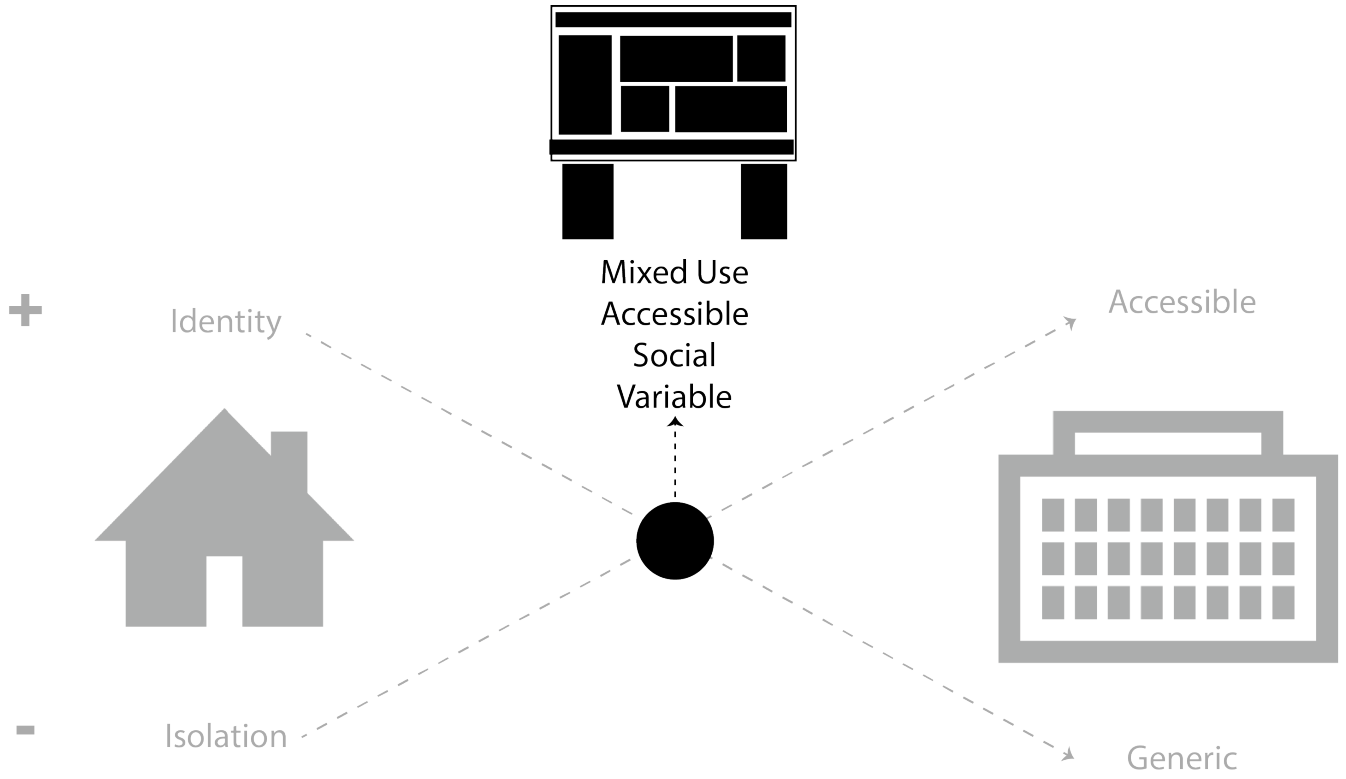


Figure 2.7: Miss Sargfabrik ground floor and first floor plans

Figure 2.8: Finding a middle ground



taken and applied to the proposal. The height and level of density in the case studies will likely be adjusted to better suit the site context for the proposal as well. In the context of the middle ground typology, the newly formed network of smaller scale facilities for senior living will both positively impact the individual users and the surrounding neighborhood. Aside from the individual's quality of life and neighborhood cohesion, the ultimate goal is to inspire positive change and as eloquently stated by Juhani Pallasmaa, "a profound piece of architecture invites and guides us to be better and more sensitive human beings" (Pallasmaa 11). Although this is a qualitative factor and difficult to incorporate in the design process, the hope is that the building will encourage people to take

time to appreciate the smaller moments in life, finding space pause and reflect. Through designing for the users in a sincere manner some of that sentiment might show through to the user, who then reciprocates by showing gratitude in other parts of their life. The idea at its core is that by designing well, the people who live there will live better and share their happiness with others. In many ways modern design has strived for efficiency and cost effectiveness, while this thesis aims to facilitate a higher quality of life and social interaction.

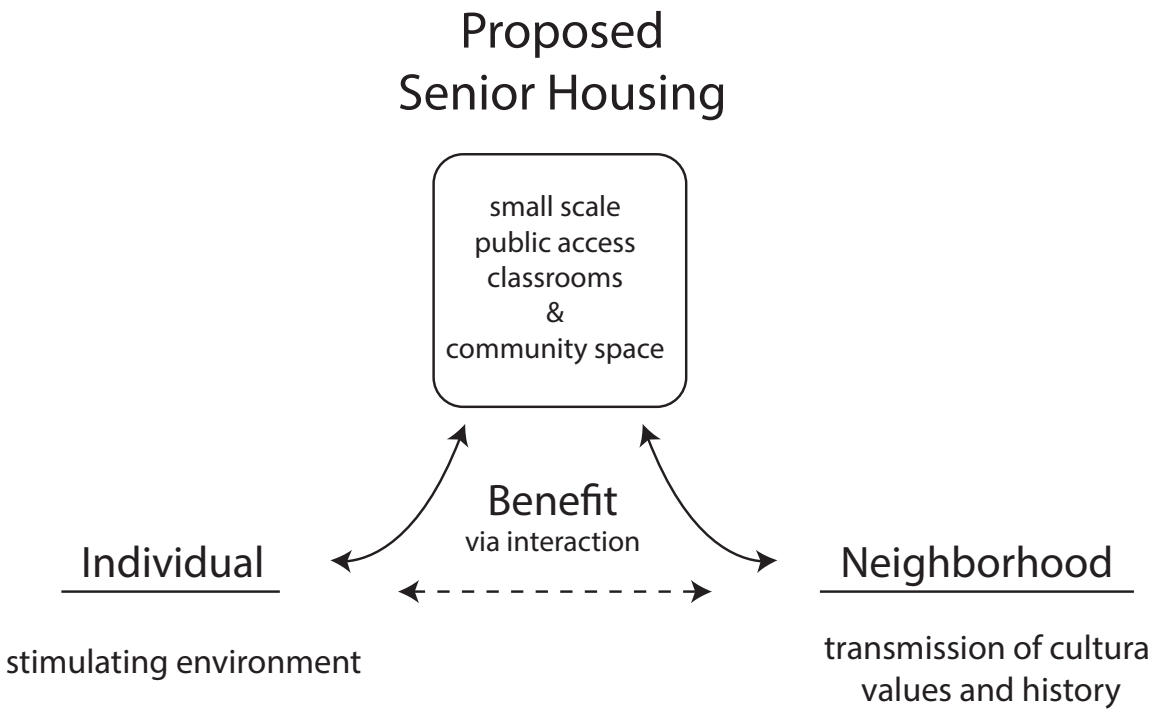


Figure 2.9: Theoretical Framework

CHAPTER 3. **Methodology**

The approach to this project involves first understanding how mental stimuli occurs internally and relates to our external physical environment. Through an analysis of the users daily routine and correlating it with the circadian rhythm a new approach to programmatic and spatial design occurs. Instead of doing a post evaluation of lighting and orientation, this thesis uses these factors as an impetus for design. While the building massing is influenced primarily by the neighborhood factors designed from an outside influences approach, the programming of space is done in reverse, designing from the most personal space, the mind, to the built environment. The integration with the surrounding neighborhood is equally important for establishing social ties and instigating physical activity, which are also important for mental health and improving the user's quality of life.

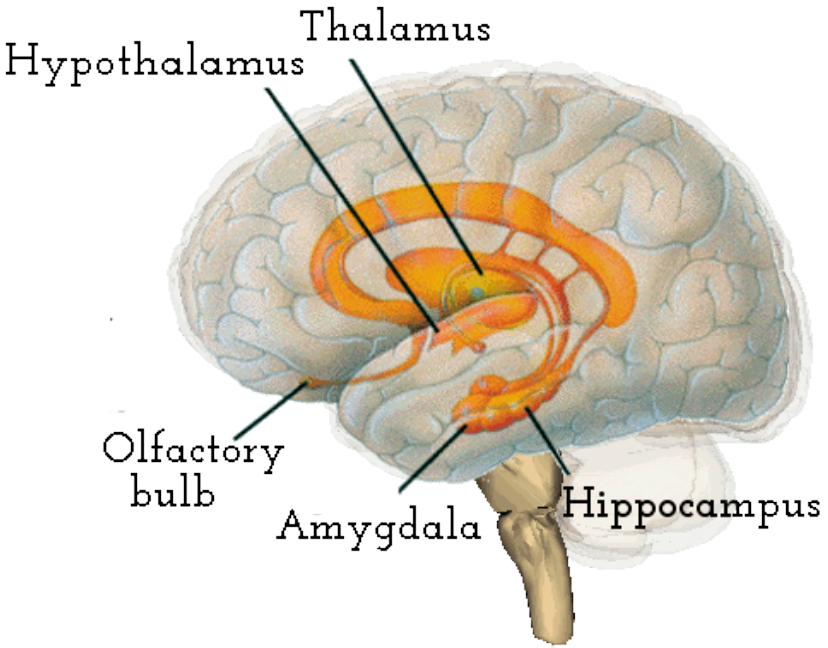
Figure 3.1: Circadian and enivronmental stimuli

In order to understand how the mind works there must first be an understanding of neurogenesis. Specifically, neurogenesis is where:

> New neurons continue to be born throughout life, particularly in the hippocampus, the part of your brain that processes new information on its way to being stored as long-term memories. This means that your capacity to add new memories and learn new skills can continue to expand. And how fast these cells are added seems directly influenced by the richness of our interactions with our environment (Badger 2015).

The hippocampus is part of the larger neural network, namely the limbic system. In simplified terms "the limbic system is a ring of interconnected structures inside the brain involved in emotion, motivation and memory"(BrainInsights). Located in the core of the brain, it is the result of interactions between the olfactory bulb, amygdala, thalamus, hypothalamus, and hippocampus. The thalamus, related to every sensory system with the exception of the olfactory system, functions as a type of sensory sorting device and is also responsible for sleep cycles. The limbic system's interaction between the thalamus and hippocampus via environmental sensory input is key to neurogenesis.

Figure 3.2: Limbic system diagram



Focusing specifically on the visual system,

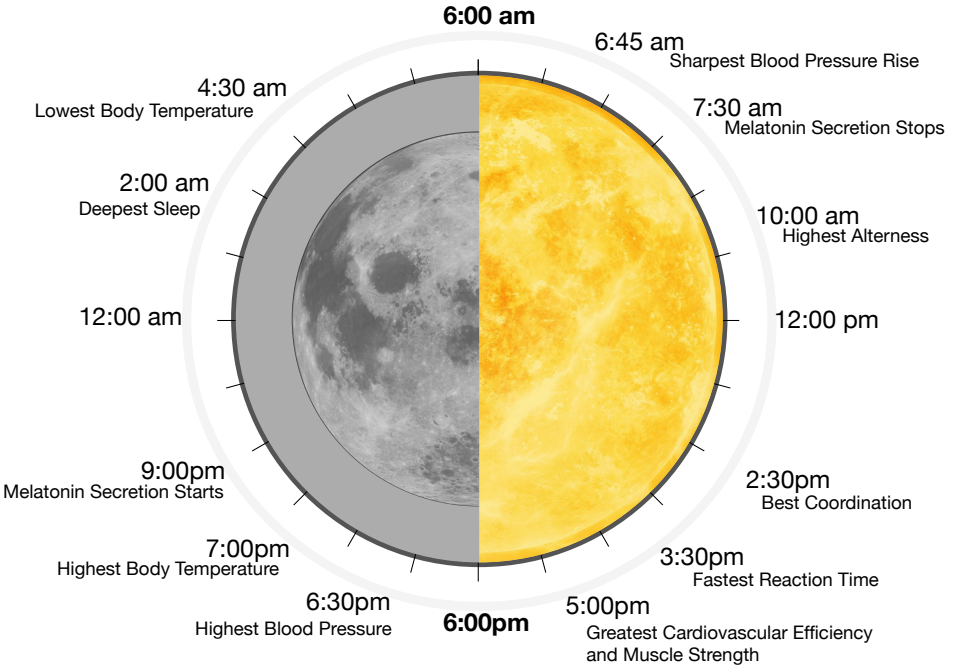
> inputs from the retina are sent to the lateral geniculate nucleus of the thalamus, which in turn projects to the visual cortex in the occipital lobe. The thalamus is believed to both process sensory information as well as relay it(Wikipedia)

This correlation between neuroscience and the built environment is the starting point for a design intervention that improves the user experience within a senior living residence. Recognizing that humans are biological creatures and are only beginning to understand how they are directly effected by our built environment through social, behavioral, and environmental studies. This thesis focuses specifically on the importance of tailoring both visual and auditory stimulus in designing living spaces, with an emphasis on the needs of elderly residents in order to enhance the neural network and quality of life for the users.

Aside from simply illuminating a space natural sunlight plays a key role in the establishing the biological clock, also known as circadian rhythms. To begin it is important to understand the definition of circadian rhythms.

> Circadian rhythms are evident in virtually all living animals and plants. They are genetically encoded and adjusted to local time primarily by an entrainment to the daily photoperiod via light reaching the eye (Bonde 380).

Figure 3.3: Body clock correlationt to circadian rythms



Furthermore,

Circadian rhythms (including, for example, sleep/wake cycles, body temperature, blood pressure, hormone secretion, digestion, metabolism, and cell turnover) are pivotal for survival and driven and maintained in a hierarchical manner by a central pacemaker (the biological master clock) located in the suprachismatic nucleus (SCN) of the hypothalamus (Bonde380).

Figure 3.4: Visible spectrum

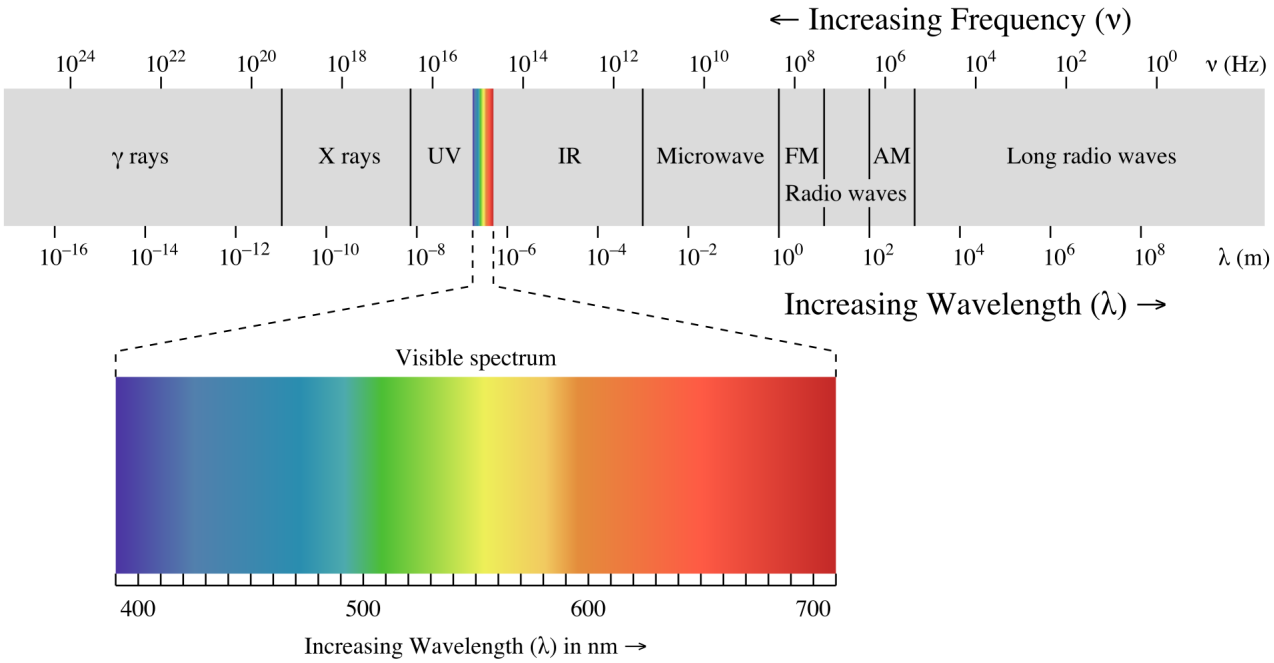
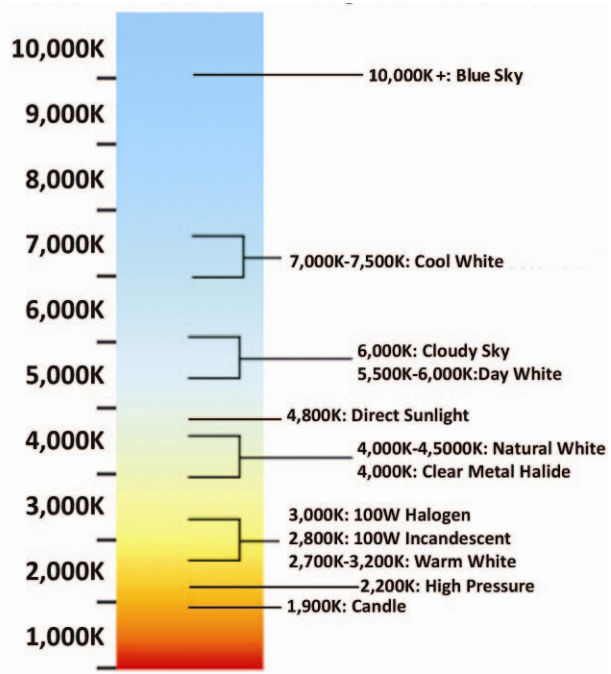


Figure 3.5: Kelvin temperature chart



The disruption of the individual's circadian rhythm and has direct correlation to health effects and is most prevalent in night shift working conditions with exposure to fluorescent or blue shift light (Lockley). In a lighting study with night shift workers they noted that in regards to melatonin production, "light with wavelength 460-480 nm creates the strongest suppression; work in constant dim

Color Temperature	Warm	Neutral	Cool	Daylight
Kelvin Range	3000K	3500K	4100K	6500K
Associated Effects and Moods	Friendly Intimate Personal Exclusive	Friendly Inviting Non-threatening	Neat Clean Efficient	Bright Alert Exacting coloration
Appropriate Applications	Restaurants Hotel lobbies Boutiques Libraries Office areas Retail stores	Public reception areas Showrooms Bookstores Office areas	Office areas Conference rooms Classrooms Mass merchandisers Hospitals	Galleries Museums Jewelry stores Medical examination areas Printing

Figure 3.6: Corresponding lighting sources

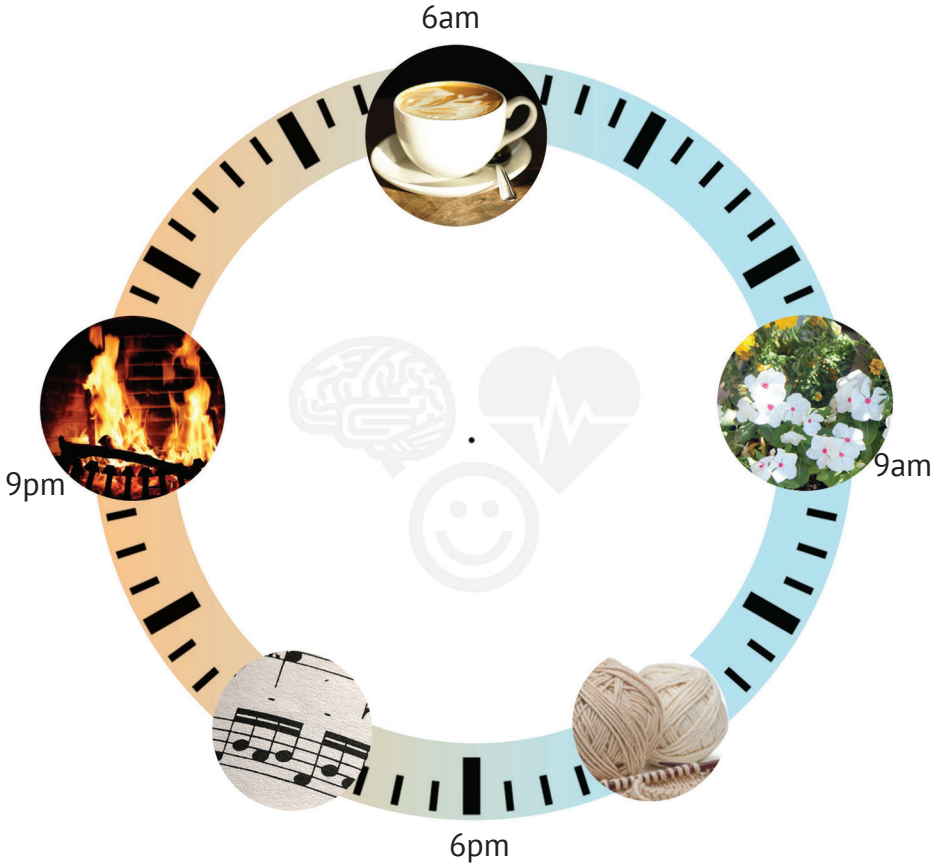
red light is hardly a realistic option since most work tasks require better lighting conditions for safety and productivity reasons"(Bonde 382). This correlates to programming social activities to optimal lighting conditions within the built environment, depending on the appropriate time of day.

Even blind people have a response to daylight patterns and process this through the ganglion cells.

> As the ear has dual functions for audition and balance, the eye has a dual role in detecting light for a wide range of behavioral and physiological functions separate from sight. These responses are driven primarily by stimulation of photosensitive retinal ganglion cells (pRGCs) that are most sensitive to short-wavelength (480 nm) blue light and remain functional in the absence of rods and cones(Ulrich).

Ideally, by creating environments which pair programmatic function with the appropriate light range according to the color temperature which fits with the circadian rhythm, the resultant mental function would be at it highest potential. This logic impacts design by locating bedrooms with southeastern exposure, so inhabitants wake up at the appropriate time and sync to their daily cycle.

Figure 3.7: Daily activities acording to circadian lighting cycles



Open air corridors will expose the inhabitants to nature and natural lighting conditions. Ending the day around 9pm with a low color temperature lighting atmosphere will help encourage the natural processes of melatonin secretion allow the body to have a better sleep cycle.

Nature also thrives with daylight and will provide another component in the realm of mental stimulation. Exposure to natural elements or ephemeral views successfully:

> generates an affective reaction of fascination, which leads to a thoughtful evaluation of a scene and elicits a preference for and remembrance of the sight. In times of stress, a lengthy cognition (as involuntary attention) and recall can allow one the time to modify emotions and can produce changes in physical and mental arousal (Abbott 69).

Incorporating nature allows for mental wanderings and has also been associated with lower levels of stress, which is good for physical health (Ulrich 38).

Personal micro-gardens would allow residents to take ownership over a small project and engage their imagination. Public walkways and corridors could become areas to socialize that are filled with green planting areas. Departing from the traditional double loaded corridor in favor of open air walkways creates visually aesthetically appealing environments that are also biologically healthy environments and provide fresh air.

Firgure 3.8 Mini-garden space
source: Janit Calvo

Open spaces could also be areas of quiet reflection so that "contemplative architecture" in one's environment may over time produce the same health benefits as traditional "internally-induced" meditation, except with much less effort by the individual"(Hoffman). The plants could include a variety of different scent profiles and encourage users to take time to smell the roses.

According to a study done by researchers at the Salk Institute,

> Adult neural stem cells continually generate new brain cells or neurons in two small areas of mammalian brains: the olfactory bulb, which processes odors, and the central part of the hippocampus, which is involved in the formation of memories and learning. Some of these newborn cells die shortly after they are born, but many of them become functionally integrated into the surrounding brain tissue. Whether they live or die is regulated by the animals' experience(Newborn 2008).

This can be applied to the design process by designating interactive landscape areas and spaces that recall memory through sound. Using music as an instigator of activity in the hippocampus, because of its link to memory, there is potential to make new mental connection within the neural network. In a study with professional piano tuners there was a direct correlation to an increase in the size of gray matter in the hippocampus. According to research published in The Journal of Neuroscience,

> findings support a role for a core set of regions in the hippocampus and superior temporal cortex in skilled exploration of complex sound scenes in which precise sound "templates" are encoded and consolidated into memory over time in an experience-dependent manner(Teki).

This could mean that in theory by using music to activate portions of the hippocampus it could also instigate neurogenesis. An earlier study from Trends in Cognitive Sciences in 2005 questions the evolutionary advantages to making music. They study postulates that music has "positive effects on the immune system, and such positive effects might represent one origin for the evolution of cooperative music-making behaviour in humans" (Koelsch). "Interestingly, it appears that human musical abilities are important for the acquisition and the processing of language" (Koelsch 2)

This avenue to neurogenesis through music will be incorporated into the building by including a music school as part of the public program elements. A public courtyard in the design could serve as an interface between the senior home and the public realm where music can literally and figuratively bring people together, allowing for intergenerational interaction and neighborhood engagement.

Physical activity is also linked to positive mental activity in older adults. Walkable neighborhoods are important to make physical activity more accessible. In order to be considered a walkable site it must be within a quarter mile distance to grocery stores, while shopping, entertainment, volunteer and learning opportunities can be within an extended mile radius. In a study supported by the Department of Veterans Affairs, Rehabilitation Research &Development Services they found that cardiorespiratory fitness is important to preserve white matter in the brain. According to the research study activities, "such as as walking, are inexpensive,accessible, and could potentially improve quality of life by delaying cognitive decline and prolonging independent function"(Hayes 696).

This is an evidence-based thesis and uses primarily a positivist research paradigm in terms of the literature reviewed and site selection. This thesis attempts to make a cohesive network of

Figure 3.9 Active Seniors

programmatic functions that encourage interaction between seniors and the neighbors. Further, it aims to create a compelling argument for a stimulating sensory scale design incorporating music, nature, and physical activity in a way that aligns with lighting design principles to reinforce natural circadian cycles.

Chapter 4. **Site and Program**

The site is located on the Northwest corner of 54th street and 11th Ave in Ballard and lies along the transition boundary between industrial commercial buffer zone and residential zoning. The site takes over two lots which have two separate zoning heights due to this location and the proposed building massing will respect these height restrictions. The southern plot is zone to 65 feet and the north end of the lot is zone for low rise residential.

The first priority in site selection was being located within a walkable neighborhood. According to inclusive urban design principles the UK government recommends providing housing within a quarter mile distance to the nearest grocery store without having to cross a major roadway (Burton 98). This was because it is considered a primary service, other primary services include banks, the post office, and healthcare facilities. Secondary services such as the library, places of worship, and leisure activities are

Figure 4.1: Site context

recommended to be within 800m which for this site is relatively close, almost within a half mile radius.

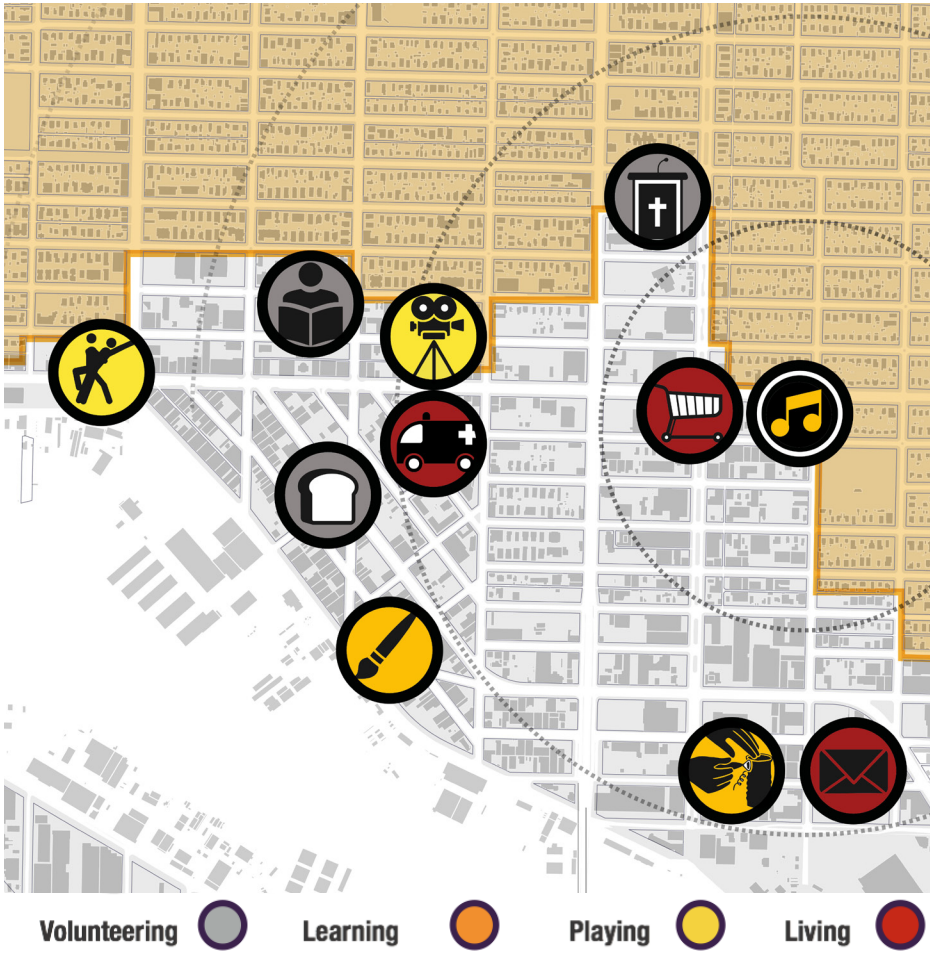


Figure 4.2: Neighborhood amenities

The building will provide housing for active seniors who want to live in a more social housing option which engages with the neighborhood through public space and program. The small private apartment style living will be combined with common dining and living room areas which are accessible to the public and facilitated by the operation of an incorporated music school program.

Moving from the building scale to the larger neighborhood scale, the goal is to design a particular site response within a community network of medium sized senior living facilities. The smaller scale allows the inhabitants to navigate their environment more easily and focus on the quality of the interior space. At each facility there would be a classroom space typology where neighborhood residents can engage with the senior population through storytelling and

mentorship activities. The mixed use component of the proposal integrates public facilities as a mutually beneficial relationship for the seniors and the community, an example of this could be a community aquatic center, library, theater, ceramics, and music school.

Although the target audience for the housing component is elderly citizens, defined as people over the age of 65 without mental illness, the general approach is one of universal design which would benefit people of all ages. There should be a clarity of public, private, and semi-private space in the building massing or materials in relation to public space as a means of inviting neighborhood inclusion without crossing personal boundaries. Mirroring the overarching goal to prolong the quality of life for the inhabitants and the neighborhood, the building design itself should exemplify sustainability, preform as an educational tool, and be a good building neighbor.

The building program will consist of senior housing of approximately 12 units and a music school. The housing is set up as independent apartment units which rely on the residents to use communal living space for most of their needs. The apartments vary among three different unit types, ranging from 600sf to 1200sf, for a total of 10,000sf. Service areas such as laundry, trash, recycling, and cleaning supplies will be allotted 800sf. Common public spaces (1200sf) include a music library and computer lab with have a semi-public nature and have access to an adjacent outdoor space. the ground floor of the building serves as a public interface and includes retail/educational operations (1800sf), reception desk (20sf), and public restrooms (800sf), and art gallery (200sf). The total programmed area is 20,020sf and 4,180sf of circulation space for a combined total of 24,000sf.

Ballard presents an interesting juxtaposition between the rapidly growing city of Seattle and the smaller scale neighborhood

Figure 4.3: Seattle context

community and history of the area. Ballard was established as a city in its own right in 1889 and was annexed to Seattle in 1907(Ballard). According to the Ballard Historical Society it is still known today, "for its strong Scandinavian ties and its character as a small town within the big city". As evidence of the Scandinavian ties there is a Nordic Heritage Museum located in Ballard, which has community oriented events year round. They are currently raising funds and designing a new facility closer to the heart of Ballard on Market street along the waterfront. Thus, showing their continued involvement and importance to the neighborhood.

Existing demographics of Ballard were fairly constant previous to 2010, but recently there has been a surge of younger generations and corporations moving to Seattle. This economic influx of activity has put the elderly population of being displaced. According to a Seattle Times article surpassed its twenty year growth rate within three years and three months and was at the time 147% of expected

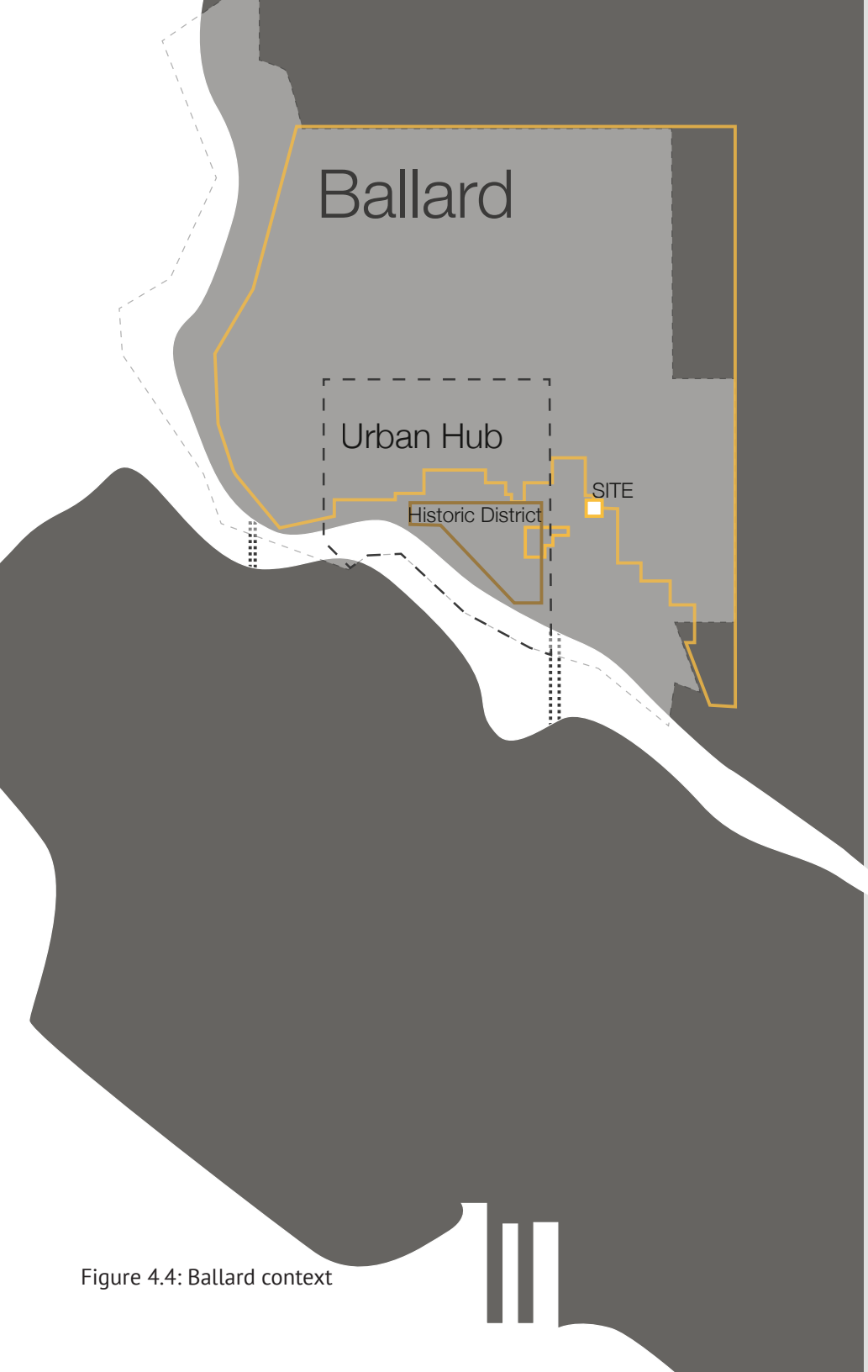


Figure 4.4: Ballard context

growth (Eskenazi 2008). An extreme example of this inspired the Disney movie UP, which is based on the story of Edith Macefield who in 2006 refused to sell her Ballard home for a million dollars. According to the 2010 Census, the Ballard Community Reporting Area has a total population of 6,739 with a median age of 37.4. In comparison, the International District has a median age of 46.5 years old with 5,333 people and First Hill has 15,181 residents with a 37.2 age median.

Ballard is a prime site for incorporating this senior housing network because of its historical character and at risk of displacement from Seattle growth. Most of the current development is located in the the Urban Hub directly North of the Historic District. Future growth is likely to continue along the transition from residential to commercial to the East of the Urban Hub. This thesis' site location is along this transition boundary and would be part of a network of senior living homes within walking distance of each other.

The siting of the senior housing is based around pertinent services and infrastructure such as hospitals, grocery stores, libraries, and recreational activities. The programmatic components will be determined based on what is lacking within the neighborhood and distributed in close proximity to public transit and green space. The insertions for senior housing and public amenities will fill the gaps between the industrial buffer zones and the residential fabric of Ballard. The network would operate under an umbrella company that is for the purpose of the thesis entitled the Active Elders Network (AEN). Similar to a typical nursing home the larger company will be responsible for building maintenance and the public amenities, while residents pay a rental fee for their housing accommodations. Each housing cluster is comprised of approximately 15 residents, based on the size of a seminar class, and suggested numbers for successful group home living social dynamics (Rosenfeld 79). Each housing cluster would be paired with a specific sensory focus. For example, the music related program will identify ways that hearing can be amplified or improved. There could be a textile studio which highlights the tactile qualities of the building's materials. A culinary component which focuses on smell and taste and traces the roots of farm to table relationships. Someone who wants to learn to watercolor would live within walking distance of the arts cluster, while residents who are willing to donate their time to teaching such a class could receive subsidized housing if they live in the network. The reciprocal nature gives additional incentive to live in this mixed-use senior housing typology. It is beyond the scope of this thesis to go in depth to each sensory program partnership, but the network as a whole would theoretically improve the senior living experience as well as benefit the general public and the surrounding neighborhood. Each building should still take into account circadian rhythms as a strategy for programming space with optimal daylight orientation.

Chapter 5. **Design**

To reiterate, the problem is that there is no appropriate solution to senior housing that maintains the individual's sense of identity and freedom, while being close to social services and amenities. The theoretical framework for this project proposes a smaller scale facility which operates within a larger network. It can thereby provide benefits to both the individual inhabitants and the surrounding neighborhood through the use of public space, social interaction, and mentally stimulating lighting and acoustical environments.

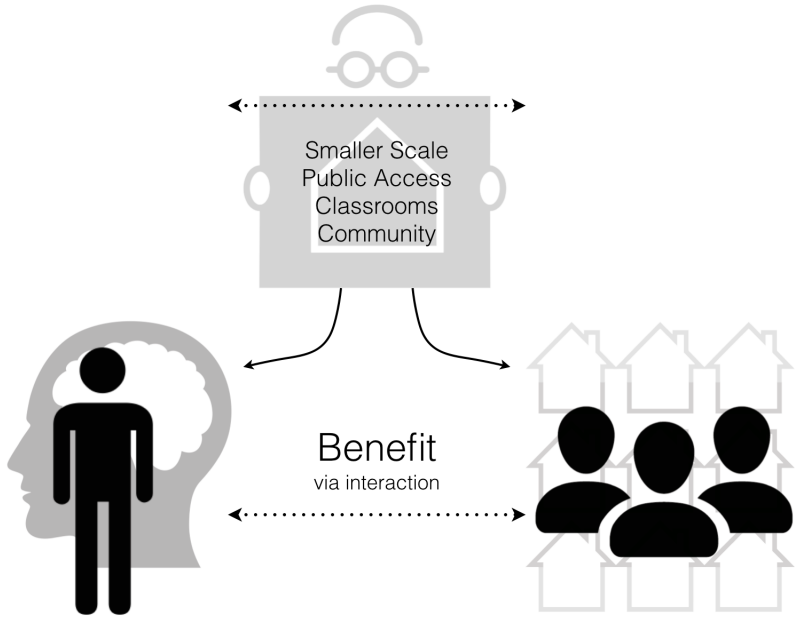


Figure 5.1: Theoretical framework graphic diagram

To summarize the research, the starting point for this project was the discovery that neurogenesis continues throughout our lives in response to our environment and sensory input. In regards specifically to the aging brain, seniors experiences slower cognitive skills, changes in the visual system, hearing loss, declining neuromuscular systems, and changes in personality (Eberhard 131).

Therefore a building which seeks to promote these aspects of the aging brain will be an especially worthwhile endeavor. A single building is not a one fits all solution to this problem, so the idea of a larger network of buildings where each housing cluster has a different emphasis is an important to allow for various subcultures. Based on current development projects and projecting for future growth the senior network would be inserted along the transition to residential zones on the eastern side of the Ballard urban hub.

The building being proposed would be the first in the series and thus the most centrally located. The majority of the other senior housing clusters would be located within a quarter mile radius to facilitate pedestrian activity between the various public amenities that each cluster offers. All of the buildings would not be built at the rate of current construction, which has only included one senior living facility, but still at a quicker pace because of the rapidly increasing senior population demographic.

Figure 5.2: Recent construction and future growth

Specifically, this proposal looks to the ways in which visual environments within and around a building can promote mental activity as part of neurogenesis. Concurrently, biology and cancer research studies have shown that our circadian rhythm, which is responsible for aspects of our physical and mental health, is directly linked to levels of daylight in conjunction with our circadian rhythm (Gaddemeehi 18790). This biological process can be interrupted through the use of electric lighting and have a harmful impact on our physical well being, therefore care should be taken to craft spaces which correlate to the appropriate lighting levels for specific times of the day (Bonde 382).

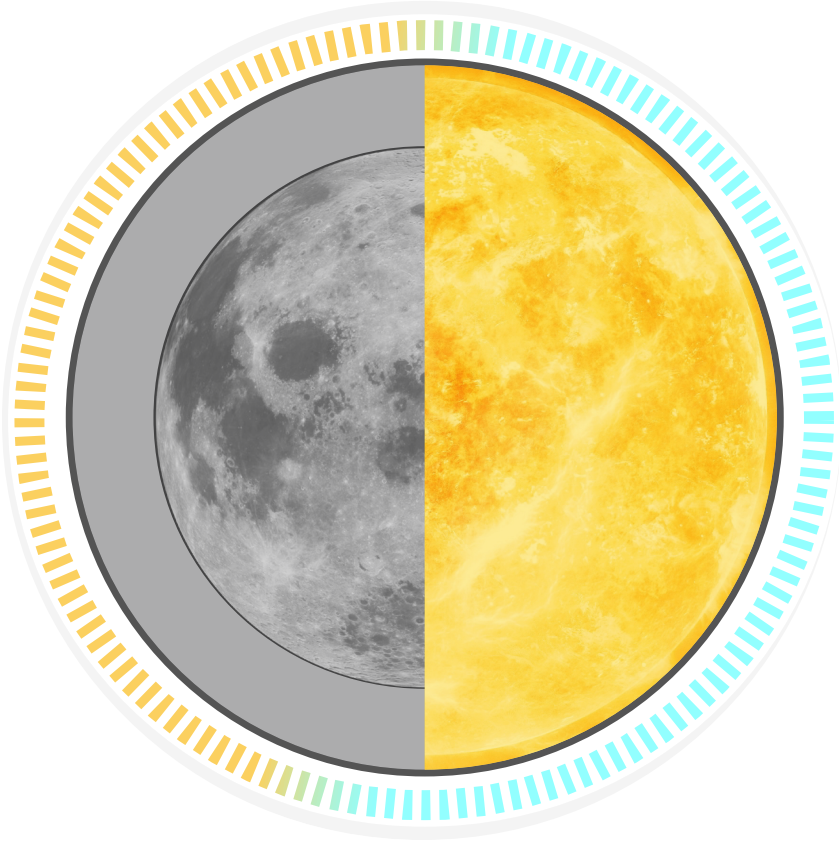


Figure 5.3 Circadian lighting with corresponding color temperature diagram

Overlaying the appropriate times of day for natural sunlight with the Seattle sun path diagram creates a key by which to cooridinate the building program elements. The blue corresponds to the time of day when it is beneficial to receive natural daylight and the orange corresponds to a shift in artificial light with a warmer color temperature, also referred to as blue deficient lighting.

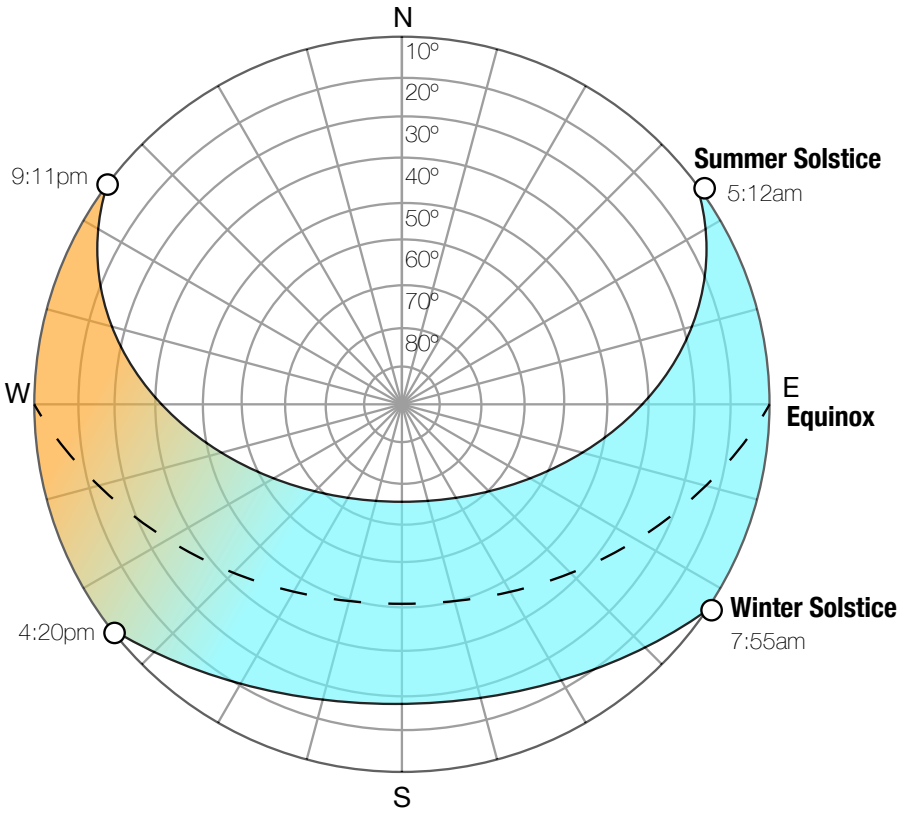


Figure 5.4: Seattle sun path overlaid with circadian lighting diagram

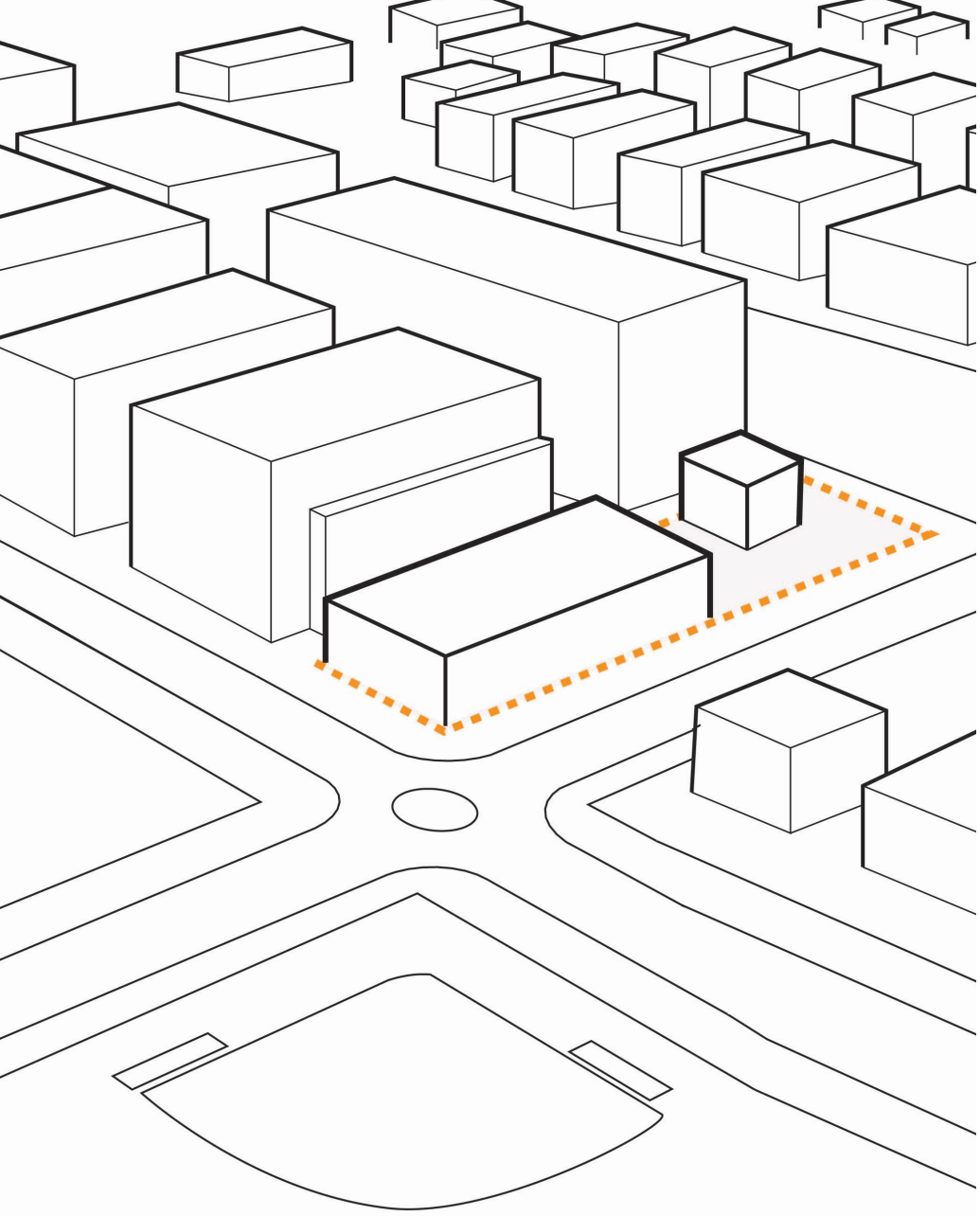


Figure 5.5: Existing site massing

The site was chosen for its location along the transition between industrial and residential uses, current under utilization, and its proximity to daily amenities and park space. The current single story storage building and single family residence would be demolished and replaced by a higher density structure. The proposed project does not exceed four stories so residents will be more likely to use stairs. To the southeast of the site is Gilman Playground which provides a nearby area to exercise.

Figure 5.6: Existing site

The two major programmatic elements of housing, which is diagrammed in blue, and the music school, represented in red, are expressed in two separate buildings connected by a bridge. All of the housing is in the southern building block with a cafe dining and living room area that are open to the public at the ground floor as a mixed use area.

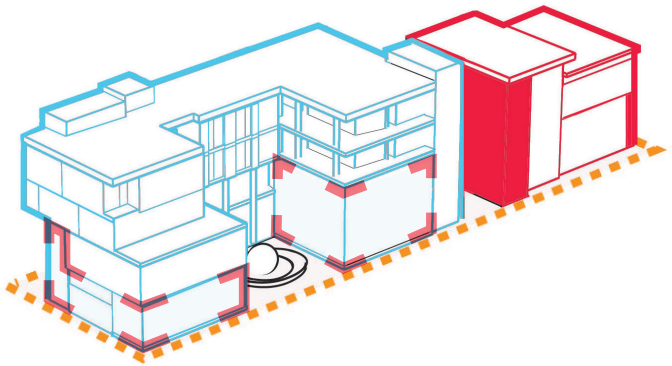


Figure 5.7: Building program diagram

Figure 5.8: Proposed massing

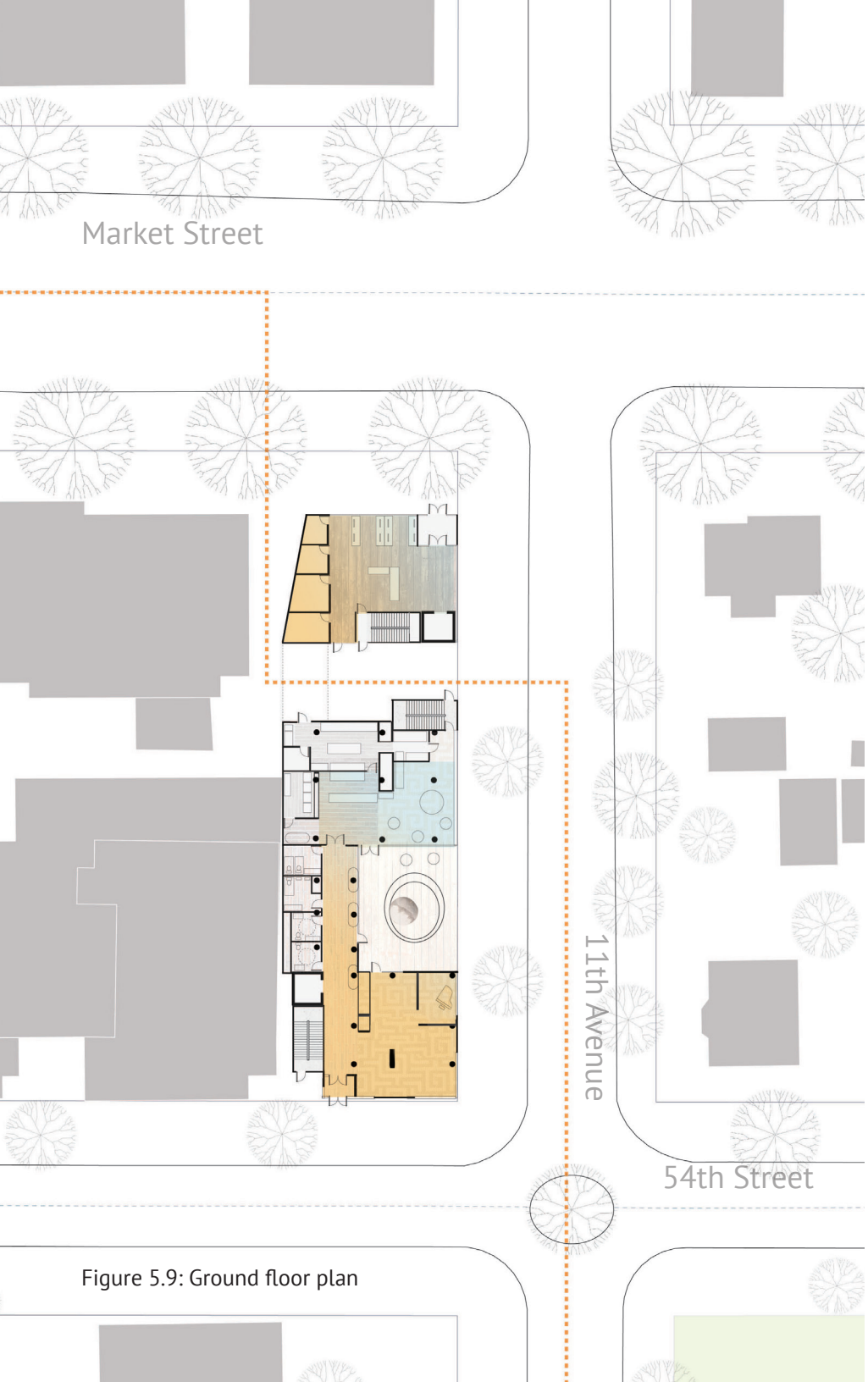


Figure 5.9: Ground floor plan

The building sits along three street edges, all of which have varying degrees of noise and vegetation. Market Street is loud from a heavy traffic, while 54th Street is much quieter. The building responds to these conditions by placing the more public program along Market Street, where the primary functions take place in sound insulated spaces. The large trees along Market Street dominate the sidewalk and therefore the building sets back from the lot line corresponding to the other buildings on the block. The trees along 11th Avenue are much less imposing and the building face is allowed to meet the sidewalk edge.

The building footprint helps to show the idea of the transition from a large block building to the smaller scale residences by incorporating a courtyard and service entrance. The dining area is illustrated in blue as a key for natural morning light as a primary design goal. Later in the evening the need for blue deficient light is marked by the orange gradient in the common living room.

Figure 5.10: All floor plans

The bedrooms are oriented on the eastern side of the building to receive early morning sunlight, coded in blue. The apartment units each have a front door that opens onto an open air walkway with opportunities for green space. The common living room to the on the south end of the building incorporates movable walls so that it transforms for special events into a performance space, but can be partitioned into spaces for music practice and for socialization. The symbolic significance of a fireplace as the center of a home and community is employed in this main living room which would coincide with evening lighting conditions, coded in orange.

As the user transitions from indoor to outdoor environments it creates a more dynamic lighting environment throughout the day, denoted by the green areas of the section. The spaces which are more service oriented do not need natural lighting and are therefore pushed to the bottom and back side of the building, where the access to light is prevented by the adjacent building. The service areas include public restrooms and a laundry room that use blue deficient artificial lighting so they could be used at any time of day.

The main corridor connecting the vertical circulation to the cafe dining space receives natural light during the day from the adjacent courtyard, but at night it would have artificial light and is therefore colored in the orange spectrum. It is also important to note that seniors experience changes in their visual system and requires three times normal illumination (Eberhard 131). The main music school program is on the north side, with smaller practice rooms on the ground floor and a larger group practice space on the second floor.

Figure 5.11: Section A through courtyard

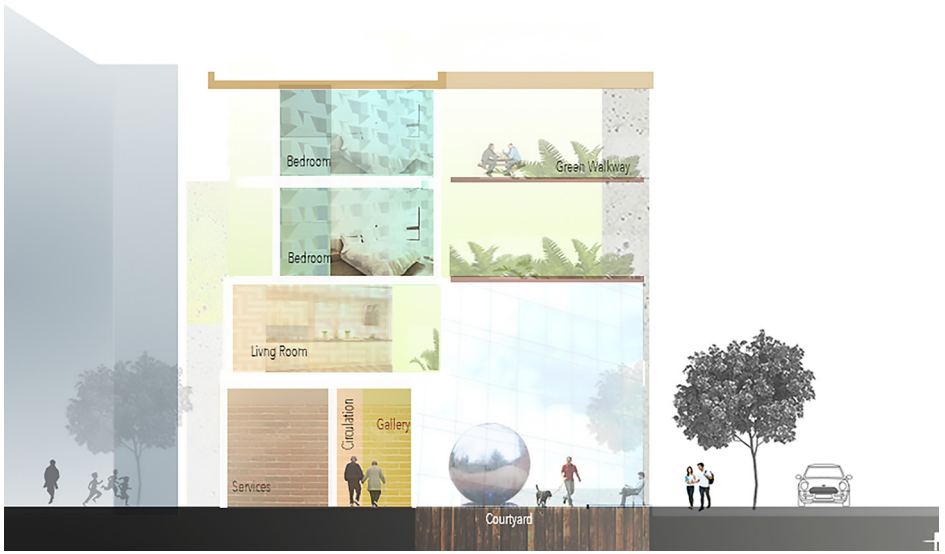
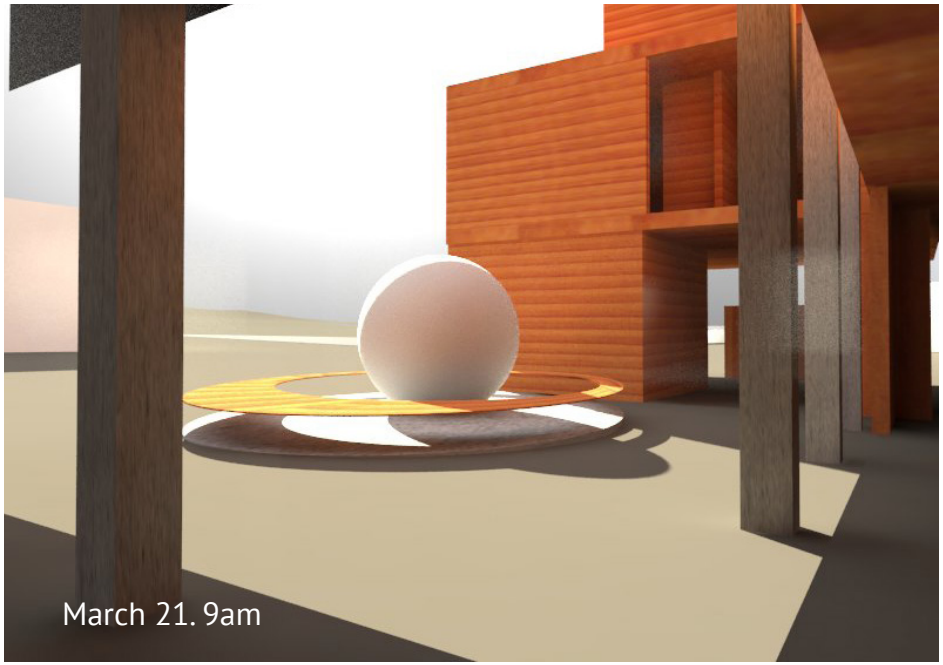


Figure 5.12: Section B through courtyard

The sculpture in the center of the courtyard is important feature in establishing a sense a place. The sphere geometry and reflective surface are meant to make the viewer be more aware of their environment in an axiomatic way.

Each senior center should incorporate some form of public art chosen or created by the community. Ideally it would be an interactive sculpture that could be manipulated by the users and change over time serving as another way to instigate neurogenesis.



The project was explored through both physical and digital models to ensure that the courtyard and adjacent cafe space would receive access to light in the morning before 10am throughout different times of the year. The comparison using the sun position for Seattle at 9am with clear sky conditions on March 21st and December 21st.

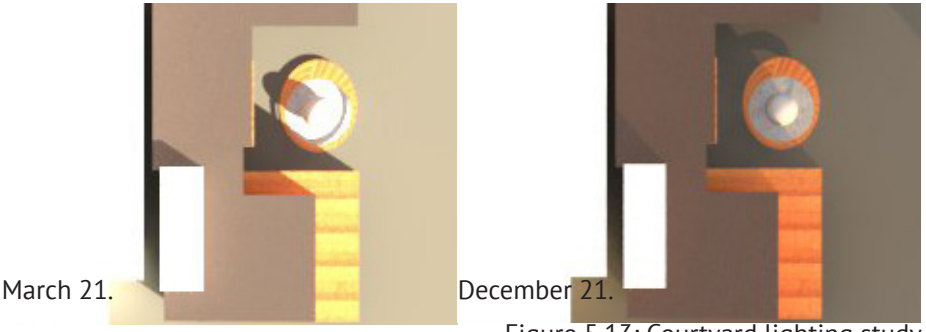


Figure 5.13: Courtyard lighting study

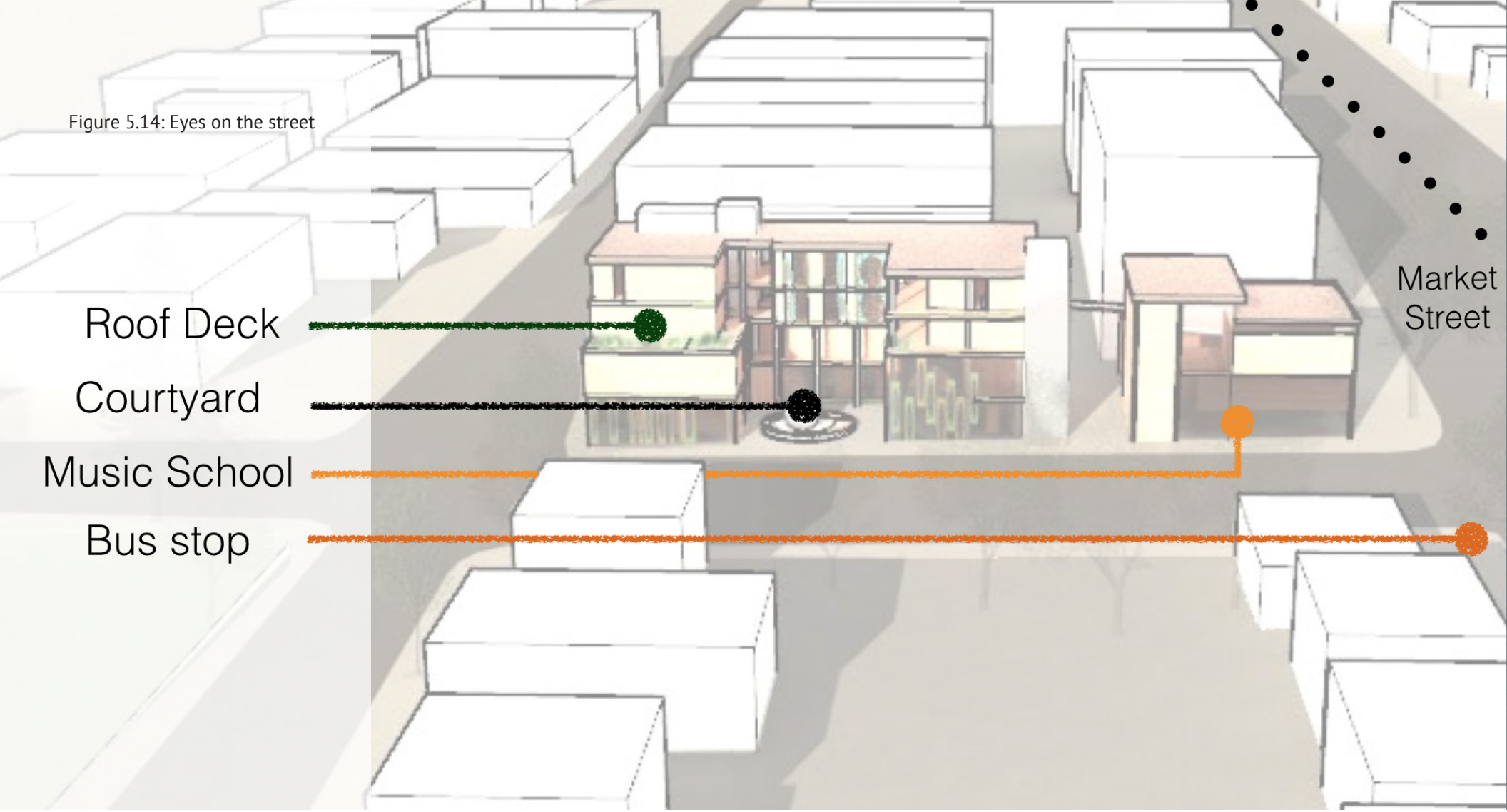


Figure 5.14: Eyes on the street

This thesis aims not only to make the building function on an internal level, but also to relate to the surrounding neighborhood in an engaging way. Due to the close proximity of the bus stop to the north and Gilman Playground on the southeast of the site, 11th Avenue has more pedestrian activity than the typical residential street and therefore the courtyard is likely to be used by local foot traffic. Through the music school program and visually accessible spaces including a garden roof deck, courtyard, and music school there are more eyes on the street, creating a safer and more inclusive environment.

Chapter 6. **Conclusion**

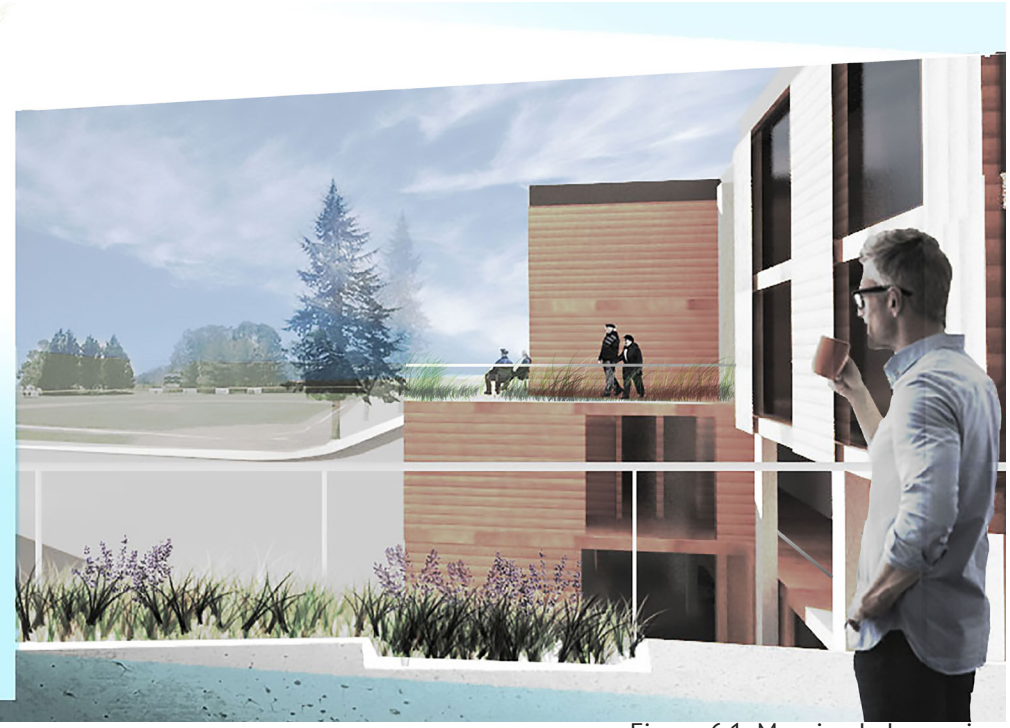


Figure 6.1: Morning balcony view

The project developed the idea programing space according to daily routines and corresponding lighting needs as the generator for design with the intention of making a building more mentally stimulating. Seniors living in this type of housing would be more engaged via interaction with the neighborhood and other residents, yet retain a sense of independence. Although this typology might not suit everyone's taste by having a variety of senior living options they will be more likely to find an appropriate housing solution for the large increase in the elderly population in the next twenty years.

The apartment units are independent nature, yet still provide access to common public space. In order to get to the group dining area they must leave their private apartment through a covered outdoor walkway instead of circulating through a double loaded corridor. This simple move of going outside provides dynamic lighting environment through changes in daily weather.

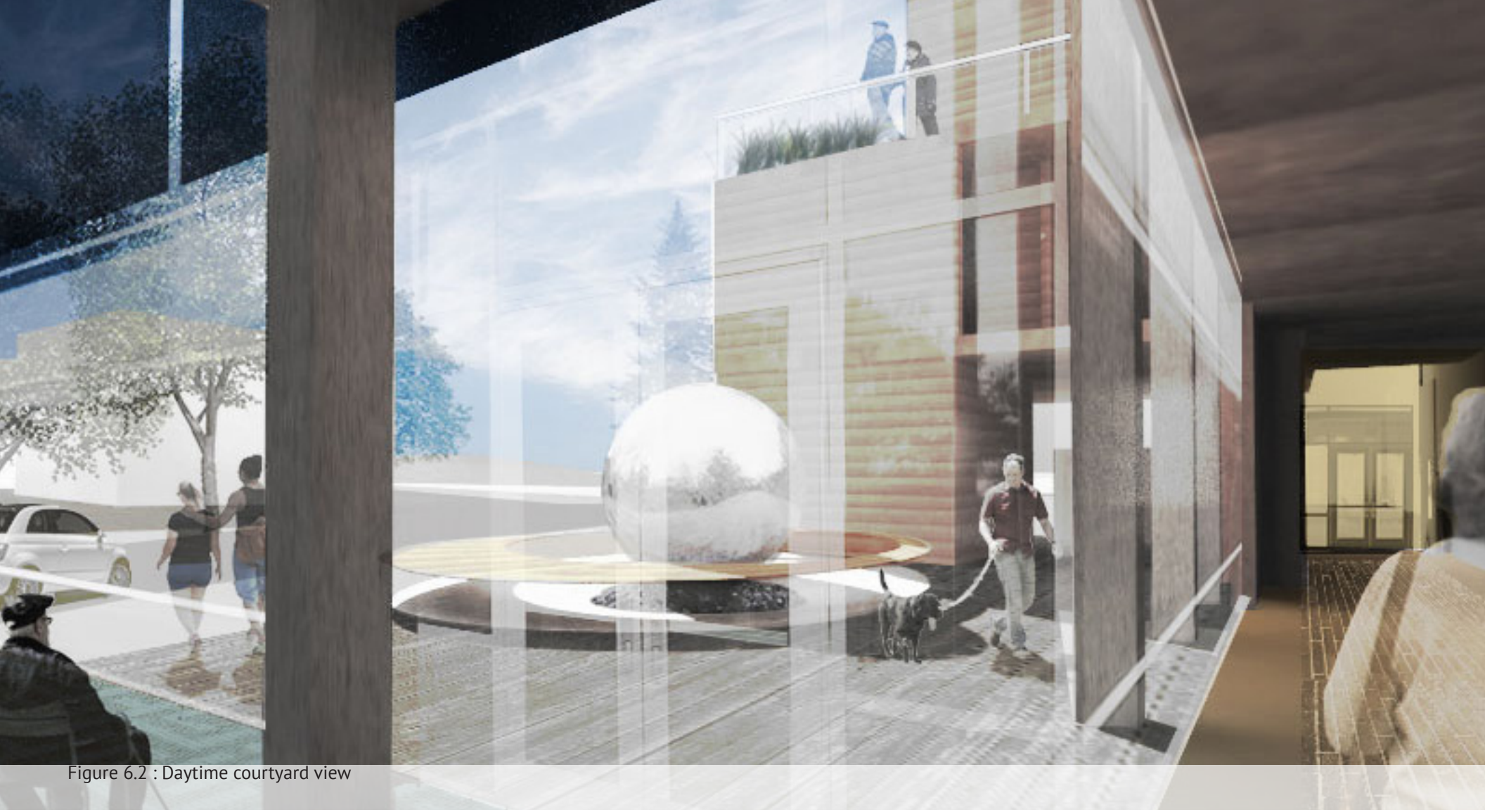


Figure 6.2 : Daytime courtyard view

The location of public courtyard on the east side of the site allows natural light to reach the dining area in the morning and invites the neighborhood to use a common space. If it had been removed from the ground plane it would not have been as accessible to other elderly residents in the neighborhood and would have felt too exclusive. Everyday activities such a walking a dog, having a conversation, or practicing an instrument it helps keep the courtyard feel alive and can help mitigate the sense of isolation experienced by my senior citizens. Going outside and providing residents with views to nature also has biological health benefits.

Figure 6.3: Evening communal living room

The fireplace is an important feature not only for social congregation and warmth, but also because it emits the appropriate color temperature light for evening activities. The a common living room provides residents with space to meet as a group and the lack of blue shift light will not disrupt their circadian system. This is not to say that the space would not be used during the day as well, but the lighting would be designed specifically for night usage.

The next step would be to more precisely evaluate the lighting levels through lighting simulation programs. Using a recently developed program called Lark, there is a way to analyze the different colors of light that would be reflected off of surfaces in the building depending on various sky conditions. The in the simulation would be to reach 80 circadian lux which is used a base value for instigating 100% circadian response (Inanici 4). This would apply in the spaces used prior to ten o'clock am, including the individual bedroom units and the cafe dining space.

The approach to building programming and design based on circadian lighting lux is especially important for seniors, but applies to people of all ages. The building could potentially be an intergenerational facility, but this thesis chose to focus on one age group considering the rapidly increasing senior demographic. The inclusion of the music school public program is meant to expose senior inhabitants to social interaction with a more diverse group of people and ages than they would typically experience in a normal senior home. Also, by designing more inclusive neighborhoods with greater walkability and public amenities, the neighborhood becomes more intergenerational and diverse.

Figure 6.4: Physical site model

List of Figures

(Author is the image source unless otherwise noted)

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