

waiting places

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Dedication

To Popsie.

Abstract

Within healthcare architecture, there is a void of attention directed towards the nonmedical spaces; the waiting rooms, hallways and all 'between moments' where many people spend extended periods of time under acute stress. Nowhere is this more prevalent that in the emergency departments where patients seek care and treatment for real or perceived, serious injuries or illnesses. While waiting for medical attention, exposure to high levels of harsh lighting, sterile furnishings, chaotic activity and cavernous rooms with others in distress can cause and increase anxiety, delirium and high blood pressure. The emotional experience of such spaces changes based upon a user's unique sensory conditions and therefore their individual perception of space.

The architectural design tools and devices to explore these highly charged sensory spaces have been historically limited to technical plans and sections and rendered marketing perspectival images, which do not fully communicate the immersive experience of these spaces when in use. Virtual reality is emerging as a powerful three-dimensional visualisation tool, offering designers the opportunity to comprehend proposed designs more clearly during the planning and design phases, thus enabling a greater influence on design decision making.

This research explores the use of ∇R in a healthcare perspective, adopting a participatory design approach to simulate sensory conditions of blindness, deafness and autism and the emotions associated with these conditions within space. This approach diverges from a purely visual method of design towards an understanding of the haptic, exploring the critical phenomenology behind these non-medical spaces. The research finds significant potential for the use of virtual reality as a design tool to simulate the experience of these spaces in early design stages.

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"Life does not have MOMENTS, however close they might be, but only meantime's, BETWEEN-MOMENTS" (Gilles Deleuze 2003)





1. Introduction

In healthcare architecture, there is a lack in consideration directed towards the design and experience of emergency facilities. Specifically, how the most predominant users (those experiencing disability) of these space might experience them. The interstitial spaces of emergency departments in particular fall into extremes of being either over or under stimulating to the individual users. Virtual Reality offers a potential to work with the users of the space, and ultimately establish a new approach towards the design of emergency departments.

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1.1 Emergency Departments

Emergency departments worldwide provide care and treatment for patients with real or perceived serious injuries or illnesses with over half of these incidents being deemed potentially life threatening (Tim Tenbensel 2017). Overcrowding and delays to treatment first emerged as a problem in New Zealand in the mid-1990s. Since then, there has been an increasing demand for more, larger and more productive emergency departments. Today, District Health Boards around the country are struggling more than ever to meet demands as they report record numbers of patients [Figure 1.5] (New Zealand Herald 2018). In the future, this situation is predicted to worsen with the increasing demand associated with growing and ageing populations as well as incidences of long- term conditions and challenges in aged residential care management (Forero 2011). In New Zealand, the Wellington region has one of the highest rates of emergency department use [Figure 1.4] and among the highest of demographics attending emergency departments are those experiencing disability(Ministry of Health).



Rate of people who were patients at an emergency department at least once during the year (2014/15)



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1.2 Disability

In 2013, an estimated 24% of people living in New Zealand were identified as disabled, an increase from 20% from 2001 (Statistics New Zealand 2013). Disability can be invisible, but can effect anyone [Figure 1.7]. Certain impairments are more likely to impact an individual's ability to engage with the physical environment, including those that affect the perceptual systems and influence how the users experience the space. People with these conditions are typically in higher need of emergency healthcare, but are limited in their ability to attend such places.





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disability may be invisible, but can effect anyone

1.3 Current Designs

Emergency department designs [Figure 1.8] constitute one of the greatest threats to quality emergency care (Forero et al., 2010; Braitberg, 2007; Schull et al. 2001; Mohsin et al. 2007; Foster et al. 2005; Sbrivulis, et al. 2006) and are associated with increased risk of error, delayed time-critical care, increased morbidity and excessive number of deaths. Detrimental effects include overcrowding and increased delays in transferring patients to intensive care units (Ou et al., 2009; Carr et al. 2007); delays in pain treatment (Forrero, et al. 2010); increased mortality (Richardson, 2006); and an increase in the numbers of patients who do not wait for treatment (Mohsin et al., 2007). Almost all of these situations occur in the interstitial spaces of emergency departments such as the hallways and waiting rooms. The negative effects are exacerbated in emergency departments where high levels of artificial lighting, institutional furnishings, chaotic activity, alarming noises and cavernous rooms are considered standard. This leads to increases in anxiety, delirium and high blood pressure (Roger S. Ulrich 2006).

Increasingly greater attention has been paid to the psychological and emotional risks involved in health care environments and the needs of the first-hand users. While this relationship has been extensively investigated with respect to demographics such as age, gender, etc., there is very limited evidence in the healthcare literature that acknowledges the needs and emotions of users with sensory impairments or disability, whether temporary or permanent (Baek, Joon-Sang, and Kun-Pyo Lee 2008).



1.4 Interstitial Spaces

Emergency departments are places where users are experiencing a very broad spectrum of emotions, ranging from, boredom, to anxiety through to fear at any given moment. The interstitial spaces such as the corridors and hallways are where users spend long periods of time 'between moments', waiting for treatment. While people typically spend upwards of 90% of their time in the hospital within these spaces, little consideration is given to their design. As a result most fall into extremes of either under or over-stimulation for the individual users [Figure 1.9] (Evans and McCoy 1998). The architecture and occupancy conditions are either unable to sufficiently stimulate those users with reduced senses for prolonged periods of time or they become overwhelming for those with intensified senses (Nicolaidis et al 2015).

"This is a space where the unexpected lives, a doorway, a place where quick responses will dictate how we are to emerge. In a space where infinite possibility and uncertainty reign, careful architecture is of the utmost importance – because where there lives the possibility of chaos, so too lives the sister possibility of comfort" (Huddy and Sanson, 2016, pp. XV)



1.5 *Designing for Impairment*

The architectural design tools and devices to explore highly charged sensory spaces, such as emergency departments have been historically limited. Virtual Reality (VR) is emerging as a powerful threedimensional 'smart' technology, offering designers the opportunity to comprehend proposed designs more clearly during the planning and design phases, thus enabling a greater influence on design decision making (Al-Kodmany, Kheir 2002). Although computer generated, VR closely resembles reality and allows the sharing of a single 'reality' by multiple people [figure 1.11] (Collins Dictionary). This research explores the potential of VR by using a strategy of participatory design and communicating design input from the primary occupants (impaired patients) to the designers, during all phases of design. It examines how VR could be used to understand the critical phenomenology of these interstitial healthcare places in relation to the impairments, typically experienced by the most predominant emergency department users and use these findings to address the future challenges of emergency department architecture.





1.6 Aims, Objectives & Scope

Aims:

- To develop a virtual reality tool which could be used to simulate disability and analyse emotional response
- To test the tool through the design of a new model of emergency department for Kenepuru Hospital, addressing both the physical and emotional needs of users with impairment

Scope:

This thesis explores the potential for Virtual Reality using a strategy of participatory design, communicating design input from the primary occupants (patients) to the designers, during all phases of design. It examines how VR could be used to understand the critical phenomenology of the 'between moments' of the emergency department such as hallways and waiting rooms. The thesis uses analysis of user emotion in relation the most predominant disabilities, typically experienced by emergency department users. Due to the limitation of time available, the scope does not extend to structural and construction details or detailed facade development. It is limited to those aspects of design that test the research question and focus on the development of a viable tool and method in relation to the earlier stages of design.

Because of the lack of easily customisable VR software, the program which the research focuses on is custom-made. There is a practical limit to the functionality that can be implemented into this during the research period. More advanced development of simulations would be left for future exploration.

Objectives:

- To use a process of participatory design, interviewing both people experiencing disability and healthcare professionals
- To use this information to develop realistic fictional 'personas' and an emergency department narrative
- To develop a virtual reality tool, simulating the experience of these 'personas' in the narrative
- To test this tool with designer participants by matching the 'personas' emotional response to the space the designed space

 How can VIRTUAL REALITY and PARTICIPATORY
PROCESSES be used as tools to inform the DESIGN
of an EMERGENCY DEPARTMENT for users with IMPAIRMENTS?





2. Research Methods

This research seeks to bridge the gap between phenomenology, disability and technology [Figure 2.1]. The methodology for this project included researching the existing field of knowledge, looking at literature and case studies, and using the findings as the framework for empathetic design throughout the rest of the study. It commenced with the development of a process for utilising VR, it then required the use of end-user participation to establish a realistic measure with which to test the success of the method. An emergency department was then designed to trial the new tool with designers, comparing designer responses with end user responses. Following the completion of each stage of design, a process of feedback from both medical and architectural experts was obtained combined with personal reflection to understand gaps in the methods and outcomes. In addition, the research was presented at a prestigious international conference of the Architectural Humanities Research Association and the Architectural Science Association conference to obtain more extensive international feedback. The accompanying paper was published in the conference proceedings (Harkness, McIntosh & Marques 2018).



2.1 Virtual Reality Method

In order to utilise Virtual Reality as a tool for design, an advanced method was required. This tool was developed through a method of participatory design, using interviews with both health care professionals and people experiencing impairments, to understand the emotional response of users to the emergency department environment. The tool allows for an empathetic approach to the design of emergency departments for end users with impairments. The method consists of seven stages, with the end goal of creating and empathetic and emotionally responsive emergency department concept. These steps are repeated and reflected on in order to reach the final outcome.

10.2		
VIRTUAL REALITY SIMULATIONS	PHENOMONOLOGICAL DESIGN APPROACH]→ "Between MOMENTS"
		-

Visualisation Technology

The VR equipment used was a HTC Vive with a 110 degrees field of view and tracking area are of 5 x 5 m. An Alienware Aurora R5 processor was connected to the VR equipment. Steam VR and Fuzor 2018 were used to run the experiment.

- **1**: interview healthcare professionals
- **2:** develop emergency department narrative
- **3:** interview people experiencing disability
- 4: create fictional 'personas'
- **5:** develop virtual reality simulations
- **6:** test simulations on participants

7: reflection

2.2 Participatory Design

Participatory Design is a well-established approach to design which involves the participation of end users to elicit their needs. In this case, by considering characteristics such as end user sensory conditions, and backgrounds (Baek and Lee 2008, Bruno & Muzzupappa 2010) it gives them a chance to affect the design process and thereby influence the overall outcome of the architecture. In this way, the design process becomes a co-operation between the designer and the end user, aiming to guarantee usability, simplicity and intelligibility of the architecture to the users. In this research, two end users are involved--the patient/healthcare users who will influence and experience the final design and the designer end user who will experience the use of the design tool to understand the requirements that are held by this unique group of users (Baek and Lee 2008).

Participation is used during three stages of the process: working with healthcare professionals to develop the narrative of the emergency department, interviewing people with impairments to develop the virtual reality simulations and finally testing the simulations on design participants to determine their effectiveness.

Three key problems with participatory design have been identified for architectural design (Bruno & Muzzupappa 2010):

- The proposed designs are presented as a set of 2D plans, which are unreadable by inexperienced users; rendered images which do not communicate the human experience; or physical models which can be both time consuming and expensive to construct, all of which can only be produced in the final stages of design
- The designers and the users do not share a 'common language' thus complicating communication and cooperation.
- Users are often not involved until the evaluation phase, limiting their input.

This research addresses these concerns by:

- Using Virtual Reality throughout the design process so participants can understand what it is like to inhabit the space
- Dealing with emotional response to space rather than asking for architectural preference
- Using VR as a mediation tool between end user and designer, thereby allowing for participatory processes at multiple stages of the design.

1: development of the personas with help of impaired people and organisations

2: develop emergency department narrative with healthcare professionals

3: test simulations with participants acting as the designer



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3. Literature & Case Studies

To design for the full complexity of an emergency room and its often impaired end users, an expanded approach to the literature review is required. Disciplinary theories or tools can be used to bridge the gap to reality; similarly, philosophical theories can address complexity and elaborate on the topic under investigation (Van Hoof and Verkerk 2013). In this situation, the philosophy of phenomenology and technology are considered for their potential to shed light on the imperatives of design. Where these theories fall short, Salutogenic Methods and Evidence Based Design principles were used. This research provided a technical approach to healthcare architecture based on the application of scientific observations.

3.1 Philosophical Approach

Broadly defined as the study of conscious experience as experienced from the subjective or first person point of view (Smith, 2018), phenomenology, a branch of philosophy, has lent itself to the area of therapeutic architecture. In particular, Juhani Palasmaa and Stephen Holl offer insights into the benefits of a phenomenological approach to architecture. In order to address the juxtaposition of using VR with a phonological approach, Martin Heidegger's theories surrounding the philosophy of technology were considered.



3.1.1 Juhani Palasmaa The Eyes of the Skin

In Juhani Palasmaa's text 'The Eyes of the Skin' the way in which a haptic environment can engage with the body's innate sensory needs and invoke emotive qualities is explored, thereby conveying subliminal 'truths' – such as calm, stillness and rest – to the semiconscious. Pallasmaa challenges the typical architectural dominance of vision and hearing as the "privileged sociable senses" (Pallasmaa 1996, pp10). He maintains that in order for architecture to have an authentic experience, it must be haptic, engaging all of the senses, and in particular, the sense of touch [Figure3.1]. "Touch is the sensory mode that integrates our experience of the world with that of ourselves" (Pallasmaa 1996, pp 11).

"the role of the body as the locus of perception, thought and consciousness, and of the significance of the senses in articulating, storing and processing sensory responses" (Palasmaa 1996 pp 10)



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3.1.2 Steven Holl Questions of Perception

Similarly, Stephen Holl explores the role of human perception of colour, light, shadow and space in the phenomenological qualities of architecture and the way in which they frame the architectural experience [Figure 3.2]. He maintains that each individual moment in the narrative of architecture is a moment to be experienced and the building has to be experienced by inhabiting the spaces (using all of the senses) rather than just viewing it. For Holl, genuine architectural experience consists of "approaching, or confronting a building rather than just the façade; of the act of entering and not simply the frame of the door, of looking in or out of a window, rather than the window itself" (Holl, 1994, pp. 35).

"Walking along the bank on a cloudy day, dull brown dominates; the water of the Hudson is a smooth grey background. The very next day is brilliantly sunny... Walking along the same bank as the day before, the experience is entirely different" (Holl 1994, pp 35)

3.1.3 Martin Heidegger The Questions Concerning Technology

In his essay, 'The Question Concerning Technology', Martin Heidegger questions the relationship of human existence with the essence of technology [Figure 3.3]. Heidegger (1977) points out that technological objects are means for ends and are built and operated by human beings, but the essence of technology is something else entirely. It depends on our manipulating of technology in the proper manner as a means. He explains how technology should be interpreted as a way of 'bringing-forth' or a 'way of revealing'. Bringing-forth becomes a method of bringing what is concealed into unconcealment, therefore revealing. This means that everything we perceive or think of or interact with "emerges out of concealment into unconcealment" (1977, pp. 5) in Heidegger's words.

Technology embodies a specific way of revealing the world, a revealing in which humans take power over reality. According to Heidegger (1977) the truth in the relationship between technology and "being" can be revealed through the use and manipulation of technological intervention. Technology can become a manifestation of the understanding of being if it is reliable but not a tool of enslavement.



"Everything depends on our manipulating technology in the proper manner as a means. We will, as we say, "get" technology "spiritually in hand." We will master it. The will to mastery becomes all the more urgent the more technology threatens to slip from human control" (Heidegger 1977, pp 5)

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3.2 Salutogenic Methods Aaron Antonovsky

The approach of salutogenic design proposes that the right environment can promote the success of an individual's health outcome . The term was originally coined by Aaron Antonovsky as a method to find the origin of health rather than search for the cause of disease, posing the question "How can this person be moved toward greater health?" (Antonovsky 1979). It derives from studying the strengths and the weaknesses of promotive, preventive, curative and rehabilitative ideas and practices creating a model that looks at health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The model creates a health-ease/dis-ease continuum, believing that every person at any point in their life lies somewhere on this continuum (Antonovsky 1996). It provides an overarching narrative structure that transcends the individual differences between people, diagnoses and circumstance (Golembiewski 2010).

"how can this person be moved toward greater health?" (Antonovsky 1979)
3.2.1 Salutogenic Architecture in Healthcare Settings

Jan A. Golembiewski's text 'Salutogenic Architecture in Healthcare Settings' (2017) discusses the salutogenic model with regard to health care architecture [Figure 3.5]. Within the architectural discipline, the salutogenic framework is compelling as it recognises the environment as a source of meaning, analysing texture, decoration and space perception in relation to patient's health outcomes (Golembiewski 2010). It provides a direct link between architectural language and psychiatry. The model acknowledges that the relationship between the patient and the environment is transactional, changing according to the subjects sensory and perceptual abilities (Golembiewski 2010). Salutogenic architecture can be psychologically influential, providing a narrative context that affects a person's behaviour, neural and endocrine systems therefore directly influences the health of the mind (Golembiewski 2017). Unfortunately, with the popularization of salutogenesis, the concept is tending to become a marketing ploy, with any healthcare architecture providing views to represent nature fitting into the category; however, when addressed on a case-by-case basis, it becomes a sound holistic approach towards healthcare architecture.

3.3 Evidence Based Design

Evidence Based Design is a process used by healthcare professionals in the planning, design and construction of healthcare facilities. The concept was originally derived from Professor Archie Cochrane's principles on evidence based medicine in "Effectiveness and Efficiency- Random Reflections on Health Services"(1972) and defined as:

"the process of basing design decisions about the built environment on credible research to achieve the best possible outcomes." (The Centre for Health Design n.d.)

It establishes an approach to healthcare architecture based on the application of scientific observations of design interventions in order to reduce stress and improve recovery [Figure 3.6].

3.3.1 Roger Ulrich View through a Window May Influence Recovery from Surgery

Roger S. Ulrich's seminal work 'View through a Window May Influence Recovery from Surgery' (1984), examines the restorative nature of assigning recovering surgery patient to a room with a view of a natural setting, comparing the results to similar patients with windows facing brick walls. The research found that views of vegetation, especially water appear to sustain interest and attention more effectively than urban views of equivalent information rate. This is due to natural views eliciting positive feelings, thereby reducing fear and anxiety (Ulrich 1984). In a later publication, Ulrich again focusses on the restorative values of nature against stress but furthermore expands that it is the overall physical environment of the medical facility that promotes improved clinical outcomes. Here he links increased stress with fatigue caused by noise, floor layouts and shared rooms. "The belief expressed by some medical professionals that patients sharing multi-bed rooms provide each other with stressreducing social support is contradicted by evidence that having one or more roommates is in most cases a major stressor" (Ulrich 2006).

Although there is credible evidence supporting the use of Evidence Based design, it has been argued that by depending on research findings, architecture will inevitably lead to rigid and sterile standards that can rapidly become outdated (Hamilton and Watkins 2009). It also has been claimed that evidence based design is being used by design firm as a marketing tool rather than as a legitimate method of design (McCullough 2010). Despite this, it lends a useful scientific approach to the design of healthcare environments, which would not be possible if only philosophical considerations were taken.



3.4 Literature Summary

A phenomenological approach incorporates the five sense and their relation to an embodied experience, but the literature does not consider how this embodied experience may change with the disability of one or more of these senses - a criteria of high importance considering healthcare architecture. As this process involves the perception of the individual to his or her environment, it must be argued that with an individual with a sensory impairment would experience the space in completely unique way compared to a fully functional individual.

Following from the philosophical and theoretical approaches of Pallasmaa, Holl and Heidegger, it seems paramount that we embrace use of modern technologies, manipulating them of our own accord in order to facilitate the understanding of bodily experience and emotive design within architecture.

For these reasons, VR has been selected as a preferred technology to work as an instrument of revealing, simulating user conditions and exploring emotional responses that might be induced in these spaces [Figure 3.7]. While philosophy can establish an overall perspective, theories and methods such as Salutogenics and Evidence Based Design can aid to direct the application of these broad ideas.





3.5 Case Studies (architectural)

Due to the expanded approach of this research, two sets of case studies were required. The first type architectural, focusing on the implementation of phenomenological, salutogenic and evidence based methods within healthcare architecture. The second type technological, looking at successful examples of VR being used as a tool to simulate disability, evoking empathy and awareness.

3.5.1 Olivia Newton John Cancer and Wellness Centre

An existing hospital design that focuses on a holistic design approach to healthcare is the 'Olivia Newton John Cancer and Wellness Centre' designed by Jackson Architecture in 2012 [Figure 3.9]. Wellbeing and wellness were fundamental in guiding the design of the Centre (Olivia Newton-John Cancer Wellness & Research Centre n.d.). The centre's design draws on both evidence-based and salutogenic design principles for a holistically responsive design-solution. The design incorporates wayfinding techniques, lighting design and methods of distraction in order to reduce the stress of its occupants.

The Hospitals exemplifies how therapeutic concepts may be successfully integrated into a design without compromising architectural form. The facility offers patients and staff a continual visual access to the central courtyard, which works as a strong wayfinding tool and reference point as it stands central to the new facility and the existing surrounds.



3.5.2 Maggie's Centre Barts Steven Holl Architects

Maggie Centres are a series new cancer centres throughout the world, designed and built in the name of Maggie Keswick Jencks. After being diagnosed with cancer in 1988, Maggie spent every week "in this windowless box and avert our eyes from the other possible victims on death row" (Jencks and Heathcote 2010).

"...waiting in itself is not so bad – it's the circumstances in which you have to wait that count... Patients who arrive relatively hopeful soon start to wilt" (Jencks 1995, pp 21)

The first Maggie's Centre opened in Edinburgh in 1996 and was designed by architect Richard Murphy. From this, more and more renowned architects joined the cause, including Frank Gehry in 2003, Zaha Hadid in 2006 and Steven Holl in 2017.

Maggie's Centre Barts [Figure 3.10] designed by Steven Holl Architects uses phenomenological principles as a way to imitate music and the way that engulfs your whole being. Like music, the architecture has both a sense of narrative and time. The design was based upon the concept of 'A vessel within a vessel within a vessel', with each layer offering different experience based upon the colour, lighting and tactile qualities. The structure is a branching concrete frame, the inner layer is bamboo and the outer layer is matte white glass (Baan 2017). The outer layer of the building is calm with colour washes offering a subtle experience based upon the sunlight entering through the walls, varying in saturation with the intensity of sunlight on a given day. The inside uses texture to convey warmth, making the space meditative and comforting to the cancer patients.

In Maggie's Centre Barts, 'healing' is expressed in the form of rehabilitation. The architecture demonstrates how a humanized, noninstitutional approach to healthcare architecture can in serve as a form of therapy.

"I believe drawing is a form of thought and music is a vital life force. At Maggie's Barts, these two are united to yield the space and light of a tiny work of architecture with large joyful hopes." (Holl, The Maggie's Centre Barts Opens in London)

3.5.3 Zucker Hillside Hospital

Array Architects adopted salutogenic concepts in the design of the Behavioural Health Pavilion at Zucker Hillside Hospital, part of the Northwell Health System [Figure 3.11].

The Behavioural Health Pavilion has an atypical design for a behavioural health facility, differing from the institutional look of many psychiatric care hospitals (Sell 2013). The salutogenic methods used include the incorporation of a glass curtain wall with a vinecovered truss system to create a sustainable 'green wall' at the front of the building; access to nature and garden spaces that serve as an area of respite for the staff; and courtyards that are located close to patients in order to promote exercise and socialization. Views to nature and natural light for patients are maximised with activity rooms and dining areas featuring partial-height partitions and polycarbonate and resin walls, allowing sunlight into the central core. The remainder of the building is clad in a fibre-cement rain screen system in different colours.

Spaces are zoned for the public, for the patient and for the staff. The public zone allows views to nature and comfortable furniture, where visitors can take a restful break. The rotunda also serves as a lounge space for students and teaching staff to meet and converse promoting the educational aspects of the institution.



3.6 Case Studies (virtual reality)

3.6.1 SimViz Halim Cagrı Ates, Alexander Fiannaca, Eelke Folmer

SimViz is a recent simulation tool for visual impairments, allowing users a first person experience of visual deterioration. It provides a compelling experience of the obstacles that people with diminished vision experience in their day-to-day life, and allows those working with patients to have a better understanding of how to improve their safety, independence and convenience. The simulation uses a wide angle camera mounted onto a head-mounted display to create a seethrough stereoscopic display that simulates various types and levels of visual impairments. The SimViz simulation was developed ahead of an anticipated increase to the number of people who will be living with a visual impairment. An ageing baby boomer generation is one of the main drivers of this anticipated increase, but another cause is the current obesity epidemic, as obese individuals are twice as likely to lose their sight due to cataracts or diabetic retinopathy.

The application implements filters demonstrating macular degeneration, diabetic retinopathy, and glaucoma among others. One general limitation of the simulation is the inability to fully verify the accuracy of the filters. A visually impaired user can provide a verbal description of their specific visual impairment but may be unable to verify the correctness of the filter as they may not be able to use the head mounted display (Ates, Fiannaca and Eelke 2015)

"Simulation of a visual impairment may lead to a better understanding of how individuals perceive the world around them and could be a useful design tool for interface designers to identify accessibility barriers" (Ates, Fiannaca & Fulmer 2015)

3.6.2 We are Alfred Embodied Labs

A second example of virtual reality with the intent to create user empathy is 'The Alfred Lab' developed by Embodied Labs. This tool uses VR in conjunction with narrative and story in order to evoke emotion. The simulation creates the persona of "Alfred", a 77-yearold man with chronic joint pain, visual impairment and an earlyonset of Alzheimer's. The app presents users with a thorough and revealing look into someone else's life, including interactions with doctors and family members allowing users to understand, see and hear what a day is like for someone battling a debilitating condition (Shpektor 2017).

"There are people who are natural born caregivers, but that's a minority of the population. Everybody, especially myself, could use a little bit of guidance" (Lowe 2016)

The user will embody Alfred as he spends time with family, visits the doctor, and receives a diagnosis (Embodied Labs n.d). Throughout the simulation, topics of advanced macular degeneration, high-frequency hearing loss, the effect of family relationships on health status and navigating the healthcare system with impairments are addressed (Embodied Labs n.d).





4. Pre Design

To commence designing for the between spaces of the emergency department, an appropriate site had to be selected, the range of disabilities to be designed for identified and the programme and size of the facility had to be developed.

4.1 Site

The selected site for this research is Kenepuru Hospital, located in Porirua. Porirua is a city in the Wellington region [Figure 4.1], at the southern end of the Kapiti Coast, with a population of 55,900 (Statistics NZ, 2013). Despite Porirua having a younger population, it is above the national average disability rate with 1/3 residents identifying as disabled compared to the national average of ¹/₄ [Figure 4.3] (Statistics NZ, 2014). This prevalence is particularly pronounced with disabilities such as autism spectrum disorder, blindness and deafness. Based on these statistics, these three disabilities were selected as the focus of the research. Porirua currently has limited facilities which specifically cater toward the needs of residents with disability making it an ideal location for this research.





figure 4.2 Porirua Statistics



4.1.1 Kenepuru Hospital

Kenepuru Hospital [Figure 4.3] opened in 1965 as a maternity hospital with the objective of becoming a general hospital in the future (Porirua City Council n.d). Currently Kenepuru Community Hospital provides medical, surgical, maternity and child health services, plus services for the elderly, a specialist inpatient assessment, treatment and rehabilitation services, and outpatient clinics. Complaints against the hospital are on the rise due to the public confusing the after-hours GP service with an emergency department. The hospital caters to the communities north of Wellington, including Porirua and Kapiti (Capital &, Coast District Health Board n.d). It is serving a population of 108,449 people, 36,000 of which are facing disability.

The hospital's mission statement is "Together, improve the Health of the District", and proclaims values of: innovation, action, people/ patient focus, living the Treaty, professionalism and leadership and excellence. Serves: 108,449 people 36,000 with disability 20% of people attending emergency departments yearly 7,200 users with impairment per year





figure 4.5 Location of site in relation to Porirua



4.1.2 Issues with Current Design

Issues with the current layout of the facility [Figure 4.6] include the whole hospital using one main entrance, creating long and confusing paths for patients. Internally, spaces have very little variation making wayfinding complicated. The hospital is also very limited in the choice of waiting spaces and does not allow for outdoor space.





4.2 Existing Emergency Departments

In order to correctly design for the appropriate size and program of the emergency department, existing emergency departments of a range of scales, from both New Zealand and around the world were researched [Figures 4.9, 4.10, 4.11].

The selected emergency departments were a mix of either new builds or additions to existing hospitals. For each of these, the population of the area served and the total floor area of the department were used to establish an average ratio [Figure 4.8].

This ratio was then used to establish the required area of an emergency department development for Kenepuru Hospital.

Upon meeting with the services manager of Kenepuru Accident and Medical Centre, some key requests were made for what a new emergency department development would include

Key Requests:

- Separate entrance to main hospital
- Allow connections with main hospital
- Larger waiting spaces
- Choice in passive or active waiting spaces

Emergency Department	Type of Build	Area m ²	City	Population	m ² per 10,000 people	
Wellington Hospital	New Construction	1740	Wellington	179000	10	Kenepuru Emergency Department:
						-27m per 10,000 people
Brunswick Family Health	Addition	3000	Brunswick	34756	88	- Serving poulation of
Methodist South Hospital	Addition	1575	Memphis	652717	2.5	108,449
Providence Sacred Heart	Addition	2500	Spokane	215973	11	2,916

Existing Department Size to Population Ratio:



4.3 Focus Disabilities 4.3.1 Autism Spectrum Disorder

In New Zealand, it is estimated that 1 in 100 people have autism spectrum disorder, although statistics are limited (Ministry of Health, 2017). Autism is a lifelong neurodevelopmental condition that affects how people perceive the world, how they think and behave, and how they communicate and interact with others. Autistic people see, hear and feel the world differently to other people (Altogether Autism n.d).

People with autism often have sensory sensitivities, which can affect any number of their senses and in some cases only affected by certain stimuli. For example, they may be affected by a dog barking, but not bothered by loud music. They may find all loud sounds aversive but seek out interesting smells. In conjunction with this, people may have difficulty with vestibular (balance) and proprioception (body awareness) meaning they may experience difficulties with coordination and ability to understand their place in relation to what is around them. Sensitivities can be fluid where they change day to day or are dependent on the environment (Altogether Autism). This should be reflected in the design considerations with the department could offering a choice in spaces. One waiting room might be silent, while the other allows for background white noise. One might use a variety of colours and materials while the other might use a more subdued pallete.

Design Considerations:

- Use of multiple textures
- Colour coding
- Calming materials
- Land marks
- Incandescent lights

4.3.2 Visual Impairment

In New Zealand, 4/100 people are experiencing Blindness or Low Vision (Statistics NZ, 2014). For the purpose of this research, the eye condition of retina pigmentosa will be looked at specifically. People with RP first notice difficulty seeing at night, or going between light and dark places when there is low light. They will find their peripheral (or outer) vision beginning to disappear. In some cases, the central vision is also affected, leaving only light and shadow perception (Blind Foundation n.d). With this, the design of the emergency facility should have a focus on what vision the occupant does have rather than what they don't. The design might focus on different lighting qualities such as backlighting and reflections to aid in stimulation and navigation within the department. The design should also have a focus on accessibility, where corridors are wide enough to allow patients the space to walk with guide dogs or canes.

4.3.3 Deafness

Hearing impairment affects 9/100 New Zealanders (Statistics NZ, 2014). Those with hearing impairments cannot hear, or have difficulty hearing, what is said in a conversation, even when using assistive hearing devices such as hearing aids (Statistics NZ, 2014). This condition is strongly related to age, with 34% of men and 23% of women over the age of 65 experiencing deafness. Symptoms of deafness range from mild to profound and this should be reflected within the architectural design decisions. The design should focus on what senses the user does have, rather than those they do not. Within the designed space, hearing shouldn't be necessary in order to successfully navigate the environment. Spaces should allow constant visual connection to staff. Circulation spaces should allow enough space for occupants to have a signed conversation, and avoid use of sharp corners which might cut off conversation.

Design Considerations:

- Strip of light on floor and ceiling to define walls
- 3m wide clear circulation space
- Backlit patterns in walls
- Straight forward floorplan layout
- Incandescent lights

Design Considerations:

- Universal symbols for wayfinding
- Curved walls and wide walkways for signing
- Semi-transparent walls to see when rooms are occupied
- Colour coding

4.4 Preliminary Design Explorations 4.4.1 Kenepuru Hospital- Site Visit

As this research largely focusses on the sensory experience of design, following the first visit to the hospital, sensory conditions of the site were examined. These conditions included the colours, textures and sounds of the hospital and surrounding buildings [Figures 4.12]. A set of paintings were made on site in order to understand the relationship of the colours and textures within the composition of the area in a way that photos do not typically allow [Figure 4.13].

This information was used in order to pick the specific location of the emergency department, away from loud noises such as the ambulances and helipad, but still accessible from these facilities. This mapping was also useful in picking colour and texture palletes that would suit Kenepuru Hospital.





1. carpark & dialysis unit



2. playground (child health services)









4.4.2 Preliminary Design Development

At the preliminary stage of this research, the first design had a strong programmatic focus, considering the three selected disabilities and methods of applying evidence based and salutogenic design strategies.



figure 4.14 Development of first design iteration

4.4.3 Use of Virtual Reality

At this point of the design process, Virtual Reality is being used as a post-design tool, in order to analyse designs from the perspectives of the three selected disabilities [Figure 4.15]. Three VR 'filters' were created to demonstrate what it might be like for a patient experiencing one of the selected disabilities to inhabit this space, allowing the space to be analysed from their point of view.





4.4.4 Design Aims

Functionality – An Emergency Department's design needs to be practical and reflect how health professionals manage and treat their patients, and how these patients who may be facing disability can navigate and experience the space

Form – Spatial considerations and relationships that promote effective interaction between staff and patients, relatives, carers, and the flow of clinical care need to be considered, as does the relationship between the Emergency Department and the Hospital. Spaces need to be designed with flexibility and ability to adapt for future proofing

Patient and staff needs – The aim of health care is not only to treat disease, but also to create a healing environment for patients that is safe and free of psychosocial elements created through poor design. With regard to this design in particular, special consideration must be given to users facing disability and how they might respond to the spaces.



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4.4.5 Evidence Based Design

The preliminary design focuses on the Evidence Based Design principles, basing design decisions on credible research in order to achieve the best possible outcomes. In the healthcare environment, the specific considerations are

- Utilising natural light in waiting rooms, hall ways and examination spaces
- Allowing access to the outdoors for patients and healthcare professionals
- Having 'pleasant' views from the examination rooms
- Using natural materials and warm wood tones to relieve stress
- Strong acoustic qualities
- Allowing space for families

4.4.6 Salutogenic Design

The approach of salutogenic design proposes that the right environment can promote the success of an individual's health outcome. With the preliminary design, it does this through addressing cognitive, behavioural and motivational principles in order to allow patients to move forward on their continuum of health. The healthcare environment is identified as source of meaning, using texture, decoration and space perception in order to have a positive influence on a patient's health outcome.



4.4.7 Response to Disabilities

Autism:

- Use of multiple textures
- Colour coding
- Calming materials
- Land marks
- Incandescent lights

Blindness:

- Strip of light on floor and ceiling to define walls
- 3m wide clear circulation space
- Backlit patterns in walls
- Straight forward floorplan layout
- Incandescent lights

Deafness:

- Universal symbols for wayfinding
- Curved walls and wide walkways for signing
- Semi-transparent walls to see when rooms are ocupied
- Colour coding







4.5 Design Review and Reflection 4.5.1 Review

At the point of the initial review, an emergency department design was proposed, at this point with a focus on salutogenic and evidence based design. The reviewers raised questions and comments regarding the demographic of the research, the existing hospital program, the phenomenal experience of the space along with the overall designed form. In particular, questions were raised on the statistics of people living with these conditions in Porirua specifically and whether by using three specific personas, if I was limiting the users of the space and if by using only three personas, I was having the opposite effect on inclusivity. No two people's experience of space is identical, regardless of ability therefore the scope for designing and simulating every variation of disability is unrealistic. In order to counter this, the aim is to develop the full story, conditions and experiences of these people with people who are in the Autistic, deaf and blind communities. By doing this, the persona's will be representatives of the wider communities.

Looking at the program, the reviewers questioned whether I might be inevitably hindering the programme and workings of the existing hospital with my development rather than enhancing it.

4.5.2 Reflection

To ensure that the proposed design benefits the existing hospital a patient journey map could show the hierarchy of connections. In order to better understand the existing workings of Kenepuru hospital I will create a patient journey map and highlight the hierarchy of connections between the hospital and emergency department as well as consider the specific journey of a patient arriving in an ambulance. It could also be helpful to meet with those who have worked on Emergency Departments, including doctors, nurses and architects.

Looking at the overall design of the emergency department, up until this point there has been a focus on getting the space working technically however, this diverted attention away from the phenomenal experience and aesthetics of the design. The waiting rooms and hallways currently have diffused or no contact with the outside, which contradicts the beneficial effects established by salutogenic and evidence-based design, which explores how connections with the outdoors can improve health outcomes. In future, rather than using a generic hospital model of internal hallways, I want to look at methods of external circulation in order to re-establish this connection.

Watercolour painting techniques were adopted in order to understand effects of lighting, colour and volumes within my designs and precedents. The reviewers discussed how I may push this method further, using the fluidity and expression of the watercolour in order to influence the form and movement of the architecture, creating more organic forms which challenge the existing model of hospital architecture. It was also suggested with this that I look at the role of art in the realm of healthcare architecture and how aspects of this can be used in influence the phenomenal experience of the space.




4.5.3 Going Forward

- Develop the full stories of the persona's, with people from within those communities
- Understand existing program and patient mapping of Porirua hospital
- Finalise the technical program of ED by talking to health professionals and architects
- Use water colour to greater effect in exploring the expression of the form
- Use virtual reality to address the phenomenal experience of the architecture







5. Developed Design

To aid the developed design stage of this research, a pilot study was undertaken. This method [Figure 5.1] consisted of meeting with healthcare professionals to establish the narrative of the emergency department that the persona might experience, interviewing people with the subject disabilities in order to develop fictional personas. From here, design variables and materials could be selected to test within the simulated space, and finally using the participation of architecture students, working as the designers, the persona experience could be analysed.



5.1 Develop Narrative

In order to develop the hypothetical emergency department simulation, it is imperative to understand the narrative of the emergency department – the process in which a patient follows upon entering the space and the key 'between-moments' and to analyse the sensory conditions in areas of high stress or high monotony.

As the first stage of participatory design, the narrative was mapped with the assistance of hospital personal, from the patient's arrival at the emergency department until their departure. Moments of waiting and moments of significant movement were identified to become the 'between-moments' [Figure 5.2]. Each of these phases will repeat throughout the narrative of the entire emergency department.

Between Moments:

Waiting – The moments of waiting both in main and sub-waiting spaces within the emergency department.

Moving – The moments of patients walking down hallways in order to get from one place to another.

Thresholds – The moments of walking through doorways or transitioning from one space to another.

Arrival – The moment of reaching a point, whether it be the emergency department as a whole or an examination room.



figure 5.2 Emergency Department narrative and 'between moments'

5.2 Develop Personas

Three fictional personas were developed based on interviews with people with the impairments most prevalent in Porirua. Traits such a gender, age and reason for impairment were developed as representatives of the wider demographic. The impairments selected were autism spectrum disorder, visual impairment and deafness.

Impaired participants to aid in in the development of the personas were recruited through organisations established for their impairment, such as the Blind Foundation. In these interviews, issues with the current designs, in relation to their impairment were discussed. Environmental settings in the VR program were established based off of these experiences. Environmental settings included adjusting the focus and altering the visual information and audio effects in order to describe the unique sensory conditions of each. These modifications allowed research participants to experience design variables from three different points of view.

With the interviewees, each of the personas was given a full backstory around them and their experience of the emergency department, in order to allow participants to sympathize and comprehend their world. Finally, interviewees with impairments were exposed to both the VR simulation and the representation of their impairment and allowed to request changes.

"In waiting rooms, you are neither here nor there. It's worse than negative. You are just existing in the space, in almost a *between moment*" - Interviewee

Questions:

Think about a time visiting the doctors:

How did you get there? How did you find your way around? What makes navigation harder? What makes navigation easier? Was the waiting room a positive or negative experience?

Think about a situation where the waiting room was a positive experience:

What made the space positive? If you could design your ideal waiting space, what would it involve?

Have you spent time in an emergency department waiting room?

Did the waiting room environment make the experience better or worse? How was the experience different to other medical facilities? Could you navigate the space? How did you find the hallways?

In order to develop my personas, I have three fictional personas. We are going to be talking about Eliza (figure 1). Eliza is 21 years old and has Retina Pigmentosa. This has left her with light and shadow perception.

What is a reason for Eliza to be at the ED?

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Who has come to ED with Eliza
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This is the basic journey (figure 2) Eliza will go on. What emotions will Eliza be feeling as she goes through each stage?

How does Olivia's impairment effect her other perceptual systems:

- a. Auditory
- b. Orienting

```
c. Haptic
```

```
d. Visual
```

How does Olivia see colour, pattern, texture and light

Is there anything in relation to these senses that Olivia would find overwhelming?

What could reduce this effect

What (with regard to the architecture) would improve Eliza's emergency department experience?

5.2.1 Olivia Autism Spectrum Disorder

Olivia [Figure 5.3] is an 8 year old girl with autism spectrum disorder. The most predominant way this effects Olivia in public places is her hypersensitivity, especially to noise, aromas and textures. Oliva arrives at the emergency department with her two parents and 2-yearold brother. Olivia has being playing at the playground, and due to a low sense of body awareness and ran into a piece of equipment and broken her arm.

As Oliva has a low sense of pain, she does not understand why she is at the emergency department nor what is going to happen to her here. Arriving at the Emergency Department, Olivia is feeling very stressed. It is a very strange place to her, very unfamiliar. There are many people around as well as lots of movement and activity. The space is very loud. All the unknowns of the situation make Oliva feel very anxious and scared of what is to come.

Requests:

- Use of colour coding and clear signage
- View of reception from waiting area and main entrance
- Choice in where to sit
- Pleasant, homey smells
- Interactive puzzles to pass time
- Privacy
- Option of active or passive waiting

"I avoid emergency departments as much as I possibly can" - Interviewee



5.2.2 Eliza Visual Impairment

Eliza [Figure 5.4] is a 21 year old girl with RP, an eye disease causing blindness. Eliza developed the condition as a child, her vision deteriorating up to the age of 13, when she was left with only light and shadow perception. Eliza is a student at Victoria University and typically is very independent, living with her flatmates in Porirua. Today, Eliza has experienced a severe eye bleed.

On her trip to the Emergency Department her mother has come with her. In this unknown place, Eliza loses her independence, not knowing where things are or how to get around. Sitting in the Emergency department, with only magazines and a silent TV provided for entertainment, Eliza feels anxious. The everyday flow of her life has been disrupted, bringing a sense of sadness. Eliza is putting on a brave face, but she feels isolated, stuck in the limbo of the emergency department.

Requests:

- Straight forward path to reception 6 or 7 paces from entrance
- Avoid big, wide open spaces
- Not have a lot of corridors
- Clear walkways
- Doors equally spaced
- Nothing on walls so they can be used as a point of reference
- Pleasant, homey smells
- Interactive architecture/puzzles so patients can talk to each other

"Waiting rooms a never really positive places. The whole sense of waiting, this sense of limbo is not the greatest. It's like there's a sense of impending doom"

Redacted Copyright Image

5.2.3 Bernie Deafness

Bernie [Figure 5.5] arrives at the emergency department with his wife via ambulance. Although his condition is not currently critical, he and his wife are unable to drive resulting in an ambulance being called. Bernie does not want to be spending his day at the emergency department. All the noises of the Emergency department blend together in Bernie's head creating a loud buzz and causing a headache. All Bernie wants is a calm space to read his book and pass the time. Although able to lip read, Bernie cannot see the face of the receptionist calling out his name, causing further confusion and chaos.

Requests:

- Simple signage
- View of reception from waiting area and main entrance
- Seats facing reception
- Spaces to not be cluttered with stuff
- Space for family
- Choice of having a quieter place to sit

"waiting rooms are neither positive nor negative – they are merely necessary" - Interviewee

Redacted Copyright Image

5.3 Variables & Materials 5.3.1 Design Variables

Dependent variables which can alter the experience of a space were identified based off of the interviews. These variables initially included the room shape and size, wall texture and colour, the lighting and the reverberation [Figure 5.6].

5.3.2 Materials

Simulation space was modelled at four stages; one of waiting, one of movement, a threshold and a destination [Figure 5.7]. Waiting and destination spaces were modelled as a 4×4 m room, movement as a 2×3 m space and the threshold as a 0.9×2.2 m opening. Greyscale material (r=200 g=200 b=200) allowed variations in white walls, providing a deeper understanding of the space and emotional impact. A single lighting system with constant brightness and colour was chosen to create consistent light dispersal over all spaces.

PILOTS STUDY VARIABLES:

- Room shape
- Room Size
- Wall (material and colour)
- Acoustics (reverberation)
- Lighting (Kelvin)





figure 5.6 Design Variables

5.4 Procedure

To test the simulation of impairment on designer professionals, each designer/participant was invited to experience the simulation as one persona. Participants were told the background story surrounding that persona, including details about the disabilities along with an image of their persona in order to allow them to understand who they were experiencing the simulation as, and what emotions they might be going through. Participants were provided with a list of 48 emotions [Figure 5.9] to choose from, but were also allowed to select an emotion that was not on the list if they needed it.

Participants were individually introduced to the VR laboratory and asked to fill in a pre-experiment questionnaire. Questions included whether they had personally been to an emergency department before and were familiar with the process. They were asked what emotion they thought their persona would experience at each of the 'between moments' (waiting, moving, thresholds, arrival) in the emergency department, and what emotion they thought the spaces should induce. These emotions were labelled as 'experienced' and 'desired' emotions.

Participants then entered the simulation, seeing the space through the eyes of their persona. At each of the 'moments', participants were asked to select the variable that best influenced their desired emotion for the room shape, the room size, wall, floor and ceiling material, the acoustics and the lighting.

Following the experiment, participants were asked to rate (out of 5) whether they thought the disability affects the emotions a person may experience in a space, and the extent to which design variables influence a user's emotional response to the space.



Olivia









Age Related Deafness

	Negative			Positive	
Dissapointed	Envy	Fear	Kindness	Lust	Sympathy
Insecurity	Contempt	Indignation	Admiration	Relief	Amused
Shame	Regret	Pity	Energized	Courage	Respect
Anxiety	Confusion	Shock	Happiness	Desire	Confident
Doubt	Distress	Sadness	Fascination	Hope	Euphoria
Lonliness	Anger	Frustration	Inspired	Pride	Suprise
Annoyance	Embarrassment	Disgust	Anticipation	Satisfied	Worship
Dissatisfied	Boredom	Guilt	Calmness	Relaxation	Enchanted

5.5 Results

Results from the pilot study demonstrated that there is a relationship between architectural design variables and how these variables might affect the experience of the space for users with disabilities.

The study found that participants initially associated emotions of envy, anxiety, insecurity and fear within the 'between-moments' of the emergency department narrative [Figure 5.11]. Participant experience changed to emotions of confidence while waiting, courage as they moved, relaxation as they passed through a threshold and amusement at the point of arrival [Figure 5.12].

More specifically, when participants were experiencing Eliza, the visually impaired simulation, they found that lighting on a rougher texture gave her more visual information, increasing their sense of amusement and decreasing the sense of fear. When experiencing the spaces as Olivia, light was seen with greater intensity. Participants found this increasingly anxiety inducing with light of 5,000-6,000 kelvin (fluorescent lighting), the lighting which is commonly found in hospital environments. This lighting quality increased participant feelings of anxiety due to the perception of overwhelming amounts of information. By changing the lighting to a warmer tone, the experienced emotion changed to one of courage.

Participant opinion of the audio experience differed between the personas. For the autistic simulation (Olivia), change in the intensity of the experience was reported where participants preferred a lower reverberation. In contrast, the experience of the visually impaired

simulation (Eliza), participants relied on other senses to provide stimulation, choosing a higher reverberation to increase enjoyment.

Prior to the experiment, participants were often critical of the influences that design variables might have on emotion and were unsure if this would change with the addition of impairment. They found it useful knowing the background information of the personas they were embodying, including how long they had been waiting at the emergency department and the injury/illness the personas were there for. This additional information helped with the identification of initial emotions. Participants were also very curious about how the experiment would go, as many of them had not previously experienced VR. Following the experiment, when asked 'how much influence do you think design variations have on emotional response', participants answered with either a rating of 4 or 5 indicating that the participant's opinions had changed significantly.

No research of this kind has been reported on in literature and it was therefore, at this stage a very exploratory study. The use of the pilot study validated the proposed method, indicating that further experimentation would provide useful and applicable results for the design of healthcare architecture.



above: figure 5.10 Example of results selected by participants

left: figure 5.11 Experienced emotions selected at each moment of the simulation

right: figure 5.12 Desired emotions selected at each moment of the simulation

5.6 Second Design Iteration

Based on these results, a second design iteration was produced [Figure 5.13]. This design focused on creating different spaces within a narrative which would each influence unique emotional responses for the personas. This included allowing for choice in spaces, for example having both an active and a quiet waiting room. At this point, the research was presented overseas, allowing for valuable input from academics within both architectural and medical fields.

Due to this being a field of research not previously undertaken, the study was met with great interest. Feedback from this included how psychologically, the brain reacts the same way to a VR simulation as it would to the actual environment, validating its use as a tool to measure emotional response.

figure 5.13 Second iteration exterior facade

figure 5.14 Second iteration floor plans

5.7 Personas Experience 5.7.1 Olivia's Experience

Olivia arrives at the emergency department with her parents feeling fearful and confused – she doesn't understand why she is at the emergency department or what is going to happen here. Standing in the reception area, the colours are muted and Olivia does not feel it overwhelming. After talking to the receptionist, Olivia's parents take her up the ramp into the sensory deprivation space where Olivia is able to escape from the over stimulating environment that was increasing here anxiety.

Walking through the hallways, the colour and texture as not over stimulating – the wood has a calming effect on the space. While her parents speak to the doctors, Olivia is able to hide herself away in the 'nook', still in clear site from the doctors and her parents.

Requests:

- Use of colour coding and clear signage
- View of reception from waiting area and main entrance
- Choice in where to sit
- Pleasant, homey smells
- Interactive puzzles to pass time
- Privacy
- Option of active or passive waiting

"I avoid emergency departments as much as I possibly can" - Interviewee

Redacted Copyright Image

Moment: waiting Experienced Emotion: distress/fear Desired Emotion: relaxation Moment: movingExperienced Emotion: fear/confusionDesired Emotion: relaxation/amusement

Moment: waiting Experienced Emotion: distress/fear Desired Emotion: fascination

figure 5.16 Spaces, as experience by Olivia

5.7.2 Eliza's Experience

Eliza arrives at the emergency department with her mum via car. They park in the car park. It is late evening and Eliza can see the entrance to the emergency glowing with back lighting and the stripes creating patterns which she finds fascinating. The head through the main entrance Eliza is able to continue walking a few paces forward, knowing the reception is in front of here. Although Eliza is here with her mother, it gives her confidence to know where she is going. After talking to the receptionist, Eliza gets a choice between the quiet or active waiting room. Wishing for something to pass the time, she chooses the active waiting room and uses the floor and ceiling lights to guide her way. Eliza takes a seat in the social seating arrangement and is able to talk to other patients decreasing the isolation that she was beginning to feel.

When is it Eliza's turn to enter the emergency department, she again uses the lights to guide her to the door to the left of reception, she has been told that she is to head to the door with the circular pattern which she can see ahead of her due to the back lit pattern.

Requests:

- Straight forward path to reception 6 or 7 paces from entrance
- Avoid big, wide open spaces
- Not have a lot of corridors
- Clear walkways
- Doors equally spaced
- Nothing on walls so they can be used as a point of reference
- Pleasant, homey smells
- Interactive architecture/puzzles so patients can talk to each other

"Waiting rooms a never really positive places. The whole sense of waiting, this sense of limbo is not the greatest. It's like there's a sense of impending doom" - Interviewee

Redacted Copyright Image

5.7.3 Bernie's Experience

Bernie is a 73 year old man with Deafness and the early stages of dementia, who finds navigation difficult, arrives at the Emergency Department via bus feeling frustrated. The bus drops him off near the entrance. He is easily able to find the entrance, and after walking through sees the reception desk directly in front of him. When given the choice between the quiet or active waiting room, he chooses the quiet. He is not bothered by the noise, but finds the surrounding activity distracting. This space makes him feel relaxed. Once through the threshold, Bernie finds it is a straight path to his room with seats along the way. He has been told to go to the blue door and the nurse's station is in the centre of the space working as a landmark for his navigation. Typically, Bernie would find it hard to read the corners of the space, but this emergency department use red on negative corners and green on positive. Once in his room, Bernie is grateful for the privacy and peace that his single person room allows him.

Requests:

- Simple signage
- View of reception from waiting area and main entrance
- Seats facing reception
- Spaces to not be cluttered with stuff
- Space for family
- Choice of having a quieter place to sit

"waiting rooms are neither positive nor negative – they are merely necessary" - Interviewee

Redacted Copyright Image

Moment: waiting

Experienced Emotion: distress/fear Desired Emotion: relaxation

Moment: moving

Experienced Emotion: fear/confusion Desired Emotion: relaxation/amusement

Moment: arrivalExperienced Emotion: anxiety/lonlinessDesired Emotion: relief87

Moment: waiting Experienced Emotion: distress/fear Desired Emotion: fascination

5.8 Developed Design Reflection

At the August design review, the focus was on the development of the methodology along with the simulations. The reviewers raised questions surrounding the clarity of the presentation with regard to the integration of philosophy and science and the apparent rigidity that came from a linear approach of narrative along with the overall design.

On reflection, I can see that the process is complicated, partly due to the exploratory nature of the research, but also with respect to my explanation of the process. In order to make the problem clearer I will trial the use of Virtual Reality as a method to analyse the emotion of the existing Kenepuru hospital. Following this, in the final presentation I will explicitly describe the problems, using quotes from the interviews in order to help reviewers picture the issue that can arise from both over or under stimulation in a healthcare environment.

With respect to the rigidity of the process, the reviewers noted that the narrative does not have to be so straightforward when it comes to designing. The moments of waiting, moving, thresholds and arrival can be broken down and repeated throughout the design using alcoves and smaller spaces to achieve emotion throughout, ultimately creating a looser, less scientific design.

On reflection, I feel the current design is not properly reflecting the results from the pilot study nor creating a unique experience for individual users. In order to address the issues I will work on better developing the function/program of this hospital, do further analysis

on the exiting hospital in order to establish links, break down 'between moments' in to smaller, sub spaces.

In reflection of the pilot study, I found that both disabled and design participants thoroughly enjoyed the experience. Some design participants commented on wanting more variables to choose from and a longer experience in the VR environment. Prior to the experiment, design participants were often critical of the influences that design variables might have on emotion and were unsure if this would change with the addition of impairment.

6. Final Design

As the third stage of this research, a final VR experiment was undertaken. This experiment developed from the success and failures of the pilot experiment, and was tested on thirty participants. Participants in this experiment were assigned one of the personas and engaged in two separate simulations, experiencing the spaces as their persona [Figure 6.1]. The first simulation was a replica of the existing Kenepuru Hospital Accident and Medical Centre [Figure 6.2], where designer participants were asked to assign their experienced emotion and the desired emotion at each of the key 'between-moments'. A second simulation bought participants (still as their persona) into the designed simplified hypothetical ED space, where they were asked to apply different material and colour variables in order to influence their desired emotion. This information would then be used in order to develop the final design outcome.

Eliza:

emotion of their persona in the space, and what emotion they instead desired the architecture to influence. This was repeated for each of the moments including moving (walking down a hallway), thresholds (going through a doorway) and arrival (reaching the room they will be treated in).

Bernie:

Olivia:

figure 6.2 Kenepuru hospital simulation plan

6.1 Simulation One Results6.1.1 Olivia

In the first moment of waiting, participants experiencing the simulation as Olivia originally felt overwhelmed while standing in the waiting room. This was due to the intensity of the fluorescent lights and the number of sound sources within the confined space. Together, these made the space overstimulating.

Participants wanted this to change to an emotion of calmness at this stage. At the second moment of moving, participants found the Olivia would feel uncertain, not knowing where they were going or what was going to happen. Here, the designers instead wanted to create feelings of confidence as they walked through the passageways. Going through the threshold, Olivia felt confused as she did not know what was on the other side of the door. Similar to the experience of moving, participants wanted to instead feel confident. At the final moment of arrival, participants found that they felt confined in the examination room, wanting to instead feel relaxed.

6.1.2 Eliza

In the first simulation, those experiencing as Eliza first felt anxious while waiting. This was due to the size of the space and not knowing what was around them. Participants requested that the space have more elements of fun, desiring the emotion of joy. At the second moment of moving, participants felt confused and designers/design participants wished to change this to feelings of confidence. For Eliza, this was due to the complicated layout of the hallways at Kenepuru hospital and the uncertainty of not knowing where they were or where they were going. At the moments of threshold, participants again felt anxious, unable to see what was through the door. Here design participants again wanted to create feelings of confidence. In the examination room, participants thought Eliza felt fear, rather than feeling relief at reaching this final moment.

Eliza Experienced Emotion

Eliza Desired Emotion

6.1.3 Bernie

As Bernie, participants felt bored while waiting. In contrast to Olivia, participants found this space under stimulating with nothing to entertain them. Participants thought that this waiting space should instead be relaxing for Bernie. While moving, participants felt fear largely due to the institutional layout and colouring of the hallways. As with the other two personas, participants wanted instead wanted to feel confident while walking down passages. At the third moment of thresholds, those experiencing the simulation as Bernie all chose a different experienced emotion, including anxious, overwhelmed and intimidated but largely agreed that while walking through doorways, Bernie should feel relaxed and that he felt anything but. At the final moment, participants found the space made them feel anxious, wanting instead for a space that influenced the emotion of hope.

6.1.4 Simulation One Reflection

The use of this initial simulation made it easier for participants to associate the VR experiment with a real life situation. Rather than having to imagine what the space might make them feel, they could experience the scenario first hand. This made it easier for participants to establish what the issues around the current design are and how they might like them to be improved. The use of this simulation also helped participants to understand the narrative of the emergency department, and therefore the 'between moments'.

6.2 Simulation Two

The second simulation, bought participants into a hypothetical ED space, reduced down to the four moments identified [Figures 6.7 and 6.8]. This space was largely based upon the pilot study simulation, but had a reduced number of areas to test, as the scope was previously too large. Due to their being existing research looking at the influence the room shape and size has on a user's emotions, this was removed from the experiment. The experiment also no longer test very the desired reverberation as there was no difference in the answers between personas. More material choices were added based off of participant requests from the pilot study. The simulation also had additional changes including the introduction of furniture and people into the space in order to make it more realistic.

In this simulation, still experiencing the space as one of the personas, participants were asked to select the design variable for the walls,

Eliza:

floor, ceiling and light that best influenced their selected desired emotion from the previous simulation. This was again repeated as they went from waiting, to moving through a threshold and then reaching the moment of arrival.

Final Experiment Variables:

Wall (three colour options for each):

- Brick
- Wood
- Concrete
- Coloured PVC
- Glass

Floor (three colour options for each):

- Carpet
- Wood
- Concrete

- Ceiling (three colour options for each):
 - Ceiling tiles
 - Wood
 - Metal
- Light:
 - 2000 Kelvin
 - 3500 Kelvin
 - 5000 Kelvin

Bernie:

Olivia:

6.3 Simulation Two Results 6.3.1 Olivia

As Olivia, in order to influence the emotion of calmness while waiting, design participants selected wood as the material for the walls, floor and ceiling. Participants found that this warm and natural material had a calming effect.

While moving, participants were evenly split about whether wood or glass would be the best material for the walls in order to influence confidence. Glass allowed participants the ability to see what was happening either side of the hallway, filling them with confidence. For both the floor and the ceiling, wood was again the chosen material.

As Olivia, participants were again split between glass and coloured plastic as the material to best influence confidence at the moment of threshold. Glass allowed participants to see ahead into the examination space, while participants also found that boldness of the coloured plastic to positively influence feelings of confidence.

At the final moments of arrival, participants wanted Olivia to feel relaxed in the examination space. In order to achieve this, both wood and concrete were chosen. The smooth appearance of the concrete and its subdued colour meant that the material was not too sensory stimulating for Olivia, causing this calming influence.

At all moments, participants chose the warm light of 3500kelvin in order to influence the varied emotions. This tone of lighting was seen to have a positive influence on the participants.

MOMENT	waiting	moving	threshold	arrival
EMOTION	calm	confident	confident	relaxed
WALL	wood & glass	wood & glass	plastic & glass	concrete & wood
FLOOR	wood	carpet		wood
CEILING	wood	wood		wood & tiles
LIGHT	3500	3500		3500

figure 6.9 Combinations selected by participants experiencing as Olivia

figure 6.10 Variables selected at each moment to influence emotion

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6.3.2 Eliza

In this simulation, participant's experiencing as Eliza were seeking to facilitate feelings of joy while waiting and selected both coloured PVC and glass to do so. Although as Eliza, the colour of the PVC could be hardly be seen, the material was partially reflective and allowed light to bounce around the space. This allowed Eliza to be more visually stimulated and influencing the emotion of joy. Unlike with Olivia, participants chose a range of materials for the floors and ceilings in order to influence positive emotions. While waiting, they chose concrete for the floor and metal panels for the ceiling. The textured grain of the concrete allowed light to catch on it influencing joy. The concrete would also allow more sensory input, stimulating the sense of touch rather than vision.

While they were moving the use of glass allowed people experiencing the space as Eliza to interpret the level of light and understand whether another interior room or the outdoors were on the other side of the glass. Knowing where they were in this respect gave participants confidence. While moving, participants chose carpet as it reduced to noise of the footsteps around them, again influencing confidence.

At the moment of threshold, participants chose glass and plastic as the materials to influence confidence. The use of glass with backlighting meant participants could see movement in the room prior to entering, telling them that the space occupied.

Once in the examination space, design participants were aiming to induce feelings of relief, choosing glass, meatal and wood in order to do so. The metal ceiling was also reflective and again allowed the light to bounce around the room.

MOMENT	waiting	moving	threshold	arrival
EMOTION	joy	confident	confident	relieved
WALL	plastic & glass	plastic & glass	plastic & glass	glass
FLOOR	concrete & carpet	carpet		wood
CEILING	metal	metal		wood
LIGHT	2000	2000		2000



Moment: moving Emotion: confident



3 2 1 0 Concrete Carpet Wood









Moment: threshold Emotion: confident



Moment: arrival Emotion: relieved









figure 6.12 Variables selected at each moment to influence emotion

6.3.3 Bernie

In moments of waiting, those experiencing the simulation were seeking to induce desired emotion of relaxation, choosing wood, glass and carpet in order to do so. Like with Olivia, participants found that the natural qualities of the wood allowed them to feel relaxed, while the glass allowed for views of the nature outside. The carpet as a flooring choice gave the waiting room a more home-like feel.

While moving, glass and plastic were chosen in order to influence confidence. Like with other persona's, participants found that it made them feel more confident to be able to see what was happening on the other side of the walls.

Going through the threshold, again to feel relaxed, participants chose glass as the material of choice.

When arriving at the examination space, participants wanted Bernie to feel hope. In order to achieve this, wood, carpet and metal were chosen. These three materials were all associated with positive feelings.

MOMENT	waiting	moving	threshold	arrival
EMOTION	relaxed	confident	relaxed	hope
WALL	wood & glass	plastic & glass	wood & glass	wood
FLOOR	carpet	carpet		carpet
CEILING	wood	metal		metal
LIGHT	3500	3500		3500





Moment: moving Emotion: confident









Moment: threshold Emotion: relaxed



Moment: arrival Emotion: hope









figure 6.14 Variables selected at each moment to influence emotion

3500 Kelvin

5000 Kelvin

2000 Kelvin

6.3.4 Simulation 2 Reflection

Following the completion of the second simulation, it was found the adding people and furniture increased the realism of the simulations. Despite this, there were some conflicts with the variables chosen by each of the personas as each of them had very different desired emotions in the spaces. Although this increased the difficulty in designing, it also proved that the addition of disability does effect the experience of a space, and people with different disabilities need to utilise different materials in order to improve these experiences. Where conflicts arose, a design decision had to be made. This generally came down to what was practical within the space. For example, although carpet is a practical choice in the waiting rooms, it is not possible to use it in the hallways and another flooring had to be used instead.



6.4 Final Design Concept

The final design applies the results of this experiential set of simulations to a 32 bed emergency department complex. While the scope of the thesis does not extend to façade, construction or structural exploration, an image has been provided to give an idea of what I envision [Figure 4.16].

Each of the 'in between' spaces is designed with elements to address the experience of each of the personas, aiming to use the selected results to influence the desired emotion.

The site plan [Figure 4.17] shows how the emergency department is situated in relation to the existing hospital. This site plan aims to use clear straight routes and minimise required walking distances and maximise useful connections to the main hospital. The façade incorporates colour in order to increase visibility and uses OKALUX glass to allow to the whole building to glow at night.

Directly in front of the main entrance is the emergency drop off point, as well as the bus stop and taxi stand. As requested by the impaired interviewee's, the reception desk is directly in front of this entrance, roughly 7 paces from the door. Patients who arrive via ambulance come through a separate entrance, towards the back of the emergency department and away from examination and waiting areas in order to reduce stress.

The ground floor [Figure 6.19] includes both public and private medical spaces within the emergency department. A division of the

waiting room into active and quiet areas and the use of mezzanine spaces to supplement these for greater privacy. As desired by the impaired interviewees, both of these waiting rooms allows clear visual connections back to reception area. Whereas before, those interviewed claimed:

"In waiting rooms, it feels like you can't talk – there's an expectation of staying quiet. Its got a level of 'taboo-ness'. You can try and talk, but it's generally met with silence or annoyance. This also makes it feel like you can't go back to the reception desk and ask for help which again adds to the level of anxiety" - Interviewee

The quiet spaces, foster calmness and relaxation by incorporating natural materials, carpet flooring, warm coloured lighting (2000 kelvin) and a tea and coffee station in order to provide 'homey' smells.



The active spaces allow for stimulation for those waiting long periods, aiming to be a playful, interactive space and achieve the desired emotion of 'fascination'. The space incorporates a larger array of colours and textures, uses a social more social seating arrangement and incorporates the use of interactive architecture puzzles.

From the waiting rooms, you can go through either side of reception to the examination, treatment, family and secondary waiting spaces, each designed with specific emotions in mind and using materials as established through the simulations in order to do so. Pathways are straightforward with a 3m wide clear space to improve navigation, corners curve in order to not cut off signed conversations and the walls have no hung decorations so those with visual impairments can use them as reference points.

Building off the findings in both salutogenic and evidence based design, examination rooms are private, sharing a bathroom between two and the design uses an increased number of nurse's stations in order to decrease walking distances of staff.

"Having puzzles that you can do to pass the time – something more than just toys and magazines. These stop you from just sitting and getting stressed. This is the difference between active and passive waiting. Fill your time and you don't feel like you're waiting" -Interviewee

Physical Areas:

Patient Arrival to ED Active waiting room Quiet waiting room Childrens zone Reception Security File storage Toilet Assessment Area Triage

Investigation and Treatment Areas Nurse station Dispensary Paediatric Mental Health Lab Area Clean/Dirty Utility Linen Storage Plaster room Eve room Consultation Psychiatric Procedure Resuscitation Ambulance Care Cardiac Bathroom

Ajunctive Department Services Medical Records Chapel Staffroom Office Cleaners room X Ray Storage



figure 6.17 Site Plan in relation to existing hospital





figure 6.19 Floor plans of final design iteration

6.5 Design Details 6.5.1 Detail A

Each examination room has a different colour door and pattern to make them distinguishable to all from the hallway [Figure 6.20]. This pattern is between two layers of polycarbonate. This means users can see silhouettes in the rooms, notifying them if the space is occupied. It also means that the walls have no external decorations, so users such as Eliza can comfortably run their hands along it to find their way. $T\nabla$ IN



6.5.2 Detail B

The wall of the quiet waiting room is constructed from two layers of okalux glass, with coloured glass panels between creating a subtle colour wash for the external façade [Figure 6.21]. It applies a non -social seating arrangement offering privacy for those patients who do not wish to speak to each other and includes a water feature under the ramp for visual interest. It also includes a tea and coffee station, as requested to provide comforting smells, away from the sterile aromas typically associated with a healthcare environment. The ramp leads up to a cosy library space, aiming to minimise sensory stimuli and to the contemplative wellness garden.



6.5.3 Detail C

Participants experiencing the simulations as Eliza selected metal as their desired ceiling material to influence confidence as paired with the lights, it provided with her with more visual stimuli as she walked through the hallways. In order to achieve this in a more practical manner, in areas of movement, lightweight translucent acoustic panels were used for the ceiling, revealing metal services overhead and diffusing the light [Figure 6.22]. All of the main circulation routes include a 3m wide clear walking space and have unique landmarks to aid in navigation.



6.5.4 Detail D

The active waiting room aims to influence the emotion of fascination using a spectrum of coloured PVC and glass as the key materials [Figure 6.23]. The space incorporates elements of interactive architecture to reduce the perceived isolation of a waiting space. From this space, the ramp leads to a children's play area and parent room to accommodate extremes of behaviour. TWO LAYERS OF WHITE OKALUX GLASS WITH GLASS BETWEEN -MAX DIMENSION 2,000 X 4,500MM



6.5.5 Detail E

Hallways employ back-lit horizontal wooden panels, strip lighting around the floor and universal symbols all with the purpose of wayfinding [Figure 6.24]. Walls are coloured to represent different stages in the narrative, allowing the user to feel some sense of orientation and control within the emergency department and aid in influencing the desired emotion of confidence.



6.5.6 Detail F

Examination rooms include the use of a bench seat with a view to the garden outside, aiming to decrease stress [Figure 6.25]. Back lit timber members are used to diffuse sharp lighting and frame the bed. The examinations rooms are private, sharing a bathroom between two and allow enough space for family members to be present.

BACK LIGHTING ON VERTICAL TIMBER MEMBERS- MEMBERS —— USED TO FRAME BED SPACE

EXAMINATION ROOM

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6.6 Persona Experience 6.6.1 Olivia's Experience

Oliva's emergency department experience aims to give her choice in whether she wants architecture that increases or decreases her stimulation.

Oliva arrives at the emergency department with her parents feeling fearful and confused - she doesn't understand why she is at the emergency department or what is going to happen here. While in the waiting space, Olivia desires the emotion on calmness, using materials of wood and glass in order to achieve this. Walking through the hallways, the colour and textures are not over stimulating - the wood has a calming effect on the space and Olivia gains confidence. Sounds are absorbed by use of translucent acoustic ceiling panels. Although carpet could not be used on the floor of the hallways, soft furnishings are used in areas such as the "nook" in order to induce the associated emotions. Moving through the hallways, Olivia desired glass walls to evoke emotions of confidence. Polycarbonate was utilised as a material in place of this. This reduces associated costs, but still allows patients to see whether an examination room is occupied, and allows light from outside to reach into the internal hallways.

As desired by Olivia, thresholds are coloured in order to influence confidence. This works as a wayfinding technique, as no two doors are the same colour.







Moment: moving Experienced Emotion: uncertain Desired Emotion: confident



figure 6.29 Olivia - 'Nook"





6.6.2 Eliza's Experience

Eliza's experience of the emergency department aims to increase her stimulation, decrease her perceived isolation and have a space that is overall easier for her to navigate independently. When Eliza heads through the main entrance, she is confidently able to find the reception desk – located roughly 7 paces from the door. While in this waiting space, Eliza desires the emotion of Joy, favouring coloured PVC and glass in order to do so. The external walls of the waiting room use two layers of OKALUX glass, with colour PVC panels between. Although she is unable to see the colours, at night she can entire department glowing with back lit patterns from the outside, while during the day she has the same effect but from the inside.

When is it Eliza's turn to enter the emergency department, she again uses the lights to guide her to the door to the left of reception, she has been told that she is to head to the door with the circular pattern which she can see ahead of her due to the back lit pattern. Her path to her examination room is not obstructed due to a 3m wide clear space in the hallways and without anything on the walls, the is able to run her hand along them to guide her.

Conflicts were found between the materiality choices of Olivia and Eliza, in particular with the ceiling choice in the hallways. Although both aiming to influence confidence, Eliza desired a metal ceiling in order to allow light reflections and increase her stimulation. In order to reduce this effect for Oliva, semi-transparent acoustic panels are used to reveal the metal services above. This still allows light to travel through in for Eliza, although decreases both auditory and visual reflections for Oliva.













6.6.3 Bernie's Experience

Bernie's experience of the Emergency department aims to increase his stimulation, but do so in a more relaxing environment. Bernie, who finds navigation difficult, arrives at the Emergency Department with his family feeling frustrated. He is easily able to find the entrance, and after walking through sees the reception desk directly in front of him. From the waiting room, it is possible for him to have constant visual contact with the reception desk. Bernie desires a relaxing spaces in which to wait, choosing wood as his material in order to do so. Within the quiet waiting room, majority of the internal fixings are wood, allowing him to achieve this emotion.

Across all of the moment, Bernie desires carpet to be used as the flooring finish. Although not possible in the hallways, several family waiting spaces come off the circulation spaces and allow for soft furnishing. Once through the threshold, Bernie's family sits in the large family space, which uses wood, carpet and glass to feel relaxing.

Bernie has been told to go to the blue door and the nurse's station is in the centre of the space working as a landmark for his navigation. Once in his room, Bernie is grateful for the privacy and peace that his single person room allows him and begins to feel hopeful.



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figure 6.40 Bernie - Ambulance arrival





figure 6.42 Bernie - Family space



6.7 Final Results

Following the final design, participants were bought back into the simulations to see if they experienced the intended emotions with the design. An overall success rate 67.5% was achieved, with participants choosing the most accurately for Olivia. This number could have been higher, but participants often articulated similar emotions but used different words, such as confidence and courage or enjoyment and fascination or calm and relaxed. In order to counter this in the future, a smaller list of emotions could be provided, with every word describing very different emotions or emotions in the end could be generalised into larger categories.



Olivia:







ø

Critical Reflection & Conclusion

dan -


7.1 Critical Reflection

This thesis had two key aims. Firstly, to develop a virtual reality tool which could be used to simulate disability and analyse emotional response and secondly to test the developed VR tool through the design of a new model of emergency department for Kenepuru Hospital and addressing both the physical and emotional needs of users with impairment.

The research had several challenges to overcome, largely revolving around a lack of knowledge about VR and the experience of those with impairments. Many do not understand the critical need for this kind of research and that the subject people both want this to be happening and want to be an active part of it. Many are frustrated by people with no connection to them or their disabilities making assumptions based upon nothing. It was often found that reviewers would stereotype disabled participants as weak, vulnerable or sick rather than active, concerned and interested members of society.

Virtual Reality is a relatively new technology, and was met with very mixed opinions when being used in this manner. Reviewers were often concerned that it may be seen as too sensitive of a topic simulating disabilities, despite those with the disabilities being fully on board and excited by the prospect. This issue was met in particular with the Human Ethics Committee (HEC), who were initially against the involvement of impaired participants, despite me going to the appropriate agencies (such as the blind foundation), and ensuring that any contributions were completely voluntary. The HEC believed that the research could be undertaken just as effectively without them. By forging these connections and developing a tool with these people, it means any designer can have the ability to know what their design will be like from these perspectives and design accordingly. This gives people a voice, in a world that might not typically be considering them, and allows them to decide for themselves what design decisions will best suit them.

The use of VR however, is not without limitations. The personas were developed with four individuals per impairment. These need further testing on a wider group of participants to validate the accuracy and clarity of the depicted impairments and their emotional response.

VR is limited in its simulation of sensory abilities as the program is currently unable to simulate the experiences of smell and taste. Similarly, the haptic experience is limited to a visual element and cannot simulate the experience of changes to air flows, surface temperatures, or the tactile feel of a surface.

Within the realm of the VR experience, further limitations result from the access to the software used and what the programme 'Fuzor' was able to accomplish. Within the simulations, an inability to move fluently when transitioning from one space to another was limited. The simulation also strays from a true emergency department experience by not being surrounded by the movement of other people. The experience of other people in this research was reduced to stationary figures and an audio component. Similarly,



The research created a tool that was successful in achieving this aim, despite limitations of technology available. The research is very exploratory, as little has been published on this kind of VR research. Three subject disabilities were chosen to simulate in order to give a broad idea on how the technology might work with different conditions. Choosing three impairments, rather than one meant that the final simulations were not as detailed and refined as they might have been given the limitations of time. This proved to be the right decision as it allowed me to test the tool with a range of disabilities, indicating that it would be further adaptable to simulate others.

The complexity of the research also created difficulty in communication. Due to the multiple facets to this research, it was often difficult to explain concisely and often reviewers would miss out on significant details which would shape the way that they perceived the research. This meant that sometimes it was hard to get across the point that this research was a significant problem that needs to be addressed in today's society.

In undertaking this research, I also found other constraints that might impact on design and could benefit from further research.

For example, the less tangible constraints such as cultural identity, language and understanding, and how these might be approached within the design. It is uncertain if these would be of greater importance than impairment in creating an ideal environment. These leave a clear path as to what further research on this topic might be able to achieve.

Difficulties were experienced by selecting a technically difficult building type, such as a hospital emergency department as the catalyst for this research. The choice of this space meant that an increased amount of time had to be devoted to the technical programme of the space, limiting the time spent available to address the emotional impact of the design variables to the different users. This choice in building type also limited the practicality of the results, as some of the selected options were unable to be used. The design of a completely different typology, such as a school might have been easier and freed up time for further implementation of the results.

The choice of using participatory processes, even though they were verytime consuming was a good decision. Conventional participatory methods such as focus group interviews or questionnaires are too general for the specific stakeholders of emergency and healthcare spaces and a more focussed and fine-grained approach is required. I found that VR can become an important medium in which a variety of participants can understand and experience the sensory conditions of others. It can allow others to inhabit the space in each stage of design providing a heightened interface which can improve usability, simplicity and intelligibility of the architecture. It also acknowledges that any design process that involves the participation of patients' needs to elicit their needs by considering characteristics such as their sensory conditions and their background as well as the simple pragmatics of moving them through a space.

Overall the method undertaken proved to be very strong as it allowed multiple opportunities for me revisit and rethink my process strengthening the overall outcome of the work. Using the participation of others gave invaluable strength to the development of the simulations, as well as general design considerations in what an emergency department facility should provide. This is a method which can now continuously be revisited, and built upon with future experiments looking at an unlimited number of impairments in endless architectural scenarios.

Results achieved through simulation were not always practical in application. An example was in flooring choice, where options such carpet would realistically not work in the emergency department environment. Additional research is required to explore faux materials, which can achieve the emotional outcome required without the downside of the materials. It was also found that sometimes, the preferences had by the personas were conflicting, in particular Olivia (who wanted to reduce stimulation) and Eliza (who wanted to increase stimulation). This became a problem in areas such as the hallways, or 'moving' moment, where all personas selected a different



light choice. More research is required to determine a process of dealing with these kinds of conflicts.

Despite limitations and boundaries in the study, I believe that a considerable body of research has been undertaken in a short period of time and that this research will be of immense benefit to the field, particularly due to it being a field that had not been explored in much detail previously. This field of research for me, required serious upskilling as prior to this research, I had no knowledge about VR and its potential use within architecture. Having a limited background with the tool limited what I was able to achieve in the short amount of time. Going forward, I now have a sound base knowledge of VR and other technologies in which to build upon in future research. It gave a voice to people who were previously ignored in architecture,

or only considered in the end stages with regard to accessibility. It utilised new technologies, and explored their use in a way that had no previously been done before. It provided positive results, suggesting that we can design for those with impairment and their individual emotional experience and that Virtual Reality is a successful way to do so. It has provided a sound starting point for future research to build upon.



7.2 Conclusion

This research explored the potential of VR by using a strategy of participatory design and communicating design input from the primary occupants (impaired patients) to the designers, during all phases of the design. It examined how VR could be used to understand the critical phenomenology of these interstitial healthcare places in relation to the impairments typically experienced by the most predominant emergency department users. It then used these findings to address the future challenges of emergency department architecture.

Emergency departments have one of the most diverse groups of users, the majority of whom are experiencing permanent or temporary impairments that in the past have not been considered with respect to the design of interstitial or 'between-moments'. Impairment is a complex phenomenon, reflecting the interaction between the features of a person's body and the features of the society in which they live. People facing impairment are not simply passive users of services and buildings, but can offer something powerful to architects and other building environment professionals if they are included and considered from the beginning phases of the design process. However, this is not easily achieved.

In this study, participatory processes were employed in three stages, in the development of the personas where people with the impairments assisted in the development of the VR experience to enrich and elaborate on their lived experience of being in the space. Second, a participatory process was used with healthcare providers to better understand the emergency department experience and processes involved. Third, the final participants using VR as a design tool engaged directly with the impairment, allowing for empathetic design through an indirect end user participation in the design. The VR tool can offer healthcare professionals and patients a chance to affect the design developments and outcomes without the lengthy process (and often high costs) often associated with traditional participatory design methods. Participatory design using VR as explored by this thesis also allows the designer to understand the emotional as well as the physical requirements that are held by this unique group of users.

This thesis examined the use of VR as a technology to reveal and simulate the experiences of three different personas experiencing impairment in this narrative. It examined how design variables relating to the perceptual systems can significantly influence the phenomenology of these spaces and therefore the human emotions elicited. The research found that despite limitations, there is significant potential for the use of VR and participatory processes, working with both people facing impairment and people in the general public in order to revise the design of these spaces. It found that by implementing these design methods, architects may be able to reduce distress, the increased anxiety, delirium and high blood pressure of patients.

Finally, the results demonstrated that the use of VR as a means of revealing and understanding human existence within space is valuable for interpreting the phenomenology of narrative and space, and how different design variables can evoke emotive qualities. The research confirms that VR can bridge the gap between philosophy and technology in order to design healthcare 'between-moments'.







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