VIRTUALLY HOME

*An Innovative Methodology for
Identifying the Housing Needs of
Marginalised Communities*

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Abstract

Home is an experience universally sought after. It is a desire somehow and somewhere built into us as humans. Yet for marginalised groups understanding what makes 'home' is made difficult by various technical and cost barriers.

This thesis proposes an innovative methodology – using immersive virtual reality technology coupled with 3D scanning processes, to facilitate an understanding of the meaning of home for both designers and marginalised groups. Several characteristics of virtual reality are explored through a review of literature to identify the potential application of this technology as an alternative method of spatial inhabitation.

Concurrently, research exploring the meaning of home and existing qualitative methodologies are analysed to establish a methodological framework for use in the current work. A pilot study applying the proposed methodology, attempts to identify the potential of immersive virtual reality, as a tool to identify what makes home for participants in the context of their own homes. As such the data generated using this methodology informs a design solution applying the qualities of home identified. The methodology proposed enables a process for identifying how the intangible nature of home is expressed within the design of housing. As such it becomes possible for both architects and their clients to 'see' what makes home.

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Thank you.

Preface

The role of the architect is inherently one of challenging the preconceived notions of how we inhabit space. Indeed this is a central theme of this work.

Similarly, Books vary in so many ways with respect to content but also in terms of their physical characteristics including size, thickness and, texture. However, one almost universal characteristic of books is the orientation of the content within – portrait and read left to right. Why is this? We see the world in landscape. Our televisions and computers are all oriented this way. Furthermore, we scroll down rather than across a digital document. So why are our books different? Daniel Flynn (2016) in his book *Chapter One*

Re-orient

suggests it is simply because this customary way of doing things has never before been challenged.

At a time when housing design increasingly embodies the notion of ‘more for less’, the desire to understand the metaphysical implications of architecture and address the emotional needs of end-users no longer seems a priority.

To this end, ‘flipping’ the orientation of this book not only represents a dissent from traditional method of publication but foreshadows the central theme of this work - to rethink our approach to modern housing design, both in terms of what we design as well as the tools used to realise a solution.

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Introduction

*“...architecture provides our most important existential icons
by which we can understand both our culture and ourselves.”*

Juhani Pallasmaa (2009)

The role of architecture as a physical manifestation of ourselves within the built environment is perhaps most clearly seen through housing. Cooper (1974) notes; “a violation of the self (house) is perhaps one of man’s most deep-seated and universal fears” highlighting the role we attribute to the house as an extension of ourselves.

However, the default housing vernacular in New Zealand is changing. Driven by a growing population and increasing unaffordability, the demand for medium and high-density mass housing has rendered the traditional detached family house obsolete in the modern built environment. As such, a disconnect now exists

between architectural designers and the end-user within the design process. As the primary means through which designers understand their clients’ emotional needs, this absence affects the ability for modern housing - via its designed characteristics, to meet the needs of inhabitants.

The impact is most evident in marginalised communities. As societal minorities, the design of mass housing developments are often unlikely to consider the specific needs of these communities rather they are designed to reach a wider group of potential buyers.

What is the potential of immersive virtual reality technology - using 3D scanning, as a tool applied within the design process to better understand the housing needs of marginalised groups?

This research proposes an alternative methodology of client research using immersive virtual reality and 3D scanning technologies to facilitate a higher level of understanding by designers of the housing needs of end-users. This is an understanding not currently possible using traditional research methods. Central to this research is the use of immersive virtual reality (IVR) as a tool for experiencing highly realistic virtual representations of housing – the ‘virtual house’. Throughout multiple case studies, a methodology is developed and subsequently tested using marginalised families living in Wellington as the target demographic. As such a framework enabling a more concise understanding of the housing needs for marginalised groups is posited.

The use of immersive virtual reality in architectural practice is increasingly commonplace. However, the application of this technology remains rather superficial – commonly as a presentation tool. Recent developments enabling an experience of highly photo-realistic virtual environments has expanded the potential for this technology. This research seeks to understand the potential implications that changing the experiential medium of housing has on the broader understanding of ‘home’ for architects. Subsequently it becomes possible to identify how these learnings may be applied within the design process.

This research is limited in its ability to conduct multiple case studies due to variables such as cost, time, and participant availability. As such, two studies are conducted. The first – a Pilot Study provides an opportunity to assess and critique an initial methodology. A single case study is then

conducted from which the findings are taken forth into a design process. Despite these limitations, a greater depth of analysis and subsequent understanding of home for the selected participants is possible using this limited scope. To this end, there is no intention for this work to facilitate a wider comprehension of the housing needs of marginalised communities. Instead, the focus is placed on developing a methodology through which the needs of specific individuals becomes possible.

As the target demographic of this research, ‘marginalised groups’ represents a wide range of people. To narrow this scope, refugees are identified as a specific community of marginalised people for whom this research and the problem identified is particularly relevant. Their unique relationship with the concept of home makes the study of refugees particularly interesting.

Contextualising the issue identified in this research is a necessary step to formulating an approach through which it may be addressed. Rittel and Webber (1973) suggest issues can be defined in one of two ways: *tame* or, *wicked*. The relative simplicity by which they can be resolved characterise *tame* problems. Most current problem-solving frameworks are structured to address these types of issues. *Wicked* problems are defined however, by their complexity and the intrinsic difficulty of identifying a resolution. As such, new and innovative problem-solving methodologies of the likes highlighted in the current work are necessary to address wicked problems. Wicked problems present ten unique qualities.

1. There is no definitive formulation of the problem

2. "They have no end
3. Solutions can only be good or bad – not true or false
4. It is not possible to test a solution
5. There is no possibility for trial-and-error – there is one shot only
6. They have an unlimited number of possible solutions
7. One problem is the symptom of another
8. Each problem is itself unique
9. Multiple solutions exist that may resolve a discrepancy in a wicked problem – it is the one chosen that determines the outcome
10. Those seeking to address a wicked problem must take responsibility for their work.

Design Thinking is a problem-solving framework specifically focused on resolving *Wicked* problems (Liedtka, Salzman, and Azer, 2017). Four key qualities define this framework, of which the first is particularly relevant here: human centred, possibility driven, option focused, and iterative. Identified in the Problem Statement, a core component of the problem identified in this research is the standardisation of design in mass housing developments. In this sense, the move away from demographic stereotyping and towards human-centred design solutions advocated for within this framework provides a valuable grounding for this work.

2.0

Literature Review

Two key topics form the basis of this research: the psychological experience of home and immersive virtual reality technology - as a tool for experiencing space. Although there are a broad range of topics covered within home focused literature, four are of interest here: the theoretical definition of home, home, and dwelling, the importance of home in the broader context of human needs, what determines an experience of home and finally, current methodologies for evaluating home. This facilitates first, an understanding of the emotional importance of housing and secondly, a framework for evaluating the role of housing in determining home experiences.

Virtual reality technology is increasingly valued for its ability to provide an alternative existence in the world. Used in this research as a tool for environmental analysis, it is believed that this alternative existence informs a new understanding

of what makes home. By identifying; the characteristics of virtual and real-world experience, the various types of virtual environments and, qualities defining the immersive nature of virtual reality systems, an understanding emerges of the extent to which information generated using this technology is applicable in real world contexts. This informs the development of a research methodology using this technology as the primary data gathering method to generate an understanding of what makes home.

Although there is currently almost no overlap between the two topics in current literature, the unique experiential qualities afforded to users immersed in a virtual environment indicates a significant potential for the use of this technology to evaluate housing needs.

Fig. 1

The term 'house' is most often used to describe the physical structure of our daily inhabitation but could also include such places as offices or schools.

INTRODUCTION

House, home and dwelling, three interlinked concepts that support an understanding of spatial inhabitation. Each however, describe different aspects of the process of inhabitation. While dwelling describes the act of existence or 'being' in the world, house is a place-based construct relating to physical settings. Home on the other hand refers to the psychological perception of a place and is therefore an intangible quality. An analysis of these concepts provides a framework for understanding what makes home.

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HOME HOUSE AND DWELLING

'House'

'House' describes the place or location of our inhabitation. Coolen and Meesters (2012) define it as "...the physical structures we live in". Similarly, Saegert (1985) identifies it as a "commodity" – "...something search[ed] for rather than produce[d]".

Key Principles of Home

The concept of home is far more vague and thus, is the focus of research by scholars including Korosec-Serfaty (1985), Hayward (1977), Sixsmith (1986), and Saegert (1985). Although definitions vary somewhat, they generally reference several over-arching themes. Coolen and Meesters

(2012) consolidate these into five key ideas. The first refers to relationships between environmental objects and people i.e. our relationships with, and the subsequent meaning we afford to physical objects and environments. Another is the spatial dimension of the physical settings referred to when using the term home. This may be a house, neighbourhood, homeland, park etc. (Figure 1). Third is the temporal nature of home. This defines home as not limited only to the present but potentially past or future places. Social relations, specifically family relationships are another key aspect of home. Finally, home is either a process or product. It can be a product of the relationships we form with place or, the process of homemaking we engage in.

‘Home’

Saegert (1985) refines these ideas into a working definition of home as “...a location in which significant activities of daily life are conducted and to which an occupant would apply this symbolically charged label”. It is place-based, however not necessarily referring to specific places. Instead, it is the perception of spaces inhabited. Home also has a psychological resonance and social meaning. Finally, it is a part of the experience of dwelling – potentially even central to it.

Saegert’s (1985) definition is particularly useful as it embodies many themes discussed in other explications while providing a framework for assessing what makes home by contextualising it within the concept of dwelling.

From House to Home

These definitions indicate a hierarchical relationship between house and home. As the location in which we may experience home, the house plays a role in determining the extent to which this occurs. It is not however, the only determinant. Home, ‘as the location of significant events’ is a reference to the act of dwelling. Saegert (1985) defines dwelling as:

“...the physical, social, and psychological transactions by which a person maintains his or her own life, joins that life with others, creates new lives and social categories, and gives meaning to the process, thus gaining a sense of identity and place in the world.”

Heidegger (1971) suggest dwelling refers to our state of existence in the world in so far as, to be human is to be dwelling:

“...the way in which you are, and I am, the manner in which we humans are on earth, is... dwelling.”

To this end, as a description of an emotional existence in the world – and a determinant of home, this experience is only possible when housing enables inhabitants to form emotional relationships with it and other people.

THE IMPORTANCE OF HOME

Abraham Maslow's (1943) Human Motivation theory illustrates the importance of home in the broader context of human existence (Figure 2). Maslow's (1943) human needs hierarchy is centred on the idea of need gratification i.e. satisfying conditions within each need category before becoming concerned with the next (Maslow, 1943). For example, access to clean and safe food and water are likely conditions for satisfying the physiological need classification. Alternatively, the desire to find intimacy and friendship may be contiguous with satisfying the love need classification. Thus triggering a desire to satisfy conditions of the self-esteem category.

Fig. 2

Central to Maslow's (1943) theory are five hierarchically prepotent basic human 'need classifications'. Maslow argues that gratification of these needs ensues 'basic satisfaction'.

Although fully understanding Maslow's theory requires significantly more complex discussion, this is not necessary within the current research. Instead these foundational concepts provide a useful framework to contextualise the importance of home in relation to human needs.

Assessing marginalised groups and particularly refugees in the context of this needs hierarchy clearly demonstrates the role of housing in the process of integrating into New Zealand society. Circumstances surrounding the transition from 'person' to 'refugee' threatens even the most basic

Fig. 3

Even the most previously successful people become solely focused on protecting their basic human needs as a refugee i.e. access to food and shelter.

human needs (Figure 3). On arrival to New Zealand, refugees begin anew, the process of satisfying each need category from the bottom up as they rebuild their lives. If housing is unable to meet the emotional needs of refugees Maslow's hierarchy suggests, they will be unlikely to satisfy any category above safety/security. This highlights the importance of housing in the context of our lives as these higher human need categories describe – to some extent, personal growth (emotion) and self-discovery. This is particularly true for the highest need category – self-actualisation; as a process of 'becoming' (Figure 4).

To contextualise this, a family approached during the scoping phase of this research declined to participate because they are embarrassed with their Housing New

Fig. 4 *Well-designed housing that meets the emotional needs of its inhabitants acts as a bridge between lower and higher human needs, enabling emotional prosperity and self-development.*

Zealand house. This embarrassment prevents them from connecting with members of their community and likely has an impact on their self-esteem and confidence. As conditions that must be satisfied before any 'higher' need categories are gratified, these have the potential to prohibit 'basic satisfaction' for this family. Because of its inability to meet the emotional needs of this family, this house serves as a great example of the impact poorly designed housing has on people.

Critiques of Modern Housing

Several scholars suggest modern housing has a functional inability to foster emotional experiences of home. Saegert (1985) suggests this is a consequence of evolving housing construction practices over time. While self-build

housing practices dominated early built environments, a move in the profession towards trade specialisation and regulation, has disconnected the act of dwelling from housing places. Alexander (1979) suggests modern housing lacks a quality that – when present, makes the building live. This quality – described by Alexander (1979) as “...the root criterion of life and spirit in a... building”, closely resembles Maslow's (1943) 'basically satisfied person' and Saegert's (1985) definition of dwelling. Alexander believes that without this quality, modern housing and – by association, its occupants are both metaphorically dead.

PLACE AND SELF-IDENTITY

Place-Identity

Place-identity describes a concept whereby the inhabitation of and, interaction with different environments informs an understanding of them. Proshansky et al. (1983) define it as an understanding of the physical world in the form of “...memories, ideas, feelings, attitudes, values, preferences, meanings and, conceptions of behaviour”. Furthermore, this understanding determines the perception of wider physical environments (Proshansky et al., 1983).

Self-identity

Place-identity is also central to determining self-identity. Botton (2006) believes “...we are, for better or for worse, different people

in different places”. Thus, the places we inhabit and our understanding of them is fundamental to our sense of self-identity

Proshansky et al., (1983) suggest the relationships we form with space informs self-identity. Botton (2006) believes buildings are ‘psychological moulds’ that both embodies us and informs who we are (Figure 5). He concludes that buildings most apt at doing this are “...honour[ed] with the term ‘home’” (Botton, 2006). This implies the extent of our relationship with space is determined by the degree to which it embodies our expectation of it – and by extension, the world. Because of

Fig. 5

The characteristics of the buildings we inhabit often closely reflect how we see ourselves or wish to be seen by others.

this, people are often drawn to architecture that exudes relatable qualities.

The concept of self-identity is not only relevant to individuals but to entire cultures, societies and, religions (Shah, 2012). Shah (2012) views the role of architecture as one of the most “...profoundly important reflections of culture” (Figure(s) 6-8).

The relationship between place and self-identity is fundamental to the concept of home, as it is inevitably the central location where self is manifest within the built environment. (Cooper, 1974). Cooper (1974) emphasises the affective relationship between the two in this context. For example, in describing the experience of moving-house she depicts a process of first being uncomfortable, cautious, and

perhaps, hostile to a new setting. Eventually however suggesting, we “...project a piece of ourselves onto its physical fabric...” as a revelation of the nature of self” (Cooper, 1974).

PLACE ATTACHMENT

Place-attachment like place-identity is concerned with people-place relationships. However, place-attachment differs in that it is informed through place evaluation as opposed to defining self-identity (Lewicka, 2008). Three key ideas common in literature describe different processes of place-attachment: affect, emotion, and feeling (Low & Altman, 1992). One less frequently discussed is the undertaking of, or participation in activities that form part of a routine as a means of creating attachment to place (Low & Altman, 1992). Manipulation and creation of place – part of the affect category, are also constantly cited in (Cooper) Marcus’ (1974) research.

Fig. 6

Fig. 7

Fig. 8

Fig(s). 6-8
The Vatican, Eiffel Tower and, Beehive, are each examples of architectural manifestations of a people, culture, religion, or institution. Over time, they have come to symbolise the identity of their respective groups.

Psychological and sociocultural processes occurring during place-attachment supplement an understanding of how this attachment reinforces our experience of home. Generally, psychological processes refer to influential experiences and events (Low and Altman, 1992). Sociocultural processes describe cultural, social, and personal ideologies that inform our attachment to place and subsequent attitudes towards them (Low and Altman, 1992). Both are significant with respect to the meaning of home. Ideologies central to these processes strongly influence what determines a place as home. These often

Fig. 9 For some, their attachment to Mosques as a place of worship stems from the buildings ability to provide space to pray and which faces Mecca. This principle also applies to housing,

define day-to-day life and thus, spatial inhabitation (Figure 9). If the house does not accommodate these needs, people are unlikely to dwell there, or form attachment to it.

Place attachment also facilitates emotional connection – to space and to other people. Altman and Low (1992) suggest this also triggers a heightened ability for emotional connection to occur with, and within this space. This includes feeling a sense of security, and the ability to ‘switch off’, using the place as a connection to family and friends, as well as less tangible connections to: ideas, memories, dreams etc. (Altman and Low, 1992). With emotional connection a central requirement for dwelling, a house-place becomes home subsequent to one’s feeling a sense of attachment to it.

The Effect of House Ownership

The financial process of house ownership may increase the potential for this physical setting to be experienced as home (Saegert, 1985). Conversely, the lack of this commitment for people residing in rental housing may significantly reduce this occurring. Because there is no financial anchor to their place of residence, in addition to the temporary nature of rental accommodation, place-attachment is less likely to form, either consciously or subconsciously. As an affective determinant for experiencing home this lack of attachment therefore lessens the potential for these places to be experienced as home.

THE MEANING OF HOME

Although many scholars have sought to posit a theoretical explication of home, there are few empirical studies seeking to understand its meaning. Judith Sixsmith’s (1986) exploratory study of environmental experience is an exception. Using a quantitative research approach, she attempts to identify various ‘types’ of home, their meaning and, their relationship, to establish a model representing the meaning of home.

Participant Characteristics

As a quantitative study, the twenty-two person participant group used is surprisingly small with seemingly very little social, cultural, and geographical diversity.

Results

Through this research, Sixsmith (1986) identifies twenty home place variations:

1. Town
2. Friend House
3. Owned Home
4. Room
5. Childhood House
6. Ideal Home
7. Future Home
8. Family (Holiday) Home
9. Married Home
10. Country (Homeland)
11. Parents Home (not a main residence)
12. County
13. Shared House/Friends
14. Shared House/Partner
15. Area
16. Miscellaneous
17. Hall of Residence

18. Campus

19. Temporary Accommodation
20. Digs' (rented bed and breakfast)

Subsequently, twenty 'content categories' are extrapolated with each describing a different meaning of home

1. Belonging
2. Happiness
3. Self-Expression
4. Extent of Services
5. Spatiality
6. Type of Relationship
7. Time Perspective
8. Permanence
9. Responsibility
10. Friends and Entertainment
11. Physical Structures
12. Architectural Style

13. Privacy

14. Meaningful Places
15. Preference to Return
16. Quality of Relationships
17. Emotional Environment
18. Work Environment
19. Knowledge
20. Critical Experiences

Finally, three distinct 'experiential' modes of home emerge within which, each content category fits (Figure 10).

Conclusions

The lack of a sizable or diverse participant group used in this research brings the relevance of the identified meaning(s) of home into question. Sixsmith's (1986) identifies a general trend amongst 'home' related studies to focus on traditional

Fig. 10 Sixsmith's S-A-I-I Plot indicating the regional structure of home. Each number represents a content category listed on page thirty-two. As such three experiential modes exist: physical, social and, personal. There are two variations of the latter, the subjective (i) and objective (ii) self.

household forms' and as such results in a large gap within this field. While there is certainly, an argument that marginalised groups are not representative of the wider population, to disregard them entirely leads to a naive ideology with respect to the meaning of home. With an increasingly diverse society emerging, it is necessary to reassess the definition of 'traditional housing environments' to include marginalised groups.

Because this research is not conducted within the context of an architectural discipline, there are no explicit implications proposed with respect to how the architecture of housing informs the experience of home. Instead, the various content categories identify the expected role of housing in terms of what it facilitates within the space.

EXISTING METHODOLOGIES FOR UNDERSTANDING HOME

To establish a framework informing the development of a research methodology, several existing methodological processes are analysed. The emotional nature of home is discussed in previous definitions suggests a qualitative research methodology. It also suggests the question of home is a problem unique to each individual. The use of a qualitative research methodology therefore enables a deeper understanding of the meaning of home for individual people and aligns with the human centred approach to this research.

TALKING TO THE HOUSE

Claire Cooper Marcus (1974) is one scholar concerned with understanding the emotional potential of architecture. The research - narrated as a collection of stories throughout her book, is itself an indication of how she perceives the concept of home. Marcus (1974) applies a methodology that can be described as 'talking to the house' to elicit thoughts and ideas from participants. This methodology is developed and tested over a twenty-year period of research. Marcus' work sits less within the realm of empirical research rather, the use of art, emotion and psychology provides an understanding of the 'deeper meaning of home' at a human centred scale.

A factor distinguishing this from other

research is an acknowledgement of home as being a quality intrinsically unique to individual people. This manifests within the research as several hundred individual case studies. As a result, Marcus has intentionally not sought to cross-compare these studies as a means for generalising an over-arching meaning of home instead, focusing developing an understanding of what it means to each individual.

Participant Characteristics

While there is no characterisation of the participants involved in this research, there is some suggestion of diversity. Participants also appear well spread geographically throughout the American state of California.

Participant selection for this research appears to be solely based on opportunity – i.e. people who approach Marcus, or knew previous participants. This directly facilitates a more representative understanding of what home means to a wider range of people.

Research Methodology

The methodological structure incorporates participant interviews as the main method for data generation (Marcus, 1974). Conducted inside the participant's house, the loosely structured interviews often focus on a central idea identified early in the discussion (Marcus, 1974). The location in which research is conducted is important as it ensures maximum participant comfort while enabling Marcus to visually examine the house.

Initially, Participants make drawings representing various associations of home - including emotions and memories connected to their home places. This facilitates an internal contemplation about their relationship with home. During this time, Marcus explores and visually documents the house. This enables her to contextualise future discussion with the participants to a physical environment. Following this, the participants describe what they have drawn – what it is as opposed to what it means. Finally, a process of talking to the house takes place (Figure(s) 11- 14).

These interviews often last more than two hours and are noted for becoming highly emotional, reinforcing the idea of home as a place of emotional experience.

Furthermore, the extended duration of this research has led to many participants being interviewed multiple times.

Discussion

Perhaps the most valuable conclusion drawn from Marcus' (1974) research is understanding the possibility of identifying emotional housing needs when applying a qualitative and human centred research methodology. Because the research as a whole, consists of several separate case studies, Marcus makes very few generalisations as to what makes home. This is consistent with the idea that home is a unique emotional experience defined by each individual's personality and circumstances. As such, it is impossible to accurately extrapolate the meaning of home for one or a small number of

Fig. 11

Fig. 12

Fig. 13

Fig. 14

Fig(s). 11-14

Using their drawing, the participant first speaks to it as if it were the house, starting the discussion with “House – the way I feel about you is...” Following this, participants ‘swap’ places with the ‘house’ and respond to comments as if from the house’s perspective.

people as being representative of a larger group. Instead Marcus (1974) posits that designers must engage with clients in order to 'empathise' with their concept of self as a tool for the design of housing that better meets their needs (Cooper, 1974).

THE TIMELESS WAY OF BUILDING

Although not strictly a research methodology Alexander's (1977; 1979), work remains useful. His work stems from the belief that all 'great' architecture of the past shares a pattern language. This language is essentially a series of ideas, principles and, philosophies used in the construction of buildings that produces a sense of life in the space. This work is a reaction to Alexander's (1979) belief that modern designers lack the skills necessary to shape buildings that embody this quality.

Central to Alexander's (1974) work are 253 interconnected patterns that inform various design possibilities. These are ordered from largest to smallest with respect to the scale of application and are categorised into

one of three groups shifting in scale from towns to buildings and construction (Figure 15). These patterns form a valuable design assessment tool useful in this research as a method for evaluating proposed design interventions. The perception of buildings as individual yet interrelated components of a whole, shares some similarities with this research to the extent that it seeks to understand how specific architectural components contribute to a sense of home.

CONCLUSION

As a place in which significant events take place, the home plays a fundamental role in not only our day-to-day life but also our understanding of the world, and ourselves. In a similar manner, the absence of home in our lives has the potential to affect the process of self-actualisation. Although often used synonymously, 'house' and 'home' describe different ideas and highlights the difficulty in measuring the architectural implications of home. While the house is often the experiential location of home it is not always the case. In this sense 'house' describes the location

Fig. 15

Each pattern includes a title (a), introduction linking it to higher order patterns (b), a problem statement (c), a discussion (d), and a solution (e).

in which 'home' may be experienced – the degree to which this happens depends on the extent to which it facilitates the experience of home i.e. enables dwelling. Understanding what makes home is further complicated by the fact that this varies from person-to-person, and over time. Thus, the focus on marginalised communities in this work limits the applicability of findings generated in previous empirical research, as they tend to focus on traditional households.

Although some scholars have attempted to elicit an understanding using qualitative research methodologies, the tools and processes used to generate data have not advanced with current technological development, prohibiting a deeper understanding of home. In this sense there

is potential for the incorporation of new technologies into research methodologies as tools used to enhance the understanding of the meaning of home.

INTRODUCTION

Through the introduction of several mass-market systems, immersive virtual reality (IVR) is increasingly available to consumers. Furthermore, an interest within academia to understand the capabilities of this technology has significantly expanded potential applications of IVR systems.

Despite this, the use of IVR in the architectural domain seems somewhat limited. Current applications are generally limited to the evaluation of design propositions in ‘walk-through’ type formats (Campbell and Wells, 2003). Not present in literature, is research investigating IVR as a tool for understanding the psychological implications of architecture i.e. the meaning of space and emotional connection with

VIRTUAL ENVIRONMENTS

The term Virtual Environment (VE) describes “a form of interaction between human and computer which consists of computer-generated audio and visual simulation of three-dimensional (3D) space, in which users have interactive experiences” (Biševac, et al., 2014). VE’s are often defined by the type of experiences had by users e.g. totally-immersive, semi-immersive, or non-immersive, as opposed to how the environment is represented (Biševac, et al., 2014)

Kwan Min Lee’s (2004) characterisation of both virtual and real environments is useful as it expands beyond just the virtual dimension of human experience. Thus, it is possible to understand how virtual and real

the built environment. This section thus, investigates psychological and artistic applications of IVR due to their focus on the experiential and emotional potential of this technology. Three different components of IVR are assessed. First, the relationship between real world environments and those created within the virtual dimension. This is important in understanding how knowledge gained within the context of a virtual environment (VE) may be applicable to real world environments. Secondly, the ideas of presence and immersion are analysed. By highlighting these concepts, key requirements for the development of a research methodology using IVR are identified. Finally, spatial perception in the context of virtual experience is evaluated to identify how IVR may change our understanding of space.

experience differs.

Types of Environmental Representation

In the real world, objects and environments are represented as actual entities (Lee, 2004) (Figure 16). Because the experience of actual entities is not possible in IVR, two alternative methods of representation: artificial and, para-authentic, characterise the ‘virtuality’ of VE’s (Lee, 2004). These are differentiated by the extent and validity of connection between virtual and actual entities. Artificial entities are characterised by the absence of any valid connection to ‘actual entities’ (Figure 17). Conversely, para-authentic entities exist within the real world and are technologically mediated to also exist in IVR (Figure 18). The extent of validity required to determine an entities’ authenticity is a subjective measure and

determined by the extent of prior-cognition of the actual entity by participants (Lee, 2004). That is to say, while the Eiffel Tower is in fact an actual entity, if an individual is unaware of its existence – in any respect, it is experienced in IVR as an artificial entity.

IVR is used in this research as a tool enabling people to experience their ‘virtual house’. To this end the house is experienced as a para-authentic VE. While participants are not experiencing their actual house, neither are they experiencing something new. What they are experiencing is a ‘mediated version’. The ability to use prior knowledge to inform this experience categorises it as ‘different’ as opposed to ‘new’ or ‘the same’.

This understanding is important as the applicability of this technology as a

research tool is determined by the degree to which information discovered during the virtual house experience is applicable in the real world during the design phase. If as Lee (2004) indicates, prior-cognition of a real environment facilitates experiential crossover into a VE, this is then possible.

▼ **Fig. 16**

Actual entities are those which “can potentially be experienced by human sensory systems without using technology” (Lee, 2004).

▲ **Fig. 17**

Artificial entities while existing in IV/R , would cease to do so absent of the mediating system.

▼ **Fig. 18**

Para-authentic entities are characterised by their valid connection to actual entities.

DEFINING PRESENCE

Central to all virtually mediated experiences are the concepts of immersion and presence (Lee, 2004). Immersion describes the ability for the technological system to emplace users within an alternative immersive reality while simultaneously excluding sensory stimulation from the real world (Mestre et al., 2006; Morie, 2008). Presence however, – as a psychological state, is a consequence of immersion describing our sense of ‘being there’ in a VE (Mestre et al., 2006).

There are several variations of this concept. Telepresence refers to the “...sense of being physically present at a remote location through interaction with the system’s human interface...” (Ijsselstein et al., 2000). Virtual presence – the “sense of

being physically present with visual, auditory or force displays generated by a computer” (Sheridan, 1992) and Mediated Presence (Lee, 2004) contextualise this construct solely within virtually mediated experience. However, as Lee (2004) suggests, the failure to sufficiently identify what virtual experience is in these explications results in a lack of cohesion in existing literature.

Presence Explications

A particularly useful definition of presence is as the “perceptual illusion of non-mediation” (Lombard and Ditton, 1997). The term perceptual infers “... continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person’s environment” (Lombard and Ditton, 1997). Therefore, the illusion of

non-mediation describes the user’s ability to experience an environment as if there were no technological system mediating it.

Lee’s (2004) explication of presence, based on a systematic review of literature is widely referenced in subsequent research. It is useful here, as it defines presence in the context of both virtual and real-world experience. Thus, by identifying the various presence typologies and their relationship to one-another it is possible to understand what characteristics differentiates virtual from real experience. Lee (2004) postulates that presence is a “...psychological state in which the virtuality of experience is unnoticed”.

Experience

Real and virtual worlds are each domains of existence in which human experience occurs. (Lee, 2004). Two characterisations define these experiences. The first – discussed earlier, describes the type of entities experienced, either: actual, para-authentic or, artificial. The second distinguishes the way in which these entities are experienced. In the real-world, actual entities are experienced sensorially. In the virtual this extends to non-sensory experience. Based on this explication Lee (2004) refines his definition – specific to virtual presence, as “...a psychological state in which virtual (para-authentic or artificial) [entities] are experienced as actual [entities] in either sensory or non-sensory ways”.

Within both the real and virtual typologies there are three possible domains of experience: physical - interaction with objects/ environments, social - experience of other actors and, self - the experience of ourselves (Lee, 2004). Each of these respectively become ‘virtual experience’ when experienced either sensorially or non-sensorially as para-authentic or artificial entities. Similarly, they become ‘real experiences’ when experienced sensorially as actual entities. Six types of virtual and three types of real experiences emerge from this characterisation:

Virtual Experience – the sensory or non-sensory experience of:

1. Para-authentic objects/environments
2. Artificial objects/environments

3. Para-authentic social actors
4. Artificial social actors
5. Para-authentic self
6. Artificial self

Real Experience – the sensory experience of:

1. Actual objects/environments
2. Actual social actors
3. Actual self

Presence Typologies

Following this explication, Lee (2004) proposes three subtypes of presence – physical, social and, self. Because of the specific application of IVR in this research, only the physical presence typology is of interest. This is defined as “...a psychological state in which virtual (para-

authentic or artificial) physical objects are experienced as actual physical objects in either sensory or non-sensory ways”.

Several variations of these presence sub-typologies are identified. Lombard and Ditton (1997) propose six ‘interrelated but distinct’ presence typologies: social richness, realism, transportation, immersion, social actor within medium and, medium as social actor. IJsselstein et al. (2000) distil these into two board classifications physical and social – seemingly incorporating both Lee (2004) and several of Lombard and Ditton’s (1997) self-typologies within the social category.

Determining Presence

The phenomenological nature of presence makes scientific measurement and the

quantification of various determinants difficult (Morie, 2008). Despite this, some research exists on the topic shedding light on what determines presence in technologically mediated experience (IJsselstein et al., 2000; Lombard and Ditton, 1997).

Lombard and Ditton (1997) identify several ‘key variables’ that they indicate determine presence. These are identified as either formal variables - qualities or functions of the technological systems or, content variables - relating to the characteristics of the environment/ reality and people experiencing (Lombard and Ditton, 1997).

Formal variables:

- Visual display characteristics,

- Aural presentation characteristics,
- Stimuli for other sensors,
- Interactivity,
- Otrusiveness of the medium,
- Live versus recorded or constructed experience.
- Number of people.
- Number and consistency of sensory outputs,

Content variables:

- Social realism,
- Use of media conventions,
- Nature of task or activity,
- Media user,
- Willingness to suspend disbelief,
- Knowledge and other prior experience with the medium,
- Other user variables,

Ijsselstein et al., (2000) categorise various presence determinants as referring to one of four ideas. The first two: the 'extent and fidelity of sensory information' and, the 'match between sensor and the display' are analogues with Lombard and Ditton's, (1997) formal variables while the remaining: 'content factors' and 'user characteristics' relate to their description of content variables. Thus, a relatively strong agreement within literature emerges as to the determinants of presence within technologically mediated experience.

Interaction - with an environment, is cited as a key influence of presence by Lombard and Ditton (1997). Lee (2004) identifies this, in addition to perception and manipulation, as being possible behavioural characteristics. Perception is the ability

to understand experienced surroundings. Manipulation - as a higher-order function of perception, describes the ability to change an environment and/or objects within it. Finally, interaction - the highest behaviour function, is the mutual affect possible between self and experienced entities. The hierarchical structure of these behaviour functions means interaction produces the largest sense of presence.

The 'Knowledge and Prior Experience with the Medium' variable is particularly relevant to this research. Lombard and Ditton (1997)

suggest that a lack of understanding of the system and of the means of experience effects presence levels in IVR. Within IVR a new type of existence takes place. This is important when considering the impact of the experiential medium on spatial

understanding. During an experience of the virtual house, not only are participants experiencing the environment but also learning 'how to' experience (exist). This is a trial-by-error process of: how to move, to explore, what motor function in the real-world correlate to action in the virtual world, how bumping into an object in the virtual world 'feels' to the physical body and more. This inevitably changes the nature of experiencing. These experiences are thus, likely to be characterised by a sense of hyper-awareness not felt in the real-world.

Novelty and 'impressiveness' associated with a first IVR experience, may impact how VE's are explored i.e. to test the systems potential and limitations (Lombard and Ditton, 1997). As such, an increased attention to detail facilitates the

identification of various environmental aspects perhaps unnoticed in the real world.

‘Vividness of representation’, is also relevant to this research. This includes the ability of the system to “produce a sensorially rich mediated experience” (Figure(s) 19-20). With modern advances in IVR technology the means to create photo-realistic immersive virtual environments is increasingly available – although still somewhat underutilised. Vividness of representation is not only important in the current research as a determinant of presence, but also because of the role of the VE in this research. As a result, digitally rendered methods are not applicable in this research as they likely distort the architectural qualities of an environment beyond what is acceptable.

Different VR Systems

Several iterations of immersive virtual reality systems are widely available. These can be categorised into one of two groups: Phone-based – Google Cardboard and Samsung Gear VR, and PC-based – Oculus Rift and HTC Vive. The increased capability of PC-based systems means they (specifically the HTC Vive) are most suited to this research.

The Immersive Nature

The Vive system consists of a Head Mounted Display (HMD) unit - ‘tethered’ to the PC device via a cable, and a pair of wireless hand controllers. These elements determine the system’s immersive nature. Visual and auditory sensory information is provided using a screen and headphones built into the HMD. Movement and spatial

interaction are possible using the handheld controllers. This movement, and the ability to manipulate objects is possible using either a finger operated ‘trigger’, a touchpad or, buttons built into the controllers. Moreover, the units are digitally mirrored in the VE as representations of user’s hands during these experiences. This method of bodily representation further enhances the immersive nature of the system.

Multiple sensor units track both the HMD and the handheld devices. Movement by these devices – and by extension the participant, within an established 2.5 by 2 meter space is translated as movement within the virtual environment. This is a key immersive feature of PC-based systems setting them apart from phone-based technology. The tracking system

Fig. 19

Fig. 20

Fig(s). 19-20
*Lombard and Dutton (1997) suggest photo-realistic
VE's (Right) are highly influential determinants of
presence and more effective than traditional digitally
rendered environments (Above).*

enables both translational and rotational movement through a VE – as opposed to just the rotational movement possible in phone-based systems (Figure 21).

Rotational

Translational

Fig. 21

The provision of translational movement enables participants to move through space as opposed to only around a point. This significantly increases the level of immersion.

ONTOLOGICAL IMPLICATIONS OF IVR

Ontologically speaking, we exist differently in immersive virtual reality – a result of an underlying change in how we are ‘being in’ the world (Morie, 2008). When we experience the real world, both the lived body and the physical body, exists solely in the real world (Morie, 2008). However, in an IVR we exist isocronically between the real and virtual worlds (Morie, 2008). ‘The physical body – unable to exist in the virtual, remains in the real world – as the vehicle for experience, while the lived body bifurcates between the real and virtual (Morie, 2008). To this end, the lived body takes with it “...much of the physicality, sensory equipment, and kinaesthetic senses with it” (Morie, 2008).

The bifurcation of the lived body and the extent to which this occurs is likely determined by the level of immersion afforded by the IVR system. To this end, the more one is immersed within the virtual reality, the more the lived body exists solely in that domain of experience and therefore, the closer the experience of the virtual world matches that of the real world. What follows is an understanding that because of this bifurcation there is a fundamental difference between our experience of virtual and real environments.

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SPATIAL PERCEPTION

Spatial perception is “the subjective interpretation of sensory stimuli” enabling an understanding of the physical environmental and the body’s relative location in it (Lee, 2004). Pop (2013) describes this process as being “...the first step we take when interacting with space”. Understanding this process is therefore critical, not only because of its role in informing an understanding of the surrounding environment, but also because of the potential for spatial knowledge to be manipulated based on how and what sensory cues are provided.

Spatial perception is a product of the relationship between body and mind (Morie, 2008). First, the body – as the

‘vehicle for sensory experience’, by virtue of the movements and actions fundamental to existence in the world, receives information that is then processed by the perceptual system (the mind) to create a spatial perception (Morie, 2008).

‘The visual sensory system is thought to be among the most critical in this process (Kushiro, 2012). However, others such as the vestibular (balance, and bodily orientation in space), auditory, and the somatosensory (nervous system – touch, pain, warmth) are all considered critical to the generation of spatial information (Kushiro, 2012).

It should be clarified that these systems do not work independently, rather operating in unison relative to the ability of each to

provide spatial information (Morie, 2008). This speaks to the concept of sensory redundancy – the ability for information received by one sensory system to be supplemented or reinforced with information by others, as such ‘bumping the believability’ of a given perception (Morie, 2008).

Although the mediated nature of virtual experience is seen to distinguish virtual and real experiences, real world experience is also inherently mediated. Because knowledge of the real world is merely inferred from sensory cues, it is therefore deemed to be ‘natural perception’ (Lee, 2004). Virtual experience is distinguished from real experience using the term technologically-generated perception. To highlight the prepotent relationship between the two

Lee (2004) labels them as first and second-order mediated experiences respectively.

Natural Perception

In the real world, ‘natural perception’ is a result of all the human sensory systems interacting with the environment (Lee, 2004; Morie, 2004). The functional body’s existence within the environment experienced creates a flawless and compellingly representational picture of what is believed to be real. Thus, the mediated nature of natural perception is unrecognisable (Morie, 2004). ‘Natural perception’ is therefore the default understanding of the world, against which the representational validity of all other mediated experience is measured.

Technologically-Generated Perception

As identified previously, rather than a difference in the environment represented, it is the way of experiencing that varies. In this situation, an understanding of the VE is not directly inferred by the sensory system rather it is first mediated by the technological system. This highlights the role of the systems hardware as mechanisms for linking sensory receptors to a VE.

Because of the limited ability for IVR systems to provide sensory information, it is reasonable to suggest that a technologically-generated perception of this environment will differ from natural perception in the real world. While this is the case, aspects such as prior knowledge and sensory redundancy also inform spatial perception. To this end, natural

and technologically-mediated perception are likely similar, despite the variation in sensory information received. This also suggests the extent to which natural and technologically-mediated perceptions are synonymous is determined by the level of immersion within the virtual environment.

This validates the idea that experiencing an environment that already exists in the real world in IVR has the potential to generate new understandings of that environment. Thus, it may therefore be possible to use information gathered by virtue of this new understanding to better identify how participants relate to a given real-world environment.

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CONCLUSION

While different, this analysis of literature shows that experiencing an environment in virtual reality is not a new, nor the same experience than that of the same real-world environment. Therefore, it is reasonable to conclude that this experience is likely to uncover an additional understanding of how we inhabit housing. Moreover, the relationship between para-authentic virtual and, actual real-world entities means these findings have the potential to inform the design process of a real-world environment.

The experience of home is fundamentally unique to each individual and as such, is difficult to quantify. Despite this, several quantitative studies have sought to identify the meanings of home. While conclusions often align with most theoretical explanations, they are often vague and fail to identify the role of architecture in defining this experience. A lack of participant diversity in many of these studies highlights a gap in the ability to understand the meaning of home for marginalised people. This is surprising as modern mass market housing, is least likely to meet the emotional needs of this community. Thus, an understanding of how, and what defines a home for these people is particularly important. Claire Cooper Marcus' qualitative research methodology seeks to understand the specific architectural

implications of home. Her analysis points to an emotional architecture that exists as a physical manifestation of an inhabitant's perceived personality. The human centred approach to understanding home provides a useful framework for the development of a virtual reality-based methodology in this research.

The potential use of immersive virtual reality to understand home stems from an ability to emplace users within an alternative form of environmental existence. Because virtual environments are not directly experienced by the body, many factors that define spatial perception in the real-world are either absent (somatosensory function) or altered (translational movement). Thus, the understanding of a virtual environment is fundamentally different to that of a

similar real-world environment. The potential for virtual experience to inform an understanding of home stems from the type of virtual environment. Paraphrased, authentic virtual environments are defined by their level of similarity with a previously experienced real-world environment. To this end, one's experience of their house in the virtual reality is characterised as 'different' rather than 'new' or 'the same'. Finally, the system's immersive nature determines the extent to which new information is generated. By facilitating a higher level of presence for participants, the extent to which the lived body exists in the virtual world increases. Thus, these experiences are more likely perceived as genuine.

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3

A Research Methodology

INTRODUCTION

Immersive virtual reality is used in this research as a tool to provide alternative methods of spatial inhabitation. This chapter seeks to develop a research methodology focused on the use of immersive virtual reality. It is hypothesised that this form of spatial inhabitation facilitates conscious understanding for participants of the various; emotions, feelings, attractions, and detractions associated with objects and spaces in their house. The feedback provided by participants experiencing their 'virtual house' forms the data set from which a more comprehensive understanding of how the architecture of housing embodies the idea of home is possible.

Influences

The work of Claire Cooper Marcus is used as a framework for the development of this methodology. Like in the current work, Marcus attempts to elicit from her participant's subconscious memory, emotional associations to their places of home. What distinguishes the current work, from Marcus' – and many others, is the use of advanced technologies. As opposed to the use of very traditional methods of data procurement including drawings, interviewing, surveys, photography etc., the methodology developed here is distinguished by its use of new technologies. The use of virtual 'tools' as methods of research has the potential to unlock a deeper understanding of how people experience, and form connections with their house, and subsequently what it is that makes these places home.

Methodological Structure

Four separate phases constitute the research methodology. Phase one involves client briefings and gathering spatial information. The creation and programming of the virtual house occurs during phase two enabling its use as a virtual environment in the HTC Vive system in phase three. Phases one, two and, four are establishment phases in the sense that they are only necessary to make the third phase possible. The third phase is therefore, the point at which the primary data set is generated. Finally, phase four consists of a client debriefing and may be used to obtain supplementary data from participants or to discuss findings. With the exception of phase three, each phase includes a separate meeting with the client over a period of approximately one month

(Figure 22).

The Introductory Meeting

Phase one consists of an introductory meeting with the participants. This is a chance for familiarisation between the two parties and is an important step prior to data collection. Without this familiarity, it is possible that participants feel uncomfortable describing the emotion of

their experience thus, diluting the potential of this process to illicit useful data.

Collecting Spatial Information

Collection of the information necessary to create a ‘virtual house’ also takes place during phase one. Thus, phase one is conducted at the participants’ house for both their comfort and to enable the

PHASE ONE

Fig 22

The four phases of this research methodology are dispersed to provide time to create the virtual house experience and for data analysis.

collection of spatial information. A tripod-mounted 360-degree scanner generates the necessary information. These scans are subsequently processed by Matterport's 3D Content Platform to create the virtual house experience (Figure 23).

This process is additive. As such information generated in each scan builds-onto and refines the spatial mesh as a whole. Therefore, it is necessary to establish a spatial grid for scanning (Figure(s) 24, 25).

Scanned areas of the house

Fig. 23

A three-dimensional mesh is created through a process of laser scanning at numerous increments of a 360-degree rotation. Simultaneously, cameras built into the scanner photograph the spatial textures superimposing them over the mesh.

Fig. 25

KEY

- = Scanning Area
- = Primary Grid Spacing
- = Secondary Grid Spacing
- = Area Not Scanned
- = Primary Scan Locations
- = Secondary Scan Locations

Fig. 24

A one-by-one-meter grid spacing ensures the creation of an accurate spatial model. - 1:100

Fig. 25
In areas with high concentrations of objects, the spatial grid is reduced to half meter increments. - 1:50

Ground Floor

Some spaces are excluded in this research to maintain the privacy of participants (Figure 26a/b). Because of their cultural and religious significance, the inclusion of rooms containing religious shrines or similar personal spaces are subject to discussion with participants before being scanned. The criteria, illustrated in Figures 26a/b provide an initial guideline and is subject to reassessment at the beginning of each case study.

KEY

= Included Spaces

= Included but not relevant
to this research.

= Excluded Spaces

Fig. 26a/b

Every space is categorised in one of three ways: Included, Included but not relevant to this research or, Excluded. These generally refer to: semi-public, utility and, private/exterior spaces respectively. While privacy issues do not prevent utility spaces from being scanned, their insignificance in defining home makes inclusion pointless. - 1:100

PHASE TWO

Phase two involves generating a virtual house compatible with the HTC Vive system.

The Base Model

The Matterport platform used in this research produces virtual environments (VE) for use in phone-based systems and as such are not compatible with the HTC Vive. Although this format of virtual reality experience is highly photorealistic, there is an inherent lack of (free) translational movement. Instead, this is substituted with point-to-point teleportation. These points correspond with various locations of the scanner. Thus, what the participant sees is analogues to what the camera 'saw' during scanning. As a significant factor in

determining presence within immersive virtual reality, the limited movement afforded by this system suggests presence is likely diminished in this format.

Building a Virtual Environment

The creation of a virtual experience using the digital mesh created in the scanning phase is necessary to resolve this incompatibility. The mesh is similar to other computer-generated spatial models in that it is three-dimensional. However, the photographic textures superimposed onto it enhance the visual realism of the model – something not possible in digitally rendered environments. The Unity software platform is used to create an immersive virtual experience compatible with the HTC Vive. This involves adding actors (digital representations of a participant)

to the model and defining conditions for movement such as how and where they move as well as collision boundaries.

Participants can apply both translational and rotational movement in PC-based virtual reality systems. However, two factors limit the extent to which this is: a) possible and, b) worthwhile. As a limitation of PC-based systems, participants only have a small real-world area in which the system is able to track movement. Therefore, translational movement is not a viable option for long distance travel. As a result, point-to-point teleportation using handheld controllers facilitates this action. That is not to say translational movement is not worthwhile in this situation. Instead its primary use is for local area movement.

PHASE THREE

The virtual house experiences' are conducted during phase three of the methodology. This occurs at the participant's house, at a time enabling all eligible household members to partake in the virtual experience.

The House as the Location for Experiencing

As in Marcus' work, it is crucial for the success of this methodology that the house is the location of the virtual experience. This is true for the same reasons Marcus (1974) cites i.e. participant ease and the ability to assess the house. Additional factors also make this location particularly important in this research. Because the extent of sensory information received by the participant strongly influences their

sense of presence, matching the 'place of experience' to the 'place experienced' means much of the sensory information received by the lived body correlates to the living body's experience of the virtual house. For example, the inability to reproduce audio stimulation in the virtual house is resolved, as ambient noise in the physical house is synonymous with what would be heard during the virtual house experience. This extends to some extent to the smell and touch senses and enables a higher level of immersion. Environmental comparison is also possible. By using the 'actual' house as the location for an IVR experience of the 'para-authentic' virtual house, participants can instantly compare their virtual experience to the same real-world environment. This enables participants to recognise how their experience changes –

in terms of what stands out to them, how they feel etc.

The Virtual Experience

A pre-experience discussion serves first as an opportunity to teach participants how to operate the HTC Vive system and secondly, to understand what 'home' means to the participants and how they have tried to achieve this in their house. This is necessary as it builds a repository of supporting information in which to contextualise primary data.

Eligible participants then experience the virtual house. During their experience, participants verbally describe their experience such as what is most/more noticeable and how they feel in different rooms/spaces This is critical to the success

of the overall methodology as it is the main method for data generation.

It is possible to see what participants look at in the virtual environment as the computer's display replicates the HMD. While this provides some useful data e.g. what is being looked at in the space, participant commentary provides a greater depth of understanding as it identifies the emotional qualities underpinning their experience.

To ensure maximum data generation no time limit is set. Rather, it is at the participants own discretion as to when they feel ready to finish. To this end, there is no pressure for participants to rush their experience, potentially diminishing the quality and quantity of data produced.

Literature indicates that participants may want to experience the virtual house multiple times. In a similar way that prior knowledge affects presence levels, it may also affect comfort and so, the participants willingness to remain in the experience. Therefore, some may wish to undertake two experiences of the virtual house. The first, a short experience to develop familiarity with this type of existence and, a second longer experience exploring the virtual house.

Another participant discussion follows the virtual house experiences. Here, the focus is on developing an understanding of various statements made during their experiences. This information is also used to supplement primary data.

PHASE FOUR

The final phase functions as a backstop to the third. Consisting of a single meeting with participants, it provides time in which to clarify specific ideas identified in phase three. This is important as it provides time after the virtual house experience to conduct a detailed analysis of primary data to identify any gaps in knowledge.

THE PARTICIPANT GROUP

Participant Recruitment

Although marginalised groups are the focus of this research, refugees are the specific community used in the case study because of their unique relationship to home. The small population of refugees living in Wellington necessitates engagement with third-party organisations to identify participants. Organisations such as: The New Zealand Red Cross, Immigration New Zealand, The Salvation Army, ChangeMakers Refugee Forum, and other local community, religious, and ethnic groups who work with refugees in New Zealand were contacted. The relationships fostered between these organisations, the people who work for them and, the refugee community make these organisations

perfect for identifying possible research participants.

Participant Inclusion Criteria

An inclusion criterion is established to specifically identify people for which this work is most appropriate. One of the key criteria is that participants were not born in New Zealand. Rather, they must have arrived in New Zealand as a refugee under UNHCR mandate. Multiple participants are involved in each case study – determined by family size. ‘Family’ is defined here as the people who inhabit the house as a primary place of residence. Only people over the age of eighteen are eligible to participate for ethical reasons with no upper age limit enforced.

Families must also currently be living in

a stable living situation. This is defined in three ways. First, they must have lived at their current address for at least three years. Second, have no current known mental health issues or concerns. Finally, be identified by the partner organisation as suitable to participate. Moreover, participants must have lived in New Zealand for more than seven years.

INTRODUCTION

Using the established research methodology a pilot study is conducted to identify; the extent to which useful data can be generated and, understand its potential applicability in practice. It is also necessary to identify the limitations of both the methodology and the virtual tools used.

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INITIAL THOUGHTS

This Pilot study specifically focuses on testing the potential of the research methodology. Thus, it is important that participant characteristics do not impede analysis. Several potential participant characteristics may affect this assessment^[1].

Religion

Many refugees – settled in New Zealand under the Governments Quota program, originate from countries with large Muslim populations including Syria, Palestine, and the Rohingya communities of Myanmar. Therefore, the potential that cultural and religious practices may prevent people from participating in this research is an

issue. As the main means of analysing the methodology's success, a limited ability for participants to provide commentary would distort any assessment of the methodology's potential.

Communication

Participants are likely to have grown-up in non-English speaking countries. This foreshadows potential communication issues. The extent of this depends on several variables such as: how long participants have lived in an English-speaking country or, how much English they spoke prior to immigrating. This research methodology requires participants to not only 'experience' but also 'communicate'. Because of the complex nature of emotion

¹ Participant selection had not occurred at this point in the research. As such these issues relate to potential worst-case situations.

and feeling, it is important that participants can describe their experience in a manner that adequately conveys the complexity and depth of their emotions. This is something a language barrier may affect.

Unfamiliarity with the Research Team

The last two issues while different have a similar impact on an assessment of the research methodology. Trauma caused by abuse of power from people with authority over refugees or with whom refugees are unfamiliar and, the lack of prior relationship developed between the participants and research team may result in a lack of trust by participants. Thus, it is unlikely that the full potential of this methodology would be realised as participants may close themselves off from, or otherwise selectively communicate information during the interview process.

PARTICIPANT INCLUSION CRITERIA

Establishing a Criteria

A refined participant inclusion criteria ensures any aspects affecting data outputs not directly related to the methodology are removed. This enables an understanding of the methodology's maximum data generating potential.

This criteria, while similar to the case study participant criteria, includes several variations. First, there must be a pre-existing relationship with the participants. Additionally the participants must be of New Zealand descent or have lived in the country for a significant portion of their lives and speak English as their first language.

THE STUDY

The Participants

The family – of Maori descent, live in the Wellington suburb of Lyall bay. Six permanent occupants spanning three generations live at the property. The property is owner occupied and has been owned or occupied on and off by members of this family across several generations. The family consists of two teenage (Occupant(s) One, Two) and four adult occupants (Occupant(s) Three, Four, Five, Six). Occupants Three, Four and, Five are in paid employment while Occupant Six is a retiree. Occupant Three and Four own the property, are married and are the biological parents of Occupants One and Two. They have also both obtained higher education. Strong community engagement is evident in the family and is reflected in their home

life with many guests frequently visiting the house. There is also a strong sense of connection to their culture, language, and family heritage.

Fig. 27
The participants' house, is reminiscent of bungalow style housing commonly seen throughout Wellington's suburbs.

Fig. 28

Located in suburban Wellington, the house also has a small front, side and, rear yard. A small sleep-out type structure is located in the rear and a detached garage in the front. - 1:100

Note: *Having only been in the house's public spaces, a complete understanding of the layout is not possible. As such, this floor plan is a best guess as to the layout of private spaces.*

Fig. 29

The walls are crowded with family photos drawing attention when in the space. I was interested to understand the role of these elements in the virtual house.

EVALUATION

Assessment of two key aspects of the methodology is necessary. First, the methodological structure and secondly, the virtual reality software. Furthermore, outputs are assessed to identify data quality. By understanding the limitations, issues and, successes of each it is possible to adjust the methodology, ensuring subsequent case studies will produce the best quality and quantity of data.

Methodological Analysis

Phase one – conducted on a Saturday afternoon, took approximately one-and-a-half hours to complete. During scanning, participants were not present. This was favourable as it is necessary for rooms to be empty of people and pets. When

scanned however, participants in the Case Studies are likely to be opposed to leaving their house during this time due to the lack of familiarity. Instead they will be asked to occupy alternative rooms during this time. The methodology applied during this phase is generally consistent with that proposed, suggesting no issues moving forward.

Phase three took place on a weekday evening over a period of two-and-a-half hours. The lounge was the location for both the virtual house experiences' and discussion. Of the six, only Occupants Three, Five and, Six chose to participate. Occupant Four was unavailable and Occupants One and Two declined to participate. The methodological structure of this phase also remained very consistent to what was earlier proposed. Several small issues are identified that

– while not necessarily affecting data output, are addressed to ensure the smooth application of this methodology in future studies.

Explaining the System – The proposed methodology does not adequately establish a process for explaining how to use the HTC Vive system to participants. By simply explaining the use of the controllers and HMD, participants were unable to contextualise actions made in the real world to resultant actions within the virtual reality. Because the nature of virtual existence is fundamentally different to the real world, a greater focus on explaining the system is necessary. To do this I undertook a virtual house experience to demonstrate the system. Because the participants could see how my actions in the real world translate to

virtual world reactions, participants gained a better understanding of the system.

Participant Mobility – Although there is no upper age limit for participation in this research, no contingencies were in place for elderly or physically impaired people. Although it is possible to enforce an upper age limit, to do so would be counter-productive. Because the fundamental purpose of this methodology is as a ‘tool’ used in the process of housing design, the idea that certain people are excluded from participating due to their age or a physical impairment is unreasonable.

As an active member of the household, Occupant Six was interested in undertaking a virtual house experience despite her impaired mobility. However, there was a risk she could fall while standing to

experience the virtual environment. To resolve this, she sat in a rotating office chair during this experience (Figure 30).

Interview Format – The level of detail provided from observational commentary was much higher than expected. Therefore, as opposed to extracting additional information in an interview type discussion after the virtual house experience, the focus shifted to elaborating on existing ideas in a more conversational format. Furthermore, instead of a one-on-one discussion, it became much more inclusive of all participants. This better reflects the qualitative structure of this methodology and leaves room for impromptu conversation.

An unexpected outcome of the observational commentary format of the experience was the varying extent of discussion by participants. Some participants provided extremely detailed feedback while others gave very little. Although this does not seem to reflect the quality of their experience or of the data outputs, it does appear consistent with their personality. This may also be a consequence of their ‘status’ within the family structure. For example, Occupant Three – perhaps the ‘head of the family’, provided the most detailed commentary. Conversely, Occupant Five who is only living with the family in a temporary capacity, provided the least. This suggests that the follow up conversation should focus on participants who provided less observational commentary to ensure a balanced data set.

Because other people were in the living space during the virtual house experiences and able to see the virtual environment displayed on the computer monitor, group discussions often occurred. These were sometimes prompted by me asking questions but were also triggered by commentary from the immersed participant.

Fig. 30

Because walking is not necessary to enable movement in the virtual world, it is possible to have a similar quality virtual house experience when sitting. The rotating function of the chair also allows movement during the experience.

Time Spent in the Virtual Environment – There was large variation in the time participants spent in the virtual house. Occupant Three spent more than thirty minutes in the experience while Occupants Five and Six were immersed for less than ten – however, Occupant Five suggested this was because she was unwell at the time. Although this does not suggest an issue with the methodology, time immersed and data quantity do appear synonymous.

Because the purpose of this study is to test the research, methodology as opposed to using it to inform design outcomes, the fourth phase was not necessary in the Pilot Study.

Analysing the Software

As a tool for generating data, an evaluation of two aspects of the virtual reality

technology is necessary. First, its application as a means to generate data and second, the quantity of data produced and its relevance to the research aim (its quality).

Testing the Spatial Model

Because of the experimental nature of this pilot study, exterior spaces on the property were included in the scanning process. (Figure(s) 31-32). The purpose of this task is therefore, to understand the relative benefit of introducing exterior spaces in the virtual house experience.

While the 'base model' generated by the Matterport software is relatively flawless, this was not the case for the spatial mesh (Figure(s) 33-34). The same limitation that prevents high quality scans of exterior spaces also applies to windows and transparent doors, making them

highly fragmented (Figure 35). Although Matterport has settings to resolve this, the inclusion of exterior scans in the pilot study prohibit their use. Therefore, because the inclusion of exterior spaces negatively affects the quality of the spatial mesh, it is neither productive nor beneficial to include these in future case studies.

Because – in general, most of the spatial model within the interior of the house is of a high quality, the HTC Vive system remains the most effective tool for experiencing the virtual house in this research. To ensure an increased quality in subsequent scans, a reduction in the scanning grid to half-square meter intervals is necessary. As places where possessions are clustered caused low geometric accuracy, a denser grid is required in these locations.

KEY

= Included Spaces

= Excluded Spaces

= Scanning Area

= Primary Grid Spacing

= Area Not Scanned

= Primary Scan Locations

▼ **Fig. 31**
The living, circulation, and exterior spaces are all scanned in the Pilot Study house. - 1:200

▲ **Fig. 32**
78 scans are made, 29 on the interior and 49 on the exterior. - 1:200

Fig. 33 - HTC Vive

Fig. 34 - Samsung Gear VR

Fig. 33-34
A comparison of the virtual house in each of the virtual systems highlights the difference in quality, particularly with regards to geometric accuracy.

The Impact of Model Quality.

The poor level of visual realism created in the spatial model – as a key determinant of the presence, may reduce this sensation in the virtual house experience. This is significant, as the potential for this method of spatial experience to generate ‘new information’ likely stems from its immersive nature. In other words, the immersive nature of virtual reality is the defining aspect separating it from other spatial assessment methods.

Fig. 35

Fragmentation is particularly bad on the exterior of the house and around windows and doors. This is not surprising both because of the known limitations of the scanning hardware, and also because of the low number of scans made over a large area.

The model created – whilst photorealistic in terms of textures and finishes, has a lower geometric accuracy (Figure(s) 35-38). As a significant place of inhabitation, participants have extensive knowledge of the spatial details of their house. Therefore, the misrepresentation of, or failure to include geometric and textural details in a virtual model could contribute to a significant decrease in the sense of realism felt by participants.

To understand the extent in which the visual quality of a spatial model may affect data output, a sub-study was conducted during phase three. Here, Occupant Three, experienced the virtual house twice, first using the HTC Vive system and then again using the Samsung Gear VR. Compatible with the virtual house

experience created using the Matterport software, the Samsung Gear provides a highly photorealistic representation of the actual house. A comparison of each experience is therefore possible using the participants' commentary to identify how the visual quality of a virtual environment affects data output. This identifies the most suitable system for use in this research moving forward.

Occupant Three quickly identified that the HTC virtual house lacks overall realism. However, he suggests that because the model was 'not quite right', recognisable parts became important as a means for contextualising himself in the environment. Thus, many details of the house stood out to him.

The participant also appeared to be considerably more investigative when experiencing the virtual house using the HTC Vive. This is observed as acts of crouching to examine objects and moving closer to different areas and objects within the virtual house. Perhaps because translational movement is only possible in PC-Based systems the participant appeared much less concerned with exploring the virtual house when using the Samsung Gear. In addition to the lack of freedom of movement, it may also be a consequence of already having had experienced the virtual house using the HTC Vive. However, this seems unlikely based on the participant's attitude at the time of his experiences.

Fig. 36

Fig. 37

Fig. 38

Fig. 39

Fig(s). 36-39
 Overall, there is a high degree
 of realism achieved within the
 interior of the spatial model
 except in areas that contain
 clusters of small objects which
 become highly fragmented.

The extent and type of commentary also differed between experiences. The participant provided very little observational commentary during the Samsung Gear experience. What commentary there was focused on the high level of realism in the virtual house. The focus of exploration seemed to be on this idea, as opposed to the experience of the space and its architectural qualities. This may be what led to the superficial nature of commentary provided throughout the experience.

These comparisons highlight the role of spatial perception in the understanding of an environment. While a highly realistic representation of the actual house enables the virtual house to be automatically understood both at a conscious and sub-conscious level the reduction in

realism forces an active process of 're-understanding using familiar elements as contextual references. The identification of three main features that stood out to the participant during his HTC Vive experience highlight this.

A clear advantage in favour of the use of the HTC Vive emerges throughout this comparison. It is also established that in the context of the current research a photorealistic virtual environment is not only not necessary but may diminish the potential of this methodology to generate data. This contradicts the initial assumption held when establishing the research methodology. Upon reflection, the logic supporting the use of an 'imperfect' spatial model makes sense. The lack of total visual cohesion between the virtual and actual

houses challenges the participant to seek out features that link the two and therefore suggests these elements may play a role in creating home as they are central to the participant's understanding of the space.

Assessing Immersive Nature

Not only do these systems vary (with respect to the current research) in terms of visual realism but also their immersive nature. Fundamental differences between these two systems – from both a hardware and software perspective, mean they each account for various presence determinants in different ways - and to different extents (Table One). Thus, it is necessary to identify how other immersive factors of VR system affect data output. By comparing the level of presence felt against the quantity of data produced it is possible to conclude

as to the extent in which the relationship between presence and data output is directly proportional. If – as I believe, a higher quantity of data is produced when using a more immersive system, this would point to the idea of a directly proportional relationship between presence and data output.

In the context of the current research, four key aspects – identified in Table One, distinguish the HTC Vive and Samsung

Gear VR systems while also being fundamental presence determinants.

While many other presence determinants exist, they are either not relevant in the context of the current work, or are equally accounted for by both systems i.e. field of view. The HTC Vive has several more immersive elements built into the system inevitably increasing the potential feeling of presence. However, because the Samsung Gear VR has a significantly

higher visual quality - which is a key determinant of presence, it likely achieves a higher sensation of presence that in the HTC Vive.

The difficulty in measuring presence means this analysis alone cannot be the sole basis from which conclusions are drawn. Instead, the data generated from each experience is analysed to identify the participant's level of immersion when using each of the systems.

Table One

IMMERSIVE FACTOR	SAMSUNG GEAR VR		HTC VIVE	
	POSSIBLE Y/N	How	Possible	How
Bodily Representation	No		Yes	Handheld controllers tracked by a series of sensors are represented within the virtual environment. As such, they become the digital representation of the hands.
				HTC Vive – this bodily representation enables people to contextualise themselves within a virtual environment.

Freedom of Movement	Some	Rotational movement only No free translational movement	Yes	Sensors built into the HMD and handheld controllers enable any movement within a limited real world area to be translated into the virtual environment.	HTC Vive – This enables free movement throughout a virtual environment in a manner similar to the real world.
Haptic Feedback	No		Yes	Handheld controllers vibrate when collisions occur between the virtual actor and the house.	HTC Vive – haptic feedback enables the participant to understand the dimensionality of the virtual house as well as their location within it.
Visual Realism	Yes	Because this is an experience of a 360-degree photograph as opposed to a spatial model, the virtual environment represented has a high level of realism.	Yes	The process of generating a spatial model using a scanning process reduces the overall realism of the virtual house. This is particularly true for the geometric qualities of the environment.	Samsung Gear VR

Table One
A comparison of various immersive factors of the HTC Vive and Samsung Gear VR systems.

The Impact

In the HTC Vive virtual house experience, the participant continuously engaged with the physical world – much more than when using the Samsung Gear. This included conversing with other people and constantly commenting on the experience without provocation. This suggests a lower degree of immersion in the HTC Vive. While it was obvious the participant felt a sense of presence within the virtual house, this did not seem as high as it could potentially be.

The participant was also observed reaching his arms out at numerous times during the experience, seemingly in an attempt to touch different elements of the physical house. While this is an obvious engagement with the physical world, it does not necessarily represent lower presence. Because hands

are digitally represented within the virtual house, the participant often moved the virtual actor to a location in the virtual house similar to that of his actual body. Subsequently he would reach his arms in an attempt to touch part of the house – an action repeated in the virtual reality. This seems to be an attempt to locate the bodies (both virtual and actual) within their respective environment. Although engagement with the physical world occurs here, this action is suggestive of an attempt by the participant to enhance the level of realism of the virtual house by increasing the sensory cohesion between the lived and living body.

During the participant's second virtual experience – using the Samsung Gear system, there was little suggestion of a low

sense of immersion. Despite asking the participant before beginning the experience to provide a commentary, there was a significant decrease in unprovoked verbal engagement. There was also no reaching observed. This is possibly because of the lack of bodily representation afforded by the system. Overall, the participant appeared far more immersed within this environment.

The differences observed between these experiences appear to stem from the variation in visual quality of the virtual house. Because it is more photorealistic when experienced using the Samsung Gear, the participant did not have to 'work' so hard to understand the environment. As such, because the virtual house matched existing spatial knowledge the participant

seemed less aware of the technologically mediated nature of the experience and thus became more immersed. The lack of realism in the HTC Vive virtual house however, caused the opposite effect.

This analysis leads to several conclusions, again dissimilar to those expected. What is apparent is that increasing the participant's sense of presence within the virtual house is not productive to this research. In fact, the opposite is true, where increasing the level of immersion reduces the quantity of data produced. It also shows that when discrepancies occur between the participant's perception of the actual house and what is experienced in the virtual reality, the quantity of data increases significantly. To this end, while it was initially thought the relationship between data quantity and

presence was directly proportional, it is now identified as being inversely proportional. It should be identified that there is a likely limit to how low the level of immersion can become before data quantity also decreases.

Although the HTC Vive is inherently less immersive than the Samsung Gear VR, it is still highly immersive. Therefore, the inversely proportional relationship between data quantity and immersion should only be considered applicable when immersion is at a level no lower than what is provided in the HTC Vive experience.

The Data – Is it Useful?

It is established throughout the previous discussion that data generated using the HTC Vive system is far more extensive in terms of quantity. However, it is also necessary to understand if the data

produced is relevant to the aims of this research. Several key ideas stood out amongst the data produced during the Pilot Study.

Although family photos were initially thought to be significant components of home to the participants, they were never identified during the virtual house experience. Instead, Occupant Three identifies the timber floors, doors and, creases in the couch as standing out. In subsequent conversations with this participant, the significance and meaning behind these elements become clear. Since owning the house, the family have made several alterations. To this end, the timber floors and doors represent a mutual affect between 'the inhabitants' and 'the inhabited' as well as the role of house in

bringing extended family together to work on these alterations. In a similar manner, the crases in the couch represent the lived condition of the house and relate to the idea of mutual affect.

These ideas strongly relate to a statement Occupant Four made during Phase One that, “home is where the whanau [family] are”. This answer is not surprising, and one that I suspect is commonly shared by many. However, this does not describe the architectural implications of home for this person. Thus, the potential of this methodology to uncover those architectural elements that represent home and the emotional reasoning behind them become apparent.

A final idea, identified during conversation

with Occupant Five was that nothing stood out as she feels her bedroom is her space within the house. She therefore suggests that had she been able to explore her bedroom, the experience would have produced more useful data. This comment is itself important. It suggests that because she is not a permanent resident in the house she feels less emotionally attached to the property. This is consistent with literature describing rental housing in which people often feel a diminished sense of home.

This analysis suggests that data produced using this methodology provides a heightened understanding of what makes home for participants. As a tool for better understanding peoples housing needs, it provides a methodology for observing how space is inhabited, and subsequently,

facilitates a discussion of how the architecture of housing can be tailored to better meet day-to-day needs.

CONCLUSION

Overall, the research methodology tested throughout the pilot study is highly effective at generating a large quantity of quality data. This data provides key insights into the housing needs of participants that is unlikely to be discovered using traditional methods of client research.

With the exception of minor changes implemented to the methodological structure during the pilot study, only one further change is noted. In addition to the more comprehensive period of teaching participants how to use the virtual reality hardware, an additional information sheet is provided. By providing this document to participants during the Phase One introductory meeting, they have time to

read and build their prior knowledge of the system. This document outlines – through both written and visual formats, how to operate the virtual reality system. To this end, the participants are better equipped to experience the virtual house in Phase Three.

4.0

Realising the Methodology

Introduction

By applying the methodology developed and tested during the previous chapter to a case study that uses a refugee family as the participant group, an attempt is made to realise its potential to inform an understanding of what makes home. By analysing the data generated, several underlying themes are identified that speak to the meaning of home for the participants. These ideas are then applied to a design process seeking to create a housing intervention that embodies the participant's 'meaning of home'.

The Participants

The family chosen for the first Case Study arrived in New Zealand from Myanmar more than seven years ago as refugees. The family consists of four members:

two young children – a boy and a girl (Occupant(s) One and Two), and their parents (Occupant(s) Three and Four). Because of their young age, neither Occupant One nor Two are permitted to participate. Occupant Three is a self-employed painter while Occupant Four is a stay-at-home mum. The family appear to be active members of Wellington's Burmese community. A gathering of friends at the family's house prior to Phase Three supports this assumption. The family are strongly connected to their Buddhist faith with a shrine established in the children's bedroom and several religious items located throughout the house (Figure 40). Having lived in New Zealand for so long, the family speak English well. However, they often found it difficult to discuss housing/home concepts due to the complexity of

vocabulary associated with these ideas.

Family Background

Less is known about the family's history, particularly from before arriving in New Zealand. While this understanding is important to the research, for people within the refugee community their past potentially involves mental/ physical trauma. Thus, discussion of this topic was entirely participant initiated. While this does leave a somewhat incomplete picture of the family's background, it ensures the participants feel more comfortable throughout the research.

The circumstances leading up to the family fleeing Myanmar were not discussed however, the family did spend some time living and possibly working in Malaysia

before arriving to New Zealand. What became apparent during the introductory meeting was a fondness of Myanmar - evident in conversations relating to their culture and religion. Occupant Four also identified an early ambition to study and practice Architecture. While this did not eventuate, she enthusiastically discussed the topic.

The House

The family do not own their house. Instead it is a Housing New Zealand Property rented by the family (Figure 41).

Fig. 40

The Buddha shrine located in the children's bedroom make the space multifunctional. However, I question the level of harmony between these two functions and the impact this has on the religious significance of the space.

Fig. 41

The building itself is relatively new. Constructed in 2010 it is designed to be aesthetically in keeping with the historic character of Newtown. While a single retail tenancy is located on the ground floor, six two-storey apartments make up the first and second levels.

Fig. 42

The house is one of six two storey apartments in the building and is located in the Wellington suburb of Newtown. Two-storey structures border the building on both its northern and southern boundaries. A narrow service lane separates the buildings along the southern boundary. - 1:200

Unless noted, all floor plans
are oriented as indicated

Street ▶

First (Lower) Floor

Fig. 43a

Centrally located in the building (fourth from the street), the house
shares an intertenancy boundary on both its east and west elevations.

- 1:100

Fig. 43b

The children's bedroom also hosts the family's Buddha shrine. - 1:100

SCANNED AREAS

Pursuant to the criteria established in the previous chapter, potential spaces suitable for scanning are identified in Figure 45a/b. The participants indicated that they had no concerns regarding the scanning of spaces excluded by the criteria. The Buddhist shrines location in the children's bedroom made the inclusion of this space beneficial to this research however no value was identified in the inclusion of any remaining spaces.

KEY

= Included Spaces

= Included but not relevant to this research.

= Excluded Spaces

Fig. 44a/b

The entrance door and entry are significant housing elements in Burmese culture. To identify their significance here, part of the common access way is scanned to enable participants to experience walking into the house during the virtual experience. - 1:100

KEY

- = Scanning Area
- = Primary Grid Spacing
- = Area Not Scanned
- = Primary Scan Locations

Fig. 45a/b

The primary scanning grid is reduced to 0.5x0.5 meter increments throughout the entirety of the house due to the large amount of possessions in each space. 145 scans are taken, 41 on the upper floor, 14 on the stairs and 90 on the lower floor. - 1:100

The Virtual House Experience

Phase three of the case study took place on a weekday evening when both participants were available. While they appeared excited about using immersive virtual reality, there was a distinct hesitation when it came time to begin the experience. Factors such as the language barrier, fear of saying the wrong thing, or the potential to embarrass themselves may have contributed to this. However, after reassuring the participants that there are no wrong answers and demonstrating the system, their hesitation appeared to subside.

Occupant Three undertook one virtual house experience in contrast to Occupant Four's two experiences. The first experience for both participants were very short, lasting less than ten minutes. During

this time, they both appeared somewhat intimidated by the experience, specifically the new way of existing that occurs in virtual experiences. Occupant Three's demeanour suggests a very shy personality and perhaps contributed to the short duration of his experience. Occupant Four on the other hand, was far more descriptive of her emotions helping to better understand this discomfort. Almost immediately during the first experience Occupant Four said she had a headache. Although it is possible this was the case, it seemed to be more of a reaction to the discomfort felt during this experience.

Occupant Four's second virtual experience was significantly longer. At approximately twenty minutes it provided the largest primary data set in this research. Participant

two's second experience seemed to be sparked by follow up questions posed to them following their first attempts. While there was significantly more engagement with the virtual house and confidence using the HTC System, there was still a degree of reservation particularly in the commentary which often ended in "isn't it" or "is that right".

Separating Primary and Secondary Data

It is possible that information gathered using this methodology – either from the virtual house experience or discussion can be used to inform a design outcome. However, it is distinguished in this research in two ways; primary or supporting data. Primary data is that which is generated through the participants' virtual house experience and is characterised as

being unlikely to be uncovered using traditional methods of client research. On the other hand, supporting data is all other information (including from the virtual house experience) which is determined as identifiable using traditional research methods. These are subjective categorisations, and because a study using traditional client research methods is not undertaken in this research, it is hard to accurately identify the potential depth of knowledge possible through these processes. However, based on the pilot study, a clear distinction between the two types of data is expected to emerge during analysis. This distinction thus, highlights the extent to which virtual technologies have the potential to uncover ‘new’ client information.

FINDINGS

Information gathered during these three experiences – Including both the participants comments and observations of the participants behaviours, are identified in Table Two. These comments often stemmed from direct questions posed to the participant(s) during their experience (identified in the left column), while others are a general observations or comments of features of the virtual house. The data gathered is analysed to identify common themes. As such, the various categories to which each data point relate are identified in the left column.

▼ Table Two

Most primary data points speak to one or more of three ideas identified through a process of analysis (right column(s)).

Table Two

NOTES/QUESTIONS (ASKED TO PARTICIPANTS)	PARTICIPANT COMMENTS	BEHAVIOURAL OBSERVATIONS	Data Category	
			Prim.	Sec.
<i>Occupant Four Experience 1.</i>				
Participants initial reaction to the virtual house. Experience begins in the lower level – living space.	1. “It is funny”	2. Immediately upon starting the virtual experience the participant starts laughing intensely	b	
	3. Indicates that the front door and stair balustrade is “broken”		b, c	d
	4. Feels small in the virtual house		a	
<i>Occupant Three Experience 1.</i>				
Occupant Four (observing the virtual house on the computer monitor)	5. Feels safe/comfortable in the communal corridor	8. Both Participant two (experiencing the virtual house, and participant one (watching the experience on the computer monitor) break into laughter – a seemingly nervous or uncomfortable laughter.	a	
	6. The corridor is “broken”		c	
	7. Describes the virtual house as very messy		c	
<i>Occupant Four Experience 2.</i>				
Initial reaction to the second virtual house experience.	9. “That is different” referring to the Buddha shrine”	10. The participant is immediately drawn to the shrine located in the corner of the bedroom. 12. The Buddha statue is still present in the virtual house, however is slightly distorted because of the scanning process. This is perhaps what the participant is referring to here.	b	l
	11. Comments that the Buddha is missing		b	l

<p>Participants initial reaction to the virtual house. Experience begins in the lower level – living space.</p>	<p>11. She feels like everything is different in the virtual house – but is not sure why.</p> <p>13. Feels safe</p> <p>14. The participant comments on each object in the shrine and if it is the same or different to the actual object.</p> <p>15. The table cloth sitting on top of drawers. is described as “folded paper” or a “3D painting”.</p> <p>16. The front door – specifically the ‘pattern’ on it created during the scanning process. It looks modern. Her first impression of the door is that it is broken, but after looking at it for a while it begins to look like a designed feature or a modern painting or folded paper.</p> <p>17. While initially liking the design of the door she later decides that she does not like it. It is broken and messy. She does not want other people to see the mess when they leave the house.</p> <p>18. The power box stands out.</p> <p>19. She likes the ‘design’ of the windows (the net curtains have been superimposed onto the windows in the virtual model) but it needs to be tidied up.</p> <p>20. Overall, participant one thinks the actual house is better than the virtual house as it is less messy.</p>	<p>b</p>	<p>1</p>
		<p>a</p>	<p>d</p>
		<p>a</p>	<p>d</p>
		<p>b</p>	<p>d</p>
		<p>b</p>	<p>d</p>
		<p>c</p>	<p>d</p>
		<p>c</p>	<p>d</p>
		<p>c</p>	<p>d</p>

Three common themes became apparent from an analysis of the data set.

- a. *Spatial Scale* – Occupant Four indicated a sense of safety (Comment14) while also feeling small (Comment4) in the virtual house. Similarly, participant two indicated a sense of safety in the communal corridor of the virtual house (Comment5). The design idea here refers to spatial variation and its importance as a means to accommodate different needs. For Occupant Four this may include large space in which she is only a small part, and for Occupant Three, smaller more intimate spaces.

- b. *Detailed Spatial Awareness* – Occupant Four in particular showed extremely

high attention to the architectural and spatial details of the house and excitement when investigating these (Comment16). Some elements of the house were also described as “paintings” and “folded paper”. This implies the need for an architecture of diversity and variation in which to stimulate this sense of exploration.

- c. *Mess* – Throughout their respective experiences both participants indicate a discomfort at the perceived ‘messiness’ of the house. This is enhanced by the level of fragmentation in the virtual house yet does not mean it is not applicable to the real house. Laughter by each of the participants (Comment(s)2, 8) can be described as uncomfortable with some underlying

embarrassment. When identifying if she liked or disliked specific elements of the house (Comment(s)19, 21, 22). Participant Four often noted they would be nicer if less messy. The architectural implications of this are relatively obvious however are not likely to be identified using other means of client research.

These themes are used in the following chapter to shape key design ideas that inform a design intervention. However, to understand the potential impact of each design decision, supporting ideas are identified from two sources, the post-experience discussion with clients and a meeting with the family’s resettlement support coordinator.

Table Three

NOTES/QUESTIONS (ASKED TO PARTICIPANTS)	OCCUPANT	PARTICIPANT COMMENTS	Data Category	
			Prim.	Sec.
What is different about the virtual house?	Four	1. The virtual house is different, the corridor in particular. Not sure what about it specifically. The interior is relatively similar.	b	f
	Three	2. Not very different.	b	f
	Three	3. The balustrades on the staircase are also different.	b	
	Three	4. The Buddha shrine is different, some things are missing. These are not good changes.	b	i
What are the important aspects of a house?	Four	5. A room specifically for the Buddha shrine. a. The shrine should not be in the master bedroom. b. This is/would be the most important room in the house.		d,h
	Four	6. The bathrooms are too close to the front door. a. They should be at the back of, or behind the house. b. The backdoor should also be at the back of the house. This is never used by guests – they use the front door.		e,h
Why are there no photographs on the stairwell wall	Three Four	7. Does not like photographs/ modern art. a. Does like these.		f
What is the most special room the in the house?	Four	8. The Buddha temple/the room with the shrine in it.		d,h
Would the Buddha still be special if it was in the lounge	Four	9. No, it must be at the highest point in the house. It would be bad to cross it when going upstairs. a. It is not the room that the shrine is in specifically that is special but the elements constituting the shrine. b. In Myanmar, the temple is located at the front of the house, often next to the living/television room.		d,h,e
	Four	10. The bedrooms are on the upper floor behind the living room. On the ground floor is the kitchen and storerooms.		b,d
Describe the houses in Myanmar	Four	11. The houses are all wood. The houses in New Zealand are good quality.		e
	Four			h

	Four	12. There are some nice types of timber that she would like to use in the shrine room a. It should be wide b. There is often a sink, and a bookshelf for religious books in the space	d,h
Do you like living in an apartment?	Four	13. No	h
	Four	14. They do not own a home in New Zealand but would like to. This is important to her for the future of her family.	h
Would you like to live in the country or the city?	Four	15. Somewhere in-between	h
	Four	16. Can not be too high, she fears heights	h
	Four	17. Does not want to mow lawns	h
	Four	18. Would not like it. The door needs to be strong. Does not matter about the quality of the door on the inside just the outside.	g,h

Table Three

Supporting data also plays a role in the design process. However, it is supplementary to primary data to the extent that it is used to validate as opposed to inform design decisions.

Six distinct categories emerge from the supporting data:

- d. *Significance of the Buddha shrine* – This religious aspect of the family’s life defines many of the architectural implications of home for them.
- e. *Programmatic requirements of the house*
 - Both in terms of what is and is not acceptable. This is often centred around and informed by the buddha shrine.
 - g. element. *Family structure* – While Occupant Three agreed with statements made, almost all conversation was led by Occupant Four. This suggests Occupant Three is less influential than Occupant Four. Occupant Four’s interest in architecture could be an alternative reason for this increased involvement as she is likely more

- h. engaged with the research.
Ideal Future House – This overlaps with category ‘e’ to some extent, however is more descriptive of the participants’ desires about what they want in a house.
- i. *Hesitancy for Change* – This is specific to spaces of particular significance to the family – in this case the Buddha shrine, and overlaps with the first category. It suggests that any change in or, of these special places is not wanted.
- In a discussion conducted with the family’s support coordinator an additional two supporting data points are identified.
- j. *The importance of possessions from a past life*
 - Often refugees fleeing their country

of origin are forced to leave most of their possessions behind. As a result, those that are brought with them take on a particularly important meaning.

k.

Community Structure - Myanmar consists of a large diversity of ethnic groups. These groupings of people remain common within the host country. It is identified that most Burmese people will primarily only socialise within their ethnic group.

When comparing the key primary and supporting themes generated during this case study, clear differences emerge. While the supporting themes often describe quite pragmatic and tangible aspects of housing design, the primary themes are somewhat more intangible and subject to

interpretation. To this end, these serve to inform a design direction as opposed to specific design elements. The clear ability of virtual technology within the context of this research methodology to extract new information therefore becomes apparent.

Whereas many of the supporting themes could be identified using traditional research methods, the primary data would not. This is because the supporting themes identified, closely relate to cultural and religious ideologies i.e. communities of people, as opposed to the primary themes which have a specific relevance to the family studied and their housing needs.

0.5

Design Intervention

The design process undertaken in this research provides a platform to investigate the applicability of data generated throughout the virtual house experience to a designed solution. As such, the design proposed remains conceptual (Figure 46) and represents one part of a multi-faceted conceptual design process. While emotional needs identified from

primary data points are the central focus of this phase, subsequent phases would address amongst others, programmatic requirements. Although a significant repository of information relating to these considerations are generated as a by-product of this methodology, as supporting data points, they do not specifically inform the design direction of this research.

Design limitations and constraints

Several existing and imposed limitations define the scope of design within the context of this research. Firstly, while information generated during the virtual house experience may be extrapolated to any potential place of home, in this research it is applied as a process of rethinking the current house. This is beneficial for several

Fig. 46

This research centres on early phases of a project timeline. As such the design solution presented remains highly conceptual.

reasons. By locating the intervention within an existing architecture, design decisions are not informed by supporting ideas that relate to programmatic, site, and some formal, and spatial requirements. With these already defined by the pre-existing structure, the design process can focus on ideas informed by the primary data points. Furthermore, by proposing a design solution directly comparable to the current house, it becomes evident throughout the process the extent to which the current solution meets the family's emotional housing needs. Secondly, the design solution proposed in this research is intended to be a practical and realistic concept for a place of home for the family. In this sense, design decisions are evaluated with respect to its affordability. This is relatively loosely defined as no specific

budget or cost limit is set.

Following these are limitations defined by the existing building. While the interior of the house is considered a blank canvas for the design phase, boundary walls define the scale of design. Moreover, exterior windows, and building services – to the kitchen and bathroom, are considered as remaining in place during the redesign. Because this intervention is confined to an existing house, limited contextual analysis is necessary. Where it is necessary, beyond that discussed in the previous chapter, analysis is undertaken in relation to the relevant design move.

Where relevant, any primary and/or secondary data themes identified previously that inform a specific design idea are

identified using: (idea: '[letter]'). This highlights the role of the data generated in informing the design outcome.

The design phase is divided into three 'design areas'. Each area relates to a specific location or element of the house and addresses one or more of the primary data points with a unique approach. While they are developed in this research as individual processes, they are designed to inform and complement each other, generally forming a cohesive whole.

The staircase is a core element of multi level housing yet often seems to be an afterthought to the design process. Furthermore, they almost exclusively function only as a means of circulation from one level to the next. This perception of the staircase as a uni-functional architectural element is disingenuous to their potential to provide rich spatial experience in housing. Moreover, these elements consume significant quantities of space within housing and as such, must

be utilised to their fullest potential. To this end, the staircase provides an abundance of potential to become a central element defining this house as a place of home.

All three primary data points inform the approach to Design Area One, however ‘a’ – *spatial scale* is identified as a key influence. The over arching idea driving Part One is the potential for the staircase to not only provide circulation but also become an inhabitable space.

This is influenced by the current lack of spatial variation within the house and may impact the family’s ability to have meaningful emotional experiences here. The importance of spatial scale as a determinant of home cannot be overstated. As the location of emotional

experiences, the spaces within a house must accommodate this. For example, when feeling vulnerable, one may seek out a small space away from other activity. As identified in (*Comments* ‘4’&‘5’) both participants feel safe in different sized spaces, highlighting the need to create spaces of varying sizes to enable the whole family to have emotional experiences within the house. While several large and medium sized inhabitable spaces exist currently, the staircase provides the basis for the creation of an intimate space.

As such, Design Phase One investigates six key design aspects of the stair space: The Entrance, Stair Location (*idea* ‘c’), Creating Space (*idea* ‘b’), A Place to Stay (*idea* ‘j’), A Place to Sit and, A Place for Reflection (*idea* ‘i’) (*idea* ‘c’).

Fig. 47

Design Area One focuses of the staircase and surrounding area. - 1:100

Focus Area

5.2a

The Entrance

Fig. 49

The programme of the lower floor does not currently suggest a primary direction of travel from the entrance. - 1:100

Fig. 50

Reorienting the main entrance, removes the staircase from direct line-of-sight when entering the house. - 1:100

The staircase as a private space - a place of spatial intimacy within the house, is a key idea to the design of this space (*idea'a*). Rethinking the spatial layout enables the architecture of the house to promote a sense of intimacy within the stairwell.

The raised floor (Figure 51) is multifunctional. First – as part of the staircase, it saves space by reducing the required length of the staircase. The change in spatial scale (*idea'a*) also breaks up the singularity of the living/entrance space without the need for physical enclosure.

▲ **Fig. 48**

The current outlook when entering the house is not conducive to a sense of privacy for people in the stairwell.

► **Fig. 51**

Stepping up and then down into the house highlights the threshold between exterior and interior.

Fig. 52

Fig. 53

Fig. 54

The staircase's location in the ground floor creates several awkward and unusable nooks throughout the living space making it less efficient (Figure 55). As a result, a refrigerator is located away from the kitchen and in front of windows (Figure 52), couches block a doorway (Figure 53), and shoe racks obstruct the main entrance (Figure 54).

This creates a general sense within the space as being cluttered (*idea 'c'*). To resolve this, the staircase is moved south from its current position (Figure 56). Consequentially, the footprint of the lower floor becomes more usable.

1.8m²
2m x .9m

◀ **Fig. 55**
The location of the staircase creates several small and awkwardly shaped spaces. - 1:100

3.6m²
3m x 1.2m

▶ **Fig. 56**
Changing its location creates a more organised and usable space on the lower level. - 1:100

Fig. 57

Precedent Study

Tūranga -
Christchurch Library

The stairs are a focal point in Christchurch's central library - Tūranga. This element is the main precedent informing Design Area One. During my own recent experience of these stairs I found the space to emulate may of the spatial qualities (*idea'a*'), (*idea'b*') sought in the design of the staircase.

Despite the fact that these staircases' are all suspended within a large void (Figure 58), the stairs are experienced as if being in an enclosed space. Although not any higher than a standard balustrade, its solidity and thickness adds to the feeling of enclosure (Figure 59).

From outside, its materiality also suggests a sense of enclosure as the timber wraps around three of four sides. Indeed from below it can almost be perceived as a fully enclosed box (Figure 60).

▲ **Fig. 57** - The balustrade design immediately changes the spatial implications for the stairwell.

▼ **Fig(s). 58-60** - The staircases in Tūranga are a spatial experience independent of the surrounding void.

Fig. 58

Fig. 60

Fig. 59

The transparent nature of the current stair's balustrade means the stairwell and living spaces are experienced as one volume (Figure 61). The use of a solid material enforces a sense of division between these spaces (Figure 62). This option is favoured over fully enclosing the stairwell with a wall as this could isolate rather than enclose the space.

To this end, the staircase becomes a small, intimate setting (*idea'a*) unique within the context of the house.

▲ **Fig. 61**

There is currently no clear distinction between the living and stair spaces.

▲ **Fig. 62**

Timber used on the balustrade wraps underneath the structure, foreshadowing a sense of encompassment when in the stairwell.

Fig. 63

The increased thickness of the balustrade enhances the perceived separation between living and stair spaces.

*A Place to
Stay*

The experience of spatial intimacy when in the stairwell should not be limited to those times when walking through the space. Instead, by functioning as both a circulation space and a place to stay, the staircase plays an active role in defining the experience of home for this family. By first addressing the issue of functionality, it is possible to make the staircase a place to stay. In its current form, the staircase is 800mm wide (Figure 64). Intended as only a means for circulating between the upper and lower floors, its narrow width allows one to either 'stay within' or 'move through' the staircase. This creates a tension between its two proposed functions when undertaken concurrently. Furthermore, when seated in the space, the solidity of the balustrade, and its narrow width may make the space feel confining.

To resolve these issues, a number of concepts attempt to address the challenge of making the staircase a place to stay.

▲ **Fig. 64**

The current width of the staircase and the incorporation of a solid balustrade does not suggest the stairwell is a place of sedentary inhabitation.

Concept One

Fig. 65

The proposed stair structure is out of scale with other volumes in the house.

Increasing the width of the staircase creates a spatial volume more suggestive of a place to stay while also enabling movement through the space. However, a larger spatial volume creates a sense of openness that takes away from the intimate spatial qualities of the space

Fig. 66

An increased width reduces functionality of other spaces within the house. - 1:100

Concept Two

Fig. 67

More space would be allocated to the entrance space (idea 4) however, this does not outweigh the negative programmatic impact of the design.

Fig. 68

The benefit of this proposal is the division between stair-circulation (a), and stair-seating (b) space within the structure. - 1:100

In an attempt to reduce the amount of floor space consumed by the staircase only the top half is widened (Figure 68). However, there are also significant functional issues with this proposal as part of the stair would extrude into the living space making the ground floor less functional than it currently is (Figure 67).

Concept Three

Fig. 69

The design of the staircase adds some visual interest to the space (idea 'b') as it diverges from the strictly rectilinear house.

Tapering towards the lower floor, the third concept provides an open space within the stairwell preventing it from feeling enclosed (Figure 70). The design also ensures the continued functionality of the surrounding space (Figure 69).

Fig. 70

As the staircase taper increases so does its vertical height off the ground. Thus, the space underneath is usable . - 1:100

In addition to changing the size of the space, the introduction of a place to sit within the staircase also makes it a space in which to stay.

Despite its multiple functionalities, the staircase is generally perceived as primarily a circulatory element. To overcome this an area dedicated solely for seating is built into the structure (Figure 72). To this end, the formal and architectural qualities of this space better express its functional duality (Figure 73).

▼ **Fig. 71**

The provision of a place to sit will ensure the staircases design expresses its dual functionality with equal emphasis.

► **Fig. 72**

The resultant space created from the tapered form of the staircase provides a place to sit within the staircase. This enables people to 'sit in' and 'walk through' the space concurrently.

1:50

Seating Place: Deeper areas at the top of the staircase create platform seating.

Stairs: Separation of each function enables both sitting and circulation simultaneously.

Perching Place: Smaller seating places allow people to 'perch' on the edge with the balustrade as a back support.

Fig. 73
The tapered form, provides two variations of seating spaces within the staircase.

To function as a place of intimate spatial inhabitation, user comfort is a central requirement in the design of the stair space. By increasing the types of seating spaces afforded, a wider range of comfort requirements are addressed (Figure 77).

Fig. 74

Fig. 75

Fig. 76

▲ **Fig. 74**

The removable seating blocks provide an additional 300mm of depth to the seating platform.

▲ **Fig. 75**

The tapered form of the structure prevents the boxes from sliding out of place.

▲ **Fig. 76**

The 'boxes' can be used to increase the height of the back support.

▼ **Fig. 77**

The staircase's seating space can be manipulated to provide multiple functions.

It is not simply enough to facilitate the act of ‘inhabiting’ within the staircase. It is also necessary to give it a purpose – to provide people a reason to be there. The intimate spatial qualities that makes this such a unique place in the house are also indicative of its potential to become a place of peaceful reflection (*idea 3*). To highlight this purpose within the space a recessed shelving unit is located at the top of the staircase. This provides a place for the family to display personal items from their life in Myanmar. This becomes the catalyst for reflection within the space.

Fig. 78

Shelving in the stairwell makes the space a destination within the house as opposed to just a place of possible inhabitation.

5.2f

A Place for Reflection

There is a poetic symbiosis that exists between the emotional and functional roles of the staircase. As a means of circulating through space, the staircase is a physical point of transition. It defines movement from the semi-public living spaces on the lower floor to the private spaces in the upper floor. Similarly, as a place of reflection, the staircase becomes a place in which the family can reflect on their transition from life in Myanmar to their new life in New Zealand (idea 'i').

▲ **Fig. 79** (Section a - a')

The additional width at the top of the stairwell makes this the most favourable location for the shehing unit as people are positioned away from it. - 1:50

▼ **Fig. 80**

The shehing unit's location within the stairwell enables it to be seen from the upper floor. Thus an experience of these possessions is not limited only when in the stair space.

Containing all semi-public, spaces in the house, the lower floor living area is a location in which significant activities are likely to occur. As such, it plays an important role in defining the experience of home for the family. The development of this space is primarily informed by **Data Point ‘c’** and supported by knowledge from **idea‘f’**.

The perceived messiness of the house is one of the strongest ideas emerging from the participant’s virtual house experience. Observations of the house made during meetings with the family identified several contributing factors to this sense of messiness. The first is an obvious lack of

storage. Except for kitchen cabinets, a hot water cupboard, an under-stair storage space, and a closet in each bedroom there is no provision for storage. As a result, many items usually stored are clustered throughout the living space (Figure 81). This is not conducive to reducing the perceived messiness of the space and makes the already small house feel even smaller. Because the scope of design is limited to the current structure, spatial expansion is not a possible solution to this issue (Figure 82). Instead, an alternative approach to spatial design is necessary that questions how each element can perform multiple roles as a means of reducing the overall sense of clutter within the living space.

An analysis of supporting data suggests that simply increasing storage space within the house, or the functionality of the space is not sufficient to resolving this issue.

Having fled their country of origin, refugee families often arrive to New Zealand with very little personal possessions. To this end, these items take on a heightened significance as representations of their past lives. Therefore, the ability to display these significant items within the house is important.

Initial exploration of this idea occurred in Design Area One, part ‘f’ and becomes a central idea informing Design Area Two. It speaks to the requirement for an architecture that facilitates the display of significant objects and elements within the house as opposed to the current random assortment of kitset shelving and book shelves.

Within Design Phase Two four primary design ideas are explored: Spatial Separations, A Lounge Space, A Display Space (**idea‘f’**) and, A Cooking Area.

5.3 | *Design Part Two*

Fig. 81
*The lack of storage space within the house has resulted
in a dense build-up of possessions in the living space
particularly around it perimeter. - 1:50*

Fig. 82
*Although the work undertaken in Design Area One
 has made the lower floor footprint much more cohesive,
 its modest size less - than 40m², requires a highly
 functional design solution. - 1:50*

Fig. 83 As opposed to building out the area beneath the staircase as is done in the current house, the space is left open. This increases the functionality of the 'nook,' allows more natural light into the space and, creates an interesting spatial feature in the room (*idea 6*).

Initial Concept - Design Area Two

This concept proposes four distinct spaces within the lower floor. The partition unit (a) functions as a space maker - distinguishing a large lounge 'nook' (b) from a smaller play space under the stairs for the children to play in (c). Although the location of services in the space determine the location of the kitchen, an extended benchtop acts as a link between the kitchen (c), entertaining (d) and lounge (b) spaces.

Fig. 84

Central to this concept is the lack of any element that physically separates the space. As such, it is possible for the layout of the space to be adjusted to meet the families changing-needs.

▲ **Fig. 85** (Section *b - b'*)

The partition unit located beneath the staircase creates an implied sense of spatial structure within the room demarcating the lounge (a), from the children's play area (b), and the dining/entertaining space (c). This visually organises the space, formalising the various functional areas (idea c'). - **1:50**

▲ **Fig. 86**

Internal spaces still receive natural light, as the partition unit does not extend beyond the staircase. Furthermore, this enables the layout of the living space to be adjusted to meet changing needs. - **1:100**

5.3b

A Lounge Space

◀ **Fig 87**

The implied lounge area proposed is somewhat smaller than the current space. However, the lack of physical spatial separation facilitates expansion into the entertainment areas.

▲ **Fig 88**

This spatial flexibility allows the living space to accommodate a variety of needs.

Fig. 89

While still a singular spatial volume, the architecture of the living space alludes to several functional areas. This aids in formalising the space (idea 'c').

Fig. 90

The television's size is restricted by spatial limitations of the wall on which it is proposed to sit. The family currently has a fifty-inch television. Thus, the proposed lounge layout requires adjustment to match the family's needs. - 1:20

Evidence of Occupant Three's shy character (Section 4.1) is also seen in the architecture of the house. Despite having limited access to natural daylight, both north facing windows are covered by net curtains. As such, the current orientation of the lounge - facing the windows, may be intimidating for the family due to the inherent lack of privacy afforded.

Fig. 91
The current proposed placement and orientation of the lounge may cause some discomfort for the family due to the lack of privacy.

Fig. 92

Fig. 93

Fig. 94

Fig. 95

Fig(s). 92-95

Concept studies explore possible solutions for the lounge space. Both the functional performance of the space and the emotional needs identified from the participants' virtual house experience are considered in each of these iterations.

Reorienting the lounge to an eastern outlook ensures both sufficient wall space to hang a fifty-inch television while also resolving underlying issues of privacy. This also enables a better degree of connectivity between the kitchen, lounge, and entertainment spaces with the couches facing into the living space (Figure 96).

Removing the partition unit is also necessary as it would only serve to segregate the lounge from other living spaces in this situation.

Fig. 96

The chosen layout is highly adaptable in so far as the implied lounge area (a) is defined exclusively by the location of the furniture within. To this end, it can be expanded into the entertainment space (b) to accommodate larger groups of people. - 1:20

Fig. 97

Removing the partition unit enables the architecture of the staircase to express its encompassing qualities. Furthermore, detaching the structure from other elements foreshadows the sense of separation between the living and stair spaces.

Formal display spaces within the house are fundamental to resolving the perception of messiness (*idea'c'idea'?*) (Figure 98). The wall mounted shelving system in the living space complements the display place proposed for the stairwell

Although the shelving in the stair and living spaces both function as display places, the former is more conducive to housing 'private' items for personal experience. Conversely the semi-public nature of the living space makes this a place to display

Fig. 98

The playful take on a traditional shelving system creates a point of focus within the living space

5.3c

A Display Space

objects intended to be shared.
The shelving unit is designed to incrementally extrude from the wall in both horizontal and vertical directions as it gets closer to the television (Figure(s) 99-100).

Because of its location, the display space can not immediately be seen by people entering the house. This adds an element of intrigue and mystery to the architecture of the house (*idea 'b'*).

▼ **Fig. 99**

*The dynamic formal qualities of the shelving unit is an attempt to balance the strictly orthogonal nature of the current house while enhancing the architectural detail of the space (*idea 'b'*). - 1:20*

▼ **Fig. 100**

While it does have an aesthetic function, the dynamic design also prevents the window (1) from being blocked. - 1:20

▲ **Fig. 101** (Section e-e')
The shelving's location within the house helps activate the area below the staircase as a separate space.
-1:50

Fig. 102
The extruded nature of the structure means not every cubical is suitable for storing objects. However, 'subsequent spaces' provide additional display space (Figure(s) 103-104).
- 1:50

1

Fig. 103

2

Fig. 104

A strong disconnect exists between the kitchen (a) and living spaces (Figure(s) 105-106). To resolve this, the proposed kitchen (b) is reorientated to open into the entertaining/loungespace(c). Furthermore, by extending the kitchen bench into the living space, the boundary between each space starts to overlap (d). This contributes to the idea of a multifunctional space, that is easily adaptable to the changing needs of the family.

► **Fig. 105**

The services in place for the current kitchen determine its location in the proposed design.

- 1:50

► **Fig. 106**

With no alternative location in the space, the dining tables placement in the living space limits social interaction between the kitchen and lounge areas.

5.3d

A Cooking Area

The kitchen exists as two areas, the 'fixed' (1) and the 'moveable' (2) (Figure 107). The fixed area generally constitutes the traditional elements of a kitchen. This includes all appliances, sinks, electrical, and gas components within a kitchen. Conversely, the moveable section (2) describes four moveable bench segments. While they function primarily as elements of the kitchen, the blurred spatial boundaries in this area of the kitchen and their moveability enables them to be used in various situations (Figure(s) 108-111).

▼ **Fig(s). 108-111**

The units can be used in their 'default' location or moved closer to the main kitchen depending on specific needs. - 1:100

Fig. 107

The function of the moveable kitchen elements is intentionally vague as this enables them to be appropriated in different ways depending on specific needs. - 1:100

Fig. 109

Fig. 108

Fig. 111

Fig. 110

Design Aspect One

The kitchen's eastern 'wing' is the first of two key aspects critiqued (Figure 112).

There are three elements that inform the eastern wing (Figure(s) 112-113). These collectively address **idea 'c'** either: by reducing visual clutter in the space (1, 2) and/or clearly defining fixed-functional spaces in the living space (2, 3) (Figure 113).

► **Fig. 112**

The east wing is designed to include an appropriately size fridge (1). Additionally, there is provision for storage that opens into the entrance space (2). - 1:50

▼ **Fig. 113**

Use of full height casework and shelving in the eastern wing provides separation between the entrance and kitchen spaces (3). - 1:20

Fig. 113 (Section c-c')

The oversized dimensions of the fridge required by the family causes the eastern kitchen wing to protrude into the entertainment space (Figure 114). This reduces the visual cohesion between the end of the kitchen, the entry step-down, and the end of the staircase.

Fig. 114 While potentially a minor detail this inconsistency impacts the functionality of the entertainment space (idea 'c').

Fig. 115

Removing and reorganising several aspects of the kitchen's design aids in reducing the length of the eastern wing. The subsequent alignment with the entrance step and staircase creates an increased visual cohesion (*idea c'*).

Design Aspect Two

The moveable bench units are multifunctional, either as an extension of the kitchen - providing additional bench space, or a place to store/display things within the living space.

Potential issues arise however with the functionality of these units as moveable elements.

Because of their exposed bench tops a build-up of clutter may occur over time, particularly in the living areas as they are less likely to be used as kitchen benches. This would prevent them from being moved and the clutter making the space feel messy **idea 'c'**.

Fig. 116

*Located within all living spaces in the lower floor, the moveable benches function as linking elements enforcing a visual cohesion (**idea 'c'**). - 1:50*

Fig. 117 Maintaining a consistent bench depth along the movable units resulted in an overhang of the northern windows (a). This causes the units to look out of place as they lack cohesion with other key architectural elements (idea 'c').

The likely-hood that the northern units are used as kitchen bench space is low. Thus, a storage structure is built around them (Figure 118). This provides additional storage within the living space (idea 'c') while preventing build-up on top of the bench units. The provision of an area of clear wall (a) in place of an additional bench unit provides space for the family to hang photographs and artwork etc. (idea 'j')

This cupboard unit is slightly recessed to sit flush with the edge of the window preventing any overhang (Figure 119)

Fig. 118

The cupboards are designed to align with the assumed boundary of the lounge space. This increases the formality of each space while not preventing expansion between the three. - 1:50

Fig. 119 To ensure the provision of adequate bench space for the kitchen, one of the moveable units is not built into the cupboard structure.

Additional moveable units sit in alcoves built into the base of the cupboards. A series of drawers in these units provide additional storage for the family (*idea 'c'*). The flush finish of the cupboards conceals them to some degree enabling them to be read as a wall element. To this end, couches in the lounge can be pushed against them without the space

Fig. 120

The bench units are wheel mounted making them easy to move throughout the living space. - 1:20

Fig. 121
The bench units are multifunctional in that they appear as a part of the cupboard while also having the ability to provide additional work space if it is needed.

Eating meals at the dining table is not widely practiced in Burmese culture. As such a dining space is not a primary spatial requirement for the family. However disregarding this element altogether may not be beneficial. The dining table in the house was relatively free of clutter and had place mats set out during the third phase meeting. This provides some indication of its use. To this end, a foldout table is integrated into the design of the largest moveable bench unit (Figure 122). This therefore functions as either an extension of the kitchen bench or as a dining table that can be set up in the entertainment space (Figure(s) 123-127).

Fig. 122
The table unit sits immediately in front of the entertainment space. When necessary, it can be moved into this space and easily unfolded. - 1:100

Fig. 123

Fig. 124

Fig. 125

Fig. 126

Fig. 127

Fig. 123
A series of panels lining the front of the unit can be removed.

Fig. 124
The structural bar supporting these panels can then be removed.

Fig(s). 125-126
The unit sits on wheels allowing it to be moved. Using extension panels stored under the table, the size of the table top can be increased.

Fig. 127
Stools are also stored under the unit to provide seating.

Fig. 128

The table fits comfortably within the entertaining space however, it is also possible be used in place.

As opposed to Design Areas One and Two which are identified through an understanding of the architectural implications of each primary data point, Design Area Three is characterised as 'remaining space'. This includes the entire upper level of the house. Because the form and location of the staircase are altered in Design Area One, it is necessary to adjust the spatial layout of this area to provide a holistic design solution. As none of the primary data points speak specifically to a possible design direction for this area, several key learning from Design Areas One and Two are used to inform a solution.

The need for an unconventional approach to resolving design issues is perhaps one of the strongest ideas from both phase one and two. At less than eighty square meters, the house verges on being too small for the family to comfortably occupy. Because of

the very conventional approach to housing design applied in the current house – its small size results in a prioritisation of basic functional requirements i.e. kitchen, bathroom, bedrooms. By thinking outside the box of traditional architectural solutions, a balance is established in Design Areas One and Two between functional, and emotional requirements. Specifically, this is achieved by identifying how various architectural elements can function in both roles

As such Design Phase Three investigates potentially unconventional solutions to the spatial design of this private area of the house. Less attention is given to this Design Area as it is not of specific interest in this research. Instead the proposed solution outlined demonstrates how knowledge from the previous Design Areas have manifest as architectural interventions.

Fig. 129

The stairwell design proposed in Design Area One alters the footprint of the upper floor area to the extent that the current programme is no longer viable in the space. As such, it is necessary to rethink the design of this space using ideas and knowledge from the previous Design Areas. - 1:100

An unconventional approach to the design of the upper level spaces is taken due to the limited space available. Furthermore, the location of bathroom services in the southern corner, and windows in the northern facade heavily restricted the possible solutions for this space.

This is most evidently seen in the design of bedpods as an alternative to the traditional bedroom for the children. This breaks the space down into two key components: the private sleeping pod and, the open room - the 'play space'. To this end, the same functionalities are afforded within this design but the manner in which they are manifest within the house is different.

Because there is no defined boundary for the play space, the large area constituting the

stair landing can also become part of this space. This speaks to similar principles of functionality and multi-functional design of space applied in Design Areas One and Two.

The Buddha shrine has been built into an alcove between the master and children's bedrooms. Being central within the space it is seen from several locations in the upper floor. This is symbolic of the Buddha as a figure watching over us.

Upon reflection. The proximity of the shrine to the bathroom may cause offense to the family. If this were the case, an alternative location on the upper floor would need to be identified.

Fig. 130a/b
The proposed bed pods provide an innovative space saving solution that remain highly functional as bedrooms. - 1:100

Although the bed pods do not meet technical requirements for habitable spaces they are arguably better than the current spaces. By opening the upper floor, more light is able to enter the space while also providing better ventilation. These spaces also provide the children with a personal private space in the house giving them a sense of ownership to an element of the house.

Fig. 131

The top bed pod has a dedicated stair entrance as well as an opening in the northern wall allowing natural light and ventilation into the space.

5.4a

A Sleeping Pod

Fig. 132

A curtain can be drawn enclosing the area directly in front of the bed pods. This creates an open space for the children to play.

Fig. 133

By recessing an alcove into the master bedroom wardrobe, no additional floor space is consumed in the upper floor. Moreover, the shrines location is highly visible throughout the upper floor of the house.

5.4b

*A Place for
Buddha*

The design solution proposed in this research highlights the success of the methodology as a tool for extracting new information to identify the architectural implications of home. While highly conceptual, the design demonstrates a heightened understanding of the family's housing needs and specifically, the role of various architectural elements in addressing these needs.

A comparison of the proposed and current design iteration of this house identifies how relatively minor architectural changes have the potential to increase the experience of home. The design proposed here does not include major changes to the current house. Instead a process of re-examining the role of several key elements and how they can serve not only functional but also

emotional roles within housing is undertaken. This highlights the need for an unconventional approach to housing design to address functional and emotional needs. In doing so, the potential for home experiences to take place within the house increases exponentially.

The data generated using this methodology is different to that of traditional process in that it speaks to architectural and emotional ideas as opposed to the specific requirements of architectural elements. Thus, the design proposed in this research is only one of many possible solutions to create a place of home for this family.

6.0

Conclusions

At the beginning of this research my belief in the possibility to uncover ideas of home using immersive virtual reality was limited, perhaps even sceptical. My understanding of the potential of this technology was restricted by the limited experiences of it in rather superficial applications. While 'scary' roller coaster games, and immersive golfing have an entertainment value, they do not generally uncover and explore new ideas and emotions for the user.

During the first design review, it became clear that this was an opinion shared by others. Several reviewers suggested that using immersive virtual reality to create an experience of a house that already exists in the real world would be futile.

Upon reflection however, I believe that it

was not so much the technology but its application - to elicit information about the meaning of home, that lead to my earlier scepticism. Because I knew at some level that virtual and real-world experience are fundamentally different, it was probably the inability to extract conclusive and quantifiable data from this experience that pushed my disbelief in the potential of this technology and of this research.

What I have come to realise however, throughout a process of developing and testing a research methodology is that these innovative uses of virtual technology have the potential to unlock a deeper understanding of what makes home than what is currently possible using traditional research methods.

This research asked the question: What is the potential of immersive virtual reality technology - using 3D scanning, as a tool applied within the design process to better understand the housing needs of marginalised groups?

To understand this, the research was divided into three components:

- Establishment of the methodology
- Testing and development
- Realising its potential to inform an architectural design process.

A review of literature in Chapter One explored, current understandings of what makes 'home'. This provided an understanding against which data generated using the established methodology was evaluated. From this, it was identified that

the psychological experience of home is determined by the extent to which a physical setting facilitates the experience of significant events. This highlights the role of emotional architecture in the process of making home.

Because of its immersive nature, virtual reality facilitates an alternative way of 'existing in the world'. To this end, the change in experiential medium has the potential to unlock a new understanding of an environment and meanings associated to it. This highlights the potential use of immersive virtual reality as tool for experiential assessment of space to identify architectural elements that define the experience of home.

Chapter two applies learnings taken from

the literature review as a framework to: establish a research methodology and, evaluate data produced with respect to the meaning of home. Because home is an intangible psychological experience of space unique to each individual, the methodology is developed with a human centred approach to client research. Immersive virtual reality forms the basis of data generation within this methodology. As a tool for spatial experience, observational commentary provided by participants exploring their virtual house is the primary data source.

A case study is then conducted in which the developed methodology is applied using a refugee family as participants. From their experience, three primary data points were extrapolated that inform an understanding

of what makes home for these individuals. As opposed to most of the supporting information identified during this process that mostly describes the technical requirements of housing, primary data points each spoke to various emotional requirements. This comparison highlights the advantage of this methodology to identify ideas, emotions, and philosophies relating to the architecture of housing that directly inform an experience of home.

The design phase of this research sought to identify how ideas identified during the virtual house experience could be addressed within the design of the house. In doing this a conceptual housing proposal was developed in which a focus was placed on creating an 'emotional architecture' that facilitates the experience of home for the

family. By increasing the potential for both emotional and functional activities to occur in the house, the design proposed becomes far more likely to be experienced as a home.

Two key elements of this methodology determine its potential to speak to the meaning of home. First, the use of 3D scanning processes to create a highly realistic immersive virtual environment facilitates a higher level of presence for participants than what is possible using digitally rendered environments. Secondly, by using the house as the location for experiencing, the potential for environmental comparison to occur between the experience of the virtual and real home increases the awareness of subtle differences and enables specific elements that stand out to be recognised.

The application of this research methodology has enabled the development of specific design interventions that could now be considered as home by the family. This places the current work well beyond the scope of a Masters research project. Nonetheless, the process seems to provide a positive perspective to the design stage. In the future, one looks for the opportunities to realise and experience these beyond the virtual home – in the actual home.

Several limitations identified throughout this research relate to either the research structure or the ability of the methodology developed to generate information.

A significant limitations for this research was the willingness of organisations to assist in identifying participant families. This affected the structure of this research as well as the scope. As the primary means for sourcing case study participants in this research, the support of refugee-associated organisations was vital. However, all but one contacted declined to assist.

Their suggestion that the aims of this work does not align with their research direction is somewhat confusing. Their work supporting refugees in the resettlement process is fundamentally aligned with the idea of addressing housing needs and more broadly, the experience of home.

This speaks to a broader lack of understanding of the importance of home particularly for marginalised communities.

Furthermore, the lack of known research outputs during the early aspects of this research due to its innovative nature, appeared to contribute to these organisation's unwillingness to partner in this work.

As opposed to the one-month period initially allocated to finding a partner organisation, it actually took slightly less than six-months. Furthermore, upon finding an organisation, the process of sourcing participants also become drawn out. As such, the scope of research was adjusted to reflect this limitation with only one case study undertaken. Instead of undertaking three case studies to generate a tentative understanding of what makes home for a marginalised group, the narrowed scope only facilitates an understanding of what makes home for a single family of people. However, based on the understanding of home developed through the literature review, this refinement of the scope of research would likely have occurred regardless as

generalisations of home do not align with the human centred nature of this research.

A second limitation relates to the data produced from the research methodology. In both the pilot and case studies, most of the data was provided by only one participant. This raises the question of the extent to which a design intervention based on this data is representative of what makes home for the whole family, versus for just the participant providing the information.

The delay in sourcing participants for this research prohibited a participant evaluation of the proposed design. This would have been a valuable means for understanding the success or failure of the design to meet the family's housing needs. However, because this is a conceptual proposal and coupled with the fact there is no built intervention the ability for participants to assess the extent to which the proposed house meets their needs is significantly reduced.

In the future, subsequent research would seek to identify the extent to which data generated throughout the participants' virtual house experience is representative of the meaning of home for the entire family group. To do this, an increased focus on participatory design, particularly in the developed design phase would be necessary. By involving participants in the design process, it is possible to tentatively gauge how the proposed design aligns with their perceptions of home.

As a process for facilitating the design of housing that better meets the needs of marginalised groups, an increase in the scope of future research would make it possible to identify reoccurring

themes throughout various groups of people. This would provide designers with an understanding of the underlying elements that make home for these communities. As a result, it would become possible to establish a design framework to identify the fundamental housing needs of marginalised groups.

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