The End-user Perception of Healthcare Waiting Environment Designs

by

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DECLARATION

This thesis is submitted to the University of Warwick in support of my application for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree. The work presented (including data generated and data analysis) was carried out by the author. Parts of this thesis have been published by the author:

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ABSTRACT

Waiting environments often represent the first interaction point of the healthcare journey and as such contribute to end-user overall experience. The design of these spaces should therefore make the experience as positive as possible. The body of evidence about the relationship between healthcare built-environments and end-user outcomes has grown rapidly in recent years. However, as opposed to inpatient and long-term care, few studies have focused on the design of outpatient settings and their waiting environments. In order to improve the waiting experience, it is necessary to understand how end-users perceive the design of the healthcare waiting environments. This research therefore aims to understand how end-users in the United Kingdom perceive the design of outpatient healthcare waiting environments (OHCWEs).

A mixed methods research consisting of quantitative and qualitative techniques was developed to address key research objectives in four studies. In Study 1, end-user perceptions were explored through 24 photo-elicitation interviews. Content analysis of the data revealed that end-users described their perception of the design of OHCWEs using design descriptors and/or emotional, cognitive and associative terms. This contributed to the understanding of the content and language that participants used to describe the design. In Study 2a, 66 participants rated images on semantic differential scales. Using Principal Component Analysis, the level of pleasantness and typical healthcare appearance were extracted as two end-user main perceptions. As these two perceptions were found uncorrelated, a direct causal effect relationship between them could not be assumed. This challenged existing knowledge suggesting a positive effect on end-users related to untypical healthcare appearance. In Study 2b, learning from the review of the literature and from the studies 1 and 2a were consolidated to form a theoretical foundation for the research design of Study 3 to assess design attributes. In Study 3, participants (N=116) evaluated seven design attributes and their sub-attributes on perceived level of pleasantness using photo-realistic renderings which were specifically created. Conjoint Analysis revealed that wooden flooring, an open reception area, upholstered, single chairs that are arranged in rows, clear signage and additional features e.g. indoor plants or refreshment facilities were perceived most pleasant. The quantifiable measures about the contribution of each design attribute to perceived level of pleasantness extend existing knowledge in evidence-based design and hence represent conceptual contributions.

In addition to the conceptual contributions, this research also contributes to the practical and methodological development of evidence-based design. The methodological framework provides a novel way of measuring end-user perceptions of the design in OHCWEs. The developed method allowed a more complete view on end-user insights which would not have been possible using traditional, pure methods. Additional learning about the design enabled the formulation of practical design recommendations to improve end-user perceptions of OHCWEs. Being able to assess the pleasantness of healthcare environments has the potential to improve the well-being of end-users.

GLOSSARY OF TERMS

3D	Three dimensional
A&E	Accident and Emergency
CDC	Centers for Disease Control and Prevention
DH	Department of Health
e.g.	exempli gratia (for example)
EBD	Evidence-based Design
GP/s	General Practitioner/s
HBN	Health Building Notes
HTM	Health Technical Memoranda
NHS	National Health Service
OHCWE/s	Outpatient Health Care Waiting Environment/s
PCA	Principal Component Analysis
PEI/s	Photo-Elicitation Interview/s
PFI	Private Financing Initiatives
POE	Post Occupancy Evaluation
SD	Standard Deviation
SHSS	School of Health and Social Sciences
SIG	Special Interest Group
Typical HC	Typical Healthcare
TV/s	Television/s
UK	United Kingdom
USA	United States of America
VCT	Vinyl composite tiles
WHO	World Health Organization
WMG	Warwick Manufacturing Group

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CHAPTER 1 – INTRODUCTION

1.1. INTRODUCTION

“The connection between health and dwelling is one of the most important that exists.”

This quote by Florence Nightingale (1820 – 1910) established that the concept of a relationship between built-environments and people’s health and well-being is not unfamiliar. However, regardless of whether this is applied to a domestic environment or a healthcare environment, this understanding requires a rather dramatic shift in people’s mind.

This chapter introduces how the increasing demand for health provision, the shift from inpatient to outpatient care, a continuously evolving medical landscape, and a more holistic understanding of the term ‘health’ form the background for this research. From within this context, the research interest of investigating the relationship between the design of outpatient healthcare waiting environments (OHCWEs) and end-user perceptions emerged and will be introduced in Section 1.3. Finally, an overview of the included chapters and the thesis structure is shown in Section 1.4.

1.2. BACKGROUND

A number of factors contribute to the need of investigating the relationship between the design of OHCWEs and its effect on end-users. Figure 1.1 provides an overview of these factors which will be covered in more detail in the following sections (1.2.1 – 1.2.4).

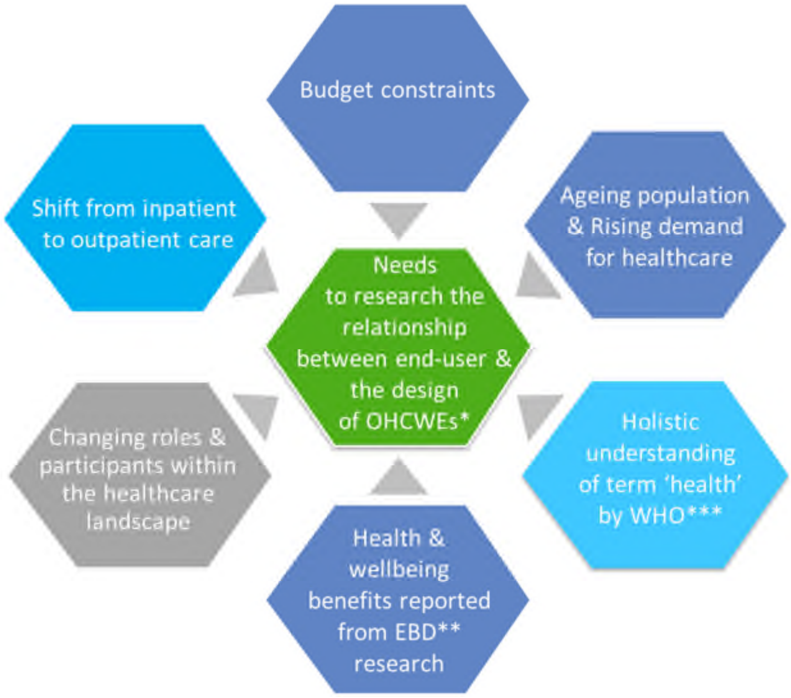


Figure 1.1: Overview of factors contributing to the research need

OHCWEs = Outpatient Healthcare Waiting Environments; **EDB = Evidence-based Design; * WHO = World Health Organizations*

The World Health Organizations (WHO) in 1948 contributed a more holistic understanding of health through the following definition:

'A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (World Health Organization 1948).

This definition of health may need to be adapted in light of changing disease pattern and advances in diagnostics amongst other factors (Huber et al. 2011). However, the initial definition by the WHO remains powerful as it takes into account different aspects of the human well-being. With this definition of health in mind, providing patients with an environment where they can relax and receive the necessary information and support could be regarded as part of the overall healing process.

1.2.1. Increase in demand for health provision and healthcare constructions

The healthcare sector is undergoing vast changes due to some major socio-economic and demographic trends resulting in multiple financial and policy considerations. One of the leading challenges is the fast development of the aging population and the associated question of healthcare demand and provision. The United Nations reported the number of people aged 60 years and older reached 784 million in 2011 with the projection of a more than triple rise by 2100, resulting in a figure of 2.8 billion (United Nations 2011). However, the same report revealed an even more alarming fact: The population aged 80 and older - the group with the highest need for healthcare, is anticipated to rise by factor eight over the same time span.

Countries have taken different approaches in response to this demographic shift and the resulting need for more healthcare facilities. The United Kingdom (UK) introduced the Private Financing Initiatives (PFI) as a way to finance the cost of healthcare constructions under which 118 hospitals were registered and valued at £11.6 billion in 2012 (Ball 2012). While PFI enabled fast creation of new facilities, their financial implications are much debated due to the high repayment (£79.1 billion) (Ball 2012; Lambert 2010). In the United States of America (USA), $36.3 billion of healthcare construction investments were reported in 2008 (Carpenter 2011). Even though the number of new constructions have declined in the past few years, mainly due to the economic recession, much of healthcare construction activities in the form of renovations are still taking place. In a national survey carried out by the Health Facilities Management and the American Society for Healthcare Engineering of the American Hospital Association, 73% of construction activities at the 598 participating hospitals were renovation, extension and modernisation projects (Carpenter 2011). These hospitals also reported that 37% of their overall capital budget had been allocated to healthcare construction in 2011 which represents an increase of almost double compared with 2010. It was also revealed that many future planned projects will be focusing on the construction of outpatient facilities such as outpatient, ambulatory surgery, urgent care centres (Health Facilities Management 2011).

1.2.2. Importance of the outpatient sector

The World Bank revealed that health expenditure worldwide accounted for 10.1% of Gross Domestic Product on average in 2011 (The World Bank 2013). In light of the rising demand for healthcare and increasing health expenditure, a continuous shift from inpatient to more outpatient care is being observed. Budget constraints in healthcare will further enhance the significance of the outpatient sector within the healthcare provision infrastructure in the future. According to the Hospital Episode Statistics, the total number of outpatient attendances in the UK rose from 42.5 million to 60.6 million between 2004 and 2009 which equals a compound annual growth rate of 6.1% (HESonline 2010).

As part of this evolving medical landscape, the role of General Practitioners (GPs) and patients are also changing. The role of GPs as the patients' first visiting point is intensified in order to reduce self-referrals, while patients are encouraged to become more involved in decision-making processes related to their personal health. The attendance in practices rose from 3.9 times per year in 1995 to 5.3 times per year in 2006 (Hippisley-Cox et al. 2007). Even though patients have been given free choice of selecting their GPs, dentists and opticians since the foundation of the NHS in 1948, patient empowerment has taken another dimension with the dramatic liberalisation of the NHS structure in the recent Health and Social Care Act 2012 (Department of Health 2012). Working drafts titled *'Liberating the NHS: no decision about me, without me'* or

'Liberating the NHS: Greater choice and control, A summary of responses' in 2012 reflect the content of this reform. Policies introducing a more liberal healthcare structure seek to encourage and promote competition within the healthcare system.

1.2.3. Importance of healthcare waiting rooms

With the shift towards outpatient care, and therefore a higher capacity of arrival and departure, an increased level of interactions in healthcare waiting environments is consequently to be expected. Healthcare waiting environments and their designs represent one of the first interaction points between end-users and their healthcare journey (Figure 2.2).

However, their design is often neglected due to the dominant focus on clinical areas for the consultation or medical procedure itself. The overall time spent outside the consultation room, in particular the time waiting to be seen by medical staff and after discharge, forms a major part of the overall patient experience. Healthcare waiting rooms are often linked to medical anxiety and stress (Leather et al. 2003) where a calm and relaxing environment has been found to be desirable (Macnaughton et al. 2005).

Waiting time affects the patient experience and '*Time is Money*' – Literature suggested that waiting time directly affects the patient's level of satisfaction (Derlet and Richards 2000; Eilers 2004). In countries like the UK where a waiting list system is applied, waiting may play an even larger role. The term 'waiting time' often refers to the length of time people spend on the waiting list until an appointment can be allocated. In this research, the term 'waiting time' if not otherwise explained refers to the time spent in the physical waiting environment. However, the actual time spent in the waiting room before being seen by the physician or medical staff is often not as predominantly mentioned. No official waiting time information for outpatient clinics is currently available as this data is not collated centrally. In 2002, over 40% of all surveyed NHS patients visiting GPs stated that they should have been seen sooner from the point of arrival, which they viewed as a problem (National Centre for Social Research 2003). The more recent results from the GP Patient Survey 2011/12 showed that 24% of patients across England waited for longer than 15 minutes despite having an appointment (Ipsos MORI 2012). The survey, however, does not allow patients to specify how much longer the waiting time was. Nearly a quarter of all surveyed patients (24%) felt that they had to *'wait a bit too long'* and 8% answered with *'wait far too long'*. According to the King's Fund report, over 232,000 patients had to wait for more than four hours at the Accident and Emergency (A&E) department from October to December 2012 which equals a 21% increase compared to the same period of the previous year and set a record high since 2003 (Triggle 2013).

Data from the American Time Use Survey (ATUS) was therefore used to provide an indication of the time and costs associated with waiting for medical services in the USA. According to Krueger (2009), all Americans aged 15 and over spent collectively 847 million hours on waiting for medical services in 2007 which equals an opportunity cost of $240 billion. Other research has supported the approach of converting patients' waiting time into opportunity cost to estimate its associated financial burden (Russell 2009).

In response to the long waiting time, an extensive amount of research focussed on the reduction of waiting time by means of improving the system's efficiency (Cayirli and Veral 2003). Another approach is to reduce patient stress-level with a wide range of suggested intervention techniques including the application of arts (Staricoff 2004), green plants, windows and light amongst others (Dijkstra et al. 2008b; Ulrich 1984). These two approaches are linked to a certain extent since the improvement of the waiting experience is suggested to make the perceived waiting time appear shorter (Becker and Douglass 2008). The improvement of patient overall experience has the potential value to contribute to the broader sense of health and well-being.

1.2.4. Evidence-based design as an opportunity for the healthcare sector

In the service industry which includes healthcare providers, individuals often interact mostly or firstly with the environment (Bitner 1992; Kotler 1973; Levitt 1981; Ulrich 2011) because their products are often intangible. As opposed to healthcare, other service industries such the hospitality and gastronomy sector use the design of their environments to address specific customer needs as part of their common practice. For example, dimmed light was applied in fine dining versus bright lighting in fast food restaurants as light settings were suggested to influence eating behaviour (Stroebele and De Castro 2004). The way other service industries apply design knowledge into their business operations emphasises the need for the same approach to be applied in healthcare.

In a healthcare setting, the design of waiting environments forms end-user first impressions and plays an important role in shaping end-user perception of the overall facility. Ulrich (2011) stated that first impressions are *sticky* which means that once created they tend to be endure and are difficult to alter. It is also suggested that people use design cues as indicators for quality judgements which will be discussed in more detail in Section 3.3.2. Arneill and Devlin (2002) also found that the design of healthcare waiting rooms can influence participant perception of the service quality.

Healthcare environment design for health and well-being – The body of evidence showing a relationship between healthcare built-environment and end-user outcomes has grown rapidly in recent years (Ulrich et. al 2008). Literature reviews suggested the effect of a number of design parameters such as lights, the view of nature and representational artwork on end-user health and well-being (Devlin and Arneill 2003; Huisman et al. 2012). Faster recovery rate, shortened hospital stay, improved sleep quality, reduced stress and pain level are amongst the suggested outcomes in evidence-based design (EBD) as a result of design interventions (Ulrich et al. 2008).

While much effort is spent on improving the physical functionalities of the healthcare environments, the visual dimension of the design and its potential effect on end-user perception is often neglected. Ulrich (1991) suggested that the interior design can impact on end-user perception and well-being. This view is also shared by consumer research as design parameters in the retail sector were suggested to function as effective marketing tools to influence end-user perception (Kotler 1973). The author further pointed out that the impact of built-environments on the end-user in service industries can even exceed that of the primary product. Simple and low-cost design interventions are of particular interest in light of the on-going budget restraints in the healthcare sector and the numerous modernisation and renovation projects taking place in healthcare construction.

1.2.5. Research need

While the outpatient sector and their waiting areas are gaining on significance, only a few studies have focused on their design requirements as opposed to inpatient and long-term care (Joseph et al. 2009). The exact relationship between the design of OHCWEs and their effect on end-users is not well-understood. This is partially due to the complexity of a large number of design variables and a high variation of possible outcome measures (Codinhoto et al. 2009b). A better understanding of how end-users perceive the design of OHCWEs will help guide future practices in EBD and may contribute to the improvement of healthcare experiences. End-user perception of the design of OHCWEs needs to be firstly understood in order to improve the end-user healthcare experience.

1.3. RESEARCH SCOPE

This research focuses on healthcare waiting environments in outpatient facilities due to the greater need for research in this area as described in sections 1.2.2 and 1.2.3. For clarity, 'Outpatient' in this research refers to all healthcare environments that do not include the provision of overnight stay and excludes specialised facilities focusing on a specific type of end-users such as children's hospital and mental health clinics. The reason is because design requirements for these specific end-user types are likely to differ from other healthcare environments and require separate research attention.

1.3.1. Research question and objectives

The overall research aim was to understand the relationship between the design of OHCWEs and end-user perception. The overall research question is detailed below along with individual sub-objectives which are addressed in four studies:

'What is the relationship between the design of outpatient healthcare waiting environments (OHCWEs) and end-user perception?'

Objective 1 – To understand end-user perceptions with regard to the language used to describe their experiences, preferences and interactions with the design of OHCWEs (Study 1).

Objective 2 – To establish measures (Study 2a) and a theoretical foundation (Study 2b) as a platform to assess design attributes.

Objective 3 – To evaluate the relative importance of design attributes on end-user main perceptions of the design of OHCWEs (Study 3).

1.4. OUTLINE OF THESIS

This thesis consists of 11 chapters, organised as follows (Figure 1.2):

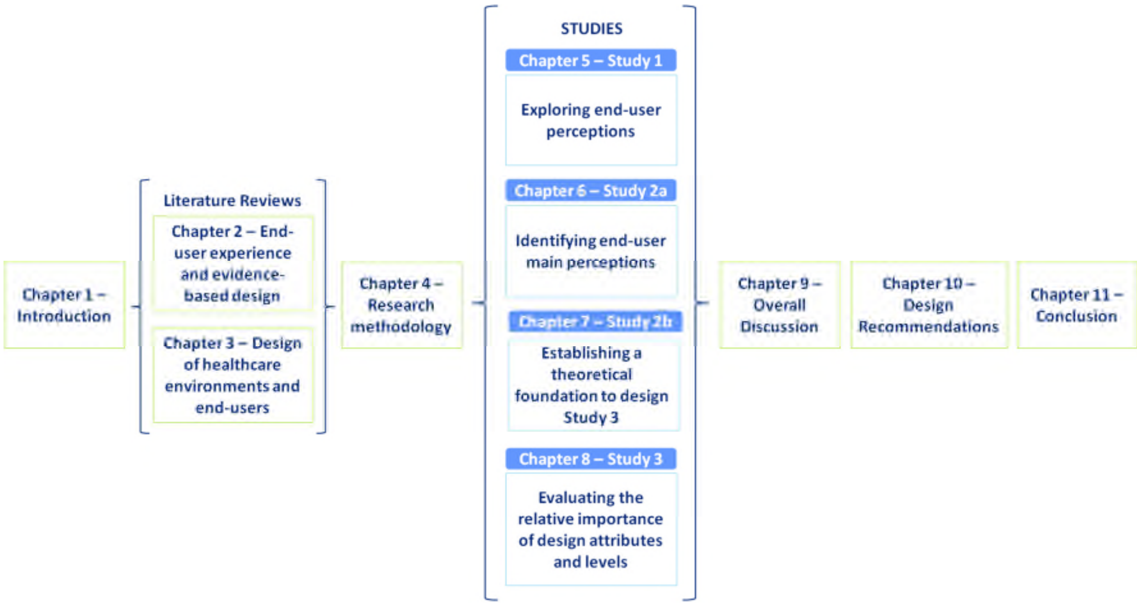


Figure 1.2: Overall structure of the thesis

Chapter 2 – Review of literature on the end-user experience and evidence-based design frameworks

By reviewing the literature on end-user perception and experience, this chapter continued the initial discussion about the role of outpatient facilities and their waiting environments in Chapter 1. An overview of the research in EBD and their frameworks were presented, followed by a critical discussion on methodological challenges found within this area.

Chapter 3 – The relationship between the design of healthcare environments and end-users

Chapter 3 presents the existing knowledge about the relationship between the design of healthcare environments and end-user outcomes. The way interior design parameters can impact end-user well-being, safety as well as their understanding of the environment were discussed. Reflections on findings from Chapter 2 and Chapter 3 formed the basis for the research inquiry and methodology.

Chapter 4 – Research methodology

This chapter introduces the mixed methods approach which has been designed to address the inquiry of this research, followed by the discussion of its underpinning theoretical foundations. The individual stages of the research methodology were introduced, along with experimental and practical considerations such as the sample frame and the use of visual representation instead of in-situ testing.

Chapter 5 – Study 1: Exploring end-user perceptions on the design of OHCWEs

This chapter presents Study 1 which used photo-elicitation interviews to explore end-user perceptions of the design of OHCWEs. Findings on end-users language, experience and perceptions of the OHCWEs contributed to the research design of the following studies.

Chapter 6 – Study 2a: Identifying end-user main perceptions of OHCWEs

This chapter presents Study 2a which reduced the complexity of perceptual responses by compressing them into few main perceptions using Principal Component Analysis (PCA). The reduced number of perceptions was then used to assess design attributes in Study 3.

Chapter 7 – Study 2b: Establishing a theoretical foundation for the research design of Study 3

In preparation for Study 3, data from different sources were consolidated and analysed to form a theoretical foundation about the relationship between design aspects and end-user main perceptions. These inputs were then used towards the research design of Study 3.

Chapter 8 – Study 3: Evaluating the relative importance of design attributes on end-user main perceptions of the design of OHCWEs

This chapter presents Study 3 which assessed the contribution of design attributes and their sub-attributes on end-user main perceptions using Conjoint Analysis. For the experiment design, photo-realistic renderings of healthcare waiting environments were created which allowed a better control and manipulation of specific design aspects. Participants evaluated the designs based on the main perceptual dimensions resulted from Study 2a.

Chapter 9 – Overall discussion

This chapter brings together overarching themes from this research and discusses them in the context of the research question. A discussion on the potential value and limitations of the overall approach was provided.

Chapter 10 – Design recommendations

This chapter provides learning about the design aspects to make OHCWEs more pleasant through the interpretation of the research findings from the developed methodology. Recommendations were presented in a non-technical manner with visual examples in order to be accessible for a wider audience beyond the research community.

Chapter 11 – Conclusion

This concluding chapter reflects on the main findings and contributions of this research. Conceptual, practical and methodological contributions stemmed from this research were summarised, followed by recommendations for future investigation.

CHAPTER 2 – REVIEW OF LITERATURE ON THE END-USER EXPERIENCE AND EVICENCE-BASED DESIGN FRAMEWORKS

2.1. INTRODUCTION

As presented in Chapter 1, the significance of outpatient facilities and their waiting environments will continue to gain as attendances and budget constraints rise. Literature suggested that the incorporation of EBD can have tangible impact on end-user outcome which in turn is reflected in cost reduction and service quality improvement. Refurbishment and constructions using EBD principles are therefore often referred to as *smart investments* (Huisman et al. 2012).

This chapter reviews literature focusing on the end-user perception and experience in healthcare and other built-environments. As waiting forms a crucial part of the overall healthcare journey, current knowledge on the waiting experience and waiting room designs are also presented. This chapter further discusses the frameworks and methodological challenges in EBD.

2.2. END-USER PERCEPTION AND EXPERIENCE

2.2.1. Perception of the environment

Despite the growing importance of the outpatient sector within the healthcare provision infrastructure, research in EBD has traditionally been more focused on inpatient and long-term facilities (Becker and Douglass 2008; Joseph et al. 2009). Healthcare facilities increasingly accept the need to move away from being purely treatment centres and embrace a more holistic definition of the term 'health' which was suggested by the WHO (see Chapter 1). With this shift and the lack of research in the outpatient sector, the end-user perception and their overall experience of OHCWEs require further research attention.

The design of OHCWEs can influence end-user first impressions upon arrival which can reflect on the entire facility. The role of built environments in end-user perception is more crucial in service industries which includes healthcare, as individuals interact with the environment often prior to the core service (Bitner 1992; Ulrich 2011). According to Ulrich (2011), first impression is linked to aesthetic response which occurs immediately within the first 100 seconds of exposure to the environment as shown in Figure 2.1.

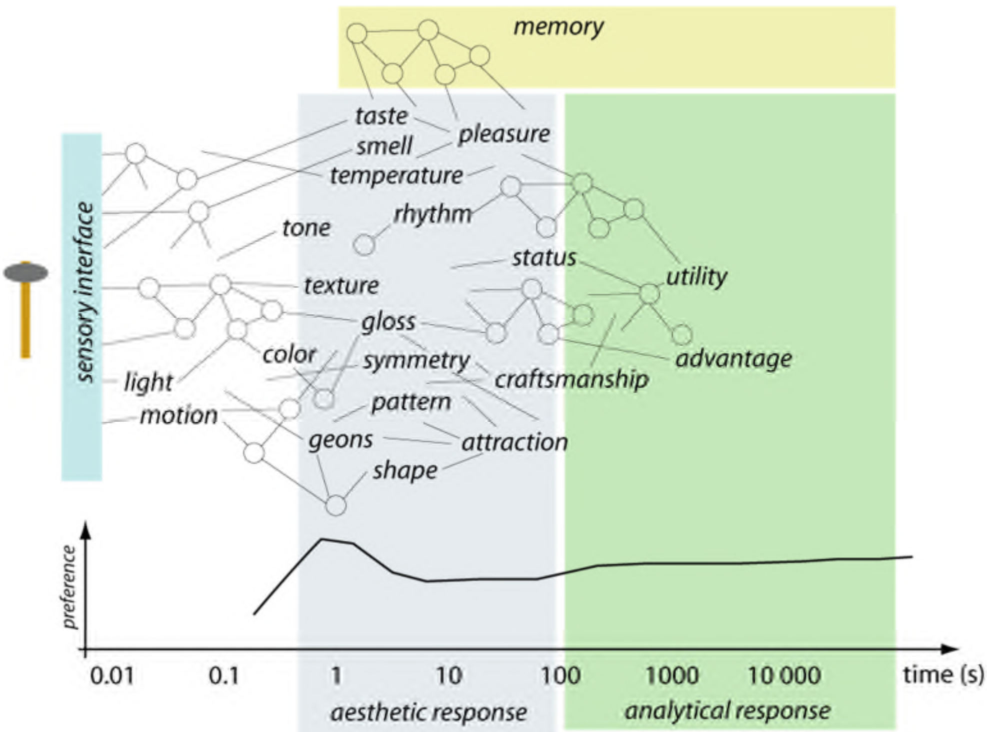


Figure 2.1: Cognitive response to design stimuli (Ulrich 2011)

The created impression was suggested to persist, or called *sticky* by Ulrich (2011) since the consequence cannot be easily altered regardless of positive experiences thereafter. The time-dependent response scheme (Figure 2.1) indicated that the majority of design features are associated with aesthetic or immediate response. Only a few design aspects including *utility* and *advantage* derive from a longer processing time which was suggested to be of analytical nature.

Perception is the process in which humans convert environmental stimuli into meaningful information by means of electro-physiological reactions, the usage of pre-existing knowledge and experience (Goldstein 2013). Even though humans take actions as a result of perceptual experiences, little focus on perception as outcome measures was found with regard to healthcare waiting environments. This may be a reflection of the complexity behind the philosophy and science of emotive and cognitive processes for which debates remain until today (Lin 2004).

As opposed to emotion preceding cognition (affective primacy), cognitive primacy suggests that individuals can only develop a feeling and form a judgement about the environment based on symbols or past memories (Lazarus 2005). Scott and Canter (1997) found in their study that people used their memories and experiences to evaluate and distinguish places that are represented in photographs. Zajonc (1980) concluded that emotional response can occur without cognitive processing taking place despite many researchers being in favour of cognitive primacy. However, the counter argument is that cognitive processing still takes place even if it occurs in an *implicit* manner (Reber 1989). Clark and Beck (2010) critiqued the notion that emotion and cognition have a direct causal-effect relationship and suggested the view that cognition has the ability to influence emotions and moods rather than causing its occurrence.

Perceptions have been suggested to arrive from a bottom-up or top-down approaches. In the bottom-up approach, the immediate input is processed, while the addition of knowledge into processing characterises the top-down approach (Goldstein 2013). Gestalt theory, formed by a group an 18th century German psychologists, suggests a different concept of how individuals assess their environment. The visual environment was suggested to be perceived based on six principles including similarity, continuation, proximity, familiarity, simplicity and movement in a common direction. Refer to Koffka (1922), one of its main contributors, for a detailed introduction about Gestalt theory.

While the fundamental debates in psychological theories are not within the scope of this research, it is important to acknowledge that the process is not as well-understood as perhaps presumed. Tofle et al. (2003) pointed out that many design interventions have been suggested and implemented without the understanding of what the design elements are supposed to do and how individuals are to perceive them.

2.2.2. Waiting experience

To better understand the waiting experience in OHCWEs, their interaction points with the waiting area during the outpatient healthcare journey were mapped and shown in Figure 2.2.

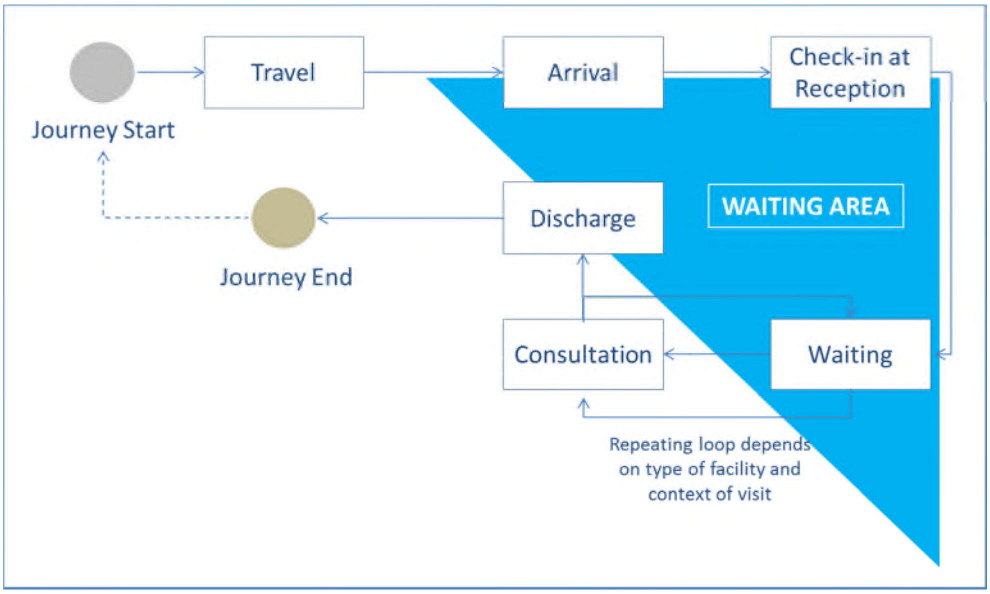


Figure 2.2: Map of patient journey and the interaction with the waiting area

Depending on circumstances and the visit context, Figure 2.2 illustrates a simplified, general path from a start to an end point of the visit. The waiting experience can be divided into three stages including before, during and after the actual service (Taylor 1994). Processes that occur in the waiting area were partially or fully allocated in the blue-marked area. While waiting takes place entirely in the waiting area, other stages including arrival, check-in and discharge can partially or fully occur in the same area. A number of factors can influence the quality of the waiting experience such as waiting time, staff morale, staff interaction, information received, sense of control and the design of the waiting environment (Arneill and Devlin 2002; Eilers 2004; Leather et al. 2003; Rice et al. 2008).

As described in Chapter 1, a large amount of time is spent in healthcare waiting environments and on waiting for healthcare-related services (National Centre for Social Research 2003; Russell et al. 2008; Triggle 2013). Anxiety, annoyance, anger and restlessness can occur as a result of waiting times which in turn can affect the perception of time (Nanda et al. 2012a; Taylor 1994). Thompson et al. (1996) found that not the actual but perceived waiting times are an indicator for user satisfaction which emphasises the importance of the experiential dimension. As waiting rooms are often linked to these negative states, a calm and relaxing environment has been found to be desirable (Ayas et al. 2008; Macnaughton et al. 2005).

Becker and Douglass (2008) suggested that there is a relationship between the design of healthcare waiting environments, waiting time, end-user satisfaction and perception of service quality. They also found that the attractiveness of the waiting room has a positive effect on perceived waiting time. This concept is in line with interventions called positive distraction which uses design to divert people’s mind from negative state, hence, promoting well-being (Nanda et al. 2012a). However, inconclusive results regarding television (TV) as a positive distraction were reported. Pruyn and Smidts (1998) found that the provision of a TV had no impact on the waiting experience while the inability to control the TV content was associated with a negative experience in a study by Ulrich et al. (2003).

Conclusive evidence suggested a relationship between waiting time and satisfaction which reflects experience (Eilers 2004; Pruyn and Smidts 1998). Satisfaction can also be linked to the design of the healthcare environment which Hathorn and Nanda (2008) consider an important aspect of the overall healthcare service. Perceived quality has also been reported to relate to waiting times. In a study using 35 images of healthcare waiting environments with different appearances, the perception of their associated care quality was investigated (Arneill and Devlin 2002). They found that waiting environments with modern furniture, artwork and good lighting conditions were well-perceived in care quality and comfort. This is in line with the notion by Ulrich (2011) suggesting that design cues can be used to make a quality judgement.

Design interventions including non-structural changes such as altering the interior, can effectively influence end-user perception and impact on well-being (Macnaughton et al. 2005; Ulrich 1991). Leather et al. (2003) compared the effect of two differently decorated healthcare waiting environments using pulse rates and self-reported measures. A number of interior parameters differentiated the old and the new waiting areas such as the overall layout, colour scheme, floor cover, furniture style and material and a number of decorative elements. They found that the more modern, newly refurbished design was more positively perceived with higher satisfaction rates and related to improved mood. Pulse rates appeared to increase over time in the new, modern space while the opposite was shown for the *traditional* waiting area. In light of the general aim to reduce stress in healthcare environments, the higher arousal in the new waiting room may indicate the opposite. However, they argued that a change of arousal in either direction can cause stress depending on individual and circumstantial differences. Tsai et al. (2007) pointed out that the perception of OHCWEs was related to patient demographics and visit context. In another study, a comparison between three waiting environments with varying comfort levels created by seating types and additional decorative elements was conducted (Ingham and Spencer (1997) cited in Dijkstra et al. (2006)). Patients rated the waiting environments with additional comfort design feature better in quality, perceived relaxation, safety and comfort. While literature suggests that interior design can influence the waiting experience in a number of ways, other factors including staff interaction also need to be considered (Ayas et al. 2008; Rice et al. 2008). While actual waiting time and social interactions are out of research scope, the concept that design can influence perceived time dimension and quality of communication and interactions is relevant for this research.

End-user perceptions and behaviours have been suggested to be influenced by the physical surroundings or *servicescapes* according to Bitner (1992). The term *servicescape,* coined by Bitner (1992), describes physical environments that facilitate and enable service provisions such as healthcare facilities. Bolton and Lemon (1999) proposed a model suggesting that the end-user *normative* expectation (definition of what *should* be) dictates their satisfaction and behaviour towards the service. This was investigated by a number of studies comparing end-user satisfactions in healthcare facilities that were operated by private and public providers. Jabnoun and Chaker (2003) reported that patients were less satisfied with private compared to public facilities in the United Arab Emirates. They concluded that patients visiting private healthcare facilities may have higher pre-set expectations. Swan et al. (2003) suggested that the facilities and services were perceived better in a more expensive healthcare setting. They found that subjects who made an additional payment of $40, rated food and care quality better in the more attractive compared to those who did not pay the premium. In another study, Pérotin et al. (2013) reported a number of differences on sub-scale measures, however, not enough evidence was found to conclude that ownership of the facility is the differentiating factor. Differences related to specific facilities and patients themselves such as their expectations may play a role in satisfaction ratings.

By adapting Floch (1988)'s framework about consumption values to patients in the healthcare context, Chalamon et al. (2009) identified four patient groupings: *Hedonist, Trustful optimizers, Functional sketptics* and *Consumerists.* The main differentiating characteristics amongst these groups were their expectations, values and shopping behaviour of medications. *Hedonists* were suggested to value the buying experience instead of the price while *Functional skeptics* approach the healthcare system in a practical manner, hence, only if necessary. The two other groups including *Trustful optimizers* and *Consumerists* differed from the previous two in that they are sensitive to price. While sharing cost-consciousness as a commonality, these two groups vary in their trust towards the system and healthcare practitioners.

2.2.3. Experience from the perspective of consumerism

In light of cost containment, healthcare providers face the need of becoming more competitive, especially since competition in the National Health Service (NHS) was found to improve performance (Cooper et al. 2011). As mentioned in Chapter 1, key literatures in marketing and consumer research pointed out the importance of the design of built-environment as influencing factors of end-user perceptions and behaviours (Bitner 1992; Kotler 1973). A number of design parameters mainly related to the interior including colour, lighting, layout, plants, space and style were suggested to be effective marketing tools as they alter the ambience (Kotler 1973; Lin 2004). It has been suggested that end-users form their perception of services by using tangible cues such as the design and appearance of the space as an indicator (Levitt 1981). Zeithaml (1988) proposed that consumers form their perception of a product or service based on characteristics that directly related to them (*intrinsic*) or information that are external to the product or service such as brand, advertising intensity and price (*extrinsic*).

As patients' involvement in healthcare decisions increases including the choice of their treatment location, healthcare providers need to consider design as part of their service provision. Other service industries use the design of their environments to address specific consumer needs due to their traditionally more competitive nature. For example, Countryman and Jang (2006) found a significant relationship between colour, lighting and style of hotel lobbies and end-user overall perception. The hospitality sector is also an early adopter of providing guests a homely accommodation to make them feel more comfortable while being away from their familiar environment (Siguaw and Enz 1999). The role of the design in influencing the dining experience and eating behaviour has also received much research attention. Stroebele and De Castro (2004) noted that the impact the environment and ambience has on eating behaviour may be greater than literature has estimated so far. The physical environment of service industries also needs to allow end-users to communicate and interact effectively, especially since their products are intangible (Bitner 1992; Verhoeven 2010). The design of educational or work spaces have been suggested to impact upon performance (The Commission for Architecture and the Built Environment 2005). Learning may be found in other environments such as hotels and shopping centres since their build and concept influenced the development of healthcare architecture (Verderber 2000). However, the core functionality and service of each built-environment e.g. clinical service in healthcare settings may represent limitations to transferable knowledge across the sectors.

2.3. EVIDENCE-BASED DESIGN IN HEALTHCARE BUILT-ENVIRONMENTS

2.3.1. Definition and development in evidence-based design in healthcare

As the relationship between the built-environment and end-user outcome gains public and academic attention, the term EBD is frequently in use. However, its definition, similar to terms such as *patient-centred care*, can be ambiguous as they often result from marketing-driven descriptions by decision-makers (Devlin and Arneill 2003). This research proposes the following definition adapted from literature (Carr et al. 2011; Huisman et al. 2012; Ulrich et al. 2008) which aims to provide a more complete view of the term:

Evidence-based design represents the conceptual framework for the notion that built-environments can have a positive or healing effect on end-users. Comparable with evidence-based medicine where research is used to form clinical decisions, EBD uses research to inform the design practice.

Evidence-based medicine represents a useful and structured approach for EBD as it considers the patient perspectives as well as the selection of rigorous research for decision-making (Edelstein 2008). The application of EBD can promote healing which translates into cost benefits, hence, often called *smart investments* (Huisman et al. 2012).

Development of EBD – The relationship between built-environment and end-user outcome goes back as far as the 19th century with Florence Nightingale (1820 – 1910) suggesting that light, ventilation and hygiene would encourage recovery. Even though the concept of built-environment impacting end-user outcome may not be new, EBD as an academic field was first developed during the 1980s (Codinhoto et al. 2009a). On the one hand, design practice has traditionally lacked a research culture and on the other hand, healthcare providers have overlooked physical environment as a health-influencing factor (Devlin and Arneill 2003). An early study by Ulrich (1984) is regarded as the initiating landmark for the field until today as his findings attracted significant academic attention. The study compared two post-operative patient groups in rooms with window views of nature and those overlooking brick walls. The group with window views of nature showed a reduced length of stay, less need for pain medications and higher satisfaction of staff. A difference though to lesser extent was also shown for re-admission rate. Ever since, a considerable amount of research has been produced in the area, particularly with regard to patient safety measures including infection control (Ulrich et al. 2004; Ulrich et al. 2008). The majority of studies focused on the elderly in long-term care and inpatient facilities (Becker and Douglass 2008; Joseph 2006a).

Acceptance and applications of EBD in practice – At the centre of the EBD concept, research should inform stakeholders in the design process so that evidence can be incorporated into design practices. However, research findings are traditionally reported in academic journals to which designers may either not have access or cannot easily understand (Devlin and Arneill 2003). Increasing efforts have been invested to make research findings more available and accessible to the public including communities such as the Healthcare Design Magazine and International Academy for Design and Health. In the USA, the application of EBD in design practice has received significant acceptance, for example in the form of the Pebble Project (The Center for Health Design). This project is an initiative by the Centre for Health which brought together 50 healthcare providers and manufacturers to help the advancement of EBD implementations (Ulrich et al. 2008).

2.3.2. Frameworks in the field of evidence-based design in healthcare

Despite the fragmented knowledge in EBD (Codinhoto et al. 2009a), frameworks have been developed as a result of literature reviews (Devlin and Arneill 2003; Huisman et al. 2012; Salonen et al. 2013b; Ulrich et al. 2008). Despite individual differences, main frameworks generally distinguish design stimuli, end-user outcomes and end-user groups. Ulrich et al. (2010) provided a comprehensive coverage of the knowledge in EBD (Figure 2.4) while other frameworks, for example by Codinhoto et al. (2009b) emphasised the interactions amongst design variables and end-user outcomes (Figure 2.3). A number of other frameworks focused on specific aspects of the designs such as light and colour by Tofle et al. (2003) and Dalke et al. (2004).

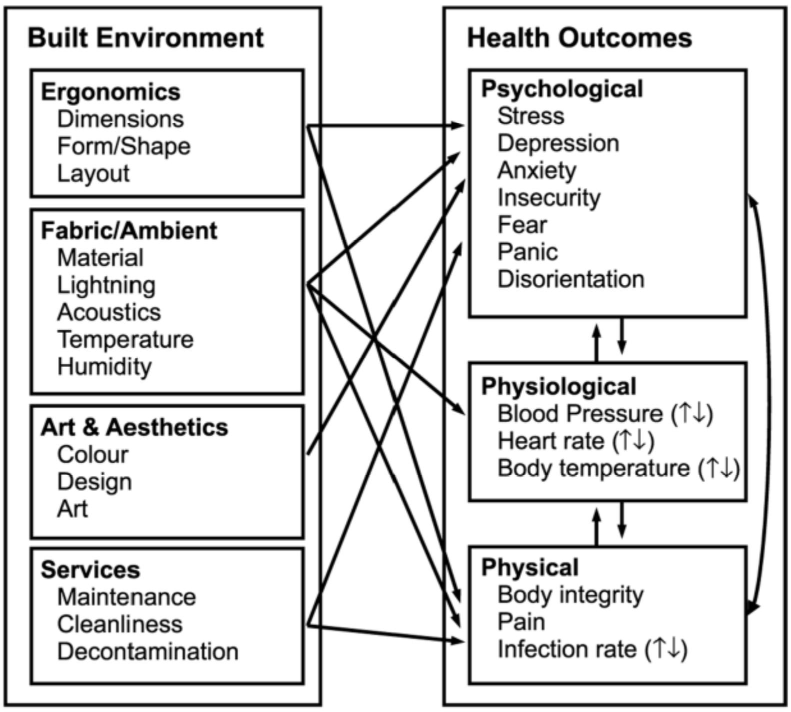


Figure 2.3: EBD framework by Codinhoto et al. (2009b)

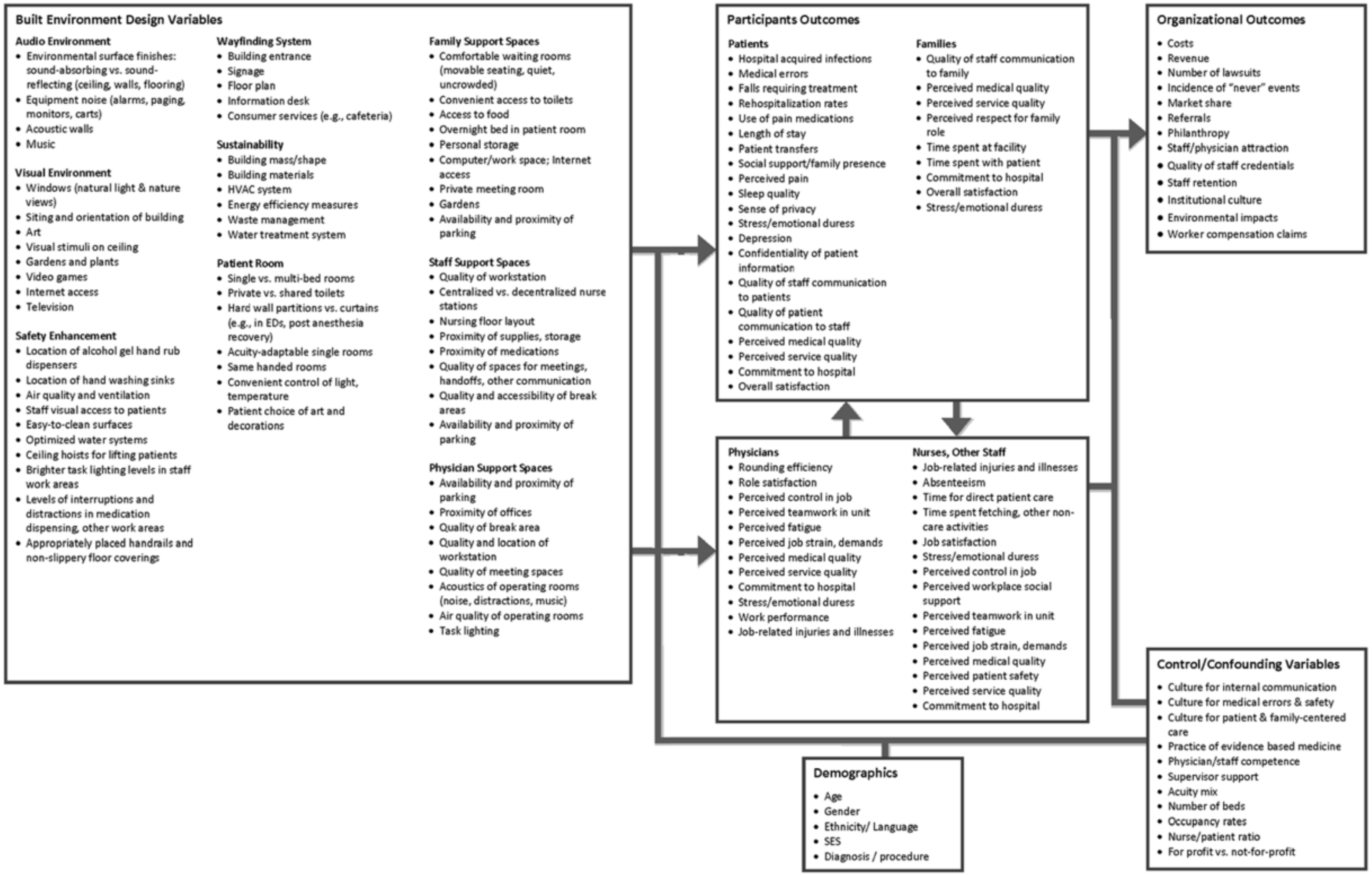


Figure 2.4: Conceptual framework for EBD by Ulrich et al. (2010)

Codinhoto et al. (2009b) differentiated four groups of design parameters Ergonomics, Fabric/Ambient, Art & Aesthetics and Services and outcomes in the form of physical, psychological and physiological measures. It could be argued that while the interactions are well-illustrated, the reflection of content in the area may not be exhaustive. The different frameworks appear to struggle with a trade-off between the demonstration of a comprehensive view of the area and the relationship amongst the variables. For instance, the framework by Ulrich et al. (2010) presents the most complete listing of existing knowledge in the area, however, may lack information about the interactions of the variables (Figure 2.4). Possible overlaps of effects and interactions between the different variables are not reflected by the illustration. From a practical viewpoint, the navigation through the large amount of content to extract the desirable knowledge may also be challenging. In another framework by Huisman et al. (2012), the tension between economic factors influencing building quality and the impact on end-users was added. The balance between these two parameters needs to be considered in practice, hence, has potentially more value in practical guidance instead of conceptual frameworks.

Research articles differentiated between the end-user main groups – patients, family (or visitor) and staff (Huisman et al. 2012; Ulrich et al. 2010). The majority of research focused on patient outcome and suggested that the design can impact on recovery state, length of hospitalisation, sleep quality, coping with pain amongst other measures (Beauchemin and Hays 1998; Stroebele and De Castro 2004; Ulrich et al. 2008). The general consensus is that changing the design of healthcare environments, with the patient in mind, can positively influence patient outcome (Ulrich 1984). Environment design can also have an impact on staff satisfaction and performance (Zimring et al. 2005). According to The Commission for Architecture and the Built Environment

(2005), 24% of all staff satisfaction rates are related to environmental factors such as comfort, air quality, temperature, noise, lighting and office layout. While this research focuses on patient and visitors, it is worth noting that a negative impact on staff can in turn affect the quality of care and the patient-staff relationship. For example, medication errors as a result of poor lighting condition can harm patient safety (Boyce et al. 2003). Patient safety including patient falls, infection control and medical errors has received much research attention (Ulrich et al. 2008). Design parameters including light, room occupancy and technical parameters such as ventilation, temperature and acoustics have shown conclusive evidence with regard to their impact on health and well-being (Salonen et al. 2013b; Ulrich et al. 2008).

Depending on the applied framework, the way design parameters as well as outcome measures were categorised can vary with usually no distinct boundaries between the groups. An example is the framework by Codinhoto et al. (2009b) shown in Figure 2.3 where the design parameters *shape* and *layout* were grouped under *Ergonomics.* However, they may also demonstrate aesthetics as well as functional properties. At the same time, different terminologies were used by different authors to label the groups of design parameters. The category *Interior* used by Dijkstra et al. (2006) and Ulrich (1991) include plants, seating arrangement, artwork amongst others which are grouped under *Ergonomics* or *Art/Aesthetics* by Codinhoto et al. (2009b). For clarity purposes, this research differentiates visual and non-visual design aspects based on the sensorial path they are perceived.

Non-visual design aspects include temperature, odour, acoustic/sound and tactile body senses. As mentioned earlier, temperature, ventilation and air quality are amongst the well-researched, non-visual design parameters, in particular with regard to their role in infection control (Chow and Yang 2004; Li et al. 2007; Ulrich et al. 2004; Ulrich et al.

2008). Research on acoustic in the form of noise, measured in decibel, is well-established with official guidelines available (Department of Health 2013b). However, not only sound level but also the quality of the overall *soundscape* can have an effect on end-user well-being in healthcare environments (Mackrill et al. 2013). Sound, in the form of music, has been reported to influence performance as well as health-related measures including anxiety, heart and respiratory rate (Körlin 2000; Staricoff et al. 2003). Design interventions using scents of orange and lavender in healthcare environments have been reported to affect anxiety, mood and the level of relaxation (Lehrner et al. 2005).

Visual aspects of the design include architectural features and interior design which Dijkstra et al. (2006) differentiated based on their degree of permanency. Architectural aspects were regarded as a more permanent aspect of the overall design compared to the interior design. A number of design aspects in both categories have been suggested to play a role in end-user health and well-being. For example, the layout of inpatient rooms has been well-researched (Chaudhury et al. 2005). Despite some disadvantages such as isolation, single occupancy rooms were considered superior over multiple occupancy rooms due to their high effectiveness in reducing infections. Various disciplines also reported conclusive and strong evidence for the impact of natural and artificial light on end-user health and well-being (Joseph 2006a). With regard to the less permanent aspect of the design, the majority of interior design parameters have not been well-researched despite their potential impact on well-being (Ulrich 1991). There is a lack of conclusive evidence on the relationship between interior design and end-user perception. Their potential benefits for end-users combined with the relatively inexpensive intervention make those design aspects highly relevant, especially in light of on-going cost containments in healthcare (Dijkstra et al. 2008b). The visual aspect of the design of healthcare environments has been overlooked by EBD and not included in hospitals' overall strategy (Caspari et al. 2006).

A number of conceptual frameworks were suggested as an attempt to establish the yet still emerging academic field of EBD (Ulrich et al. 2008). Further evidence is required to extend and validate existing frameworks which are fundamental as they can inform future research (Ulrich et al. 2008) However, due to the lack of consensus on conceptual frameworks in the area, its usefulness for future research is limited to some extent (Codinhoto et al. 2009a; Daykin et al. 2008). The widely dispersed knowledge that contributes to this area makes it difficult to gain on consensus (Codinhoto et al. 2009b). By applying different frameworks, researchers investigate the same phenomenon but under different assumptions which in turn produces further findings that cannot be easily compared.

2.3.3. Methods used to investigate end-user perception

A number of literature reviews reported a lack of studies showing methodological rigour in the area of EBD (Dijkstra et al. 2006; Huisman et al. 2012). Out of over 500 potentially relevant studies, Dijkstra et al. (2006) was only able to identify 30 papers that used controlled clinical trials. A similar result was reported in the review by Huisman et al. (2012) where less than 33 articles were considered as demonstrating good level of rigour.

This small amount of rigorous evidence may be a reflection of the multi-disciplinary nature of the area for which traditional evidence measure may not apply (Dijkstra et al. 2006). Another challenge may also lie within the difficulty of controlling the design parameters in healthcare environments. In outpatient facilities where the fluctuation of end-users arriving and leaving is greater, this challenge of controlling testing conditions might be even greater. Ulrich et al. (2008) explained that changing one design aspect could lead to the alteration of a number of other environmental aspects. For example, the conversion of a multiple occupancy room into one for single occupancy may not only change the bed capacity but also the ratio of hand-washing sinks per bed and ventilation systems. They suggested that certain design interventions including artwork and music would allow the control of testing conditions more easily. This may be argued that the size, content and the medium of the displayed artwork may also influence the perception of other design aspects such as space, lighting or colour contrast (De Kort et al. 2006).

Findings from design interventions that include multiple parameters generally support the notion that physical environments influence end-user outcome (Dijkstra et al. 2006). An example is the design intervention of the entire psychiatric ward where ceiling height, material and colour of flooring, layout and wall decorations were modified (Christenfeld et al. 1989). Patients showed a more positive self-image, increased satisfaction and the level of violence reduced by nearly a half. However, a number of measures were not affected including depression, isolation and irritability. The simultaneous modification of multiple design parameters does not allow for the allocation of the exact design-effect relationships. Consequently, the cause and mechanism for outcomes that were affected by the design as well as those that were unaffected are not well-understood.

In contrast to multiple-design studies, single-design interventions often lack the experimental rigour as the individual design parameter is often not truly controlled. Even in the most renowned study by Ulrich (1984) mentioned in Section 2.3.1, the positive outcomes of patients in rooms with window views to nature may be attributed to the effect of higher natural light instead of the views. The effect of individual design parameters needs to be understood separately, as well as their effect when considering them jointly in the real environment where they interact with other variables.

Most studies made use of data from hospital records, observational (natural) experiments, interviews or survey with self-reported measures (Dijkstra et al. 2006; Huisman et al. 2012). In a study comparing the effect of an attractive with an unattractive healthcare environment, Kasmar et al. (1968) found no difference in subjects' moods. They concluded that expressing moods verbally may be challenging and that the self-reported questionnaire may not be the suitable format to record this data. Efforts to reduce bias from subjective data were undertaken by triangulating them with physiological measures such as heart rate, blood pressure, and muscle tension amongst others (Ulrich et al. 1991; Leather et al. 2003). While increasing the rigour of the collected data, these mixed methods do not provide additional insight into subjects' rationale which is needed to gain a better understanding of their perceptions. As the perception of the environment is complex, data that provides a more complete view of end-user perspectives may be needed while reducing the reliance on purely qualitative measures.

In other research disciplines multivariate analyses were found to be widely used to investigate people's perceptions, especially since the advancement and availability of statistical programmes (Jolliffe 2002). In order to retrieve useful information from a large data set, researchers are often interested in extracting the main information and understanding the underlying structure. Amongst the most popular techniques is PCA which reduces the data set while retaining the main information. The technique was for example used to determine 680 outpatients' main perceptions of healthcare waiting areas (Tsai et al. 2007). The initial 15 items resulted in four main components reflecting that patients perceived the environment mainly based on visuals, acoustics, touch and cleanliness.

Another study investigated main user perceptions of factors that relate to the design of healthcare built-environments. From initially 16 questionnaire items, Mourshed and Zhao (2012) extracted three main themes related to the visual, non-visual and hygiene factors of the environment. PCA is also popular as a supporting technique to be used prior to another method. An example is provided by Bikker and Thompson (2006) where the nation's satisfaction with the healthcare services was investigated. In order to measure satisfaction, PCA was firstly used to determine the dimensions that were indicators of satisfaction from a data set containing secondary data of 3052 people. In other cases, PCA was used to investigate end-user perceptions of automobile sounds (Cain et al. 2013; Jennings et al. 2010).

Conjoint Analysis has been identified as another popular method to investigate buyer decision-making amongst academics research and industry (Green and Srinivasan 1978). Its popularity is mainly attributed to the capability to reveal the end-user perception of individual product or service features (Wittink and Cattin 1989). Conjoint Analysis originates from mathematical psychology (Luce and Tukey 1964) and assumes that people base their decisions on the value they place on each product (or service) characteristics. Increasingly, trends to replace verbal descriptions of the product and services by visual images in conjoint experiments have been observed (Green and Srinivasan 1990). Since visual methods are more suitable to test the aesthetic and visual dimension of the product (Page and Rosenbaum 1992), Conjoint Analysis combining visual stimuli are often used to test end-user perception of product appearance (Vriens et al. 1998). The study by Silayoi and Speece (2007) provided an example for the use of this technique to test the perception of food packaging. However, the method has not been widely applied to study the perception of interior or architectural space.

An attempt to study the perception of architectural objects using Conjoint Analysis was demonstrated by Fawcett et al. (2008) who used photographs of office buildings as shown in Figure 2.5. The type of roofs, wall material and architectural characteristics were used to assess the perception of architectural objects. Returning to the earlier discussion on the difficulty of controlling experimental conditions, this challenge may also apply to this example. It is questionable whether people have evaluated those three test parameters or whether they were influenced by other visible elements on the images. In Figure 2.5, the presence of trees (Images 1, 3), automobiles in front of the building (Image 2) or the light illuminating inside the building (Image 3) may represent potential biases to people's perceptions.

Flat/Traditional/Strong (1)

Flat/Non-traditional/Strong (2)

Flat/Traditional/Weak (3)

Figure 2.5: Examples of images used in Conjoint Analysis by Fawcett et al. (2008)

Overall, the use of mixed methods and learning from techniques used in other disciplines may provide a more complete view of end-user perceptions. Due to the multi-disciplinary nature of EBD in healthcare, the use of quantitative as well as qualitative evaluations will contribute to a better understanding of end-user perceptions (Staricoff 2006).

2.4. REFLECTION ON END-USER PERCEPTION, WAITING EXPERIENCE AND CURRENT KNOWLEDGE IN EVIDENCE-BASED DESIGN

A reflection on findings from the reviewed literature in this chapter is summarised below.

Research attention has been on inpatient and long-term facilities instead of outpatient care – Research has mainly focused on inpatient and long-term care which include those designed for sub-populations with special needs such as dementia. The design requirements of clinical areas are therefore better understood due to the traditional emphasis of healthcare facilities as treatment centres. As a consequence, areas with low or no clinical involvement have not been well-researched. In light of this lack of research as well as the growing role of the outpatient sector, the design of outpatient facilities requires more research attention.

Focus on functional, technical and operational design aspects and patient safety measures – Literature showed a considerable amount of evidence for the effect of functional, technical and operational design aspects on patient safety. Examples of these design aspects include the design of single and multiple-occupancy rooms, ventilation systems and the acoustic environment. Few non-technical aspects of the interior space have been well-researched apart from the effect of lighting which is amongst the best-understood design parameter in EBD.

End-user perceptions and the waiting experience – Waiting times and staff interactions are often used as indicators for end-user satisfactions. The design of healthcare waiting environments also needs to be considered as a potential indicator as it can impact the end-user experience and staff performance. Waiting forms an important part of the overall healthcare journey, thus, it is important to understand people's perception of the design in order to improve their experience. As healthcare facilities are no longer pure treatment centres and 'health' as defined by the WHO goes beyond the mere absence of illnesses, research needs to focus on end-user perceptual dimension of well-being in public spaces such as waiting environments.

Debates on perceptual processes remain unresolved – Perceptual processes are complex and debates about the order and interaction between emotive and cognitive processes remain unresolved. The majority of contemporary views are in favour of theories stating that cognition always takes place regardless of awareness. The focus shifted mainly to the aspect that cognition and emotion can influence each other rather than the previous debate on the order of their occurrence. While the psychological and philosophical debates are not in the centre of this research, they demonstrate the complexity of investigations related to end-user perceptions. Research should therefore consider this complexity when designing studies and making recommendations.

Characteristics and impact of healthcare architectural styles are not well-understood – The general consensus within the EBD community is to divert from an institutional appearance to provide a healing and patient-supportive environment. However, healthcare architecture styles with regard to their formal classification and effect on end-user perception are largely under-researched and not well-understood. Apart from some theoretical discussions e.g. on homeliness, no follow-up investigation can be found.

Growing evidence in EBD but lack of rigorous research – Despite the increasing amount of research in EBD, only a few rigorous studies with a high level of evidence were recorded by major literature reviews. This may result from methodological challenges to control design variables as well as the interdisciplinary nature of EBD for which traditional measure of evidence e.g. clinical trial may not be applicable.

Techniques from other disciplines to investigate end-user perception – The majority of studies within EBD use data from hospital records, surveys with self-reported measures and natural experiments. In order to reduce the bias of subjective measures, a number of research studies have incorporated objective, physiological measures in their experimental design. While this triangulation of methods strengthens the rigour of the findings, it does not add to a better understanding of end-user rational and perception of the design. Applied multivariate analyses were identified as popular and established techniques in psychology and social sciences. PCA and Conjoint Analysis in particular can help to gain a better understanding of end-user perceptions. Despite the wide application in academic research and industry, Conjoint Analysis has not been previously used to investigate end-user perception of healthcare interior spaces.

CHAPTER 3 – THE RELATIONSHIP BETWEEN THE DESIGN OF HEALTHCARE ENVIRONMENTS AND END-USERS

3.1. INTRODUCTION

This chapter discusses existing knowledge about the relationship between the design of healthcare environments and end-users. The discussion first focuses on the different design concepts in healthcare architecture, followed by interior aspects of the environments and their effect on end-users. The interior of healthcare environments are discussed with regard to their role in positive distraction, aesthetic dimension, patient safety and how they contribute to a clear understanding of the environment. The chapter concludes with reflections on current knowledge and resultant research opportunities.

3.2. DESIGN CONCEPTS IN HEALTHCARE BUILT-ENVIRONMENT

The appearance of built-environments can vary greatly depending on a number of factors including differing design process and the practitioner's individual style. Each organisation and project also may follow a different design process (Design Council 2007) while the process is not always clearly defined. Chan (1992) described individual style as the result of selected choice and the order of applied methods during the design process. Due to differences in the decision-making process, designers may therefore arrive at very different results.

The variation of existing appearances in healthcare settings is also attributed to the development and trends in healthcare architecture. Due to its clinical function, the development of healthcare architecture has always differed from the other architectural applications. In the 1970s and 1980s, the development and fast changing nature of technology dictated the functional and forced to be flexible way healthcare facilities were built (Devlin and Arneill 2003). Up until the 1990s, healthcare environments evolved into less stark and friendlier settings and those accommodating specific patient groups e.g. Dementia. However, Burton et al. (2011) suggested that there is still limited knowledge about built-environments that supports healthy ageing. Nowadays, the diverse landscape of healthcare architectural styles is a result of these past developments, combined with more recent construction and renovation activities.

Literature suggested that the appearance of healthcare environments can affect end-user experiences by evoking different emotions. Out of a large number of possible emotions involved, calming and non-stressful were reported to be desirable effects (Macnaughton et al. 2005). In order to reduce stress and promote a calming environment, various design interventions such as the inclusion of nature and garden have been suggested to be effective (Daykin et al. 2008; Dijkstra et al. 2008b). Unfamiliarity, limited or inability to control the environment as well as lack of information can cause stress and anxiety (Ulrich 1991). While the general consensus is to move away from the institutional style (Leather et al. 2003), the execution can be for example homely or inspired by hotels and shopping centres. The understanding of the term *institutional* and *non-institutional* can be ambiguous as they are often coined by decision-makers (Devlin and Arneill 2003; Lundgren 2000).

Homely Environment – The provision of a homely environment with a familiar atmosphere is recommended by literature (Marsden 2001) and has the purpose to foster positive outcomes (Imamoğlu and Imamoğlu 2006). In Europe, Maggie's centres have demonstrated pioneering work in providing cancer patients non-institutional, therapeutic and homely environments in recent years. Another example showing the dedication towards the creation of patient-supportive environment by applying EBD principles is the Planetree Model in the USA. In a controlled study, Devlin and Arneill (2003) compared a number of health outcomes between patients in a Planetree renovated unit compared to the control group. Their findings showed that patients in the Planetree renovated unit demonstrated improved general well-being, communication and responsiveness. However, no difference in length of stay between the two groups was captured. A tension between patient and staff response was also found in that staff felt that the variation of care they were able to provide was more limited. In a randomised controlled trial, Martin et al. (1998) reported higher patient satisfaction and health education in the Planetree adopted unit compared to the control unit. Patients' mental well-being was better than the control group after discharge. However, the effect appeared to level off after three to six months. This may suggest that the reported positive outcomes did not provide a long-term effect but were rather linked to hedonic well-being.

Being able to control the environment as well as the use of carpet has been suggested to influence the perception of a homely environment. According to Huisman et al. (2012), the use of carpet can create a comfortable, homely feel that diverts from the institutional style Enabling end-users to regulate the environments with for example the use of light and other adjustable features can also create a homely feel (Macnaughton et al. 2005). However, apart from these few examples, the execution of a non-institutional style in healthcare environments is largely based on intuition and experience rather than research evidence. Verderber (2000) noted that homely environment is an attitude rather than an exact design intervention.

The concept of providing a homely environment has informally been rather applied in specific healthcare specialities including maternity wards and long-term care. The term was used in studies focusing on the provision of a home-like child birth centre (Hardy and Ekbladh 1978; Klee 1986). Since family support plays an apparent role in childbirth clinics, the concept of a family-supportive environment appear more advanced compared to other specialties. The creation of a homelike environment in child-birth clinics also reflects the trend of homebirth while receiving professional medical support. Homely design in long-term care, nursing and residential homes, however, differ strongly in their focus and execution since the majority of end-users are elderly residents and many of them suffer from mental illness (Cooper et al. 2008; Rigby et al. 2010). While maternity wards mainly focuses on providing a family-supportive environment, long-term facilities focus on recreating an environment that allows them to have a normal daily routine. This reflects how the term homely can be executed in various ways depending on the context of the application. The term homely was for example found to be frequently used by end-users to describe a positive perception of the healthcare built-environment (Macnaughton et al. 2005). However, apart from a few theoretical discussions such as one by Kellett and Collins (2009), no attempt of investigating these results further in order to establish design guidelines can be found.

Hotel-like and shopping centres – Public spaces such as hotels and shopping centres influence the way people think about healthcare environments (Verderber 2000). Healthcare buildings in the style of these built-environments were therefore suggested to increase end-user level of comfort and familiarity (Nesmith 1995). In the late 1980s, healthcare facilities adopted atrium features as seen in modern malls and hotels. This trend was, however, short-lived due to the high associated costs (Verderber 2000). Macnaughton et al. (2005) compared healthcare facilities before and after the move to a newly created healthcare building that incorporated mall-inspired design and patient-centred care. Respondents reported associations of the mall-inspired area of the healthcare facility with other public spaces including airports and art galleries. However, the mall-inspired space with atrium feel has also led to confusions amongst end-users. Patients and staff were not confident about the function of the space and their expected behaviour within the space. For example, it was unclear to end-users whether or not they were allowed to eat or sit in those spaces. This demonstrates the complexity and tension in healthcare environments when diverting too much from the traditional concept of healthcare environments as a treatment centre. One of the reasons lies within the association people create with built-environments. Lay people in particular tend to use associations to describe built-environments as a way to express the meaning and interpretation of these spaces (Rapoport 1982). According to Arneill and Devlin (2002), people have a certain schemata of what a typical, institutional healthcare environment may look like.

There appears to be an incongruity between conceptual theories, execution of patient-centred care and the actual perception by end-users of the healthcare built-environments. For example, while people may associate a modern, technology-driven environment with better medical quality, the reassurance of being in the correct place and feeling homely are also important (Nesmith 1995). Other remaining tensions within healthcare architecture include the scale dimension, height, centralisation and compactness (Verderber 2000). For example, while a spacious environment is desirable, a large newly designed facility was perceived *'intimidating'* by end-users (Macnaughton et al. 2005). To a certain extent, this tension is a result of the lack of understanding about the characteristics of healthcare architectural styles and their effect on end-users. It should be noted that not many rigorous evaluations of their impact exist in the area despite the growing reputation of EBD and the incorporation of its principles in many healthcare buildings in the 1990s (Martin 1998).

3.3. DESIGN VARIABLES AND THEIR EFFECTS ON END-USERS

The various appearances in healthcare architecture are made up of combinations of individual design variables. Interior and ambient design parameters are often used to differentiate the styles from one another (Devlin and Arneill 2003; Staricoff 2004; Tofle et al. 2003; Ulrich et al. 2008). The lack of understanding the overall healthcare concepts as described in Section 3.2 may lie within the yet to be established knowledge on how individual design variables affect end-user outcome. This is attributed to the large number and inter-relationship amongst design parameters and end-user responses (Codinhoto et al. 2009b).

Interior parameters including furniture, seating arrangements, lighting, plants and artwork have been suggested to influence end-user health and well-being (Hathorn and Nanda 2008; Leather et al. 2003; Mizan 2004; Staricoff 2004; Ulrich 1991). The distinctive effect appears to arise not merely from the existence of the design parameter but from their specifications and combinations. Examples are material and type of furniture including leather seating or two-seater sofas, carpet flooring and decorative elements (Macnaughton et al. 2005). Those details are also suggested to be determinants for aesthetic response and a signal of true quality (Ulrich 2011) which may explain the different perceptions.

The following sections will review literatures on the effect of interior design with regard to the following aspects related to end-user health and well-being: Their role to positively divert people from a negative state, their aesthetic value and how they contributed to patient safety and end-user understanding of the space. These four aspects reflect the main themes in EBD based on reported evidence and theories in literature (Ulrich 1991; Ulrich et al. 2008).

3.3.1. Positive distraction to improve end-user health and well-being

Positive distraction refers to the property of the design to take people's mind off their anxiety by attracting their effortless attention, and as such create positive health outcome (Kaplan 1995; Ulrich 1992). Design attributes with the potential to create a positive distraction include TVs, artwork, plants, colour design and the style of the environment itself (Devlin and Arneill 2003; Staricoff 2004; Tofle et al. 2003; Ulrich et al. 2008).

Furniture – Dazkir and Read (2012) found that the curvilinear interior settings received better evaluations compared the rectilinear designs on a number of measurements as shown in Figure 3.1. Curvilinear settings were rated significantly more pleasant than rectilinear settings and were associated with relaxing and calming emotions.

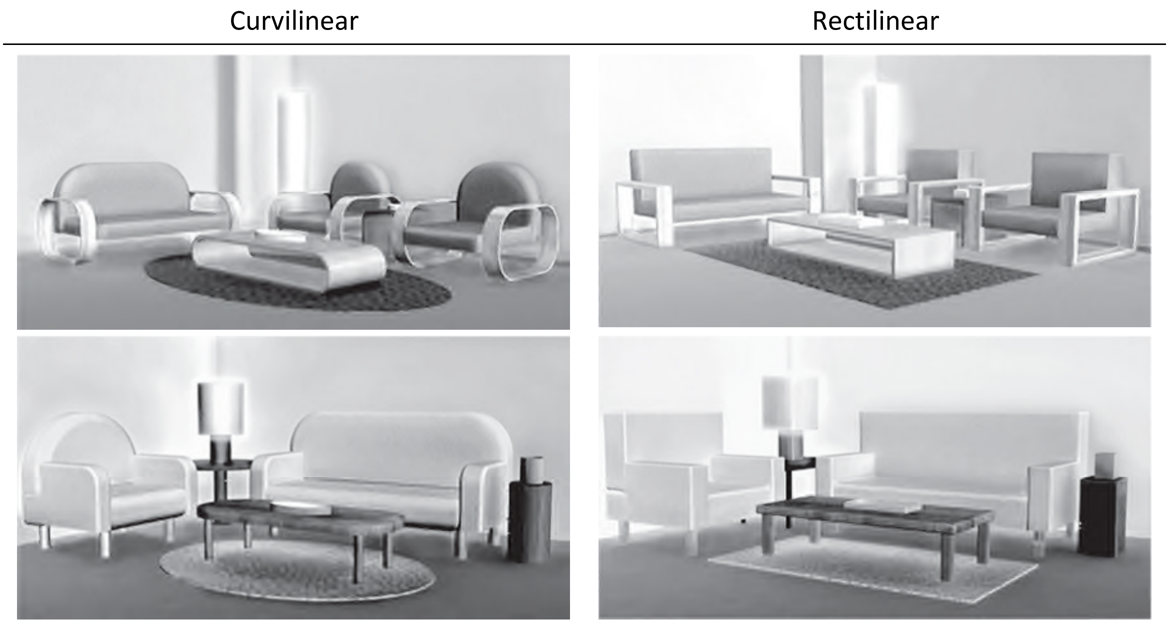


Figure 3.1: Curvilinear and rectilinear interior designs used as visual stimuli by Dazkir and Read (2012)

The reception area also plays an important role in a healthcare waiting area, especially with regards to the communication between staff and patients, hence, discussed in Section in 3.3.3.

The effect of light on health and well-being – The evidence for the positive impact of light on people's health and well-being is amongst the most conclusive and established in the area of EBD. Research investigated the impact of light on end-user outcome differentiate natural light and artificial light. While both light sources are used in interventions, the overall consensus is that natural light shows higher health benefits and is generally preferred by end-users (Joseph 2006a). As an example, the production of Vitamin D which depends on natural light and cannot yet be replaced by artificial lighting (McColl and Veitch 2001). In addition to the positive effects of natural lights on health and well-being, its usage is also at no cost and therefore the incorporation is recommended wherever possible (Joseph 2006a).

As part of a number of biochemical processes, light plays a vital role in controlling the human circadian system, affecting mood and perception as well as mediating important physiological processes in the body and most apparently, allowing visual performances (Boyce et al. 2003). These processes indicate that the impact of light is relevant for every human's health despite the strong focus of most studies in this area on the sub-population with mental health. Outcome measures related to light include depression, length of hospital stay, alertness, pain, sleep and mood (Joseph 2006a; Ulrich et al. 2004). Beauchemin and Hays (1996) compared the length of hospitalisation of patients with depressive symptoms in sunny and dull rooms. Subjects allocated in brighter rooms showed on average a hospital stay of 16.9 days compared to the control group who stayed in darker rooms with 19.5 days. This result equals a 15% (2.6 days) difference between the two groups. A slightly larger difference was found in a similar study by Benedetti et al. (2001) where a 3.67 days longer hospital stay was recorded for patients in darker rooms. The shortened length of stay recorded in these two studies also shows that light has the property to reduce depression, hence, has an impact on people's mental well-being. In a follow-on study, Beauchemin and Hays (1998) found higher mortality rates (11.6%) amongst patients in the darker rooms compared to those in brighter rooms (7.2%). In another study, La Garce (2002) observed that occupants with Alzheimer's disease showed 41% less disruptive behaviour in rooms with no light fluctuation compared to the control group under varying light intensity conditions. According to Walch et al. (2005), patients admitted into rooms with 46% brighter light intensity reported less stress perception and required 22% less pain medications per hour.

Windows and window views – In addition to the effect of lights, windows and views from windows have been reported to impact patients' length of stay and medication consumptions. In a retrospective survey, Keep et al. (1980) revealed that patients from a windowless room showed weaker cognitive ability to recall the hospital stay experience and suffered more from sleep and visual disturbance. While results provide strong evidence that there is a relationship between the design parameters and end-user outcome, it is unclear which design parameter causes the effect. It remains unclear whether the positive health outcomes were attributed to the effect of light, windows, window views or a combination of those factors. Dijkstra et al. (2006) explained this inconsistency as a result of methodological flaws. This may explain the inconsistent evidence for the potential impact of windows on mood found by Boyce et al. (2003). Kaplan (2001) concluded that many studies despite claiming to study the effect of windows, in fact investigated what impact viewing and interacting with nature may have on end-users.

Window views and nature – In a study comparing six different window views in residential homes Kaplan (2001) found that the content is highly relevant for subjects' satisfaction and well-being. These measures were found to be influenced by the views of nature while the view of buildings was only associated with satisfaction measures. The presence of trees in residential neighbourhood was found to be valued by residents (Schroeder et al. 2006). Schroeder et al. (2006) also found that there was no difference between participants from the UK and the USA which may relate to the discussion on innate affinity towards nature in Section 3.3.2.

In healthcare settings, research has also indicated that the sight of nature can have several positive impacts on health such as improved recovery and reduced pain medication requirements (Ulrich 1979, 1981; Ulrich 1984). The positive health outcome was suggested to relate to the stress-reducing, restorative property of nature (Kaplan 1995; Hartig et al. 2003) which might explain people's affinity towards nature (Van den Berg et al. 2007). However, Coles et al. (2013) pointed out that while the generally positive views on nature might be shared, individual differences can play a role in the way people perceived and interacted with nature.

Kaplan (2001) suggested that studies focusing on subjects being in a natural environment differ from investigation of natural window views in that the interaction duration is longer. It was suggested that this effect can be compensated by exposing the subjects to the natural view in repeated events. The experience of being in a natural environment involves multiple sensory inputs while viewing nature through a window only involves visual stimuli. Studies, therefore, also investigated the relationship between the presence of indoor plants in healthcare environments and its effect on end-users. Bringslimark et al. (2009) established that there is strong evidence supporting the positive impact of indoor plants in built-environments on health and well-being. Outcomes include various measures of emotional and cognitive states as well as pain perception and performance. Dijkstra et al. (2008b) tested patients' perception of images showing hospital rooms containing either indoor plants or a painting of urban scenes on the wall. In line with theorised restorative and stress-reducing effect of nature, they found a lower perceived stress level amongst people viewing images with indoor plants. Aesthetics was also found to be the mediating factor explaining why people perceived nature to be less stressful.

Artwork and the representation of nature – Natural elements can be incorporated into healthcare indoor spaces by using window views, artwork and digital technologies. As window views may be dictated by the facilities' location, the other mentioned alternatives may allow more opportunities for intervention. An example is a study by Ulrich et al. (2003) where views of nature were shown on TV screens to investigate their effects on patients while waiting at a blood donor facility. In an earlier study, Ulrich et al. (1991) also tested the effect of videotapes showing natural and urban scenes on patients. Based on a number of physiological measures such as heart rate and muscle tensions, it was concluded that patients exposed to the videotapes with nature showed an improved recovery. However, both studies pointed out that the inability to control the TV might have increased the level of stress as opposed to be a positive distraction. In support of the possible negative effect of TVs, blood donors were reported to show higher stress levels on the days when the TV was on compared to days where it was turned off (Ulrich 1992). However, neither of the studies contributed to the understanding of to what extent the display medium of nature might play a role in mediating or delivering the positive effects on patients.

De Kort et al. (2006) investigated the relationship between the level of immersion of stimuli and its restorative effect on people. They conclude that the level of immersion has an effect on physiological measures such as heart rate and skin conductance level, hence, enhances restorative potential. However, the effect was not reflected in self-reported measures and may influence the experiential aspect of outcome. Jaeger et al. (2001) supported the relevance of immersion for perceptions by suggesting that the degree of realism in a product representation influences people's decision-making.

The role of arts on end-user health and well-being – In a comprehensive review, Staricoff (2004) revealed a large body of evidence (385 medical articles) supporting the notion that visual and performance arts impact health and well-being. The main benefits for patients include the reduction of medication intake and length of stay as well as improvement of patient-staff relationship, mental health and clinical outcomes. Nearly half of all hospitals in the USA apply artwork interventions to their facilities (Hathorn and Nanda 2008). There are, however, views that the knowledge on artwork with regard to EBD is rather limited and their selection as an intervention needs to be research-based (Ulrich and Gilpin (2003) cited in Huisman et al. (2012)).

In a randomised controlled trial, Diette et al. (2003) tested the effect of paintings and sounds with natural elements to patients before, during and after their bronchoscopy operation. Patients with the intervention had significantly higher pain control but showed no difference in reported anxiety compared to the control group. With regard to the content of displayed visual arts, those showing realistic scenes of landscape and nature, also called representational art, are suggested to be better perceived than other styles. Ulrich (1992) found that post-operative patients who were exposed to images with nature and water features showed the lowest anxiety, followed by those without any artwork interventions and abstract artwork. The implementation of abstract arts resulted in higher anxiety levels compared to the control group with no intervention which indicates that certain content and type of art interventions may also cause negative distractions.

The idea of positive health benefits mediated by views of representation of the natural environment is supported and consistent with theories on restorative potential of nature (Hartig et al. 2003). However, Yamada (2009) found that the preference of representational and abstract art was related to people's cognitive ability to verbalise the reasons for their like and dislike. The author revealed that people who were able to express themselves verbally found it easier to explain why they prefer representational or abstract art regardless of the true preference. The implication of this finding is that abstract artwork is more difficult to describe, hence the verbally stated preference of representational arts may require careful interpretation with regard to its real effect on people. There is also the notion that it is not the information of the view content but its aesthetics and that beauty is relevant for preference and perceived well-being (Kaplan 2001) which is in line with findings by Dijkstra et al. (2008b).

3.3.2. Perception of visual aesthetics in design

Evolutionary based theories – Aesthetics and human perceptions were famously discussed by 18th century philosophers Immanuel Kant and David Hume (Dutton 2003). In the centre of focus were the debates on the objectivity of aesthetical perception and whether judgement was made based on context or the existence of universal beauty. The contemporary view amongst evolution psychologists is that the human's mind and its aesthetical perceptions are adaptable despite certain innate predispositions (Dutton 2003).

Despite individual and cultural differences the concept of universal beauty is based on the theory that humans share evolution-based characteristics. Biophilia theory, firstly hypothesised by Wilson (1984), suggests that humans have a genetically-embedded affinity towards nature and living organisms (Kahn Jr 1997). Aesthetics is also suggested to have the property to enhance affective responses (Mehrabian 1974; Schellekens and Goldie 2011). Positive outcomes as a result of design interventions involving nature, indoor plants, representational arts or light in healthcare environments are examples supporting this theory (Boyce et al. 2003; Ulrich et al. 1991). As previously discussed, Dijkstra et al. (2008b) found a three-way relationship between nature, aesthetics and the positive outcome on subjects. They found that indoor plants have created an aesthetically pleasing environment which in turn led to desirable outcomes. Attractive healthcare environments were therefore concluded to have the potential to enhance healing. Dijkstra et al. (2008b) noted that the concept of universal beauty may be limited to design interventions involving nature and not applicable to other design parameters due to varying preferences. Related to the lack of knowledge about style classifications as discussed in Section 3.2, research on aesthetics in healthcare environment is also limited. One of the few investigations on aesthetics in healthcare environments was conducted by Caspari et al. (2006) who identified 11 items to assess aesthetics. Visual and non-visual indicators were amongst these 11 items with visual aspects reflecting interior design parameters such as nature, light, artwork and colours.

Studies on aesthetics and end-user perceptions – In an early study, Kasmar et al. (1968) compared the perceptions on two aesthetically differing psychiatric facilities which they called *beautiful* and *ugly*. The two identically sized rooms differed in their tidiness and décor specifications including flooring, wall art decoration, indoor plant, lighting and waste basket. They found a significant difference in the aesthetic evaluation and room size perception. The less attractive room was also perceived smaller. Self-reported mood and staff evaluation were not significantly different for the two aesthetically differing room designs. This lack of significant difference was, however, suggested to be methodologically-related and depends on subjects' individual differences.

Becker and Douglass (2008) investigated end-user perceptions and experience of six outpatient facilities, three attractive and three non-attractive ones. The attractive environments showed higher satisfaction, reduced anxiety amongst patients as well as better perceptions of quality and staff interaction. However, it remains unclear whether the indoor plant, wooden wastebasket, contemporary desk light or other factors were responsible for the more attractive perceptions. While both mentioned studies showed the general potential of aesthetics in healthcare environments, their inclusion of multiple design parameters do not allow the allocation of design - effect relationship. In addition, Becker and Douglass (2008) included the gynaecology, dermatology and gastroenterology practices in the study design. Differences related specifically to each speciality such as functionality and purpose of the space may intervene with the measure of aesthetic dimension.

Research has also investigated how the attractiveness of single design parameters such as flooring, colour and lighting affect end-user perception. The appearance of flooring is important for visual perceptions due to its large space coverage (Nanda et al. 2012b) and with carpet often referred to as comfortable and aesthetically pleasing (Salonen et al. 2013b). Evidence for the effects of colour on health and well-being remains inconclusive. From their comprehensive literature review, Tofle et al. (2003) concluded that colours themselves do not have the property to impact on health and well-being. Literature suggested colour and light to influence end-user perception and have a number of effects on their psychological and physiological well-being (Dalke et al.

2005). Joseph (2006a) noted that natural light enhances colour quality, thus, the visual appearance of the space.

Aesthetics & Quality – Aesthetics are also suggested to be an important indicator of *true* quality according to Ulrich (2011). He suggested that aesthetic responses occur within the first 100 seconds of interacting with the environment which creates a lasting impression. The aesthetics of handmade axes in ancient times is hypothesised to link with the perception of male fitness in the natural selection (Mithen (2003) cited by Ulrich (2011)). This appears to apply to the perceptions of healthcare environments based on the following examples. Swan et al. (2003) compared two aesthetically opposing healthcare environments and found that patients perceived the quality of service and personnel in the attractive setting to be more positive. Patients who rated them positively were also more likely to use the service again or to recommend it to individuals from their network. The attractive space was also related to better ratings of physicians and nurses, however, with no statistical significance for ratings of nurses. In the previously mentioned study by Kasmar et al. (1968), the positive perception of medical staff associated with a more aesthetically pleasing environment was also not confirmed.

Despite the suggested health and cost benefit associated with the design of healthcare environments, the aesthetic dimension remains neglected (Caspari et al. 2006). In a survey of 64 Norwegian hospitals and an expert interview study, it was found that aesthetics were not part of the formal strategy in healthcare settings which represents a missed opportunity (Caspari et al. 2006, 2011).

3.3.3. Understanding and having control over the environment

Studies have shown that the inability to influence or engage with the environment is a major aspect of stress in healthcare environments which can affect well-being (Ulrich 1991; Ulrich 1992). Giving end-users control over the environment lies within the fundamental concept of patient-centred care (Devlin and Arneill 2003; Ulrich 1992). This principle was also suggested to be the driving force for a home-like design in healthcare environments (Dovey 1985).

Creating spaces that end-users can influence was a way of responding to the challenge arising in the 1990s that no single design solution can accommodate multiple end-user groups' requirements. Design interventions mainly focussed on enabling end-users to adjust the temperature, ventilation, lighting, windows, ergonomics of furniture and entertainment (Huisman et al. 2012). Apart from reducing contamination effectively, single occupancy rooms also allow greater control and personalisation due to the defined space (Ulrich et al. 2008). Limitations for personalisation may apply to clinical and patient areas due to infection control specifications. In healthcare waiting environments where safety limitations for design interventions may be lower, challenges arise from accommodating multiple end-user groups in a shared space. For example, the inability to control specific aspects of the TV in healthcare waiting rooms can turn the positive effect of the design intervention into a negative outcome as mentioned in Section 3.3.1 (Ulrich 1992; Ulrich et al. 2003).

Privacy and Communication – According to Huisman et al. (2012), privacy is part of being in control over the environment which further explains the advantage of single occupancy rooms. The design of healthcare environments can dictate how frequent and severe privacy issues may occur (Mlinek and Pierce 1997). In shared spaces such as healthcare waiting environments, spatial dimension, the arrangement or form of seats and reception can play a role in the provision of privacy. The majority of issues relate to conversations being overheard during the interactions by the reception area (Rice et al. 2008). Design guidelines such as HBN 40: Public Areas provide directions for the specifications of reception desks and areas (NHS Estates 1995). Recommendations include for example the visibility of the reception desk from the entrance and its accessible height for people in wheelchairs. Public spaces including healthcare waiting environments often face the challenge of privacy issues. In a study at the emergency department, over half of all patients (53%) reported the lack of confidentiality in the waiting areas (Mlinek and Pierce 1997). The authors recommended the application of background music or incorporating partition walls was a way to improve privacy during interactions by the reception. While music can positively impact end-users' health and well-being (Staricoff et al. 2003) the inclusion of background music may also introduce new challenges such as their volume and genre. In healthcare waiting areas, people need to be able to hear announcements clearly and acoustics must comply with official guidelines set by the Department of Health (2013b).

Crowding in public spaces was suggested to affect end-users negatively due to the desire of personal space (McClelland and Auslander 1978; Yildirim and Akalin-Baskaya 2007). Literature suggests that privacy is needed not only for patients but also for their families and visitors, especially in facilities such as maternity wards where patients are typically accompanied (Douglas and Douglas 2004). Seating arrangements were suggested to influence end-user social behaviour and interactions (Holahan and Saegert 1973). Patients showed a significantly higher level of social and personal interactions in *sociopetal* and mixed arrangements compared to *sociofugal* or unstructured arrangements. The relationship between the design and social behaviour was also tested in another study where subjects were asked to maintain letter correspondence in different lighting and interior conditions (Gifford, 1988). It was found that both factors had an impact upon the level of social interaction. Home-like interior increased the intimacy of the communication as opposed to office-style décor. Bright light encouraged general conversation while this is reduced in dimmed light conditions. In contrast to the author's hypothesis, written communications declined in both lighting conditions over time.

Orientation – Navigating through a complex, unfamiliar healthcare facility can lead to (perceived) loss of control over the environment which in turn can result in stress (Baskaya et al. 2004). Established guidelines under the broad topic of *wayfinding* are available to inform healthcare providers and practitioners in this regard (NHS Estates 2005). The use of colour contrast has been suggested to emphasise a destination or to differentiate areas and departments from one another. Devlin and Arneill (2003) raised the issue that despite the known problem for people suffering from colour blindness, the use of colour coding for orientation is widely spread.

3.3.4. Interior design and patient safety

As mentioned in Section 2.3.2, patient safety aspects such as infection control and medical errors are amongst the most researched end-user outcomes in the area of EBD (Ulrich et al. 2008). These outcomes have been associated to a number of technical and functional aspects of the design including air quality, temperature, noise, dampness and building conditions (Cooper et al. 2008; Salonen et al. 2013b; Ulrich et al. 2008). This section reviews the relationship between the interior design of the environment with regard to patient safety.

Despite the healing potential of indoor plants as outlined in Section 3.3.1, research strongly focused on their risk of infection even though evidence for contaminations through soil and water remains inconclusive (Dijkstra et al. 2008b). Flooring materials, curtains and furniture covers may affect end-user perception but are also subjected to regulations of infection control. As an example, the Centers for Disease Control and Prevention (CDC) recommend healthcare facilities to follow specific cleaning instructions to reduce or prevent the airborne contamination through the use of carpet (Sehulster et al. 2004). The use of carpet may also be limited to areas where spillage is unlikely to occur. Overall, carpet was suggested to be more preferred over vinyl composite tiles (VCT) due to the perceived comfort, reduced noise and patient falls (Harris 2000; Hignett and Masud 2006; Ulrich 2001). One major drawback is that carpet nurtures the existence and the growth of infectious micro-organisms (Joseph 2006b; Skoutelis et al. 1994), hence, more difficult to clean and disinfect than VCT. Another reported disadvantage of carpet was the difficulty to push wheelchairs and other wheeling transportations (Joseph 2006b). Research has also compared the advantages and disadvantages of fabric and vinyl covers for healthcare furniture. Noskin et al. (2000) investigated the survival of micro-organisms on seats covered by fabrics and vinyl material and reported that both showed contamination and can be transferred onto hands. However, micro-organisms on vinyl-covered chairs can be removed by standard disinfectants as opposed to fabric covers. Since carpet is perceived more comfortable, this may also apply to the perception of fabric seat covers. Ergonomic factors were also reported to affect the health and well-being of end-users in healthcare environment, for example armrests enable patients to push themselves out of chairs. The arrangement of furniture was found to affect staff performance which in turn can harm patient safety (Malone and Dellinger 2011).

Medical errors as a measure of patient safety can occur as the consequence of lighting conditions (Boyce et al. 2003). Buchanan et al. (1991) examined the impact of three illumination levels between 450 and 1500 lux on pharmacists' prescription errors in an outpatient facility. The authors found the highest medication errors (3.8%) occurring at the lowest illumination (450 lux) and least error was made (2.6%) when applying 1500 lux. In line with these results, Booker and Roseman (1995) revealed a seasonal effect of medication errors with a 58% rise during winter seasons where less daylight was exposed. The rate was found nearly twice as high in December compared to September. Perceived level of brightness can also affect the staff's mood which in turn can impact upon their motivation, attention and quality of delivered care (Küller et al. 2006).

Overall, literature shows that the relationship between built-environments and infection control becomes increasingly established with a strong focus on the functional aspects of the design (Ulrich et al. 2008). Within interior design, research has primarily investigated the effect of lighting and materials on patient safety. While literature has mainly focused on physical measures of patient safety, the perceived dimension of safety may contribute to the overall perception and experience of healthcare.

3.4. DESIGN GUIDELINES ON HEALTHCARE DESIGN

Design guidelines can stem from several sources including official bodies and authorities such as the NHS and the Department of Health (DH), researchers and design practitioners. Figure 3.2 provides a simplified overview of both the content types and sources of guidelines.

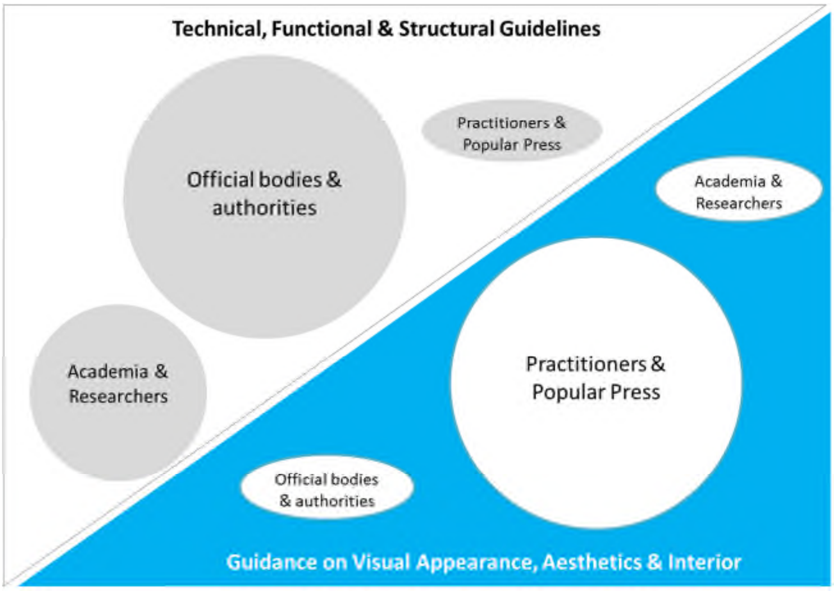


Figure 3.2: Map of guidelines sources by the type of content

A vast amount of design guidelines on technical, functional and structural aspects of the design are based on research, hence, published by official authorities and the academic communities. Due to the research-based nature, they reflect to some extent the available, established knowledge in the area of EBD. The DH and NHS Estates provide a compilation of guidelines in the form of Health Building Notes (HBN) and Health Technical Memoranda (HTM) (NHS Estates and Facilities 2013; Department of Health 2013a). HBN represent a compilation of best practices in healthcare design that seek to inform stakeholders of the planning and design process as well as for refurbishment projects. The definition of best practice often relates to the cost effectiveness of design interventions arrived from benchmark exercises. According to the National Institute for Health and Care Excellence (2010) cost effectiveness is the expression of how much quality-adjusted life years were achieved through the investment spent on interventions. HBN cover guidance for specific healthcare typology (e.g. HBN 01-01: Cardiac facilities or HBN 04-01: Adult in-patient facilities), an aspect of the design (e.g. HBN 00-10: Flooring, walls and ceilings) and infection control (e.g. HBN 00-09: Infection

Control in the healthcare environment). HTM on the other hand provide technical specifications for standards that apply specifically to healthcare constructions to which healthcare providers are obligated to comply. Examples include fire safety standards and infection control specifications such as HTM 05-01: Managing healthcare fire safety and HTM 01-05: Decontamination in primary care dental practices. Official bodies at international level also provide overall or country-specific guidelines such as infection control guidance from the CDC.

Another source of evidence-based recommendations that may or may not become official guidelines stems from researchers. A number of comprehensive reviews also provide a compilation of findings in the format of design guidelines including multiple design parameters (Salonen et al. 2013a; Ulrich et al. 2008). Reflective of research focus on particular aspects of the design, populations or outcomes, guidelines for these specific aspects have been produced. Examples for the focus on particular design aspects include those regarding room occupancy type (Chaudhury et al. 2005), *wayfinding* (Baskaya et al. 2004), flooring (Nanda et al. 2012b), artwork (Hathorn and Nanda 2008) and light (Boyce et al. 2003; Joseph 2006a). Guidelines for specific sub-groups of end-users or types of outcome include those for dementia (Zeisel et al. 2003) or to reduce stress (Dijkstra et al. 2008b) and infection by means of thermal control (Brager and de Dear 1998), ventilation systems (Li et al. 2007).

Design recommendations from practitioners tend to be guided by their intuitions and experiences rather than on empirical evidence. Guidance on the aesthetics and interior dimension of the healthcare environment in particular are pre-dominantly available on non-academic platforms such as websites from designers and design associations, whitepapers and the mass media. While efforts of transferring research knowledge to the wider public have taken place (Devlin and Arneill 2003), research-based recommendations to replace decentralised, subjective recommendations by practitioners would contribute to further development of EBD.

3.5. REFLECTION ON THE RELATIONSHIP BETWEEN DESIGN AND END-USER

Overall, reviewed literature showed that it is challenging to investigate the relationship between the design and end-user perception. The two main reasons appear to be the large number of variables involved which in turn contributes to methodological challenges of measuring perceptual responses. The main findings are summarised below.

Unclear relationship between design parameters and end-user outcome – Despite the increasing body of evidence suggesting a relationship between the built-environment and end-user outcomes, the exact cause-effect relationship remains unclear (Codinhoto et al. 2009b). The complexity lies within a large number of design variables existing in the built-environment as well as the amount of possible end-user responses. The majority of design interventions alter multiple parameters simultaneously so that the effect of individual design parameters remains unknown. Single design parameter interventions on the other hand often fail to control or consider the effect of other untested variables in the environment.

Affinity towards nature and aesthetics – Design interventions that involve light, a window view of nature, representational artwork and indoor plants have been suggested to benefit health and well-being. This may relate to end-user perception of design aesthetics which in turn can influence their perception of quality. Evolution-based theories such as *biophilia* suggest that people have an innate affinity towards design appearances that relate or reflect living forms and nature.

Guidelines – A large number of research-based guidelines focus on technical, functional and structural aspects of the design such as ventilation, air quality and temperature amongst others. Their dominance reflects the amount of established evidence in the area of infection control and patient safety. Due to the lack of focus on OHCWEs and the visual dimension of the interior space, the number of specific guidelines for this type of facility and design aspect is limited. Research may also produce results that cannot be easily compiled into design guidance that are practical and useful to practitioners. With regard to the visual appearance of healthcare environments, design recommendations are produced by non-academic press and based on experience or intuition rather than research evidence.

Learning from consumer-oriented industries – Other industries are superior in their knowledge and practice of using design to differentiate themselves from competitors and apply the built-environment as part of their overall service provision. Due to the less competitive tradition of the healthcare sector in the UK in the past, healthcare providers are less advanced with regard to adopting user-focus approach and providing an overall experience. With legislative changes in place, healthcare needs to become more competitive, especially since competitiveness was suggested to improve performance in the healthcare sector (Cooper et al. 2011). Limitation to possible transferable knowledge from other disciplines will apply due to the various core function of each built-environment.

3.6. RESEARCH OPPORTUNITY

Concluding from literature reviewed in this chapter as well Chapter 2, the main research opportunities have been identified as shown in Figure 3.3.

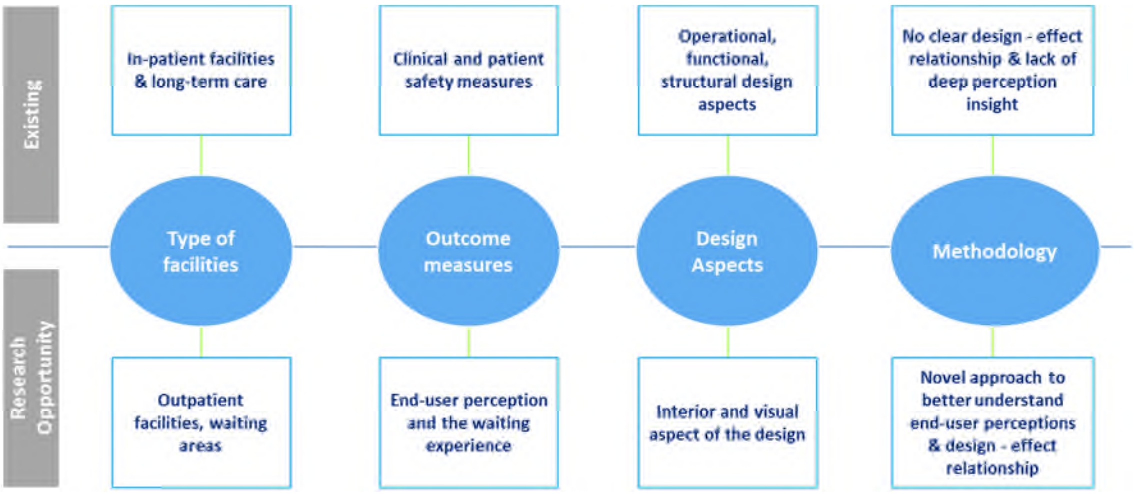


Figure 3.3: Overview of existing knowledge and research opportunities

Waiting room and waiting experience – Literature lacks the focus on OHCWEs design and its effect on the waiting experience. This relationship is not well-understood as a result of the attention on clinical outcomes and operational or technical design measures. However, waiting forms an important part of the overall healthcare journey and outpatient care becomes increasingly important in the healthcare provision infrastructure. Understanding how the relationship between the design of OHCWEs and end-user perception therefore can help to improve the healthcare experience.

Visual dimension of the design – The visual dimension of the design and their potential effect on end-user perception is not well-understood. No formal classification exists for the various healthcare architectural concepts which partially explained this lack of knowledge. This understanding can be, however, of potential value as they have been suggested to contribute to end-user wellbeing and can be easily implemented at low cost.

Design variables and end-user perception – Due to the complex relationship between design variables and end-user outcome, there is a lack in understanding of the exact design-effect relationship, their interactions and main effects. Outcomes can be a result of multiple design factors while a number of outcomes may be interchangeable, not of equal importance or differ in their effect size and priority. The complex relationship between design parameters and end-user perception needs to be simplified in order to identify main interactions amongst the variables. This will allow a focus on specific aspects of the design to achieve design interventions with higher impact. Studying individual design parameters and their interactions may also contribute to an improved understanding of healthcare architectural styles and their effect on end-user perception. With the majority of rigorous studies focusing on patient safety, there is a need to focus on end-user perceptual dimensions.

Methodology to study end-user perception of healthcare environments – Current approaches using self-reported measures and observational studies show a strong reliance on subjective measures. A number of rigorous studies combined subjective measures with physiological measures. This combination of methods increased the rigour through methodological triangulation, however, does not provide a deeper insight into end-user perception and their rationale. Understanding the contribution and effect of individual design parameters on end-users appeared to present another methodological challenge. This is because design interventions either vary multiple aspects simultaneously or test a single parameter but lack the control of untested variables. Comparing the effect of single design interventions can also be challenging if they are case-specific and tested in isolation.

From these two challenges, it can be concluded that there is a potential value in developing novel approaches to investigate end-user perceptions of the design of OHCWEs. Mixed methods approaches that incorporate learning from other disciplines such as consumer research may offer a more complete view of end-user perception while reducing weaknesses of traditional methods.

3.6.1. Research question and objectives

As a result of the literature review and the identified research opportunities, the research question and main objectives are summarised as follows:

'What is the relationship between the design of outpatient healthcare waiting environments (OHCWEs) and end-user perception?'

Objective 1 – To understand end-user perceptions with regard to the language used to describe their experiences, preferences and interactions with the design of OHCWEs (Study 1).

Objective 2 – To establish measures (Study 2a) and a theoretical foundation (Study 2b) as a platform to assess design attributes.

Objective 3 – To evaluate the relative importance of design attributes on end-user main perceptions of the design of OHCWEs (Study 3).

CHAPTER 4 – RESEARCH METHODOLOGY

4.1. INTRODUCTION

Chapter 2 revealed a need to investigate the relationship between the design of OHCWEs and end-user perception as well as the lack of a systematic approach to address this research inquiry. A mixed methods approach was therefore designed to address the different aspects of the research question. This chapter introduces the overall research methodology and explains the rationale for selecting a mixed methods research design. The overall research question was divided into sub-objectives which were addressed in four studies with different methodological approaches. The chapter further addresses points related to the experimental conditions, trustworthiness and practical considerations.

4.2. THEORETICAL FRAMEWORK UNDERPINNING THE RESEARCH

As mentioned in Section 1.3.1, this research aimed to understand the relationship between the design of OHCWEs and end-user perception. The concept that physical environments, such as healthcare waiting environments can affect its occupants' health and well-being is embodied in the fundamentals of two established disciplines: (i) architecture/design and (ii) health sciences. This places the research within the emerging field of EBD whose theories and practices, in healthcare environments, underpin the rationale and approach of this research. Main conceptual frameworks in the area of EBD are reflected through the work by Ulrich et al. (2010) and Codinhoto et al. (2009b). As shown in Figure 2.4, Ulrich et al. (2010) included nine groups of design variables and multiple end-user groups where design variables can affect multiple or specific end-user groups in different manners. Another approach is provided by Codinhoto et al. (2009b) with emphasis on the interactions between several design categories and three groups of health outcome psychological, physiological and physical. For a detailed review on conceptual frameworks, refer to Section 2.3.2. Theories and practices of EBD appear to stem from environmental psychology (Codinhoto et al. 2009b) which is a field focusing on the relationship between human and the socio-physical environment (Canter and Craik 1981; Mehrabian 1974). Mehrabian (1974) pointed out that a conceptual framework in environmental psychology provides information on the major variables that occur in most situations and which ones need to be controlled or investigated. Since EBD is an emerging field, further research will continue to contribute to the theoretical framework (Ulrich et al. 2010).

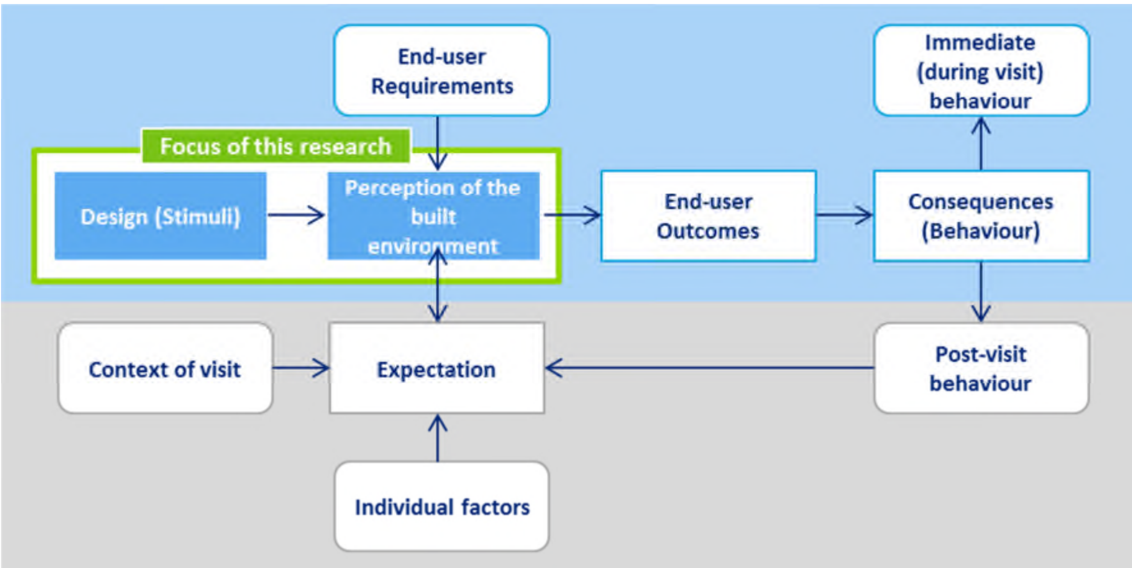


Figure 4.1: Framework to illustrate the position of this research within the multi-disciplinary space of EBD and related areas. *Adapted from* Fottler et al. (2000) and Levitt (1981)

Due to the multi-disciplinary nature of the research area, theories and methods were also drawn and adapted from adjacent fields of such as engineering, design research, business consumer research, health and social sciences. Figure 4.1 illustrates where this research sits within EBD and the larger space of related multidisciplinary areas.

4.3. RATIONALE FOR SELECTING A MIXED METHODS RESEARCH DESIGN

A mixed methods approach (Figure 4.2) was selected as its application will lead to answers in quantitative and qualitative manner (Teddlie and Tashakkori 2009). Both types of outcome are required to address the exploratory and confirmatory nature of the sub-objectives. Johnson and Onwuegbuzie (2004) defined mixed methods research as the combination of quantitative and qualitative techniques into a single study. Potential weaknesses of single methods may be reduced or be complemented by the other method when using mixed methods. This also represents the fundamentals of the application of methodological triangulation in order to increase the rigour of findings (Morse 1991). Johnson and Onwuegbuzie (2004) concluded that the application of mixed methods often leads to *superior* outcome compared to those with single methods.

Despite the given advantages, similar to single methods the application of mixed methods research also presents its own set of challenges. From practical considerations, increasing time and cost may present a possible issue as the skills of multiple methods may need to be acquired (Johnson and Onwuegbuzie 2004). Only with the knowledge of multiple methods, individual researchers would be able to decide on their appropriate integrations. Alternatively, a team containing qualitative and quantitative researchers may need to be recruited. However, the more prominent debate remains the philosophical stance about the compatibility (or incompatibility) of paradigms. Morgan (2007) illustrated paradigm as '*shared belief systems that influence the kind of knowledge researchers seek and how they interpret the evidence they collect*'. The debate refers to the potential epistemological conflict (also called *Paradigm wars*) when combining different paradigms such as *constructivism* and *positivism* (Teddlie and Tashakkori 2009). Quantitative researchers follow the paradigm of *positivism* and later *postpositivism* while many qualitative researchers subscribe to *constructivism* or *anti-*

positivism (Morgan 2007). Nonetheless, these views appear to be increasingly replaced by those in support of mixed methods research (Creswell 2009). Greene and Caracelli (1997) pointed out that the discussion arising from potential opposition of paradigms can provide additional insights to the research. Others like Teddlie and Tashakkori (2009) suggested that mixed methods are most associated with a separate philosophical paradigm called *Pragmatism. Pragmatism* is defined as '…*a deconstructive paradigm that debunks concepts such as 'truth' and 'reality' and focuses instead on 'what works' as the truth regarding the research question under investigation*' (Tashakkori and Teddlie 2010).

In a review on the mixed methods research landscape, Creswell (2009) pointed to the large proportion of psychology, health and social sciences research which embrace this approach. In a few disciplines, mixed methods are manifested to the level that discipline-specific textbooks on the method exist. *Mixed methods research for nursing and health sciences* by Andrew and Halcomb (2009) formed such an example. This supports the appropriateness of applying a mixed methods design in this research considering that health sciences represent an adjacent domain.

4.4. OVERALL RESEARCH DESIGN

A mixed methods approach containing three stages was designed to accommodate the different sub-objectives of this research. This approach allows data to be generated while concurrently confirming hypotheses which helps to answer research inquiries in a more complete way (Johnson and Onwuegbuzie 2004). The choice and order of selected methods of the studies depends on the nature and stance of their inquiry.

Concepts for creating the *mixed models* and the notations were based on Morse (1991) and Johnson and Onwuegbuzie (2004). Depending on the order of used methods, Morse

(1991) differentiated two types of triangulations: *sequential* and *simultaneous triangulation*. As shown in Figure 4.2, the plus sign (+) indicates the use of methods at the same time while an arrow (→) reflects the sequential application. Morse (1991) also used upper and lower case notations to indicate the primary (QUAN/QUAL) or secondary methods (qual/quan). Combinations of qualitative and quantitative methods were adopted both across and within stages creating *across-stage mixed-model* and *within-stage mixed-model designs.* Figure 4.2 shows the mixed method approach designed to address the sub-objectives of this study, hence contributing to the answer of the overall research question.

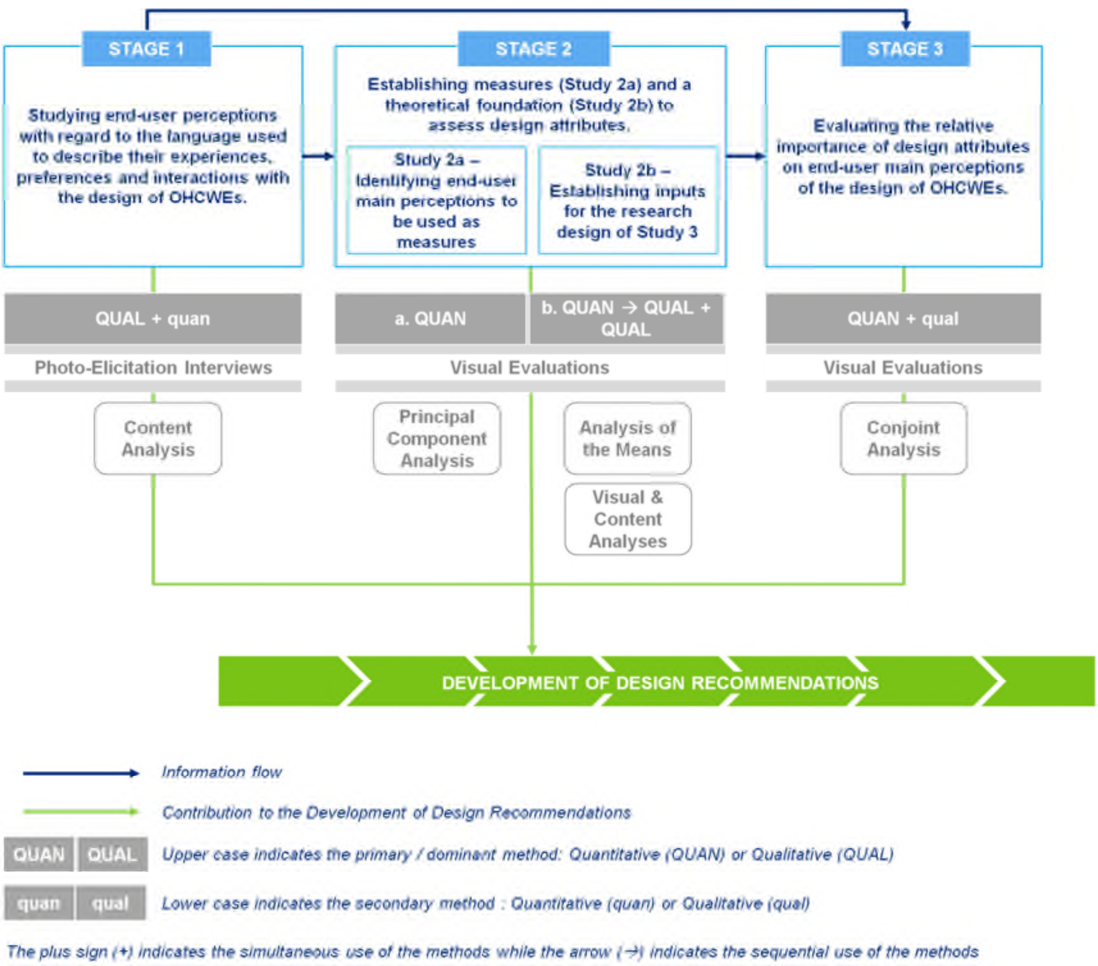


Figure 4.2: Overview of the mixed methods research design

Stage 1 (Study 1) – End-user perceptions on the design of OHCWEs were gathered through an exploratory study using semi-structured interviews. This qualitative method was selected since data in an interview is generated rather than collected (Baker 2004) which serves the exploratory nature of the inquiry. Colour photographs of various healthcare waiting environments were used as visual stimuli and to ease the communication between the researcher and participants. All interviews were transcribed and analysed using content analysis. The frequency of terms mentioned by participants was recorded to gather supportive quantitative data. The vast amount of design variables as well as end-user perceptions and the resulting need for its simplification set the direction for Study 2a.

Stage 2 (Studies 2a and 2b) – The aim of this stage was to develop a platform that allows the assessment of design attributes in the next stage. For this purpose, two studies were designed to establish perceptual measurement scales (Study 2a) and a theoretical foundation for the research design of Study 3 (Study 2b).

Study 2a –This study aimed to simplify the data set generated in Study 1 by extracting end-user main perceptions of OHCWEs. Using end-user perceptual responses from Study 1, semantic differential scales were developed in preparation for the evaluation task. Representative photographs from Study 1 were selected to elicit participants' perceptual responses. During the experiment, participants evaluated 14 selected images based on the 26 developed semantic differential scales. PCA as an established data reduction technique was selected to compress the number of perceptual scales into a few main dimensions. The more manageable yet representative number of dimensions represented end-user main perceptions and consequently allowed the focus on the measurement of design attributes. This stage is primarily a quantitative exercise

(QUAN) which, however, allowed further insight to the underlying structure of the data set.

Study 2b – Study 2b triangulated mixed types of data from Study 1 and Study 2a to establish existing learning about the relationship between design variables and end-user perceptions. Additionally, knowledge from literature was incorporated to form a theoretical foundation for the research design of Study 3. This stage is predominantly characterised by its qualitative nature (QUAL) due to the usage of qualitative and visual analyses.

Study 3 – Study 1 and Study 2a provided insights into end-user perceptions of different design concepts[1] in OHCWEs. For a more complete view, it is necessary to understand how end-users perceive both, the overall design as well as individual design attributes[2]. The objective of this study was therefore to evaluate the relative importance of design attributes on end-user perceptions with regard to the design of OHCWEs. The experiment design used inputs established in Study 2b as a theoretical foundation for possible relationships between end-user perception and specific aspects of the design. For the systematic manipulation of design attributes, photo-realistic renderings were created. Participants were then asked to evaluate these renderings as part of an online conjoint survey which also included exploratory, qualitative questions. Conjoint Analysis was used to quantify the role of design variables (QUAN) combined with qualitative analysis of participants' responses to appreciate their rationale (qual).

[1] As defined in Section 4.5.3, the term 'design concept' in this research refers to an overall design scenario which is regarded as a whole and consists of multiple design variables.
[2] As the term 'design attributes' and 'design levels' are commonly used in conjoint analysis, Study 3 uses these terms to refer to design variables and sub-attributes respectively.

4.5. EXPERIMENTAL CONSIDERATIONS

4.5.1. Sample frame, size and target

This research focuses on the members of the general public as end-users of the OHCWE which is comparable with the end-user groups Patients and Families in Ulrich et al. (2010)'s conceptual framework (Figure 2.4). Members of the general public were included as they represent past, existing and future users of the healthcare facilities. If a participant was a healthcare or design professional, their responses were included in the study as they were asked to consider the environment from a visitor perspective. The relationship between healthcare environments and staff will be omitted from this research as the different context of healthcare setting requires separate research effort.

Since the research interest is on end-users from the general public instead of members of any particular special interest group, convenience sampling and wherever necessary purposive sampling was adopted. Convenience sampling is a qualitative, non-probabilistic sampling technique that is not targeting any specific groups of participants but recruited by accessibility of subjects (Marshall 1996). Elements of *purposive sampling* such as *snowball sampling* through referrals was also adopted to ensure the inclusion of diverse backgrounds such as academic/non-academic, healthcare, architects or design professionals and lay people. Marshall (1996) described purposive sampling as a technique where the researcher selects participants whom he/she considers most suitable to answer the research question. A sampling frame consisting of inclusion and exclusion criteria was set as follows:

Inclusion requirements – These requirements ensured the inclusion of adult participants and their correct understanding of the given task.

(i) Members of the general public with a minimum age of 18 years old

(ii) Subjects must demonstrate a sufficient level of the English language to conduct the experiment without the help of a translator.

Exclusion requirements – Participants were excluded if they

(i) suffer from any uncorrected visual impairment as viewing and making decisions based on visual material are required tasks

(ii) do not have the capacity to consent

(iii) not meeting the above mentioned inclusion criteria

In order to reach a broader audience, additional effort to promote the studies was carried out by displaying posters and flyers at publically accessible areas of the university such as Warwick Art Centre. In Study 3, the diversity of samples was sought after by using an online questionnaire. The URL link was publicised within the University of Warwick and social and professional network platforms such as LinkedIn and Twitter.

Sample size – The sample size requirement was directly related to the selected method and the objective of each particular study. In Study 1, the exploratory study required the number of participants after which no additional insight to the inquiry can be gained, also called theoretical saturation point (Marshall 1996). In the studies 2a and 3, the use of non-inferential statistical methods (PCA and Conjoint Analysis) means that no formal calculation of the sample size can be carried out. However, recommendations from literature and similar studies were used as an indication. For PCA, the minimum required sample size was set at a ratio of 1:2 between scale variable and sample as

Barrett and Kline (1981) found that it was sufficient to establish stable scales. Recommended sample sizes for Conjoint Analysis (used in Study 3) vary greatly where a sample size below 100 in research (Akaah and Korgaonkar 1988; Green and DeSarbo 1978) and between 300 and 550 in commercial application (Cattin and Wittink 1982) are regarded as common practice. The goal was to be able to estimate the perception of OHCWEs within a margin of error of ±5% and a 95% confidence level.

4.5.2. Standardised scenario for all studies

A standardised context was given to participants across all stages of this research. Prior to every experiment, participants were instructed to picture themselves visiting the OHCWEs for a routine check-up that is unrelated to any particular medical concerns. In Study 2a and Study 3, this scenario was extended to the detail that they visit the healthcare environments as a patient and unaccompanied unless otherwise specified during the experiment. Literature emphasises that the context and meaning of the built-environment can affect perceptions (Cherulnik and Bayless 1986; Gustafson 2001). By standardising the context across participants, the challenge of uncontrollable variables related to participants' different self-created scenarios was able to be limited.

4.5.3. Design concepts and variables

Design concepts – For clarification purposes, this research refers to design concepts as an overall design scenario which is regarded as a whole and consists of multiple design attributes. As such, design concepts are used to describe different styles or the combination of design attributes.

Design attributes and design levels – Design attributes are therefore the decomposition of a design concept as a whole. They represent single design aspects or parameters such as chairs, reception desks, plants, flooring amongst others. In Study 3, the terms design attributes and design levels were used due to the specific terminology applied in connection with the method Conjoint Analysis. Design levels referred to sub-attributes such as height and colour of a chair.

4.5.4. The use of visual representation versus in-situ testing

As the decision of conducting the research using visual representations or in-situ experiments would impact the course and outcome of the overall research, the decision was carefully considered. The use of visual representations of the real environment in the form of photographs (Study 1 and Study 2a) and photo-realistic 3D renderings (Study 3) were regarded superior to in-situ testing due to the following reasons. As the purpose of this research was to investigate how end-users perceive the design of OHCWEs, the variety of design scenarios was considered beneficial to understand this relationship. The use of visual representations also corresponds with existing methods used by the design community to interact with other stakeholders in the early stage of the design process. Mehrabian (1974) and Stamps (1990) acknowledged that the use of visual images in experiments is a well-established method to represent a real life environment.

Moreover, using images as a representation of the real life environment allows the study of a large number of settings from geographical locations which may be difficult to access. This approach allows potential learning from both extreme cases and hypothetical design scenarios. Both of which are particularly relevant for the exploratory stage of the research. Using representations will also provide the flexibility to create or select specific designs for confirmatory testing. A laboratory setting allows a better control of the experimental conditions and fixed variables which contribute to the rigour of outcomes as well as the repeatability of the experiments.

A possible challenge of using visual representations is that they may not reflect all aspects of the real life environment (Scott and Canter 1997), as a real healthcare waiting environment represents a multi-sensory space with multiple occupants. However, as established earlier, EBD in healthcare is an emerging field (Ulrich et al. 2010) where the causal relationship between the different design elements and possible outcomes remains unclear (Codinhoto et al. 2009b). Therefore, this research chose to focus upon the visual perception of OHCWEs for which the use of images was regarded suitable. Images help participants to focus on the visual aspect of the design instead of being exposed to various sensorial inputs from a real environment.

In-situ testing may, however, be more suitable for experiments where participants are required to interact with the multi-sensory environment. This includes examples from measuring the level social interactions in a built-environment (Egli et al. 2002) or the impact of waiting time on end-user satisfaction (Eilers 2004).

4.6. RELIABILITY, VALIDITY AND GENERALISABILITY

Reliability & Validity – Reliability refers to the consistency or stability of an effect while validity reflects the accuracy of the measure (Graziano and Raulin 1999). These two criteria are to ensure the correctness of the measure and that it can be repeated to produce the same results. Different strategies were used to ensure the fulfilment of these criteria. For example, the mixed methods research design enabled methodological triangulation which in turn helped overcoming the challenges of validity (Morse 1991). For reliability measures, individual studies used different techniques that are suitable for the relevant methods. For example, Study 1 used Cohen's Kappa, κ, as a measure of inter-rater reliability to ensure the coding consistency of qualitative responses (Dewey 1983). The internal consistency of scales established in Study 2a was ensured using

Cronbach's alpha, α, values (Field 2009). The application and effectiveness of reliability and validity measures will be discussed in Chapter 9.

Generalisability – This point refers to the degree to which findings from this research can be generalised to the real environment which is also referred to as external validity (Graziano and Raulin 1999). In the context of this research, it deals with the question of how transformative the findings are with regard to the application in different types of healthcare waiting environments as well as to other areas within healthcare. This will be discussed with regard to the testing conditions and samples used in the studies in Chapter 9.

4.7. PRACTICAL CONSIDERATIONS

Ethical Approval **–** Ethical considerations were approved by the Biomedical Research Ethics Committee (BREC) at the University of Warwick as shown in Appendix A.

Cost **–** Participants were recruited on a voluntary non-remunerated basis. Facilities and standard software packages (such as IBM SPSS) were provided at no additional charges by the department (WMG) and the University of Warwick. For the creation of professional photo-realistic 3D renderings that were required for Study 3, an external consultant was contracted to create the 3D models based on the researcher's specifications. Resulting cost was covered by the Engineering and Physical Sciences Research Council (EPSRC).

Research Audience – Conceptually, this research seeks to contribute to the body of knowledge in EBD, thus, allowing researchers with related inquiries to build upon existing evidence. However, this research intends to also provide practical implications by informing those involved in the planning and design process of OHCWEs. These may be design professionals but also healthcare and estates personnel as they themselves are often responsible for the design of healthcare waiting environments.

4.8. SUMMARY

This chapter introduces the overall research methodology and explained why a mixed methods approach was considered most suitable for the research inquiry. Furthermore, the methods of the three stages of the research process were described along with their rationale. The research inquiry was initiated by an exploratory study (QUAL), followed by the next stage for further clarifications that consisted of both QUAN and QUAL methods. In Study 3, a confirmatory experiment was conducted using a quantitative approach as the main method (QUAN).

Findings of narrative, visual and numerical nature will contribute to a deeper understanding of the relationship between the design of OHCWEs and end-user perception. This insight will contribute to the development of design recommendations for designers, architects, the healthcare community and others who are concerned with the creation of healthcare waiting environments.

CHAPTER 5 – STUDY 1: EXPLORING END-USER PERCEPTIONS ON THE DESIGN OF OUTPATIENT HEALTHCARE WAITING ENVIRONMENTS

5.1. INTRODUCTION

As established in the chapters 2 and 3, the relationship between the design of OHCWEs and end-user outcomes has not been well-researched (Rice et al. 2008). The initial step of this research was, therefore, to conduct interviews with members of the general public to explore their views on the design of OHCWEs. This chapter presents the findings from this exploratory work and learning that informed the further direction of this research.

5.2. OBJECTIVES

The objective of this study was to explore the language and content used by end-users to express their views on the design of OHCWEs. Findings from this study should be used to establish hypotheses which will inform the course of the following studies.

5.3. RESEARCH METHOD

Individual interviews were considered an appropriate technique for the exploratory purposes of this study. It is also the most frequently used technique amongst qualitative methods (Gubrium and Holstein 2002). Baker (2004) emphasised that data are generated rather than collected in an interview which is in line with the exploratory nature of this stage. The generation of data implies that there is an interaction between the researcher and participants to jointly shape the conversation. A flexible, semi-structured approach was taken in order to allow the content and direction of the interviews to develop. Images were combined with the traditional interview format which form the fundamentals of the photo-elicitation interview technique (PEI), first introduced by the anthropologist Colliers (1957) according to Harper (2002).

5.3.1. Selection of images

While PEI is not restricted to the use of photographs but can also include other types of visual and graphical material (Harper 2002), photographs were selected for the following reasons. As explained in Chapter 4, the use of photographs to represent the real-life environment is an established method (Mehrabian 1974; Stamps 1990). They are also associated with psycho-physiological arousal, hence, appropriate to elicit participants' responses. The use of photographs in a PEI can ease the communication between participants and the researcher which explains its popularity in studies involving children as participants (Bagnoli 2009).

A variety of images showing commonly experienced as well as unconventional healthcare appearances was selected to provide participants a broad range of design concepts (Figure 5.2 and Appendix B). The angle from which the photographs were taken as well as their exposures were not uniform across images due to the exploratory purpose of this study. The control of these aspects would be necessary when evaluating and comparing the content across images, as was the case in Study 3. A number of potential biases that could impact the selection of images as well as end-user perception were identified and controlled as follows: (i) subjectivity by the researcher, (ii) picture quality, (iii) picture content and (iv) participants' familiarity with the healthcare waiting environments shown in the photographs. Each of the potential biases was addressed and minimised using different strategies. The first bias was addressed by consulting two architects, a planner and a designer to ensure that the selected range of images reflected the diversity of possible designs in healthcare waiting areas. These design professionals confirmed the broad design variations were reflected within the selected images. They further pointed out that some of the designs, such as the examples shown in Figure 5.1, may not be common for facilities in the UK or within the NHS. However, theses designs were retained due to the exploratory purpose of this stage.

Figure 5.1: Examples of designs that may be uncommon for healthcare facilities in the UK or within the NHS

In addition, the variety and representativeness of the images were also confirmed with participants during the experiments. In order to minimise the other identified potential biases, a structured selection process employing inclusion and exclusion criteria was introduced (Table 5.1.)

Category	Inclusion Criteria	Exclusion Criteria
Picture Content	- Photographs taken inside the room to focus on interior design and to increase the level of immersion. - Multiple design variables[3] shown, for example a room with chairs, carpet, reception desk, windows - National and international settings to increase diversity of design concepts - Healthcare waiting areas	Avoidance of: - People and animals in the picture - Children's play corner - Signage with emotionally provocative images or verbatim such as *'Cancer'*, *'Botox'* etc. - Pictures from a local, familiar healthcare provider to avoid familiarity
Picture Quality	- Colour photographs - Pixel dimension: minimum 1024 x 768 pixels - Size of printed photographs: 5x7 inches (13 x 18cm) - Type of printing paper: matte	- Low resolution pictures with pixel below 1024 x 768 criteria

Table 5.1: Overview of inclusion and exclusion criteria used to select images

[3] Design variables refer to individual aspects or features of the overall design as defined in Section 4.5.3.

Figure 5.2: Examples of images used as visual stimuli in interviews

Picture Content – In accordance with the focus of this research, only pictures showing healthcare waiting environments were selected. However, the selection was made regardless of whether they are operational or purely representational healthcare waiting environments since only their visual content was assessed in the experiment. Chapter 2 and Chapter 3 revealed that there is a need to investigate the perception of interior design of OHCWEs.

Multiple design variables should be clearly identifiable so that they can be considered in the overall context of the environment instead of in isolation. Since the visual appearance of healthcare environments was suggested to influence end-user perception (Becker and Douglass 2008), a broad range of design concepts representing examples from national and international facilities were included. The large variety further aimed to reduce participants' possible familiarity with the shown environments as well as maximise learning potential from various design scenarios. The selected images therefore included those matching the typical schemata of a commonly experienced healthcare environment as well as those with a non-conventional appearance. The presence of people and animals were avoided due to their possible influence on participants' perception. Ulrich (1981) noted in one of his earlier studies that *'…the absence of people and animals probably increased the pleasantness levels…'*. Other potential sources of stressors including signs showing names of diseases such as *'Cancer'* were avoided or masked using PowerPoint 2010 (Microsoft Corp, Redmond, WA). Another exclusion criterion applied to children's play corners in the images since specific healthcare environments such as children's hospitals are not within the scope of this research.

Picture Quality – As differing image quality can influence respondents' perception of the design (Ulrich 1981), a minimum resolution requirement of 1024 x 768 pixels was applied to the quality of all images. This requirement was based on the recommended resolution for photographs to be printed at the size of 13 x 18 cm (5 x 7 inches). Images were gathered from several online sources including healthcare providers' websites and research institutes (e.g. King's Fund), architectural practices (e.g. Nightingale Associates) and search engines (e.g. Google image). The use of online sources allowed the inclusion of broader design concepts from geographical locations that were otherwise not easily accessible. As images were only used as stimuli and due to the non-commercial and educational nature of the research, the use of images complies with *fair use* regulations. For publication purposes, permissions for selected images were additionally sought from the copyright owners.

5.3.2. Data collection

The interviews were conducted at different places convenient to the participants, ensuring a quiet environment with minimal distractions. After an introduction of the overall research and the study, participants were given the 65 selected colour images displaying a range of possible designs in healthcare waiting areas (Appendix B). They were also instructed to picture themselves visiting the healthcare environments shown in the pictures for a routine check-up. This brief was to ensure that everybody had a standardised context in mind when carrying out the task as detailed in Section 4.5.2 . Participants were asked to sort the images into similar groups based on their own concept of similarity (Figure 5.3) following adapted sorting instructions from Harloff et al. (2006) and Scott and Canter (1997).

The process of sorting images into groups allowed participants to familiarise themselves with the designs and helped them to express their views during the interview. Previous studies have shown that the sorting procedure is advantageous for the conceptualisation of visual materials (Groat 1982). Participants were encouraged to share their perceptions verbally during the sort or once the task was completed.

Figure 5.3: Examples showing participants sorting images

The aim of the interview was to keep a flexible content structure that allows data to emerge from the open-ended conversations. Nevertheless, a number of broad key topics were used as guiding questions to ensure a certain structure and consistency across the interviews. Examples of prepared topics included the following:

- Experience of healthcare environments
- Interaction with the environments
- Preference of designs
- (Dis-) similarity of designs
- Concept of an ideal healthcare waiting environment

A short questionnaire to capture participant profile data was handed out at the end of the interview sessions. This information was gathered to learn more about participants' background which in turn helped to interpret the data and to detect possible outliers. The duration of the interviews ranged from 40 to 90 minutes.

5.3.3. Data analysis

Generated data from the interviews were transcribed and analysed using content analysis which was guided by the philosophy of grounded theory (Strauss and Corbin 1998). Grounded theory was identified as a useful technique to guide the data analysis in an inductive and data-driven manner until main themes *emerged* from the data. Braun and Clarke (2006) pointed out that this approach is commonly used in qualitative research and can also be viewed as a stand-alone method. In order to reduce subjective bias, an independent researcher was asked to perform a second coding of the qualitative content. Once both coding procedures were undertaken independently, the percentage of agreement as well as Cohen's κ (Cohen 1960, 1968) as a measure of the inter-rater reliability were calculated using the online tool ReCal2 developed by Freelon (2010). Lombard et al. (2002) noted that researchers are in favour of different measures but Cohen's κ was the recommended measure for inter-rater reliability according to Dewey (1983) and most widely used for behavioural-related content (Bakeman 2000).

All qualitative data analysis was carried out using the software NVivo8™ and its updated version NVivo10™ (QSR International Pty Ltd. Version 8, 2008; Version 10, 2012). Descriptive statistics were performed on participant socio-demographic data and semantics describing design aspects using SPSS 19 (IBM Corp., Armonk, USA).

5.4. RESULTS AND DISCUSSION

After the completion of 24 in-depth interviews (N=24, 12 males, 12 females), participants' responses and the way they interacted with the images emerged into themes that led to the formation of a number of categories. Prior to the completion of the interviews, it was noted that the way people used design aspects as well as emotional, cognitive and associative perceptions to describe the designs began to reoccur. This stage reflected the theoretical saturation point where additional information would not have led to a new relevant category or theme (Keyton 2006). Consequently, no further interviews were required.

Participants' age ranged from 18 to 64 years old following a normal distribution with the largest group (79.2%) being between 25 and 44 years old (Table 5.2). Even though not all age groups of healthcare users are included such as the elderly above 64 years old, the sample served well the exploratory purpose of the study.

		Gender		
		Male	Female	Total
Age group	18 to 24	0	1	1
	25 to 44	10	9	19
	45 to 64	2	2	4
Total		12	12	24

Table 5.2: Participants' age and gender

The majority of participants (91.6%) were users of the NHS, of which 70.8% were exclusive users of the NHS while 20.8% combined their NHS status with additional health insurance or self-payments. A smaller proportion of participants used services from private healthcare providers (N=2) or from abroad services in addition to the NHS (N=3).Around half (54.2%) of all participants have visited primary care facilities most frequently while others have most frequently been to secondary care facilities (16.7%) and both types of settings (8.3%).

The overall data revealed that people described the design of OHCWEs by using perceptual responses and design aspects as shown in Figure 5.4. The categories *End-user Perceptions* and *Design Aspects* are presented and discussed in Section 5.4.1 and Section 5.4.2 respectively.

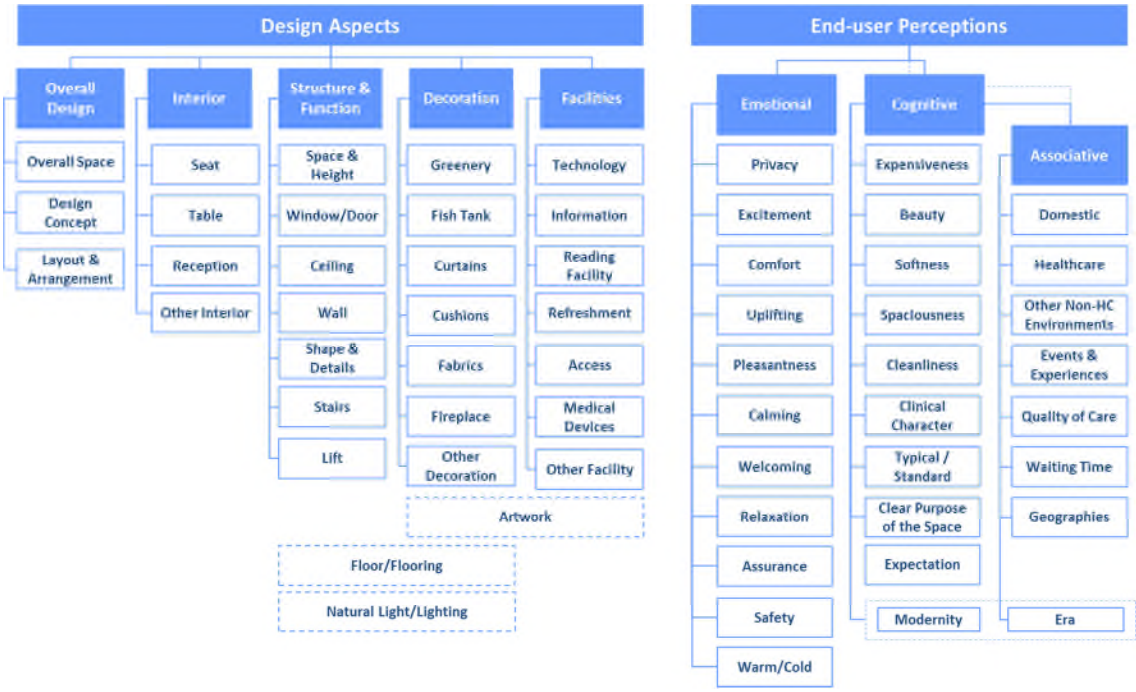


Figure 5.4: Summary of descriptors of OHCWEs *extended from* Vuong et al. (2012)

5.4.1. End-user perceptions of outpatient healthcare waiting environments

Generally, participants described the design by its possible effect on them in a rather intuitive manner which resulted in a large number of perceptual concepts. They often provided voluntarily possible explanations of how the design may affect them or suggestions for improvements.

First, all perceived responses were coded into 36 differently termed aspects of end-user perception by the researcher and an independent second coder. The two independent coding procedures showed 66.78% agreement with Cohen's κ = 0.65. After addressing the differing codes through a discussion, 94.92% agreement was achieved with a Cohen's κ = 0.95. These values indicate a very high reliability since κ = 0.61 - 0.80 is considered *'substantial'* and κ = 0.81 - 1.00 *'almost perfect'* (Landis and Koch 1977). Table 5.3 provides an overview of inter-reliability measured in percentage of agreement and Cohen's κ before and after the discussion.

	Agree-ment in %	Cohen's Kappa κ	N Agreements	N Disagreements	N Cases	N Decisions
Before Discussion	66.78	0.65	378	188	566	1132
After Discussion	94.92	0.95	561	30	591	1182

Table 5.3: Result of inter-rater reliability

The discussion led to the following modifications:

(i) Two new categories created including *Expected* and *Typical* to better reflect the perceptual responses

(ii) Two categories eliminated due to ambiguity including *Reminder of Illness* and *Natural Feel*

(iii) Five codes merged with existing ones due to similarity (e.g. *Confidence about the Place* merged with *Clear Purpose of the Space* or *Liking* combined with the category *Pleasantness*)

As a result, 31 codes representing end-user responses were identified and grouped into three categories of perceptions: emotional and physiological, cognitive and associations (Table 5.4).

Emotional Perceptions	Cognitive Perceptions	Associative Perceptions
Privacy	Lightness	Domestic
Excitement	Flexibility	Healthcare
Comfort	Expensiveness	Other Environments
Uplifting	Beauty	Events & Experiences
Pleasantness	Softness	Quality of Care
Calming	Modernity	Waiting Time
Welcoming	Spaciousness	Geographies
Relaxation	Cleanliness	Era
Assurance	Clinical Character	
Safety	Typical/Standard	
Warm/Cold Feel	Clear Purpose of the Space	
	Expectation	

Table 5.4: Codes reflecting end-user perceptions of healthcare waiting environments

Emotional perceptions focus on how the design makes you feel whereas cognitive perceptions are concerned with the evaluation of the perceived design quality. Associations refer to places or events people have experienced in the past which are used to compare and form a perception of the other designs. Strictly speaking, the category Associations can be viewed as a sub-category of cognitive perceptions due to its nature of recalling past memories to arrive at a judgment. However, they were presented as a separate category to reflect their dominance in the data.

5.4.1.1. Emotional Perceptions

Participants expressed a wide range of emotions with regard to the environment using various descriptors as shown in Table 5.5. Emotions that were mentioned and discussed by over half of the participants included *Privacy* (N=16), *Excitement* (N=15), *Comfort* and *Relaxation* (N=13 each). All categories also included their opposing descriptors indicated by the symbol (≠), e.g. '*Boring*' in the group *Excitement*.

Emotional Perceptions	Example Descriptors and Quotes
Privacy	*Private, on my own, alone* *(≠) Sociable, connect with someone, part of the community, not isolated* *'People who sit down are forced to look straight ahead and sit side by side rather than facing each other […] in any kind of nice atmosphere, where they feel they could engage with each other.' (Participant 12 = P12)* *'I don't particularly like to sit in next to someone else; [I] quite like a bit of privacy.' (P2)* *'I think in a HC setting, especially when you are already stressed out, when you go there to see a doctor, can be stressful for people. And it's important that you have different levels where you feel like you can share if that helps, you should be able to do that.' (P16)*
Excitement	*Interesting, exciting, playful, intrigued, grabs your attention* *(≠) Boring, dull, uninspiring, idle, plain* *'…not wasting your time and then you can do something else or you can interact with something else to kill time.' (P17)* *'…very uninspiring. There is nothing to distract you, to take your mind off your appointment. It's not going to make you feel particularly comfortable.' (P15)*
Comfort	*Comfortable, comfy* *(≠) Uncomfortable* *'And that one [pointing at an image] I don't know; may be it looks more attractive but it looks very stark. There are no soft textures at all, so the seats don't look comfortable.' (P3)* *'There are some chairs that are comfortable but most of them you don't feel comfortable.' (P17)*
Uplifting	*Cheerful, happy, refreshed* *(≠) Depressing, grim, sad* *'…with light and design it automatically makes you happier…' (P15)* *'That looks clinical but ok, it doesn't look depressing. They've kind of made an effort to make it ok.' (P1)*
Pleasantness	*Nice, enjoyable, pleasurable, pleasant* *(≠) Unpleasant, awful* *'I just feel good looking at this picture […] It kind of works you know, I would enjoy sitting there waiting…' (P5)*
Calming	*Calming* *(≠) Upset, annoying, frustrating, disturbing, drive you insane* *'…it's quite green, calming…' (P1)*
Calming (*cont'd*)	*'…happy environment with more lighting probably makes you calmer. […] They always end up playing sort of elevator music don't*

Emotional Perceptions	Example Descriptors and Quotes
	they - That would drive you insane.' (P21)
Welcoming	*Welcoming, inviting* *(≠) Not welcoming, unfriendly, impersonal, intimidating* *'The fact that they are in rows, hard. Flooring is hard as well. Just looks unfriendly' (P1)*
Relaxation	*Relaxing, relaxed, laid-back, unwind* *(≠) Stressful, reminded of […] being sick* *'…this one while it's quite neat and looks like it's been cared for, It looks very clinical which is possibly ok but it just makes it harder to relax…' (P3)* *'…how much I like them [the designs] depends on how relaxed I'd feel […] I'd feel more relaxed in a less structured environment.' (P11)*
Assurance	*Reassured, feel relieved* *(≠) Scary, creepy, anxious, nervous* *'It's close enough to the receptionist, so you know what is going on and to make sure they know you are still there. And also you can see this door [pointing at a door on an image]. So it's important to know what's going on.' (P1)*
Safety	*Safe, secure* *'…there would be other people in the same space […] This space can make me feel more secure.' (P23)*
Warm/Cold Feel	*Warm, cold, cold and hard* *'…this one is less attractive and a bit boring actually but it just feels quite warm.' (P3)*

Table 5.5: Descriptors for emotional perceptions

A number of key themes emerged from the results presented in Table 5.5 will be discussed in more detail below.

Distraction – Several participants (N=10) complained about having nothing to do while waiting and being bored which were expressed as *'wasting time'* and '*…just go there and wait…'* (P17). Bringing own reading material was reported as a way to overcome this, expressed as: *'Well, I have been waiting a lot of times. I normally bring a book along, so that's what I do'* (P2). Differing opinions about TVs as a distraction technique were found. While several participants were in support of having a TV to *'take their* *minds off the illness'* (P20), not being able to control its settings and channels were concerns as shown by the following quote:

'Sometimes a TV can be really annoying because you can't control it. If you know there is something on that you actually don't want to watch or if there is something you do want to watch [but it] is on mute and the fact that you can't actually do anything about it.' (P24)

The mixed views on the effect of having a TV in the waiting area are consistent with findings from literature. It has been suggested that design elements such as TVs can be used as a positive distraction if they divert people's mind from the negative state (Nanda et al. 2012a). However, the inability to control the environment can have an adverse effect on end-user well-being (Ulrich 1991). The provision of a TV in common areas was suggested to have either a neutral (Pruyn and Smidts 1998) or negative effect on patient experience (Ulrich et al. 2003). At the same time, people appeared to also accept the fact that they will just sit and wait when going to a healthcare waiting environments, expressed as *'It fits much in your schemata of what a waiting room is […] you just wait there for your appointment...'* (P15). Bitner (1992) suggested that expectation is linked to satisfaction which according to Bolton and Lemon (1999) depends on their preconception of how products and services should be.

Privacy – A number of participants (N=16) discussed issues related to privacy with nearly all of them (N=15/16) referring to the desire of having sufficient personal space to relax. The perception of privacy was mentioned in the context of spatial provision, seating arrangement and sound level. Previous studies showed that crowding in public spaces affected people negatively by interfering with their need for personal space (McClelland and Auslander 1978; Yildirim and Akalin-Baskaya 2007). In a healthcare context, Douglas and Douglas (2004) suggested that the environment needs to provide patients not only a space for their personal use but also to interact with their family and visitors. However, not all participants expressed the desire to have a quiet time without interacting with others as part of the waiting experience. Fewer participants (N=5) explained that being able to interact with others might ease their anxiety and stress. To feel that you could engage with others is the important aspect, regardless of whether or not in reality you chose to do so (P12). The environment should be designed in a way that*'…you can sit and feel [like being] part of a community…'* The opposing views on privacy and social engagement emphasised the challenge of a healthcare waiting environment that can accommodate multiple end-user needs.

Feeling relaxed, comfortable and having a sense of privacy can be influenced by a number of factors including the arrangement of furniture (e.g. P11, P12). For example, Participant 3 pointed out seats that were arranged facing away from each other, forming smaller units as '…*less stressful, kind of tucked away on my own. I quite like the way these [seats] are pointing away. Almost like a little world I can retreat into.'* The desire to be able to relax is in line with the study by Macnaughton et al. (2005) where calming was found the most conclusive emotion mentioned by end-users. A large number of literatures focused on effect of art and indoor plants or the view and interaction with nature to reduce stress and promote relaxation (Daykin et al. 2008; Dijkstra et al. 2008b) which was however not predominantly mentioned by participants in this study. This could be related to the method of visual representation, as discussed in Section 4.8.1.

Information – The lack of information and disorientation were further factors that participants linked to negative emotions. Over half of all participants (N=13) also expressed that feeling assured and '…*knowing what's going on*' is important since healthcare environments can be a confusing place (e.g. P10, P13). This was also expressed by Participant 2 as follows:

'I am never sure what's happening, who is going to call me, when, and from where, so I like to see as much of the place as possible. Because hospitals can be a very confusing place where you don't know where to go and you feel a bit intimidated and staff seems to assume that you know what's happening next but you don't.' (P2)

Literature suggested that the disorientation in healthcare environments, especially in the context of *wayfinding* can lead to the loss of control which in turn can cause stress (Baskaya et al. 2004). However, the issue that design cues can be misleading and cause confusions has not been much discussed. Positive emotions have been expressed with regard to places that are easy to understand and make them feel reassured. Other emotions frequently mentioned by participants referred to how welcoming (N=8), uplifting (N=9) and pleasant (N=11) the place makes them feel. Generally, people found it difficult to feel relaxed and comfortable if the design of the space is not liked which demonstrates a close connection between emotional and cognitive perceptions. As an example, participants (e.g. P21) explained that the way the design makes them feel would dictate their evaluation of the design.

5.4.1.2. Cognitive Perceptions

Overall, participants enthusiastically shared their views and made voluntary judgements about the designs which are presented as various cognitive perceptions in Table 5.6.

Cognitive Perceptions	Example Descriptors
Lightness	*Light, bright, natural light, fluorescence lighting* *(≠)Dark, not bright enough, gloomy* *'…they are very light and airy and […] would feel quite comfortable and probably quite relaxed [if I] have to go and wait in those areas' (P20)* *'Some in the other piles are very dark. I wouldn't really want to be there. You would probably feel nervous' (P21)*
Flexibility	*Open, movable, relaxed structure, less structure/d* *(≠) Stark, structured, regimental, forced concept* *'…how much I like them depends on how relaxed I'd feel. I'd feel more relaxed in a less structured environment.' (P11)*
Expensiveness	*Exclusive, fancy, luxurious, executive, classy* *(≠) Tacky, down-market, cheap* *'…a group that seems to be expensive […]high-technology, modern or highly-stylised.' (P3)*
Beauty	*Stylised, sleek, swish, funky, fashionable,* *(≠) Ugly, nothing decorative, awful* *'…very stylised, modern, futuristic, quite distinct style […] sleek furniture, metal and wood as people like them today. Stand out…' (P13)* *'…different type of chairs, carpet is awful but they are trying to make it attractive and a more comfortable place to be in.'(P10)*
Softness	*Soft, soft and cosy* *(≠) Hard, hard and shiny, angular, cold and hard* *'It looks quite clinical because of the cover they use on the seat whereas others use fabrics for seating, the seats look softer (P1)*
Modernity	*Modern, cutting-edge, contemporary, futuristic* *(≠) Old-fashioned, old and clustered* *'…these are the futuristic ones, modern, make you forget that you are waiting in a healthcare environment.' (P8)*
Spaciousness	*Spacious, big, spaced out, more distance, spread out, empty* *(≠) Cramped, cavernous, small, stuffed, overcrowded* *'I like the fact that the ceiling is very high. It gives [you the] feeling of more space, you don't feel claustrophobic in there.' (P21)*
Cleanliness	*Clean, wiped-clean, clean and fresh, sanitised, disinfected* *(≠) Contaminate, messy, dirty* *'… [this one has] old, dirty walls and everything [is] cluttered and not so clean.' (P12)*
Clinical Character	*Clinical, institutional, hospitally, medical* *'…the homeliness ones have a bit of uncleanliness about them. They are less clinical.' (P15)*

Cognitive Perceptions	Example Descriptors
Typical/Standard	*Typical, standard, generic, traditional, conventional, undistinguishable* *(≠) Stood out, distinct style, quirky* *'Lots of them are undistinguishable. The standardised healthcare – To me they look like most healthcare [environments], not so much perhaps distinct about this area.' (P13)*
Clear Purpose of the Space	*Understand the space, know where to check-in* *(≠) Strange, odd, weird, feels wrong, hard to define, not a proper room* *'These [images] I piled together because they don't automatically tell you that you are in a waiting room which can be a difficult thing for dementia because the place needs to tell them where they are.' (P10)*
Expectation	*Expected* *(≠) Astonishing, unexpected, above expectation* *'…groups [of images] that quickly stood out called conventional or expected and conventional above expectation.' (P6)*

Table 5.6: Descriptors of cognitive perceptions

The healthcare waiting environments were evaluated mostly by their spatial arrangement and the resulting perceived sense of spaciousness (N=17), followed by whether the purpose of the space was clearly communicated through the design (N=14). Spatial comfort was discussed previously with regard to privacy and how it can impact on the perception of personal space. Participants also preferred environments which were easy to understand, possibly as it reduces the potential stress of disorientation and promotes reassurance. As mentioned in Section 5.4.1.1, people expressed the desire of feeling assured which related to the evaluation of whether the environment was easy to understand. Participant 20 expressed the confusion over ambiguous design cues which influenced the overall impression of the environment as follows:

'I am not really sure what's going on there. On the walls, I assume that's a projection of something which would be a nice idea for a different room […] the floor with cracks - It kind of looks like a warehouse that's been painted. And what are they doing behind

the curtain? Is that where you are going to see the doctor? Because if that's the case, I wouldn't like that - that's far too open.' (P20)

Three other design criteria that influenced people's evaluation included their level of modernity, expensiveness and attractiveness (N=12 for each category). These three categories appeared to be related concepts as modern designs were also commonly perceived as expensive. While a modern and expensive design was frequently expressed in connection with physical attractiveness, this is not always the case as pointed out by a participant as *'…looks like it's trying too hard'*.

A number of participants commented on the lighting and brightness of the space (N=10) with well-lit and spacious environments being more liked and perceived as more attractive. The impact of light on various health and well-being outcome has been conclusively shown in literature (Joseph 2006a). Aesthetics was suggested to play a mediating role in reducing stress (Dijkstra et al. 2008b) as well as to influence people's perception of the quality (Ulrich 2011). People also expressed the importance of cleanliness (N=9) which in some cases may interfere with perceived comfort of the design. As an example, Participant 7 noticed a comfortable sofa in one of the images and pointed out that*'…it looks like one that could be cleaned if something went wrong.'* The perceived level of hygiene as well as lighting quality appeared to influence participants' preference of the design. Participants also judged the design by their clinical character (N=5) and how much they appeared to be typical for a healthcare facility (N=9). To some extent these categories relate to the third category of *Associative Perceptions*.

5.4.1.3. Associative Perceptions

Associative Perceptions	Example of Descriptors
Domestic	*Living room, homelike, homely, someone's front room, lounge, residence* *'…trying to make it more homely but it's still a waiting room.' (P15)* *'…if you don't look carefully, you could presume that they are somebody's home. So they are more homely.' (P10)*
Healthcare	*Examination room, healthcare building, GP, waiting room, hospital* *'…feels sanitised, it couldn't be a hotel or anything, couldn't be anything else but a hospital. It just looks very disinfected, the shiny floor.' (P19)*
Other Environments	*Airport lounge, lobby, atrium, office, hotel, restaurant, spa, library, gallery* *'That looks like a hotel; that looks like an office building; that looks like a typical healthcare building and that's trying to look like a home. So I tend to see the overall design rather than looking at the details.' (P2)*
Events & Experiences	*Holiday, funeral, conference, times being sick* *'The way I look at it is when you go to a place where you don't necessarily think that it's beautiful but places like a student union, where you feel comfortable, feel at home (then it's more relaxing)' (P16)*
Quality of Care	*'…cold environment gives the impression that staff might be unfriendly, impatient.' (P22)*
Waiting Time	*…presumably for a reasonable period of time…* *'Large spaces, these are made for lots of people waiting, and presumably for a reasonable period of [waiting] time.' (P9)*
Geographies	*Scandinavian style, English look, American, Chinese hospital* *'…it's very open, hard furnishing, more sort of Scandinavian style because of the wood they use, simple style but well-executed…' (P6)*
Era	*70s and 80s, 60s/70s style* *'…some [designs] are stuck in the 70s and 80s…' (P2)*

Table 5.7: Descriptors for associations

People intuitively compared designs with other places or events they have experienced in the past or in their imagination. This is in line with literature that people describe built-environments by their meanings which are often expressed through associative terms according to Rapoport (1982). Examples of the mentioned associations are shown in Table 5.7. A large proportion of participants expressed associations of different types of *Healthcare* facilities (N=14), home or *Domestic* places (N=12) and various non-healthcare environments grouped under *Other Environments* (totalled N=18). The latter mentioned included associations of various public spaces such as airport, hotel, office and spas. Overall, these categories are broadly distinguished by the association of typical and untypical healthcare environments. While homely is commonly used to describe a positive feeling, it was also associated with a less clinical, unhygienic condition in a healthcare context (P15). The term *homely* was also found to be used to describe positive emotions in a study by Macnaughton et al. (2005), partially explained by the familiarity and ability to influence the environment (Devlin and Arneill 2003; Dovey 1985). However, the findings indicate that depending on the circumstances, an institutional and not homely environment might be preferred as they comply with infection control regulations.

Associations of hotels, spas and other commercial environments appeared to relate to modern and expensive character of the design. The use of specific material such as glass, wood and metal was mentioned as visual indicators for participants to arrive at these associations (P13). Built environments such as hotels and shopping centres influenced the development of healthcare architecture which explain the possible resemblance (Verderber 2000). These environments shape the way people conceptualise healthcare environments and may explain why their frequent comparison was made. Macnaughton et al. (2005) found that atrium type of spaces in healthcare environments can be intimidating. This shows that while environments with a homely and hotel-like appearance are both untypical and do not resemble what is typically expected of a healthcare environment, they are not always liked by end-users. Designs were also associated with events and experiences such as *'holiday'* (P7, P10) or *'…looks like a* *funeral hall or something'* (P3). These associations were used to emphasise an extreme response towards the environment.

Fewer participants (N=3) also speculated about the possible quality of service they will receive depending on the design style and the condition of the space, as simply put by one of the participants '*the nicer the environment, the nicer people might be…'* (P22). Even the ones that claimed not being *'the type who would make judgment about the medical service'* have revealed the opposite in further conversation. People appeared to form their judgement about the service quality based on the design of OHCWEs despite knowing that design cues may not be a reliable indicator. This phenomenon was expressed by one participant as follows:

'I mean you automatically think...I mean it's silly to think that but you think you'll get much better quality from here [pointing at a picture with a new, modern design] which is probably not true at all […] but it gives that sort of impression. If you go somewhere where the design is just state-of the art, you kind of think that the care is just as good because they invest so much in the environment and in well-being.' (P15)

The relationship between design and perceived quality has been pointed out by literature. For example, people use tangible artefacts such as the design to assist their judgement on services which are intangible (Levitt 1981). It is also suggested that aesthetics of artefacts are used to form a perception about the quality according to Ulrich (2011) as well as to enhance our emotion towards an environment (Mehrabian 1974; Schellekens and Goldie 2011)

5.4.2. Design aspects

Design variables mentioned by participants were categorised into five main categories: *Overall Design*, *Interior*, *Structure & Function*, *Decoration* and *Facilities* (Figure 5.4).

Participants communicated about the design using physical and non-physical aspects of the design. Physical aspects include all visible elements of the space such as the *Structure & Function*, *Interior* and decorative elements while non-physical attributes refer to *Facilities* that are linked to the physical design such as TVs for entertainment and hygiene facilities. The frequencies of design aspects are shown in Figure 5.5.

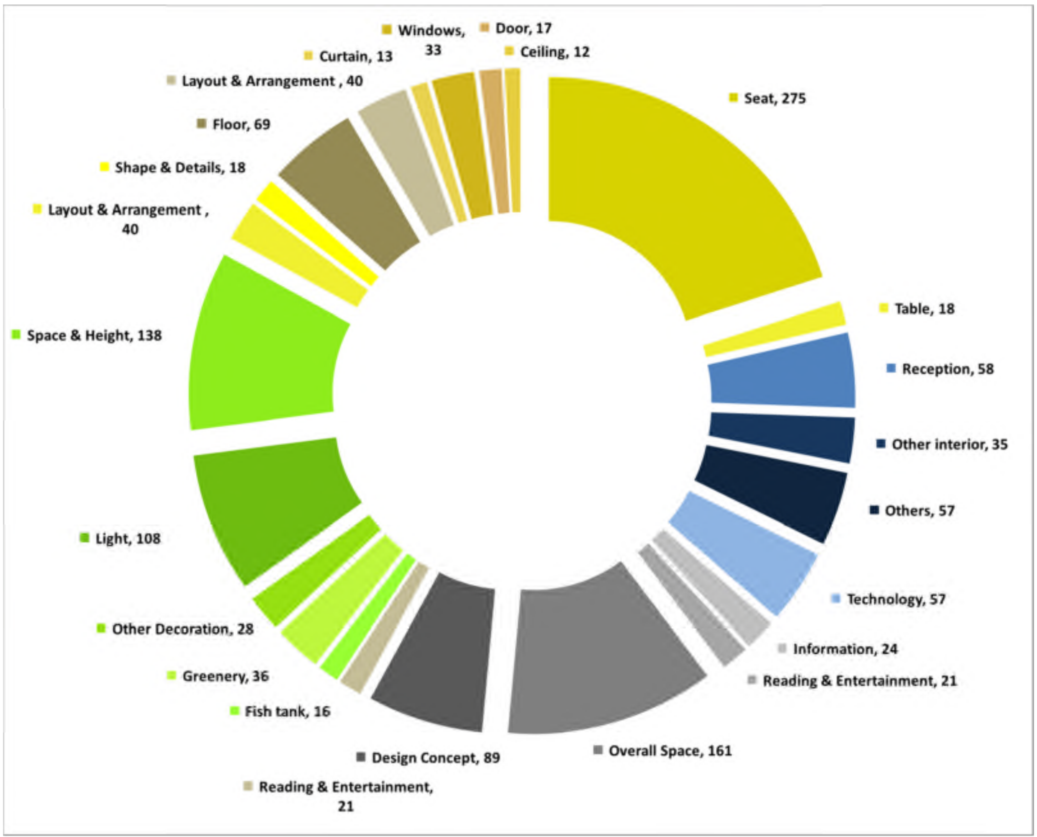


Figure 5.5: Overview of design attributes and their frequency

The most frequently mentioned design variables were seats (275 counts), followed by and overall space (161 counts), height/space (138 counts) and light (108 counts). Word counts included terms describing a similar or identical design aspect such as sofa and chair are both grouped under *Seat*. An overview of the categories with examples of terms used by participants is provided in Table 5.8.

	Design Aspects	Count	Examples
Overall Design	Overall Space	*161*	*building, room/s*
	Design Concept	*89*	*style/s, concept*
	Layout & Arrangement	*40*	*layout/s, arrangement, facing*
Interior	Seat	*275*	*armchair/s, chair/s, seat/s, seating, sofa/s*
	Reception	*58*	*reception, counter/s, desk/s, hatch/-es*
	Other interior	*34*	*furniture, interior, cupboard*
	Table	*18*	*table/s*
Structure & Function	Space & Height	*138*	*space/s, height, roomy*
	Light	*108*	*light/s, lighting, lamps*
	Floor	*69*	*floor/-ing, carpet/-ed/-ing*
	Window	*33*	*window/s*
	Wall	*31*	*wall/s*
	Shape & Details	*18*	*shape/s, panels, surface/s, borderlines*
	Door	*17*	*door/s, entrance*
	Ceiling	*12*	*ceiling, roof*
	Stairs	*8*	*stairs, staircase*
	Lift	*5*	*lift/s, elevator*
Decoration	Greenery	*36*	*tree, plant/s, flowers, greenery*
	Artwork	*18*	*art/s*
	Fish tank	*16*	*Aquarium*
	Curtain	*13*	*curtain/s, blind/s, drapes*
	Cushions	*8*	*cushions, pillow*
	Fabrics	*7*	*seat cover, fabric/s*
	Fireplace	*6*	*fireplace, fire*
	Other Decoration	*28*	*basket, vase, décor*
Facilities	Technology	*57*	*TV, computer, phone*
	Information	*24*	*information, sign, leaflet, posters, whiteboard*
	Reading & Entertainment	*21*	*book/s, magazines, music, newspaper*
	Refreshment	*9*	*Coffee, drinks, tea, food*
	Access	*5*	*access, accessibility, exit*
	Medical Devices	*3*	*wheelchair, needle*
	Other Facilities	*6*	*activity/-ies, facility/-ies*

Table 5.8: Examples of semantics used by end-users to describe design aspects

Overall Design – This category was described by design concepts, layout and arrangements as well as the overall space such as building or room. Layout referred to the set-up of interior furniture, especially the arrangement of seating facilities. Participants described design concepts and styles mainly through associations. The dominant perception of the overall space relates to *Gestalt theory* which suggested that people perceive designs as a whole based on characteristics such as symmetry and similarity (Koffka 1922). Overall, it was found that people usually communicated about the design by linking design aspects with their potential effects on them. It appears to be challenging to establish a clear single causal-effect relationship between the design and end-user perception as the combined effect of multiple design factors is difficult to separate. This challenge was also found in the reviewed literature in Chapter 2. This combination of artefacts or their accumulative effect on end-user perceptions and outcome was expressed by a participant as follows:

‘It’s the use of space and light and knowing where to go when you first walk into the room and having distraction because of the anxiety […]. The relaxed ones are the ones that have got windows or TV screens and chairs that are not too close together.’ (P4)

Interior – As suggested by Ulrich (1991), interior design can play a role in promoting healing and wellness which is supported by findings from this study. Participants paid strong attention to interior aspects of the design and linked them to their perceptual responses such as comfort and relaxation. Seats were the most frequently mentioned design attribute within this category (275 counts), followed by the reception desk (58 counts). Specific details of the furniture can belong to other categories, for example the shape or material as part of *Structure & Function* and *Decoration*. As discussed previously, the arrangement of seats and perceived spaciousness can affect privacy and psychological comfort while physical comfort was referred to the product specification such as upholstered seats. Participants may have taken more notice of seats and described them in detail because they are directly associated with sitting and waiting. Specifications of the reception were also discussed, with particular remarks on their height and openness. Those that were built in a closed manner were for example referred to as *‘hatches’* and described as unfriendly.

Structure & Function – This category contains architectural elements that contribute primarily to the structural and functional aspect of the built-environment. As shown in Figure 5.4, *Natural Light/Lighting* and *Floor/Flooring* can be grouped under this as well as the neighbouring category *Decoration* depending on their context. As an example, natural light provided by architectural specifications may be regarded as part of this category while ambience lighting may serve more decorative purposes.

Decoration – This group includes design attributes that extend beyond the basic functionality of the space and add to the aesthetic value of the overall design. The most frequently mentioned design variables in this category include flowers and plants (*Greenery*, 36 counts), followed by artwork that was mentioned 18 times. Both aspects have been shown by literature to have beneficial effects on health and well-being such as reducing stress (Dijkstra et al. 2008b; Staricoff 2004). A number of design variables from this category as well as the previously mentioned design aspects such as lighting, plants, layout, space and style can be used to change the ambience (Kotler 1973; Lin 2004). According to Kotler (1973), they can be used as effective marketing tools to influence people's perception and behaviour in the service industries.

Facilities – This group comprises design variables that participants related to services provided by OHCWEs. Participants noticed a number of design artefacts such as TVs that were grouped under *Technology* (57 counts) but can also be for entertainment purposes. Reading materials were also frequently mentioned, either in the context of providing information such as leaflets (24 counts) or to entertain such as magazines (21 counts). As discussed in *Privacy*, while participants showed mixed reactions towards entertainment facilities such as TVs, the provision of reading material was expressed in a positive manner. This was communicated by a participant as follows:

'It's good to have some literature around to read, possibly not literature on healthcare because you want something to take your mind off while you are there. At my doctor they would always have some trashy magazines there, just something to take your mind off. TVs may be but nothing too loud; music is probably not so good because they always end up playing sort of elevator music don't they - that would drive you insane' (P20).

Refreshment facilities were mentioned nine times by participants as desirable which can be provided through vending machines or water coolers if no cafe area was available.

5.4.3. Discussion on the approach

End-user language and perceptions of the design of OHCWEs were investigated using photographs as visual stimuli. The method delivered rich content data on end-user perceptions and revealed the language used by end-users to articulate about healthcare built environment designs. Since healthcare environments are traditionally viewed to be clinical treatment centres, it was unclear at the start of the research whether participants would be able to easily relate to the more holistic view of end-user perception in this research. However, people showed no signs of difficulties relating to the topic and demonstrated a high level of enthusiasm to discuss and share their views on the design of OHCWEs. The technique of using photographs to engage people in a sorting task proved to be an effective tool to involve people and getting them well-prepared for the discussion. Photographs helped the researcher and participant discuss ideas with a specific visual concept in front of them which reduced potential misinterpretations of responses. PEIs also resulted in rich content that comprises of qualitative data linked to specific visual materials which were used to form a theoretical foundation in Study 2b. Due to a number of considerations explained in Section 5.3.1, a wide range of images were used as stimuli in the interviews. An advantage of the broad variety of images is that participants are less likely to be biased by any given design. However, the large amount of photographs resulted in time-consuming interviews. Another challenge of using images is that they may not reflect all aspects of the real life environment (Scott and Canter 1997). Considerations regarding the use of visual representations instead of in-situ environments were presented in Section 4.5.4. Images were purposely selected without the presence of people and animals as Ulrich (1981) noted that they may affect perceived level of pleasantness. However, participants have pointed out that the absence of people made it difficult for them to picture to potential interactions in the shown places. The decision to exclude humans and animals from the images was made based on the consideration that being able to control experimental conditions was more important.

5.5. REFLECTION ON EXPLORATORY FINDINGS AND FORMED HYPOTHESES

This section reflects on exploratory findings from the study presented in this chapter which influence and underpin the approaches taken in the later stages of this research. A large number of both, design attributes and end-user perceptions were mentioned which confirmed the complexity of their relationship as noted by literature (Codinhoto et al. 2009b). The most frequently mentioned design attribute was seats or seating-related terms, while the overall impression of the design was commonly described by perceptual responses. This finding led to Hypothesis 1 that certain design attributes, such as seats, may influence end-user perceptions more than other aspects of the design. End-user perceptions of the design of OHCWEs were expressed through three categories - emotional, cognitive and associative perceptions. These perceptions were often linked to one another, for example participants expressed that they would feel more relaxed (emotional) if they liked the design (cognitive). This close relationship between individual perceptions and the challenge to separate them are reflected in Hypothesis 2. The third hypothesis referred to the conflicting findings about the relationship between un-/typical healthcare appearance and end-user perceptions.

The three hypotheses stemming from this study are:

- **Hypothesis 1 –** Certain design aspects play a greater or lesser role in influencing end-user perceptions of the design of OHCWEs. As participants paid particular attention to various aspects of seats such as seating arrangement and seating comfort, they are anticipated to have strong effects on end-user perceptions.
- **Hypothesis 2 –** Emotional, cognitive and associative perceptions are strongly related, hence, it is difficult or impossible to separate them.
- **Hypothesis 3 –** Typical and untypical healthcare appearance are not a reliable indicator of end-user preferences. While there are indications that some people prefer being distracted from the fact of being in a healthcare environment, others view untypical designs negatively.

The research design of Study 2a and Study 3 will take these hypotheses into account in order to produce results that can help to confirm or reject them. The next step is, however, to reduce the complexity of the generated data which moves the research to the next chapter.

CHAPTER 6 – STUDY 2A: IDENTIFYING END-USER MAIN PERCEPTIONS OF OUTPATIENT HEALTHCARE WAITING ENVIRONMENTS

6.1. INTRODUCTION

In Study 1, interviews were conducted to explore end-user perceptions of OHCWEs which resulted in a large amount of data. The aim of this study is to simplify and better understand the structure of the data set to retain the most important information. PCA is used as a data reduction technique to compress the numerous perceptual terms into a few main dimensions. The more manageable yet representative number of dimensions will consequently allow the assessment of design variables. This chapter presents the end-user main perceptions as well as the insights gained from the structure of the data.

6.2. OBJECTIVE

The objective of this study is to identify end-user main perceptions of the design of OHCWEs which will then be used to assess design variables.

6.3. RESEARCH METHOD

PCA was identified as a suitable data reduction technique, defined by Dunteman (1989) as follows:

'…a statistical technique that linearly transforms an original set of variables into a substantially smaller set of uncorrelated variables that represents most of the information in the original set of variables...'

The method is used widely across disciplines, especially with the rising convenience provided by statistical programmes (Jolliffe 2002). In conjunction with the compressed data, PCA would reveal the structure of the components, hence; provide insights into the underlying structure of end-user perceptions. The technique has been used by other researchers such as Mourshed and Zhao (2012) to investigate the end-user (healthcare providers) perception of the built-environment. An overview of the research method for this study is shown in Figure 6.1.

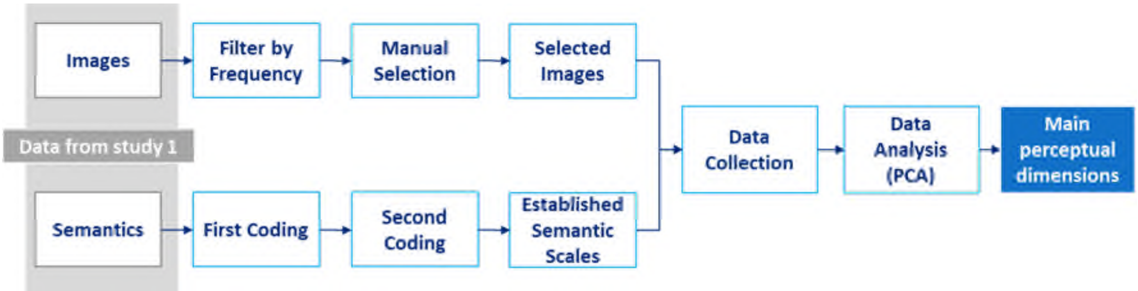


Figure 6.1: Overview of research method used (Study 2a)

As described in Section 2.3.2, the main theoretical frameworks in EBD for example by Ulrich et al. (2010) do not reflect well the relationship amongst end-user outcomes (Figure 2.4). Using PCA the structure of perceptual scales will be revealed which helps to understand the potential theoretical overlap amongst the perceptions.

6.3.1. Sampling frame and target

This study involved participants from the general public, mainly recruited through the University Of Warwick and their referrals. Emails were sent to administration staff at Warwick Manufacturing Group and School of Health and Social Sciences (now part of Warwick Medical School) at the University of Warwick asking them to circulate the poster advertising the study along with the information sheet. Additionally, posters were displayed in areas of University of Warwick that are open to the general public such as Warwick Arts Centre in order to reach a broader audience. Refer to Appendix C for these supporting materials.

Sample size – As mentioned in Section 4.5.1, no formal calculation of the sample size can be carried out for non-inferential statistical techniques such as PCA. However, a ratio value was used in order to establish a stable dimensional scale. Literature recommends a wide range of sample sizes (MacCallum et al. 1999) but Barrett and Kline (1981) found that a minimum of N= 48 equalling a ratio of 1:2 between scale variables and sample size was sufficient to establish stable scales. For 26 pairs used in this study, a minimum of 52 participants were, therefore, aimed to be recruited. To ensure the quality of data and the stability of established scales, statistical measures were applied prior to the main analysis (PCA) including a high level of homogeneity amongst the data expressed by high correlation coefficients and a high *Kaiser-Meyer-Olkin (KMO*) which measures sampling adequacy (KMO = 0.5 is acceptable, (Field 2009)).

6.3.2. Preliminary stage of the research design

This study continued the usage of images as a technique to elicit participants' perceptual responses. The experiment was designed in a two-fold preliminary stage starting with the selection of images to be tested, followed by the development of semantic differential scales for the evaluation.

Selection of images – The purpose of this stage was to select a small, representative set of images covering a wide variety of design concepts in OHCWEs. The number of images needed to be compressed to a feasible amount for empirical testing in order to avoid participant fatigue. The aim was to arrive at a maximum of 15 images, so that if the display and evaluation time for each image would take between two and three minutes, the overall experiment would take 30 - 45 minutes. The final selected images for this study are shown in Figure 6.2.

Figure 6.2: Selected images for visual evaluations (Study 2a)

The selection process was based on how often the images were selected as most representative in Study 1. As the desired number of selected images is 15 and the frequency of three would deliver 29 images, the cut-off criterion was set for ≥ 4. That means images that were rated most representative at least four times were selected for further considerations. Table 6.1 shows the first systematic filter procedure that reduced the number of images from initially 65 to 18.

Frequency	0	1	2	3	4	5	7	8	9	11
Count of images per frequency group	10	15	11	11	5	6	1	3	1	2
Selection status	OUT				IN					
Total number of images				**47**						**18**

Table 6.1: Results of the first selection procedure using the frequency filter

Subsequently, a manual selection was carried out with the support of another independent researcher following two specific aims a) to ensure the broad variety of design concepts to be tested and b) to reduce the number of images to the targeted number of maximum 15. As a result, eight images were removed due to similar or repetitive design styles while four images with the next highest frequency of three were added to complement the variation of design concepts. Results from the manual selection procedure are summarised in Table 6.2.

Frequency	Picture ID	Selection Status 1 = IN, 0 = OUT
4	P27	1
4	P30	1
4	P41	1
4	P57	1
4	P59	0
5	P10	0
5	P12	0
5	P21	0
5	P31	1
5	P34	1
5	P43	0
7	P37	0
8	P17	1
8	P50	0
8	P61	0
9	P60	1
11	P58	1
11	P67	1
Additional Images		
3	P 47	1
3	P 51	1
3	P 63	1
3	P 69	1
Total number selected		**14**

Table 6.2: Results of the manual selection process

Establishing semantic differential scales to evaluate design concepts – The goal of this stage was to establish scales that reflect end-user perceptions of the design of OHCWEs. In Study 1, a large number of end-user perceptions were generated through in-depth interviews which were categorised into emotional, cognitive and associative perceptions. As shown in Table 5.4, Section 5.4.1, these three categories entailed 31 codes based on which differential semantic scales were developed. These scales will then be used for the evaluation of selected images in this study.

To ensure that the semantic scales reflected well the aspects relevant to end-user perceptions, evaluation toolkits used by the NHS were triangulated including *A Staff and Patient Environment Calibration Toolkit* (ASPECT) (DH Estates and Facilities 2008b) and *Achieving Excellence Design Evaluation Toolkit* (AEDET) (DH Estates and Facilities 2008a). However, no additions were made as differing aspects such as the staff perspective in ASPECT were not relevant for the scope of this research.

The scales which contain contrary descriptions at opposite ends were developed following the technique introduced by Osgood et al. (1957). Oxford, Cambridge Online dictionaries and thesaurus were used to verify the meaning and antonyms of semantics. From the 31 codes identified in Study 1, 26 semantic differential scales were developed as shown in Figure 6.3. The codes *Warm/Cold, Other Environments, Events & Experiences, Geographies and Era* were considered unsuitable to be used as semantic scales and therefore disregarded. The decision was made after a pre-test with three independent researchers. For the complete evaluation sheet with instructions, see Appendix C.

Uneven-numbered scales such as a 5-point or 7-point scale offer the option to select a neutral state but a 7-point semantic scale was selected as considered more superior. This is because of the following reasons: (a) Higher scales are suggested to be more reliable (Alwin 1997) and (b) Participants from the pilot study found that 7-point scales provided them a more comfortable range of differentiation compared to the 5-point scales (Section 6.3.3.1).

Domestic	1	2	3	4	5	6	7	Non-Domestic/Business
Healthcare	1	2	3	4	5	6	7	Non-Healthcare
Good Medical Quality	1	2	3	4	5	6	7	Bad Medical Quality
Long waiting time	1	2	3	4	5	6	7	Short waiting time
Expected of Healthcare	1	2	3	4	5	6	7	Unexpected of Healthcare
Light	1	2	3	4	5	6	7	Dark
Flexible Arrangement	1	2	3	4	5	6	7	Rigid Arrangement
Expensive	1	2	3	4	5	6	7	Cheap
Beautiful	1	2	3	4	5	6	7	Ugly
Soft	1	2	3	4	5	6	7	Hard
Fashionable/Modern	1	2	3	4	5	6	7	Old-Fashioned/Outdated
Spacious	1	2	3	4	5	6	7	Cramped
Clean	1	2	3	4	5	6	7	Dirty
Clinical	1	2	3	4	5	6	7	Non-Clinical
Typical	1	2	3	4	5	6	7	Atypical (Untypical)
Social	1	2	3	4	5	6	7	Private
Exciting	1	2	3	4	5	6	7	Boring
Clear Purpose of Space	1	2	3	4	5	6	7	Unclear Purpose of Space
Comfortable	1	2	3	4	5	6	7	Uncomfortable
Uplifting	1	2	3	4	5	6	7	Depressing
Pleasant	1	2	3	4	5	6	7	Unpleasant
Calming	1	2	3	4	5	6	7	Annoying
Welcoming/Friendly	1	2	3	4	5	6	7	Not Welcoming/Unfriendly
Relaxing	1	2	3	4	5	6	7	Stressful
Assuring	1	2	3	4	5	6	7	Worrying
Safe	1	2	3	4	5	6	7	Unsafe

Figure 6.3: Semantic differential scales used in evaluation sheets

6.3.3. Data collection

Quantitative data required for the statistical analysis PCA was collected through the visual evaluation of images showing healthcare waiting environments. Instructions for the procedure were adapted from research on the perception of *soundscapes* by Cain et al. (2013). Participants rated the images on semantic differential scales which reflected end-user emotional, cognitive and associative perceptual dimensions.

Lab-controlled conditions – For the visual evaluations, the audio-visual laboratory (International Digital Laboratory, WMG at the University of Warwick) was chosen due to the minimal distraction and the possibility to control other experimental conditions such as temperature, background noise etc. The room allowed the provision of constant conditions across all participants. No sound was played in the background and the temperature was kept between 19.5°C and 21.5°C to ensure the thermal comfort (18-21°C are comfortable temperatures according to Moore (2005)). Only a reading light was left switched on during the experiment to allow participants to immerse themselves in the task and focus their attention on the displayed images.

6.3.3.1. Pilot study

A pilot study was carried out with five participants in order to test the feasibility of the evaluation task, face and construct validity of the semantic scales. The pilot was completed after the participation of five subjects as their views did not appear to conflict one another. Verifying the representativeness of selected images as well as participants' time requirement to complete the evaluation was amongst the objectives of the pilot study. The experiment was aimed to last no longer than 45 minutes in total in order to avoid respondents' fatigue.

First, participants' understanding of the semantic differential pairs was verified with regard to the clarity of their meaning and the way they were arranged in the evaluation sheet. To do so, participants were asked to explain their understanding of the semantics and in case it differed from the study's intention, alternative wording options were discussed. After ensuring the correct understanding of the method, participants rated the design shown on the displayed images. Participants were told to picture themselves visiting the OHCWEs shown in the photographs, for a routine health check-up. This was to ensure a common context across all participants as explained in Chapter 4. Evaluations were subsequently carried out for the 14 selected images.

As a result of the pilot study, the language used in the questionnaire was simplified. The side of a few semantic scales were reversed so that semantics with rather negative properties were aligned on the left-hand side while the rather positive terms on the right-hand side of the scale. This was to ease the cognitive process for participants. Participants were more comfortable with the 7-point compared to the 5-point scales as they provided sufficient degrees of differentiation as well as allowing them to choose a neutral state. Seven-point scales were therefore selected for the main data collection procedure. Furthermore, randomisation of images was adopted for the main data collection. It was also noted that the description of the context given to participants needed more details such as participants' role of visiting the OHCWE. Participants commented that their design perception and requirements may vary depending on whether they visit the healthcare environment as patient or companion. Especially those with young children explained that they often take their children to the doctor where their design needs centre around the child's needs such as play corner. As a result, the description of participants going to the OHCWE as a patient on their own was added to the standard briefing.

6.3.3.2. Main data collection procedure

An overview of the data collection procedure is provided by Figure 6.4. Once participants had read the information sheet (Appendix C) and signed the consent form (Appendix A), the prepared questionnaire including 26 semantic differential scales was handed to them. Participants received a practice sheet and image prior to the actual experiment which allowed them to become familiar with the task as well as to give them the opportunity to raise any outstanding questions before the actual evaluation.

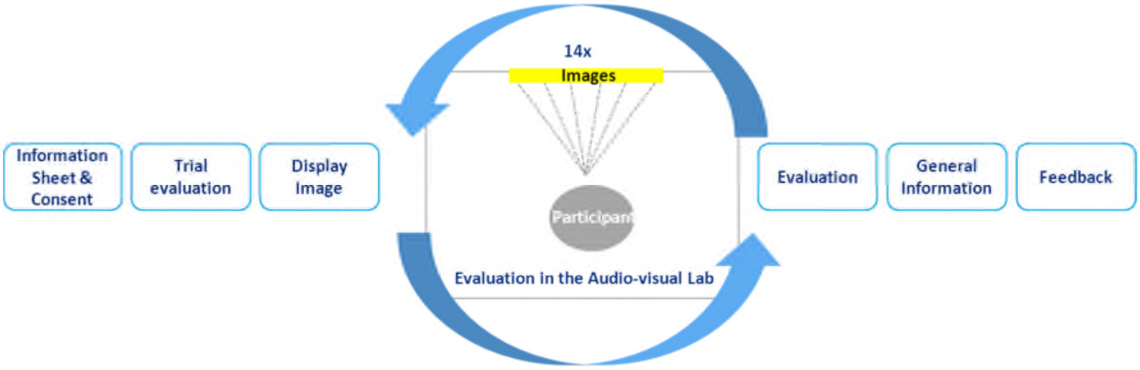


Figure 6.4: Overview of the data collection procedure

Images were shown in a random order which was created using the randomised command in Excel 2010 (Microsoft Corp, Redmond, WA). This procedure was adopted as a result of the pilot study in order to compensate the effect of participants becoming more familiar with the evaluation process during the course of the experiment.

Participants were asked to evaluate each image on all 26 scales. A new image was displayed after each completed evaluation until all 14 images were rated as shown in Figure 6.4. Initially, thoughts were given to limit the display time of each image to a maximum of 100 seconds. According to Ulrich (2011) most aesthetic and analytical responses will be formed within this time. However, the final decision was not to restrict the displaying time of images in order to avoid possible disruptions to the otherwise continuous flow of the evaluation. Moreover, the pilot study also showed that the majority of participants required less than 100 seconds per image so that there was no need for imposing the display time restriction.

An exit questionnaire including exploratory questions about participants' background and their familiarity with OHCWEs was handed to participants upon completion of the evaluation task (Appendix C). This was to ensure a spread of participants and to help the interpretation of the results. Participants were also asked to provide feedback regarding the experiment itself to help improve future study designs.

6.3.4. Data analysis

PCA was applied to reduce the data and to extract the main components which represent end-user main underlying perceptions. Prior to this, pre-analyses were performed to ensure the adequacy of the sample size as well as data suitability for the PCA technique. Results from PCA also provided insight to the structure of the perceptual space, thus, the relationship amongst the scales. All statistical analyses were carried out using SPSS 19.0 and 21.0 (IBM Corp., Armonk, USA).

6.4. RESULTS

6.4.1. Sample

Participants (N=66, 33 males, 33 females) were recruited from the general public, primarily within The University of Warwick and their referrals. Participants' age averaged 38 years (19-76, SD = 14.7) and the largest group falling between 22 and 36 years old as shown in Figure 6.5. The majority of participants (72.7%) were British nationals while 27.3% were UK residents with different nationalities. Most participants stated that they did not have a background in healthcare (68.2%) or design (74.2%). The frequency of visit averaged seven times per year (SD = 9.6) with an estimated average waiting time of 26 minutes (SD = 21.9). Estimated waiting time varied widely with a range from less than five minutes up to two hours. The attendance rate is higher than the figure provided for GP visits in literature which will be discussed in Section 6.5.1.

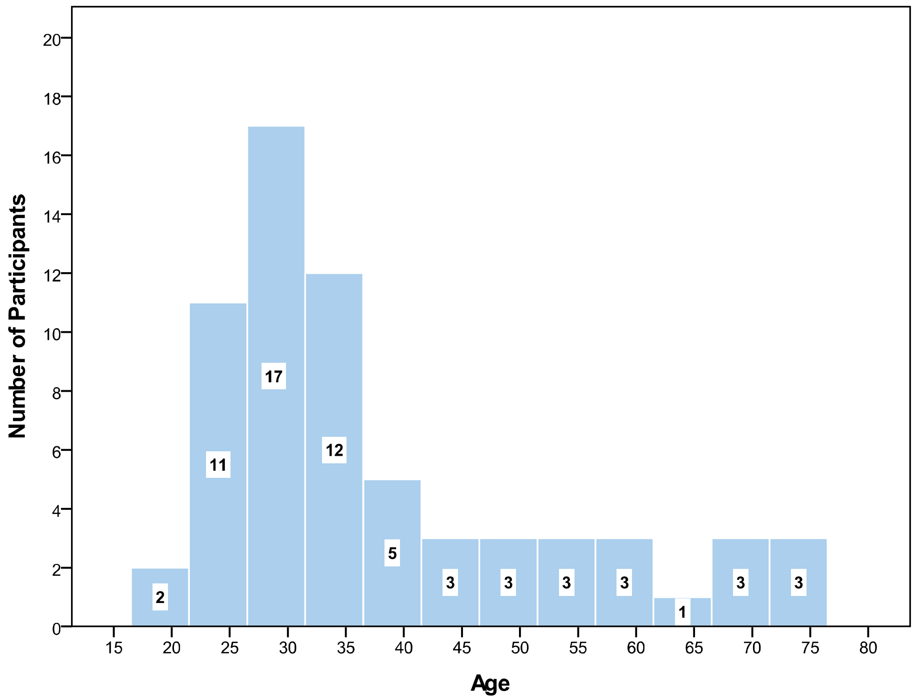


Figure 6.5: Participants' age distribution

6.4.2. Preliminary analysis

First, correlation coefficients of all scales were examined in order to verify their suitability for PCA. Correlation matrix in Table C-1 revealed that the two items *Social - Private* and *Long Waiting Time - Short Waiting Time* were not sufficiently correlated with the rest of the data and therefore removed from PCA. Low correlation coefficients in this context indicated that they were likely to measure a different construct compared to the other scales and that their information could not be adequately represented by the suggested factor solution.

Prior to extracting the main components through PCA, the data was then screened for sampling suitability and adequacy using correlation coefficients, Barlett's Test Sphericity χ^2 and KMO respectively. Barlett's Test of Sphericity χ^2 (276) = 18084.9, $p < 0.001$ suggested that the overall data was sufficiently correlated and therefore suitable for PCA. Overall KMO = 0.96 with the lowest scale showing KMO = 0.833, sampling adequacy was regarded highly satisfactory. According to Field (2009) KMO = 0.5 is considered '*acceptable*' and values above 0.9 '*superb*' (Field 2009).

Communalities of the scales were also assessed to ensure that they are reliable indicators. These values express how much variance of each scale can be explained by the factor solution. Scales with communalities below the standard accepted point of 0.5 were removed from the further analysis as less than half of their variance would be explained by the factor solution. In two iterative steps, four scales *Light* - *Dark*, *Flexible* - *Rigid* and *Domestic* - *Non-Domestic* and *Spacious* - *Cramped* were removed due to their low communalities of 0.35, 0.25, 0.47 and 0.47 respectively (Table 6.3). The 20 final scales with a satisfactory communality above 0.5 were retained for PCA (Table 6.4.).

Communalities before Iteration

	Initial	Extraction
Domestic - Non-Domestic	1.000	.473
Healthcare - Non-Healthcare	1.000	.706
GoodMedQ - BadMedQ	1.000	.653
Expected - Unexpected	1.000	.779
Light - Dark	1.000	.339
Flexible - Rigid	1.000	.271
Expensive - Cheap	1.000	.736
Beautiful - Ugly	1.000	.792
Soft - Hard	1.000	.701
Modern - Old-fashioned	1.000	.658
Spacious - Cramped	1.000	.507
Clean - Dirty	1.000	.635
Clinical - Non-Clinical	1.000	.634
Typical - Atypical	1.000	.718
Exciting - Boring	1.000	.696
ClearPur - UnclearPur	1.000	.622
Comfortable - Uncomfortable	1.000	.773
Uplifting - Depressing	1.000	.801
Pleasant - Unpleasant	1.000	.848
Calming - Annoying	1.000	.709
Welcoming - Not Welcoming	1.000	.710
Relaxing - Stressful	1.000	.729
Assuring - Worrying	1.000	.627
Safe - Unsafe	1.000	.559

Extraction Method: Principal Component Analysis.

Iteration 1

	Initial	Extraction
Healthcare - Non-Healthcare	1.000	.729
GoodMedQ - BadMedQ	1.000	.647
Expected - Unexpected	1.000	.779
Expensive - Cheap	1.000	.741
Beautiful - Ugly	1.000	.798
Soft - Hard	1.000	.652
Modern - Old-fashioned	1.000	.703
Spacious - Cramped	1.000	.474
Clean - Dirty	1.000	.621
Clinical - Non-Clinical	1.000	.726
Typical - Atypical	1.000	.742
Exciting - Boring	1.000	.733
ClearPur - UnclearPur	1.000	.621
Comfortable - Uncomfortable	1.000	.763
Uplifting - Depressing	1.000	.801
Pleasant - Unpleasant	1.000	.852
Calming - Annoying	1.000	.731
Welcoming - Not Welcoming	1.000	.727
Relaxing - Stressful	1.000	.770
Assuring - Worrying	1.000	.671
Safe - Unsafe	1.000	.601

Extraction Method: Principal Component Analysis.

Table 6.3: Iterative approach to retain scales with communalities above 0.5 for PCA

Communalities

	Initial	Extraction
Healthcare - Non-Healthcare	1.000	.732
GoodMedQ - BadMedQ	1.000	.642
Expected - Unexpected	1.000	.780
Expensive - Cheap	1.000	.745
Beautiful - Ugly	1.000	.806
Soft - Hard	1.000	.641
Modern - Old-fashioned	1.000	.723
Clean - Dirty	1.000	.594
Clinical - Non-Clinical	1.000	.730
Typical - Atypical	1.000	.752
Exciting - Boring	1.000	.761
ClearPur - UnclearPur	1.000	.619
Comfortable - Uncomfortable	1.000	.761
Uplifting - Depressing	1.000	.808
Pleasant - Unpleasant	1.000	.853
Calming - Annoying	1.000	.732
Welcoming - Not Welcoming	1.000	.724
Relaxing - Stressful	1.000	.768
Assuring - Worrying	1.000	.676
Safe - Unsafe	1.000	.613

Extraction Method: Principal Component Analysis.

Table 6.4: Communalities after iterations

6.4.3. Principal component analysis

The number of components to be extracted depends on several criteria such as Kaiser's criterion, scree plot and parallel analysis. The latter method is considered most superior of the three according to Zwick and Velicer (1986). As a result of parallel analysis, two components were extracted. Initially, a 3-dimensional solution was considered based on the indications given by Kaiser's criterion and the scree plot. Three components fulfilled Kaiser's criterion by showing eigenvalues > 1 while the inflexion point on the Scree plot occurred at the third component shown in Figure 6.6. However, Kaisers' criterion tends to overestimate dimensionality while scree plot method often involves reliability issues (Zwick and Velicer 1986) depending on sample size.

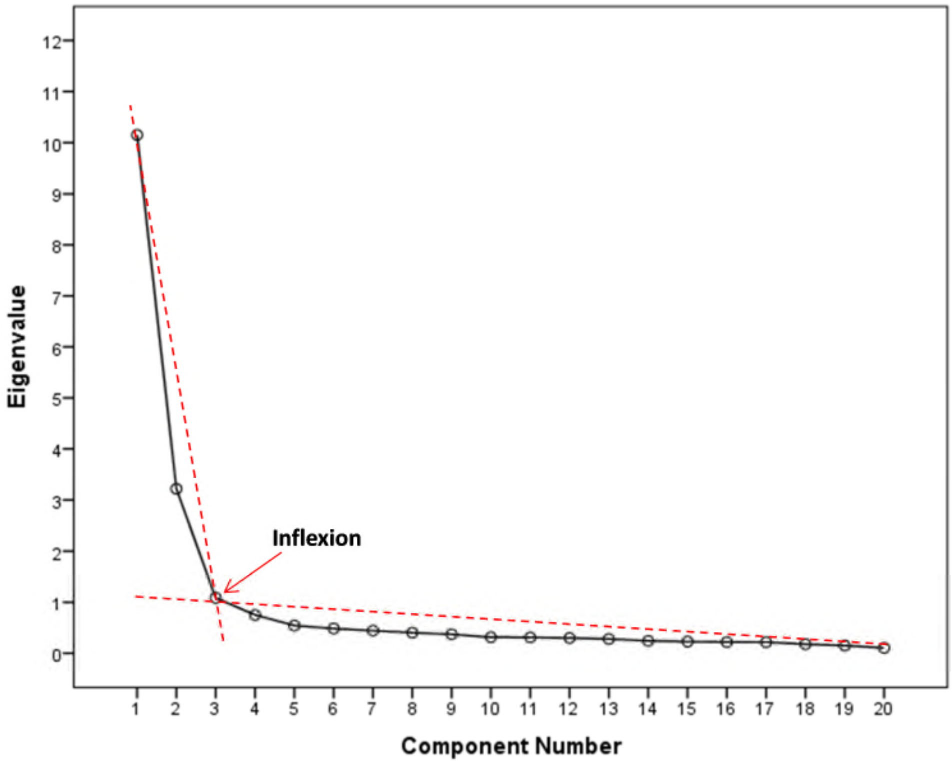


Figure 6.6: Scree plot showing eigenvalues for 20 scales and the inflexion point

Parallel analysis was conducted using Monte Carlo simulation which calculated criterion values for a same size matrix using random numbers. The calculation was carried out using the code written by O'Connor (2000) and software by Patil et al. (2007). According to Horn (1965), components exceeding the criterion values generated by the simulation should be extracted. Table 6.5 shows that only the first two components fulfilled the criteria and were therefore retained.

Component Number	Eigenvalue from observed data	Criterion value from parallel analysis	Decision
1	**10.151**	**1.270**	**accept**
2	**3.218**	**1.222**	**accept**
3	1.088	1.186	reject
4	0.751	1.156	reject

Table 6.5: Eigenvalues from observed data vs. criterion value from parallel analysis

Analysis of the component matrix also revealed that no variables loaded highly onto the third component which would not fulfil the purpose of reducing the data set. A 3-component solution was finally rejected and a 2-component solution was re-computed. Table 6.6 shows that the first component explained 50.76% of the total variance while the second component contributed 16.09% of the total variance. This resulted in a 2-component solution explaining 66.85% of the variance in the original data.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.151	50.757	50.757	10.151	50.757	50.757	9.820	49.102	49.102
2	3.218	16.088	66.845	3.218	16.088	66.845	3.549	17.743	66.845
3	1.088	5.441	72.285						
4	.751	3.755	76.041						
5	.544	2.719	78.759						
6	.485	2.425	81.184						
7	.443	2.217	83.401						
8	.403	2.017	85.418						
9	.371	1.855	87.273						
10	.315	1.573	88.846						
11	.310	1.550	90.396						
12	.299	1.494	91.890						
13	.280	1.398	93.288						
14	.243	1.216	94.504						
15	.229	1.143	95.647						
16	.219	1.095	96.742						
17	.218	1.090	97.832						
18	.178	.891	98.723						
19	.150	.749	99.472						
20	.106	.528	100.000						

Extraction Method: Principal Component Analysis.

Table 6.6: Percentage of the total variance explained by each variable

For the assessment of the relationship between scale variables, the two main components as well as the relationship of the scales amongst one another, a rotated matrix solution was needed. Based on the recommendations of Pedhazur and Schmelkin (2013) an orthogonal rotation should be selected if the two components were independent. However, since there was no theoretical foundation to assume this, an oblique rotation technique was used in the first instance along with an assessment of the component correlation. Their component correlation matrix revealed that the correlation between the two components were negative and small enough to be regarded negligible ($r = -0.164$), thus, an orthogonal rotation was able to be applied.

The rotated component matrix in Table 6.7 showed that 15 scale variables loaded highly onto the first component while the other five loaded strongly onto the second one. All scales apart from *Modern - Old-fashioned* ($r = 0.69$) showed factor loadings above 0.7 which indicated a high correlation between these scale variables and the components. The scale variables also loaded highly onto only one of the two components, which demonstrated the independence of the components. Analysis of the content of the scales showed that Component 1 followed a common theme which was termed Pleasantness while the scales loading onto Component 2 described the typical, expected appearance of a healthcare environment, hence, called Typical Healthcare (Typical HC). Figure 6.7 provides a visual illustration of how the scales loaded onto the components Pleasantness and Typical HC in a 2-dimensional space.

High internal consistency and good reliability of both scales were verified through Cronbach's α values: α (Pleasantness) = 0.96 and α (Typical HC) = 0.87 ($\alpha = 0.8$ considered good according to Field (2009)). No scales within the components could have been removed in order to improve the overall reliability any further.

Rotated Component Matrix[a]

	Component 1	Component 2
Pleasant - Unpleasant	.914	
Uplifting - Depressing	.879	
Beautiful - Ugly	.876	
Comfortable - Uncomfortable	.847	
Calming - Annoying	.843	
Relaxing - Stressful	.825	
Welcoming - Not Welcoming	.814	
Expensive - Cheap	.799	
Assuring - Worrying	.788	
Exciting - Boring	.773	
GoodMedQ - BadMedQ	.759	
Soft - Hard	.753	
Safe - Unsafe	.739	
Clean - Dirty	.731	
Modern - Old-fashioned	.690	
Expected - Unexpected		.867
Healthcare - Non-Healthcare		.841
ClearPur - UnclearPur		.783
Typical - Atypical		.760
Clinical - Non-Clinical		.728

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 6.7: Rotated component matrix showing factor loadings of scale variables onto the two main components

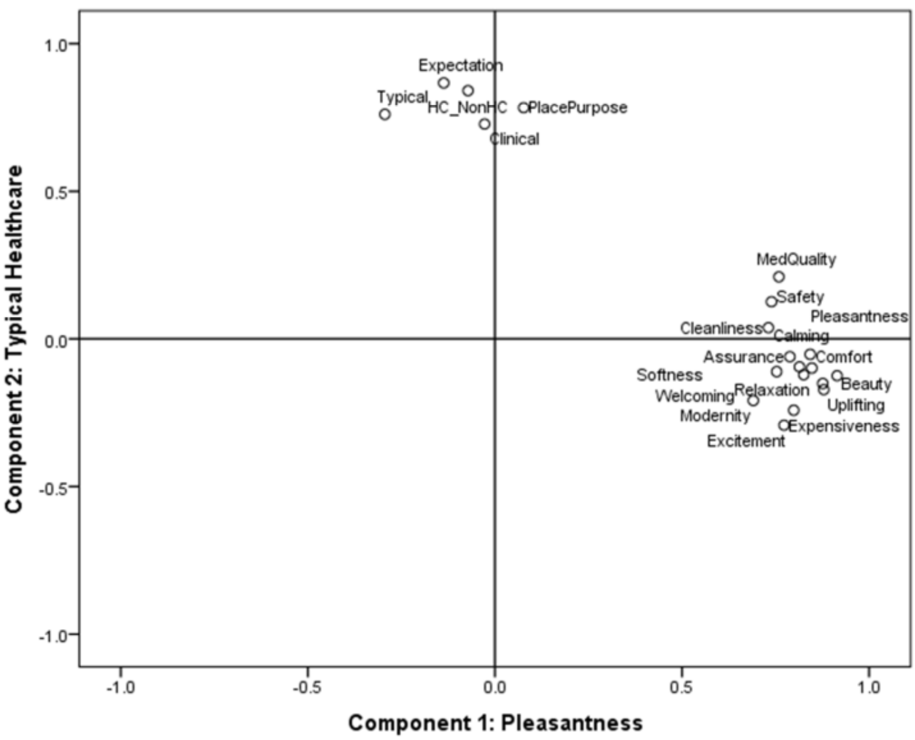


Figure 6.7: Rotated plot of the two components Pleasantness and Typical HC

6.5. DISCUSSION

The aim of this study was to simplify the data on end-user perceptions which were generated in Study 1. The following sections discuss how this objective was achieved using PCA, along with the benefits and challenges of the method.

6.5.1. General discussion of the results

6.5.1.1. Sample characteristics

The recruitment of participants included a wide range age amongst participants (19 - 76 years old) and a combination of students, academic, non-academic staff, non-university employees and retirees. However, a possible limitation may lie within the largest age group being between 22 and 36 years old. While the main recruitment mode was done through the University Of Warwick, diversity within the university as well as their referrals from outside the university was specifically sought after.

Participants stated an average visit frequency of seven times per year which is higher than the figures reported by Hippisley-Cox et al. (2007) which averaged 5.3 times per year for GP visits. The frequency collected in this study refers to participants' own estimation instead of being objectively collected; hence, the difference may arrive from the different methods. The average waiting time estimated by participants was 26 minutes with a wide range (SD = 21.9) including participants indicating a waiting time of up to two hours. As mentioned in Chapter 1, the actual waiting times at the healthcare facilities are not centrally collected but literature indicated waiting times of up to ≥ 4 hours for A&E facilities and ≥ 15 minutes at GP's despite appointments (Ipsos MORI 2012; Triggle 2013). While this study does not measure the relationship between waiting time and end-user perception, it is worth mentioning that literature suggests waiting time to directly impact upon patient satisfaction (Eilers 2004). Therefore, this information was used to appreciate participants' past experience with OHCWEs when interpreting results.

6.5.1.2. Perceptual dimensions unsuitable for further analysis

Two perceptual dimensions *Long Waiting Time - Short Waiting Time* and *Social - Private* were excluded from PCA as they are not sufficiently correlated with the rest of the data set. Qualitative data, however, suggested that they have a role in influencing end-user perceptions of OHCWEs which will be discussed in the overall discussion in Chapter 9. As part of the preliminary analysis, the reliability of the scales was ensured by only retaining those with communalities ≥ 0.5. Consequently, four of them including *Light - Dark, Flexible - Rigid* and *Domestic - Non-Domestic* and *Spacious - Cramped* were removed in two iterative steps from further analysis. It was concluded that these scales were either measuring a different construct or cannot be exclusively assigned to any of the suggested components. Participants may have used very different criteria for the visual evaluation of those scales. However, these dimensions are likely to play a role in understanding end-user perceptions as they have been previously mentioned by participants from Study 1.

The established body of knowledge also supported the impact of light on perception, healthcare and well-being (Joseph 2006a). As presented in Section 3.3.1, the effect of light on people's health and well-being is amongst the best researched design attributes in this area with the most rigorous evidence from across disciplines. In an extensive literature review on lighting in healthcare environments, Joseph (2006a) confirmed that natural and artificial light impact on end-user mood and perception amongst many other outcomes. The brightness of the place as well as the lighting quality may be difficult to evaluate using images as the perception of light may be more suitable for in-situ testing.

This aspect will be discussed in the Section 6.5.2. Another example is the dimension *Flexible* **-** *Rigid* which was also found to be unsuitable for PCA due to low correlations but mentioned by participants in Study 1 with regard to seating arrangement. At the beginning of the evaluation, one participant asked whether this scale referred to the flexibility of appointment scheduling. It was explained to this participant that this scale in this context referred to the layout and arrangements. However, the question provides an indication that participants may have differing interpretations of this scale which may have caused the low correlations.

The two dimensions *Domestic* **-** *Non-Domestic* and *Spacious* **-** *Cramped* showed communalities that were only slightly below the 0.5 cut-off point. Whether they could have been retained for further analysis or not is arguable and depends upon the intended purpose of the extracted components. For exploratory purposes, it may be beneficial to retain them. However, since the components were to be used as to assess design variables in the following study, they were removed from this study in order to ensure the reliability of the scales. Domestication of healthcare and other public facilities could have an impact on people's perception and require further research attention in future (Devlin and Arneill 2003). In Study 1, participants made the distinction between places that *'feel homely'* and those that *'looks like someone's home'.* While '*homely'* was used to express a positive emotion which consistent with findings by Macnaughton et al. (2005), the latter was often related to a negative context such as confusing purpose of the place, unhygienic or not professional for a healthcare environment. While homeliness appears to be a quality people desire, the exact characteristics of such designs are largely unknown (refer to Section 3.2).

6.5.1.3. Pleasantness and Typical Healthcare as end-user main perceptions

As described in Section 6.4.3, parallel analysis was considered the superior method (Zwick and Velicer 1986), thus, used to make the final decision on the number of components to be extracted. This led to the rejection of a 3-component solution and the acceptance of the 2-component solution to describe the data set. The two extracted components Pleasantness and Typical HC represented end-users' main perceptual dimensions of the design of OHCWEs. Together, they explained 66.85% of the variance of the original data.

Component 1 – This component (Pleasantness) consisted of 15 scales, a mixture of emotional and cognitive perceptions. Nearly all scales indicate a positive and a negative meaning at each end of the scales apart from *Soft* **-** *Hard* which could be argued whether it is also polarised. Qualitative data from Study 1 and later in Study 2b indicated that soft referred to a positive perception while hard is less preferred. For example, upholstered and soft furnishings were perceived more pleasant than the counterpart with hard material and surfaces. The positive ends of the scales describe characteristics of a place where people would prefer to be and was therefore termed *Pleasantness*. Furthermore, the scale *Pleasant* **-** *Unpleasant* itself showed the highest loading factor (0.914) within Component 1 which means that it represented the most reliable indicator for this component.

In Study 1, it was hypothesised that emotional, cognitive and associative perceptions may be difficult or impossible to be separated due to their close relationship (Hypothesis 2, Section 5.5). The structure of the components revealed a mixture of emotional and cognitive scales presented in each component, hence, supports this hypothesis. This also supports the decision to create scales from all three categories:

Emotional, cognitive and associative perceptions. Cognitive perceptions may influence emotions and much of them may happen at a sub-conscious level or as Reber (1989) referred to as *implicit processing*. As an example from this study, people evaluated the design with regard to their perceived medical quality and cleanliness (cognition) in a similar pattern as feeling assured and relaxed (emotion). This evaluation may or may not arrive from the consciousness, refer to Section 2.2.1 for more details on the debates about the relationship between emotional and cognitive perceptions. Analysis of the structure of the perceptual space therefore provides valuable insights to the relationship amongst the cognitive and emotional perceptions.

Component 2 – The Typical HC scale represented five mostly associative and cognitive dimensions describing the construct of the typical, expected appearance of a healthcare environment. The low component correlation coefficient ($r = -0.164$) between the two components suggests that they are not likely to be dependent upon each other. With $r^2 = 0.027$ only 2.7% of the variance of one component was explained by the other, thus, can be considered negligible. The two separate, uncorrelated components suggest that the typical healthcare appearance is not a sole indicator of perceived pleasantness of the OHCWE. The relationship between the design of OHCWEs and end-user perception is likely to be influenced by a number of other factors and their combinations. This is in support of Hypothesis 3 from Study 1 (Section 5.5) which stated that the un-/typical healthcare appearance may not be a reliable indicator of end-user preferences. A new facility that does not resemble a typical healthcare environment can be perceived as discomforting and their purpose and role confusing to people. This was found by Macnaughton et al. (2005) where people were not at ease in a atrium-inspired area of a new healthcare facility. Furthermore, the uncorrelated relationship of the two components challenges previous research suggesting a negative relationship between the standard institutional appearance with positive outcomes (Leather et al. 2003). However, expectation has been suggested to play a role in influencing people's liking of *servicescapes* (Bitner 1992) despite its contribution to the component Typical HC in this study. The role of expectation will be discussed in connection with other influencing factors of end-user perceptions of OHCWEs in Chapter 9.

The objective of this study was met as the large number of perceptual dimensions was reduced to the two end-user main perceptions Pleasantness and Typical HC. They enabled the assessment of design attributes in Study 3.

6.5.2. Discussion of the strengths and limitations of the method

The use of images as a representation of the real environment was well-perceived by participants, as previously seen in Study 1. Participants found the data collection approach to be immersive and that it allowed them to easily picture themselves being in those displayed OHCWEs. After the evaluation, the majority of participants a felt strong urge to explain their rating decisions and shared their personal experience with healthcare resulting in additional qualitative data and valuable insights. Furthermore, this confirms the appropriateness of choosing a mixed methods approach for this research as explained in Chapter 4. It also shows that the research deals with a topic that appears to pre-occupy people from the general public, especially once brought to their awareness. Participants also confirmed that a good variety of design concepts was given with many of them showing commonly experienced and unconventional design concepts.

As discussed in Section 6.3.3, the evaluations under lab-controlled conditions allowed a constant setting for all participants which added to the rigour of the method. However, apart from the initial brief and the advantage that participants can raise questions directly with the researcher, the evaluations may have also been feasible using a computerised platform. This is relevant for research seeking to recruit a larger number of sample size as well as a broader reach of participants' diversity.

Despite notable advantages, the use of images to represent the real-environment also comes with methodological challenges. For example, a number of perceptual scales may be better suitable for in-situ testing. This applies in particular to scales that were found either unsuitable for PCA (due to low correlations) or unreliable as an indicator (low communalities). These perceptual dimensions may require participants to experience the environment in a different manner or through different sensorial input. This holds truth in particular for dimensions like *Long Waiting Time* - *Short Waiting Time* and *Social* - *Private* that are strongly related to the circumstantial context of the visit. The dimension *Spacious* - *Cramped* may also require participants to make an evaluation based on actual usage and experienced interaction with the environment. Future research may therefore benefit from a differentiation between perceptual scales suitable for in-situ and those for representation studies.

Finally, some participants also found the use of scales not as intuitive and would prefer a verbal description on each of the scaling point which will be considered in Study 3.

6.6. SUMMARY

Two dimensions Pleasantness and Typical HC were identified as end-user main perceptions of the design of OHCWEs. This simplification of end-user perceptions enables their further use to assess design attributes which will be undertaken in Study 3. Another key finding was the uncorrelated relationship between the two main components Typical HC and Pleasantness which supports Hypothesis 3 from Study 1

(Section 5.5). The hypothesis suggested that the un-/typical appearance of healthcare environment may not be a reliable indicator of end-user preferences which will be discussed in more detail in Chapter 9. Hypothesis 2 was also confirmed as each component revealed a structure that contains a combination of emotional, cognitive and associate perceptions. Two dimensions *Long Waiting Time* **-** *Short Waiting Time* and *Social* **-** *Private* showed low correlations with the rest of the data set, hence, are likely to measure a different construct. Their role in end-user perceptions of OHCWEs will be discussed in Chapter 9.

CHAPTER 7 – STUDY 2B: ESTABLISHING A THEORETICAL FOUNDATION FOR THE RESEARCH DESIGN OF STUDY 3

7.1. INTRODUCTION

The empirical studies so far (Study 1 and Study 2a) provided insights into how end-users perceive different design concepts. However, the contribution of design variables towards the two end-user main perceptions remains unclear which will be assessed in Study 3. In preparation for the research design of Study 3, a theoretical foundation about the possible relationship between design aspects and the perceptual dimensions Pleasantness and Typical HC was developed. This chapter describes the process of how data from different sources were consolidated to establish these inputs, followed by their discussion.

7.2. OBJECTIVES

The objective of this study was to generate inputs to be used as a theoretical foundation for the research design of Study 3 by building upon existing knowledge from the studies 1 and 2a.

7.3. RESEARCH METHOD

Figure 7.1 provides an overview of the research method used in this study including data sources and analyses that were applied.

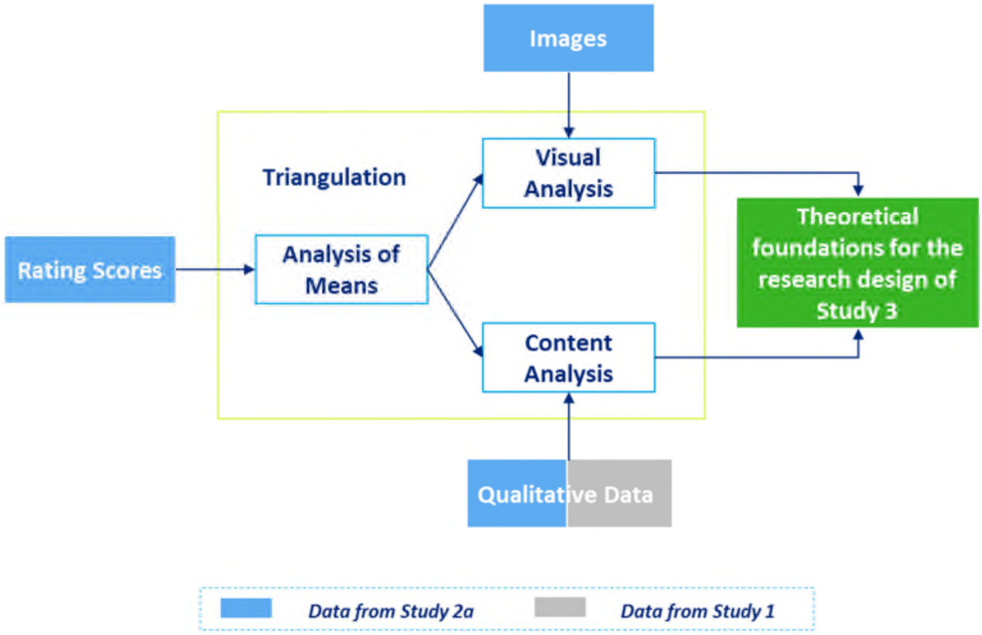


Figure 7.1: Overview of research method to establish the relationship between design aspects and end-user main perceptions

First, the mean scores of the participant ratings from Study 2a were ranked on the Pleasantness and Typical HC scales. Visual and content analyses were then carried out for all images and interpreted with regard to their rank on the scales. The analysis of the images was carried out following techniques and theories from visual social sciences. Kolb (2008) suggested that the information from visual images should be treated and analysed in a similar manner as verbal responses. The initial step was, therefore, to analyse the content of the images, followed by their categorisation into themes as they emerged. A checklist using design aspects from Study 1 served as a template to ensure that the same criteria were applied across all images in the analysis (Table 7.1). Refer to Table D-1 for an example of such visual analysis.

Picture ID	Criteria/ Description	Overall Design	Interior	Structure & Function	Decoration	Facilities
ID Number	Style/Overall					
	Size					
	Colour					
	Arrangement					
	Material/Surface					

Table 7.1: Matrix used as a template for the visual analysis of images

Upon completion of the visual analysis of images on the scales, findings were mapped against qualitative data and jointly interpreted. Qualitative analysis was carried out using the software package NVivo10 (QSR International Pty Ltd. Version 10, 2012).

The combination of several qualitative methods used in this study was to ensure the rigour of the findings and is in line with the methodological triangulation approaches by Morse (1991).

7.4. RESULTS

The mean of participants' rating scores in Study 2a were used to produce the two visual scales shown in Figure 7.2. To ensure that the mean scores were a suitable measure of the central tendency, they were compared with both the mode and median values. It was found that all three measures of central tendency were comparable. The mean rating scores of the images on individual scales are presented in Appendix D.

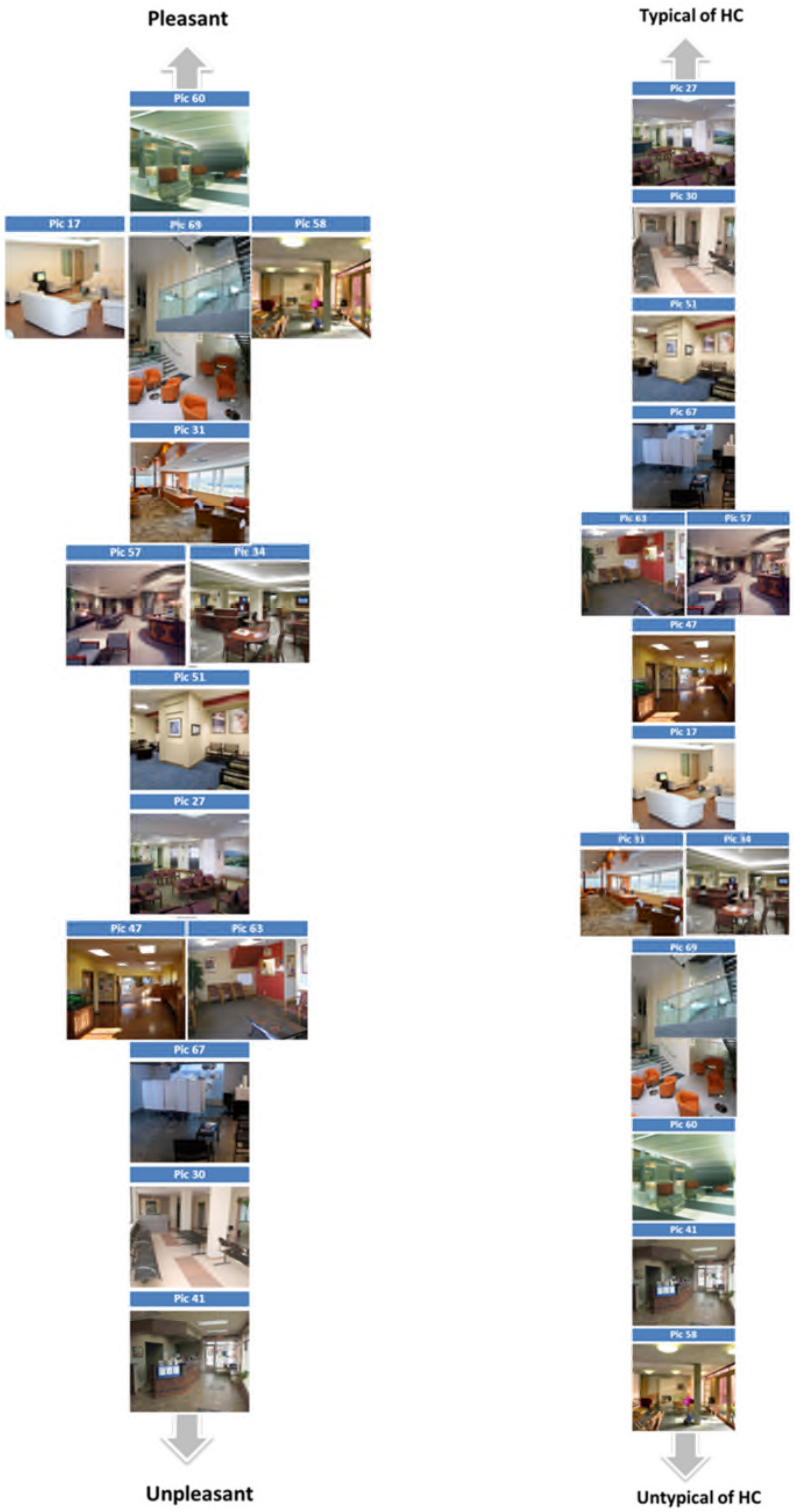


Figure 7.2: Visual scales of Pleasantness (left) and Typical of HC (right) *extended from* Vuong et al. (2013)

7.4.1. Images on the Pleasantness scale

Qualitative and visual analysis of the data revealed that nine aspects of the design dictate the level of perceived pleasantness as detailed in Table 7.2.

Descriptors for Pleasantness	Explanation
Hygiene	Perceived cleanliness of the overall place and the interior
Seating Comfort	Seating comfort can be reflected by the seat design, in particular with regard to whether the seats were upholstered or made of hard surfaces.
Space Accommodating Different Needs	This criterion describes the way the space was used and whether it provides end-users different seating facilities or allowing different activities to simultaneously happen. Aspects such as seating arrangement, types of seats and spatial division are considered.
Natural Elements	Design elements or strategies that were applied to convey a natural feel in the overall space e.g. green plants, natural lights etc.
Condition of the Space and Interior	This criterion refers to the state of the space and interior as well as the degree of their maintenance and care regardless of their style and modernity.
Clear Function of the Waiting Room	The assessment is made based on whether the purpose of the waiting room was well-communicated to end-users through design visual cues.
Additional Features	Additional features refer to elements that may exceed the primary and functional requirements, thus, demonstrates additional effort and attention to the detail.
Welcoming Reception Desk	Visibility and openness of the reception desk (if present in the images) were used as indicators of their welcoming and assuring quality.
Modern Style of Interior	The level of modernity may be assessed through the shape, function, colour and material of the interior.

Table 7.2: Definition of descriptors for Pleasantness scale

Overall, images were ranked *pleasant* demonstrated the highest fulfilment of these design characteristics while the lack of these characteristics was perceived unpleasant. An overview of the results is detailed in Table 7.3.

TABLE OF RESULTS – CHARACTERISTICS OF IMAGES ON THE PLEASANTNESS SCALE

Descriptors	Pleasant	Mid-Scale	Unpleasant
Hygiene	Images at the pleasant end of the scale (e.g. 60, 69 and 58) appear very clean, partially due to the excellent condition of their space and interior. The seat covers were mainly made of materials that could be easily cleaned such as smooth leather or hard plastic. Apart from Image 31, the floors of those images were not carpeted but laminated or used a non-shiny flooring material. Even though carpet was often disliked due to the associated concern for the lack of hygiene, its condition appears to also play a role in the perception of pleasantness. For example, the carpet shown on Image 31 appears to be in a good condition and was perceived as *'…carpet is awful but they are trying to make it an attractive and a more comfortable place to be in.'*	Perceived hygiene of images in this category ranged from acceptable to a good level. Images showed carpets that differed in their condition and appearance. For example, the carpet in Image 27 appeared to be more for industrial use and worn-out compared to the one in Image 31. However, there were no stains or any obvious signs for uncleanliness compared to Image 63 from the group 'Unpleasant'.	The overall design in this category appeared to be less hygienic compared to the other two groups. Image 63 showed carpeted flooring with a visible stain to the left side of the room. Other visual cues for the perception of an unhygienic environment included for example the plastic wrapping material on the arms of the seats (Image 30), the fully cluttered reception desk (*'Part of the reception is lowered for wheelchairs but then they covered that area with paper and other stuff'* – Image 41) or the dark tiled, concrete flooring *'awful, floor dirty…'* – Image 67.
Seating Comfort	Seats were either upholstered, *'soft and cosy'* (Image 17) or consisted of a combination of upholstered and non-upholstered seating options (Image 60).	Seats were also upholstered similar to images towards the pleasant end of the scale. However, the padding and style appeared to be less comfortable (e.g.	The low level of seating comfort was characterised by the non-padded seats *'…they just seem very cold. There are lots of hard surfaces.'* or *'…can't even lean back when you*

Descriptors	Pleasant	Mid-Scale	Unpleasant
Seating Comfort *(cont'd)*	Comfort was also enhanced by the provision of soft cushions within the space (Images 58, 60). Even though participants generally expressed their preference for soft furnishing *'…oh this is nice, it has soft furnishing…'* – Image 58, there were also concerns regarding the practicality of these seats in a healthcare context *'…sofas there seem comfy but for old people they are not practical, hard to get up…'* - Image 17.	Image 27 compared to sofas from Image 17).	*sit on those benches…'* – Image 41. Other images (Images 30, 47) also showed seats with hard surfaces or with some padding (Images 67) *'…these seats are terrible, they are not comfortable. They are awful.'*
Space Accommodating Different Needs	Most rooms were small or medium-sized apart from Image 69 which appeared to be part of a larger facility. All images showed an effective use of the space by providing a functional number of seats without overcrowding the space. Different types and styles of seats were provided and grouped into smaller clusters. *'It's kind of nice where you got these chairs there and then you have a bit more of a private area in there as well. It's just like a nice place to wait. They are like cubicles aren't they.'* – Image 60. The majority of seats were either sofas or individual padded armchairs (Images 69, 31).	Different seating arrangements were displayed including rows of seats in the room (Image 27), rows against the wall (Image 51) and clusters of seats (Image 34).	An increased level of rigid seating arrangements was found amongst images ranked unpleasant e.g. *'…terribly cold and rigid…'* – Image 30. Seats were lined up in rows mostly against the wall (e.g. Images 67, 63, 30). The space, therefore, did not provide a flexible arrangement to accommodate different needs: *'…three separate chairs in a row against the wall: It's ok if you come with a friend but if on your own it's hard to sit in the middle.'* – Image 63.
Natural Elements	A number of strategies to create a natural feel in the space was adopted such as the	This group showed the use of wall decoration such as representational	Some of the designs showed a good amount natural lighting due to large windows (Image

Descriptors	Pleasant	Mid-Scale	Unpleasant
Natural Elements *(cont'd)*	inclusion of large windows with a view of a green landscape (Image 31) or a garden (Image 58): *'Lots of them have very large windows which for me is a big plus…'* or *'You can look out of the window and see some green…'* Image 60 showed the use of wood materials on the wall as well as a green and earthy colour tone for the interior. Another strategy was to create an airy atrium atmosphere (Image 69) that evoked the outside feel.	photographs and artwork (Image 27) as well as the use of green plants (Images 27, 57) and flowers in the room (Image 57).	41) and included wooden material (Image 47) but do not convey a natural appearance as a result of other design aspects in the room. *'They are trying to make an effort with the plant in the corner to give it a bit of an outside feel but it doesn't really work with what else is going on in the room.'* – Image 63.
Condition of the Space and Interior	The overall state of the space was distinctively different compared to images that were ranked neutral or unpleasant. The designs towards this end of the scale appeared to be in an immaculate state either because they were new or very well-maintained (e.g. Images 60, 69).	Some designs included older but well-maintained furniture (Images 34, 27).	All designs towards this end of the scale were consistently old (Image 63), made of poor quality or not well-maintained. Image 30 was referred to as *'…run-down waiting rooms…'* or associated with *'…drug addict drop-in centre area or something…'* The association of an old warehouse was mentioned with regard to Image 67: *'This concrete…floor with cracks…, so it kind of looks like a warehouse that's been painted.'*
Clear Function of the Space	A number of images did not resemble a commonly experienced healthcare environment but the spaces were obviously created to be used as a waiting area: *'There's*	The purpose of the spaces as a healthcare waiting environment was best communicated by the designs in this category. Apart from Image 34, other	Designs that were found most confusing with regard to their function and purpose were found at this end of the scale. This was expressed by for example the insufficient

Descriptors	Pleasant	Mid-Scale	Unpleasant
Clear Function of the Space *(cont'd)*	*a lot going on, it's a mix of all these things but it has the right combination – it didn't drift too far from the waiting room…'* – Image 58. Confusion was, however, expressed regarding the function of the high seats and those that appeared to be convertible into a bed as shown in Image 60: *'Is this a spa? Are these seats or beds?*' or *'Not clear at all. Is it hospital bed or waiting room?'* The number of seats could also affect the clear purpose of the waiting room: *'There are only four seats so it doesn't look like it's been designed to be a waiting area.'* – Image 60.	neighbouring images resembled a commonly experienced healthcare environment and the purpose of the waiting areas were apparent which was also referred to as *'conventional, expected'* – Image 27.	number of chairs for a waiting room (Images 41, 67) or the presence of untypical design elements such as a white curtain separating the room (Image 67). The following examples show how participants questioned the primary function of the room: *'Not obvious that it's HC, unforgiving'* – Image 41 *'Seats are like at Heathrow airport where they have to be cleared below in case of a bomb threat - Unwelcoming, could be anything'* – Image 30 *'And it's really strange because they have got these medical screens, cheap chairs, and then big image on the walls…So it's very difficult to get any clues from this on what exactly the space is there for, except that people do sit there for quite some time. It's very dark, and it's a bit scary*.' – Image 67
Additional Features	Additional elements such as artwork, greenery, magazines, ambience lighting, and water coolers were integral parts of the overall design. People took notice of the additional details *'It's got a TV, a coffee*	Many of the additional features were also present in this group but their conditions were generally not as immaculate or exclusive as images ranked more pleasant. Individual design elements were not	Images ranked unpleasant showed pre-dominantly designs with poor quality and that were not well-executed with attention to the detail or to the overall concept. No additional features and efforts made towards the design

Descriptors	Pleasant	Mid-Scale	Unpleasant
Additional Features *(cont'd)*	*table…' (*Image 17) as well as appreciated them due to the associated level of care: *'There is a sense of space, sense of comfort and colour…a sense that people who have to wait there are valued…More effort was put in this to make it a pleasant time…'* – Image 31. Other additional details included painted skirting boards to enhance visibility or designed colour schemes of the interior to match the overall style.	designed to fit in an overall concept.	were apparent.
Welcoming Reception Desk	Images, if showing the reception area e.g. Image 31, included an open, eye-levelled built reception desk that is visibly placed in the centre of focus.	Designs included open-built reception desks with clear visibility in the room which was perceived welcoming (e.g. Images 27, 34). However, exclusive interior could also be perceived as *'…intimidating, reception counter looks like it's trying too hard…'* – Image 57.	Reception desks were positioned in a corner with less visibility (Images 47, 63) compared to the ones towards the opposing end of the scale. In both images, the reception desks were built as a separate unit where potential interactions between staff and visitors would happen through glass dividers. The importance of being able to interact with medical staff or at least the feel that it would be possible in a healthcare waiting environment was expressed as follows: *'I have been to places where that's [reception desk/area and waiting room] completely separated. And if you don't see them [medical staff, receptionist] you might wonder whether*

Descriptors	Pleasant	Mid-Scale	Unpleasant
Welcoming Reception Desk *(cont'd)*			*they have forgotten about you. Do they know I'm here? Mind you that could happen as well when they are there, I have seen people sitting there for hours asking: I have been there for three hours, have you forgotten about me?' -* Image 67.
Modern Style of Interior	Apart from Image 17 which *'looks old-fashioned'* but showed well-kept interior and sofas, most images consisted of very modern designs. '*The chairs are different, they look like they are from Ikea or so, contemporary, funky…'* – Image 69. Participants perceived the modern style as pleasant (*'stylish and creative'* – Image 58) or *'…very modernistic and I like this. It grabs your attention, it's attractive.'* – Image 60.	A range of styles from *'modern', 'sort of modern enough'* (Images 51, 34) to *'old-fashioned*' (Image 27) was presented in this category. However, all of them appeared to be well-maintained.	Interior was dated (Image 41), designed in an *'old-fashioned*' manner (Image 67) or *'old and cluttered'* (Image 63).

Table 7.3: Characteristics of images on the Pleasantness scale

7.4.2. Analysis results of images on the Typical Healthcare scale

The same analysis was applied to images on the Typical HC scale which revealed that their designs were distinguished by the following four aspects (Table 7.4):

Descriptors for Typical HC	Explanation of Criteria
Flexibility of Seating Arrangement	In the assessment of the sub-groups of Pleasantness flexibility was also part of the descriptor 'Space accommodating different needs'. However, since the arrangement was found to be a clearer indicator for the Typical HC scale, this criterion was made more specific.
Modern Style of Interior	A common criteria for both, assessment of image groups based on pleasantness and Typical HC
Association with Non-HC Public Spaces	The designs within this group showed characteristics and cues that were associated with public places other than healthcare.
Colour Activity	*Active – Passive* was used in Ou et al. (2004b) as one of the measurement of the activity factor for colour emotions.

Table 7.4: Definition of descriptors for the Typical HC scale

Images ranked typical for healthcare showed least fulfilment of the specified differentiating aspects compared to other images on the Typical HC scale. A mix of different designs was found towards the centre of the scale with some appearing rather neutral, neither very typical nor very untypical of a healthcare environment. The designs within the group, therefore, varied in many aspects. Designs at or towards the untypical end of the scale fulfilled most of the differentiating aspects. Table 7.5 provides an overview of design characteristics found for the perceptual dimension Typical HC.

Table of results – Characteristics of images on the Typical Healthcare scale

Descriptors	Typical HC	Mid-Scale	Untypical HC
Association with Non-HC Public Spaces	This group comprised designs with characteristics that matched specific schemata of the healthcare setting appearance: *'Based on experience. Single seating, back to back, back to wall, a bit of magazines; a bit of artwork…'* or *'…reception, seats back to back, magazines put together a waiting room of what I expected.' – Image 27.*	This category consisted of a number of images that were neither very typical nor very untypical of healthcare.	The designs within this group showed characteristics that were strongly associated with non-HC public places e.g. *'spa'* (Image 60), *'café'* or *'hotel lobby'* (Image 69) or a *'take-away shop'* (Image 41). Design qualities of images within this group varied widely. In fact, the two images that were previously rated most pleasant (Image 60) and least pleasant (Image 41) with contrasting design quality levels shared this common group of Untypical HC.
Flexibility of Seating Arrangement	The designs included rigid seating arrangement as the most dominant characteristics. Upholstered single chairs (Images 51, 27) and hard benches (Image 30) were arranged in straight rows, either in the room or along the walls: *'…conventional in terms of single seats, position around the edge or back to back…'* – Image 51.	Images 63, 57, 47 showed rigid seating arrangements in rows while other images (34, 31 and 17) displayed small clusters of seats. Row arrangements were described as functional and in a negative manner: *'Chairs put so that everybody has to face each other. I know that the place is often tight and their plan is to get people through as quickly as possible. You often sit there for hours on uncomfortable chairs, staring at strangers.'* – Image 57. The importance of flexibility of seating arrangement to accommodate different visiting context and scenario was	Designs ranked towards this end of the scale appear to have flexible, grouped or clustered seating arrangements with the exception of Image 41.

Descriptors	Typical HC	Mid-Scale	Untypical HC
Flexibility of Seating Arrangement *(cont'd)*		pointed out as *'…you may want to be somewhere like here [pointing at Image 34] where seats are more spread out. Even though you may not have that space everywhere but it might be more preferable. Or if you go with somebody, you might want to talk to them and you would feel that you had a little bit of privacy. Yeah, so haven't thought about it but going on your own and going with somebody is a different sort of experience isn't it'* – Image 34. The ambivalent desire of privacy while still being able to interact with others if needed was expressed as follows: *'…this one is kind of better in the sense that you don't have people sitting and engaging but they can still approach you, they are not too far away…'* – Image 47.	
Modern Style of Interior	The functional style of seating with cover materials that appeared to be easy-care (apart from Image 51). Row alignments and *passive* colours were often referred to as *'conventional'* or *'traditional'* by participants in studies 1 and 2a. They may serve as design cues for a typical healthcare waiting environment setting. The condition of the interior and the space itself varied from image to image within this group with e.g.	The type of seats also varied greatly from hard wooden bench (Image 47) to cushioned, comfortable sofas (Image 17). Some images resembled non-healthcare places with interior that were either old-fashioned (Image 63) or modern (Images 34, 31). The latter ones also adopted the use of ambience lighting (Images 57, 31) and elements for distraction e.g. a TV (Images 34, 17). Image 57 was, however, perceived *'dark and gloomy'* despite the use of ambience lighting showing the importance of the multiple aspects of lighting.	A mix of modern designs (Images 58, 60) as well as *'old-fashioned'* style (Image 41) was reflected by images towards this end of the scale. A number of seating styles were presented in this group e.g. foldable, wooden chair (Image 58), high seats (Image 60) and hard corner benches (Image 41). The extensive use of material such as glass (Image 69), shiny metal and plastic surfaces (Images 60, 69) or tiled flooring and reception desk (Image 41) might add

Descriptors	Typical HC	Mid-Scale	Untypical HC
Modern Style of Interior *(cont'd)*	Image 51 showing a very good design quality and condition (*'It's what I expect of a waiting room but it [design] surpasses it [expectation]. It's more about the execution rather than the content. How they have done it is above expectation. So quality, high quality…'*) while the design from Image 27 is older but also well-kept. Images 30 and 67 showed designs that were classed as poor quality.		to the appearance that is 'untypical' for a healthcare environment. The modern designs appeared to be well-perceived and expressed as: '…busy, light, colour, interesting character…', *'…fun, would enjoy…', 'very refreshing, relaxed, more domestic, very light'*- Image 58 or *'very modern', 'quite fashionable and modern, especially this one [pointing at Image 60*].' – Image 60.
Colour Activity	Designs were in *passive* colours with fluorescent lighting that were mainly used for the functional purpose of visibility. Image 51 represented an exception where ambience lighting was applied.	Images 31 and 63 showed interior with *active* colours while others used pre-dominantly *passiv*e tones. However, it was noted that the red shades used for the walls and the interior in Image 63 were not well-perceived: *'I do not like the seat covers and I think the red going on here [wall] is just not a good shade of red, just not inviting.'*	Modern designs were associated with the use of *active* colours (Images 58, 60) while the *'old-fashioned'* style appeared to be linked with 'passive colours' (Image 41).

Table 7.5: Characteristics of images on the Typical HC scale

7.4.3. Quantifying qualitative findings

Results from Table 7.3 and Table 7.5 revealed that the fulfilment of the design characteristics appears to change from one end of the scale to another. As an example, images ranked pleasant are those that were perceived most hygienic which becomes less pleasant due to the reduced level of hygiene towards the middle of the scale. Images that appeared unhygienic were ranked unpleasant.

In order to form the theoretical foundation for Study 3, it would be helpful to illustrate these findings in a more compact form. This would also allow a better comparison of how the design characteristics change along the two scales. Qualitative data from Table 7.3 and Table 7.5 were therefore quantified using the code 1 and 0, following guidance from mixed methods literature e.g. by Auer-Srnka and Koeszegi (2007). The codes 1 and 0 were assigned based on whether the images along the two scales have achieved the defined design characteristics (1 = Fulfilled, 0 = Not fulfilled). The weighted sum average of each group (both ends of the scale and the scale centre) is shown in Table 7.6 (Pleasantness) and Table 7.7 (Typical HC). Refer to Table D-2 and Table D-3 for the full coding and the calculated weighted average for both scales.

Criteria*	Pleasant	Pleasantness	Unpleasant
Hygiene	1.00	0.75	0.00
Seating comfort	1.00	1.00	0.20
Space accommodating different needs	1.00	0.25	0.00
Natural elements	0.80	0.25	0.00
Condition of the space and interior	1.00	0.75	0.00
Clear function of the waiting room	0.80	1.00	0.40
Additional features	1.00	1.00	0.00
Welcoming reception desk	1.00	1.00	0.00
Modern style of interior	0.80	0.50	0.00

Table 7.6: Ratings of each group on the Pleasantness scale based on selected characteristics

Criteria*	Typical (Typical HC)		Untypical
Flexibility of seating arrangement	0.00	0.50	0.75
Modern style of interior	0.25	0.33	0.75
Association with non-HC public spaces	0.25	0.67	1.00
Colour activity	0.25	0.33	0.75

Table 7.7: Ratings of descriptors on the Typical HC scale based on selected characteristics

On the Pleasantness scale, images that showed a good level of *Hygiene, Space Accommodating Different Needs, Natural Elements, Condition of the Space and Interior* and *Modern Style of Interior* were perceived pleasant. On the other hand, unpleasant designs were those that did not fulfil these characteristics. *Seating Comfort, Welcoming Reception Desk* and *Additional Features* were equally achieved by designs that were ranked pleasant and those in the middle of the scale. With regard to the clear function of the room, images that ranked in the middle of the scale scored the highest. On the Typical HC scale, all four characteristics showed a gradual change from least fulfilled (*typical*) to most fulfilled (*untypical*) even though not to the same degree.

7.5. DISCUSSION

The aim of this study was to consolidate existing knowledge from the studies 1 and 2a to form a theoretical foundation for the research design of Study 3. This was achieved by using methodological triangulation of qualitative, visual and quantitative data from different sources which improved the rigour of findings (Morse 1991). The approach also provided insights to the potential relationship between the design and end-user perception of OHCWEs. Images on the visual scales provided a non-verbal and non-numerical illustration of how the design characteristics change along the two scales. This enables an immediate visual insight on how design concepts were perceived with regard to Pleasantness and Typical HC even prior to applying a traditional analysis such as content analysis.

Inputs established in this study can be used towards the design of Study 3 as well as contribute towards future investigations. Overall, the established inputs contributed to existing framework in EBD which according to Ulrich et al. (2008) is fundamental to the emerging area.

7.5.1. Design aspects responsible for Pleasantness and Typical Healthcare

As most of the identified design characteristics that are responsible for differentiating images from one another appeared to be related to the interior design, their role in end-user perception is underlined. This is in agreement with literature suggesting that end-user health and well-being can be impacted by the interior e.g. by Ulrich (1991).

Condition of the design – Designs rated pleasant by end-users appeared to be either new or in very good condition regardless of their styles. Literature indicated that the design quality and its perceived level of pleasantness may be more important rather than the specific appearance of the interior. For example, the effect of freshly painted colours in schools was found to impact teachers and students regardless of the specific colours (Rice (1953) cited in Tofle et al. (2003)). It was also reported that a good, well-maintained environment can be perceived by the end-user as an effort and commitment towards them. The majority of images showing designs in well-maintained conditions incidentally were also modern in style. Image 17 represents an exception where the interior and décor appear to be old-fashioned, yet well-maintained. More research is needed to improve the clarity of the individual impact of these two characteristics in order to verify whether the condition of the design overrules the modernity aspect.

Perception of hygiene – The perception of cleanliness also appears to relate to the condition of the overall space and its interior design. New and well-maintained designs may also be favoured because they were perceived to be more hygienic. Their role in end-user perception may relate to the associated risk of infection and contamination in a healthcare environment which has been an on-going issue in patient safety (Ulrich et al. 2008). The material used may be an important design cue for the perceived level of hygiene. The images rated pleasant tend to have matt, bright flooring. However, a number of carpeted designs were represented along the Pleasantness scale, so that the relationship between the type of flooring and perceived pleasantness are unclear. The qualitative data, however, revealed that carpet was often mentioned in a less favourable context. At the same time, soft furnishing appeared to be perceived more pleasant due to the comfort factor. This represents a challenge for manufacturers to consider material that offers both, comfort and easy-care properties. Also, it emphasises the importance and difficulty to balance and trade-off design attributes when designing an OHCWE. The advantages and disadvantages for carpeted and vinyl flooring were discussed in Chapter 3. The level of required hygiene also depends on the exact space and the type of outpatient facilities. Within the outpatient sector, a waiting area in outpatient hospitals may be perceived as more clinical, and therefore, at higher risk of infection compared to a waiting room at the dentist.

Additional Features and Natural Elements – Participants rated images that contain *active* colours (Ou et al. 2004a) more pleasant. However, this may relate to the combination of factors such as lighting, interior style and the condition instead of colours themselves. Tofle et al. (2003) pointed out that colours themselves do not have the property to directly influence emotions and that their perceptions lie within the individual's associative and cultural origin. Images showing decorative elements including green plants and paintings were also rated more pleasantness. These features add to the aesthetic dimension of the overall environment which can be regarded as indicators for true design quality (Ulrich 2011). Staricoff (2004) concluded from an extensive literature review that various forms of arts can promote health and well-being in healthcare environments. The inclusion of indoor plants in the design was found to impact health and well-being positively according to Dijkstra et al. (2008b). The preference of natural elements has also been suggested to have its roots in evolutionary foundations (Dutton 2003). Overall, participants perceived features exceeding the fundamental, functional requirement of the environments ('must have') as a reflection of the amount of invested effort and the level of appreciation towards end-users.

Spatial dimension and Modernity – Images showing either small spaces or larger spaces that were divided into smaller sub-units appeared to be perceived more pleasant. This was also found in the study by Macnaughton et al. (2005) where people expressed their preference for small, friendly, old-fashioned and homely spaces over large scale environments. They also found that participants felt discomforts towards the modern environment as it was *'intimidating'* which is consistent with findings from this research. This raises the question of when modernity is perceived positive in an OHCWE and whether there was an optimum level of modernity. One participant from Study 2a pointed out that it should only be *'modern enough'* and that once the design reaches a certain level of quality and modernity, people will want other aspects such as additional services within the OHCWE.

Reception desk – Open, accessible reception desks or reception areas were more preferred than those that appeared less accessible and detached or separated from the waiting area. This applies to images where a reception desk was included as a number of images did not show a reception area. However, the absence of a reception desk did not appear to affect participants as many of images were rated pleasant regardless of the inclusion of the reception area. An explanation could be that participants were given the set context of being in those OHCWEs, so that no initial orientation was needed. This potentially reduces the necessity of having a reception desk as a design cue for guidance and reassurance. An absence of a reception area in reality may, however, contribute to disorientation and increase end-user stress level (Baskaya et al. 2004). From the end-user perspective, most privacy issues were reported to be in the reception area during their interaction with the reception personnel (Rice et al. 2008). While the staff perspective is not within the scope of this research, the design of the reception area needs to also consider their requirements and well-being. For example, as end-users in A&E departments can be more emotional and potentially aggressive, the reception staff may require a more protected reception area (Design Council 2013). The area behind the reception and a space that accommodates staff's need should also be considered since their well-being can impact upon staff performance (Zimring et al. 2005) which in turn can affect the end-user experience.

Seat specifications and arrangement – Single seats and combinations of single and multiple seats were frequently found in designs rated pleasant. Single chairs may be preferred due to the perceived level of privacy or hygiene factors. Designs with flexible seating arrangements were perceived more pleasant compared to those more structured and rigid. This may be linked to the social behaviour which was suggested to be influenced by seating arrangement (Holahan and Saegert 1973). However, flexibility whether applied to seating type or arrangement may be well-perceived as people are provided with a choice, which gives them ownership over the space. Literature suggests that being able to influence the environment can contribute to people's well-being as people feel in control (Ulrich 1991). This is especially relevant in healthcare environments where unfamiliarity and disorientation can become sources of stress (Baskaya et al. 2004). Groups of soft and mixed types of seats may also be more pleasant due to the preference of curvilinear arrangements as found by Dazkir and Read (2012). Rigid rows of seats were more often found in designs that were referred to as Typical HC. This arrangement is the most economic and functional way to fit the maximum number of seats in the waiting area. While the aesthetic aspect of this arrangement and the *passive* colours (Ou et al. 2004a) often found in Typical HC designs may not score highly, they may be more in line with people's expectation of OHCWEs. Depending on the age of the interior and the end-user, certain types of design may also be typical for healthcare due to their manufacturers, trends and regulation at the time. Geographical differences can also play a role: In countries with tropical and sub-tropical climate other materials such as tiled flooring and hard seats might be perceived more Typical HC or more pleasant.

Association of a typical or untypical healthcare environment – Associations were discussed in Study 1 (Chapter 5) as a type of end-user perceptual response towards the design of OHCWEs. In literature, terms including *institutional* (Arneill and Devlin 2002) or *traditional* (Leather et al. 2003) were used to describe the concept of a Typical HC design. However, no exact description of their characteristics can be found as the perceived degree of 'typical' may depend on the individual differences and their perceptions. Rapoport (1982) explained that end-users from the lay public use associations to explain their understanding of the built-environment. Arneill and Devlin (2002) also mentioned that the perception of quality was rated less positive if the design differs from '*a schema that patients have of a doctor's office*'. Refer to Chapter 9 for an overall discussion on the perceived dimension of typical healthcare and how it relates to end-user perceptions.

7.6. SUMMARY

This study provided a theoretical foundation about the possible relationship between a number of design aspects and end-user main perceptions as shown in Table 7.3 and Table 7.5. These findings are summarised in Table 7.8 and Table 7.9 and will be used as inputs into the research design of Study 3. Results also confirmed that the un-/typical healthcare appearance may not be a reliable indicator of end-user perception of pleasantness which was hypothesised in Study 1 (Hypothesis 3).

Descriptors for Pleasantness	Their specification for a pleasant design
Hygiene (Input 1)	The perception of hygiene shows a positive relationship with the level of perceived pleasantness. The more hygienic the design is perceived, the more pleasant it will be. The perception of hygiene appeared to be communicated through the condition and specification e.g. material of the design and the space.
Condition of the space and interior (Input 2)	Images with new or well-maintained designs were perceived more pleasant than old spaces that were not well-looked after. This characteristic is linked to the perception of hygiene.
Seat specification (Input 3)	Upholstered, comfortable seats were perceived more pleasant. Single seats or their combination with multiple seats were preferred over the provision of only multiple seats.
Seating arrangement (Input 4)	Flexible seating arrangement in the form of clusters or a combination of groups and rows
Reception desk (Input 5)	Open, accessible and visible reception desk
Additional features (Input 6)	Features that are added on to the basic design and demonstrate attention to the detail and that end-users are being 'valued')
Natural elements (Input 7)	Places using natural elements conveying an outside feel are perceived pleasant.
Clear function of the space (Input 8)	Rooms that appear to be a dedicated waiting room
Modern style of interior (Input 9)	Designs with modern features were more likely to be perceived pleasant or neutral. However, 'too modern' can become unpleasant as the optimum level of modernity remains unknown.

Table 7.8: Design specifications related to the perception of Pleasantness

Descriptors for Typical HC	Specification of a typical healthcare environment
Flexibility of seating arrangement (Input 10)	Rows of uncomfortable single chairs and benches were associated with more typical for a healthcare environment
Modernity (Input 11)	Old-fashioned designs were more linked to a typical healthcare environment. This characteristic, however, appeared to be linked to the colour scheme and condition of the design.
Association of non-HC public spaces (Input 12)	Design cues associated with the schemata of an OHCWE from past memories and experiences were ranked typical for healthcare
Colour activity (Input 13)	Tendency of including old or old-fashioned interior with *passive* shades of colours.

Table 7.9: Design specifications related to the perception of a Typical HC

CHAPTER 8 – STUDY 3: EVALUATING THE RELATIVE IMPORTANCE OF DESIGN ATTRIBUTES ON END-USER MAIN PERCEPTIONS OF THE DESIGN OF OUTPATIENT HEALTHCARE WAITING ENVIRONMENTS

8.1. INTRODUCTION

Studies 1 and 2a provided a better understanding of how end-users perceive different OHCWE design concepts. For a more complete understanding, it is also necessary to investigate end-user perception of design attributes which forms the basis for this study.

In preparation for the research design of this study, measures were developed in Study 2a and inputs for the selection of design attributes were established in Study 2b. Pleasantness was found to be the main perception, explaining most of the total variance (50.76%) while Typical HC contributed 16.09% (Study 2a). This study, therefore, focuses primarily on the assessment of design attributes with regard to perceived Pleasantness. As shown in Table 6.7 (Study 2a), the component Pleasantness consists of a combination of 15 emotional and cognitive perceptual scales which include aspects such as relaxation, comfort and beauty. Findings about how pleasant end-users perceived specific design attributes have the potential to be more relevant for practical design implementations.

This chapter explains how photo-realistic renderings were included in a traditional full-profile Conjoint Analysis method to assess end-user perceptions of specific design attributes. A discussion on the findings and learning that stemmed from the approach is provided at the end of the chapter.

8.2. OBJECTIVES

The main objectives of this study were to understand and to predict the role of selected design aspects with regard to perceived pleasantness (Objectives 1 and 2). A secondary goal was to better understand how the circumstantial context of the visit may influence the perception of pleasantness in OHCWEs (Objective 4). Another sub-ordinate goal was to explore the level of Typical HC of the selected design scenarios (Objective 3). This will contribute to the broader discussion on the relationship between typical healthcare appearance and pleasantness. All objectives for this study are summarised as follows:

1. To quantify the contribution of selected design attributes and levels towards end-user perception of a pleasant design in OHCWEs
2. To predict the level of pleasantness for untested design scenarios
3. To explore the contribution of selected design attributes and levels with regard to perceived level of Typical HC
4. To better understand how circumstantial factors may influence end-user perception of pleasantness in OHCWEs

8.3. OVERVIEW OF THE RESEARCH METHOD

To address the different objectives of this study, a mixed methods research design comprising quantitative and qualitative aspects was developed as shown in Figure 8.1. The main part of the conjoint survey consisted of participants' evaluation of the developed photo-realistic renderings. Conjoint Analysis was then used to quantify the relative importance of design attributes and their levels (sub-attributes). Additional questions in the survey were analysed using methods that were suitable for their quantitative or qualitative nature.

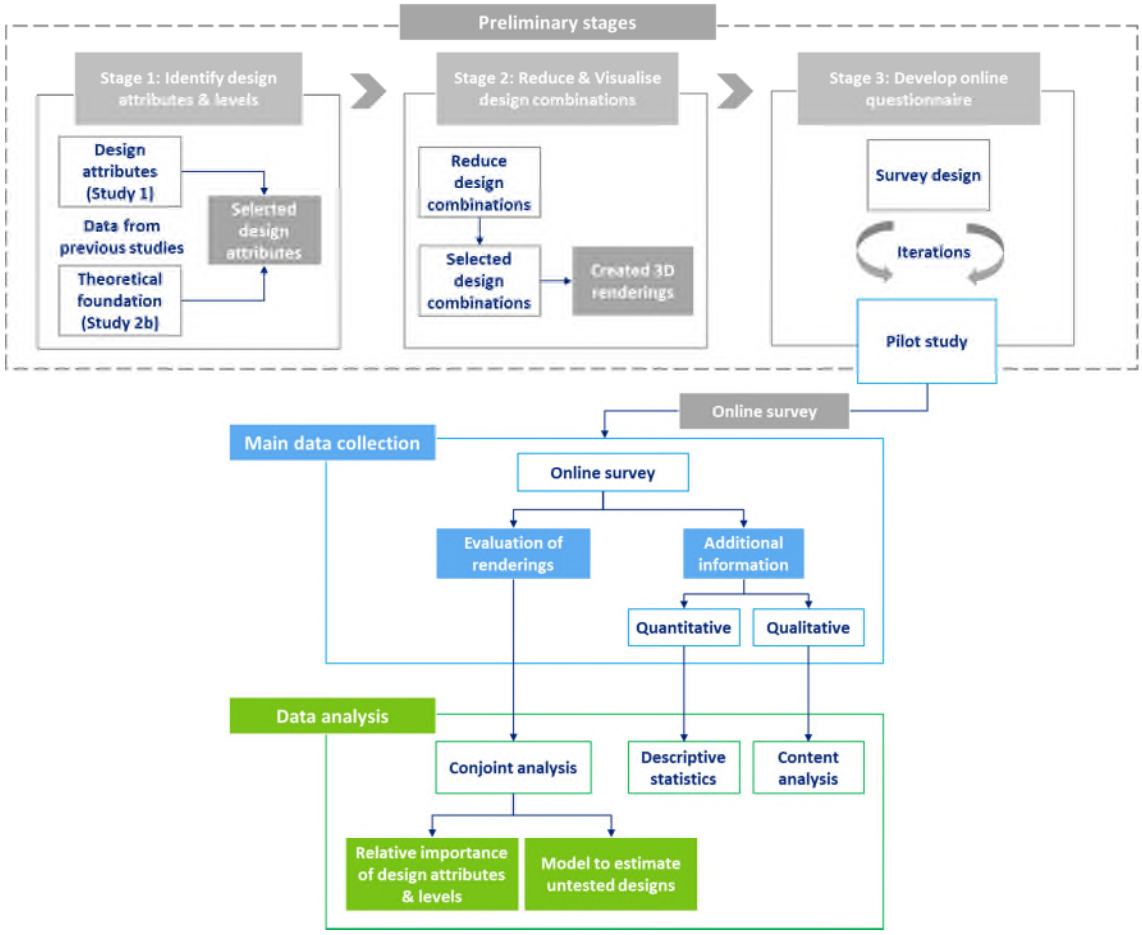


Figure 8.1: Overview of the research method design (Study 3)

Rationale for Conjoint Analysis – Asking people to express the importance of individual design features by means of distinctive values can be challenging. This is because they tend to think of the design as an overall concept rather than as a set of separate design features. Based on Gestalt theory (Koffka 1922) which was mentioned in Chapter 2, people were suggested to group designs by factors such as their symmetry, similarity or movement and perceive them as a whole unit instead of viewing them in isolation. Conjoint Analysis was selected to overcome this challenge. As an established method, it is frequently used in consumer research to understand buyer's decision-making (Green and Srinivasan 1978). Originating from mathematical psychology (Luce and Tukey 1964), the method is now widely used due to its capability to reveal end-user perception about individual features of products and services.

Considerations for the different conjoint approaches based on the guidance provided by Orme (2003) and Hair et al. (2010) were summarised in Table 8.1. This was to ensure that the most suitable approach for the purpose of this study was selected.

Conjoint Methods	Full-profile Conjoint	Choice-based Conjoint	Adaptive Conjoint
Number of Attributes	Up to 6 (Orme 2003), Up to 9 (Hair et al. 2010)	> 6 (Up to 10) (Orme 2003), Up to 6 (Hair et al. 2010)	> 6
Data Collection Method	Computer and Paper format possible	Preferably computerised	Must be computerised
Data Level	Individual level utility	Group level utility	Individual level utility
Sample Size Requirement	Small sample size	Large (due to group data level)	Small sample size
Experiment Duration	Long	Short	Long
Pricing Research	Not recommended	Preferable	Preferable

Table 8.1: Comparison of different conjoint methods (Orme 2003; Hair et al. 2010)

The full-profile conjoint approach was selected for this study as it requires a small sample size and can provide individual level data. While the adaptive conjoint method also offers these two benefits, it is limited to a computerised data collection method. Choice-based and adaptive conjoint methods are advantageous for studies that include the price variable which is irrelevant for this study. The full-profile approach can include up to six (Orme 2003) or nine attributes (Hair et al. 2010) which was regarded sufficient for this study as seven design attributes were selected (see Section 8.4.1). Similar to the adaptive conjoint method, the full-conjoint approach requires a longer duration time which was accepted because individual-level data was needed to gain insights on the relative importance of each design attribute.

8.4. PRELIMINARY STAGES

The purpose of the three preliminary stages was to prepare the experimental design which combines the traditional full-profile conjoint approach with photo-realistic renderings. Design attributes were firstly selected and relevant design levels assigned, followed by the visualisation of their design combinations. The final preliminary step before data collection involved the development of an online survey that incorporated these created renderings.

8.4.1. Stage 1 – Identifying design attributes and levels to be tested

Design attributes[4] and design levels[5] were selected for testing using previous findings from Study 1 and inputs from Study 2b. The selection was carried out in two steps as described below.

First, design aspects from Study 1 were considered based on their suitability to be used as visual stimuli in this study. For example, design descriptors involving multiple aspects of the design such as Design Concept were disregarded, as the purpose of this study was to assess individual design attributes and levels. Spatial and height dimensions were regarded to be better suited for in-situ testing, hence, fixed as a constant variable as specified in Table 8.5. Another example was lights which were frequently mentioned by participants in Study 1 (108 Counts). Their effect was not tested since the impact of light on end-user perception, health and well-being is amongst the most consistent and well-documented in the field of EBD (Dijkstra et al. 2008b; Joseph 2006a). Lights and associated design aspects such as colour, windows were set as fixed parameters in the study design as shown in Table 8.5, Section 8.4.2.

[4] Design attributes refer to single design aspects or parameters as defined in Section 4.5.3
[5] Design levels describe sub-attributes as defined in Section 4.5.3

In the second step, retained design attributes were then ranked based on the number of times they were mentioned by participants in Study 1 (Figure 8.2); refer to Figure 5.5 in Section 5.4.2 for details on design aspects and their frequencies. Those design attributes with highest frequencies and summed to a cumulative frequency of 80% were then maintained for further considerations. This cut-off point was based on the Pareto Principles, where 20% of causes are suggested to explain 80% of the overall problem (Juran and Riley 1999).

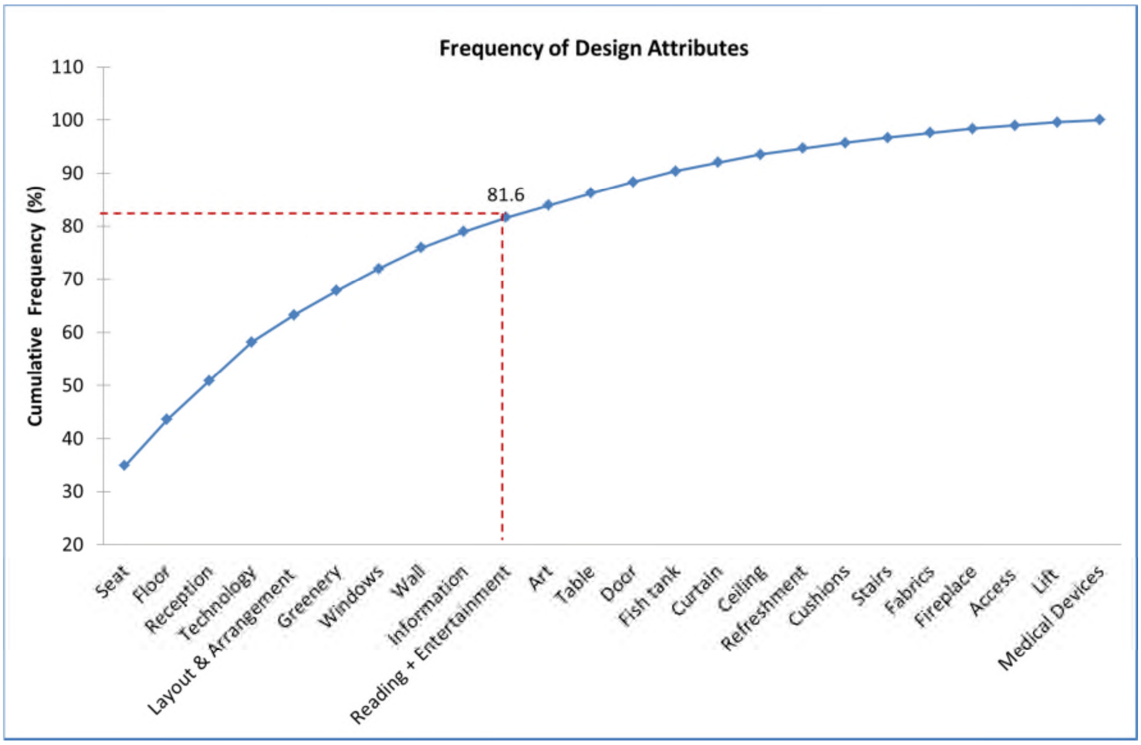


Figure 8.2: Cumulative frequency of design attributes from Study 1

Results from the Pareto analysis were then triangulated with learning from Study 2b as shown in Table 8.2. Due to the dominant role of seats in the Studies 1 and 2b, three attributes involving different aspects of seats were included. Design levels were defined using rules specified by literature (Gil and Sánchez 1997; Orme 2002). Table 8.3 shows the final design attributes and their associated levels which were included in the experiment.

Pareto Analysis (Study 1)	Rationale & Inputs from Study 2b	Decision
Seats	Seat specification (Input 3) – Seat comfort, seat occupancy	Include different seat types and seat padding/upholstery
Arrangement & Layout	Seating arrangement (Input 4) – Flexibility of arrangement	Include structured and flexible seating arrangements
Floor	Expressed through the hygiene aspect (Input 1) – Material used in the space	Variation of flooring materials
Reception	Reception desk (Input 5) – Openness and accessibility	Include degrees of openness, visibility and accessibility
Window	Related to light and outside view (fixed parameter)	Include as constant parameter
Information	Design cues related to what participants expressed as *'Knowing what's going on'*	Included in the form of design cues that provide information e.g. signage, time display etc.
Technology, Greenery and Reading & Entertainment	With a count of 32/57, TV was the most frequently mentioned design attribute amongst Technology. Greenery is part of Natural Elements (Input 7) but was described combined with lights and other features conveying an outside feel which are not included for testing. All three categories share overlapping concepts mentioned in Input 6 - Additional Features	These three categories were combined to create a new category called Additional Features as they share the common characteristics of exceeding the basic functionality of a waiting room.

Table 8.2: Triangulation of design attributes from Study 1 and inputs from Study 2b

Design Attributes	Design Levels
Seating Arrangement	Groups
	Rows
Seat Capacity	Multiple Seater
	Single Seater
	Both Seating Types
Seat Padding	Hard (non-padded)
	Padded
	With and Without Padding
Reception	Closed, Against the Wall
	Open, Against the Wall
	Closed, In the Wall
Floor	Wood
	Vinyl
	Carpet
Additional Features (AddOn)*	Yes
	No
Signage**	With Signage
	No Signage

Table 8.3: Overview of design attributes and design levels

**AddOn = TV screens, reading material (magazines and newspapers on tables), vending machine (refreshment facility), green plants*

***Signage = A set of signage showing 'Waiting room', waiting time, time/clock, consultation rooms, exit signs and 'Reception'.*

8.4.2. Stage 2 – Reducing and visualising design combinations

The selected design attributes and their levels would result in a total of 648 design variations based on the 2x3x3x3x3x2x2 design. Due to participant cognitive capacity and time restriction, it is empirically not possible to test this number of design profiles. As part of the common practice when using the full-profile conjoint approach, an orthogonal main-effect design is used to reduce the number of profiles to an empirically feasible amount. SPSS 21.0 (IBM Corp., Armonk, USA) was used to produce the fractional factorial design which is a subset of all possible combinations of design levels. This subset of data, also called an orthogonal array, ensured that the main effects of the design levels can be estimated. Table 8.4 gives an overview of all design combinations generated by the orthogonal design which will be translated into 3D renderings. In addition to the 16 design profiles to be tested (Card ID 1-16) four Holdout profiles (Card Profiles 17-20) were produced for validity purposes. Holdouts are design profiles included in the evaluation but 'held out' from the estimation calculations.

Card ID	Arrangement	Seat Capacity	Seat Padding	Reception Desk	Flooring	Add ON	Signage
1	Rows	Multiple Seater	Both	Closed, Against the Wall	Vinyl	No	Yes
2	Rows	Multiple Seater	Hard	Open, Against the Wall	Carpet	Yes	No
3	Groups	Multiple Seater	Hard	Closed, Against the Wall	Wood	Yes	Yes
4	Rows	Single Seater	Hard	Closed, In the Wall	Wood	No	Yes
5	Groups	Both Seating Types	Both	Closed, In the Wall	Carpet	Yes	Yes
6	Rows	Multiple Seater	Padded	Closed, Against the Wall	Carpet	No	Yes
7	Rows	Single Seater	Both	Closed, Against the Wall	Wood	Yes	No
8	Groups	Multiple Seater	Both	Open, Against the Wall	Wood	No	No
9	Rows	Multiple Seater	Hard	Closed, In the Wall	Vinyl	Yes	No
10	Rows	Both Seating Types	Hard	Open, Against the Wall	Wood	No	Yes
11	Groups	Single Seater	Hard	Closed, Against the Wall	Carpet	No	No
12	Groups	Multiple Seater	Hard	Closed, Against the Wall	Wood	Yes	Yes
13	Groups	Single Seater	Padded	Open, Against the Wall	Vinyl	Yes	Yes
14	Rows	Both Seating Types	Padded	Closed, Against the Wall	Wood	Yes	No
15	Groups	Multiple Seater	Padded	Closed, In the Wall	Wood	No	No
16	Groups	Both Seating Types	Hard	Closed, Against the Wall	Vinyl	No	No
17*	Groups	Single Seater	Padded	Open, Against the Wall	Carpet	No	Yes
18*	Rows	Both Seating Types	Padded	Closed, In the Wall	Vinyl	Yes	No
19*	Groups	Both Seating Types	Both	Closed, Against the Wall	Vinyl	No	Yes
20*	Rows	Multiple Seater	Both	Open, Against the Wall	Carpet	No	Yes

** Holdout*

Table 8.4: Overview of design profiles to be tested

Using the descriptions of the design profiles shown in Table 8.4, photo-realistic renderings of healthcare waiting environments were created with the help of an external

3D modeller using 3DS Max 2012 (Autodesk, San Rafael, USA). The theoretical specifications stemmed from the researcher while the technical and rendering skills were provided by the external 3D modeller who was recruited for this purpose. Photo-realistic 3D renderings were selected to represent the real environment instead of photographs due to the following reasons:

- A high level of flexibility to modify design attributes and levels systematically while having control over fixed variables
- Results with high level of realism
- As computer-aided design techniques are commonly used in the conceptual and design stages, the application of renderings in this study is in line with current industry practice.

The development of photo-realistic renderings started with the creation of a basic model of an OHWE and the set-up of constant design variables. The basic model was not a reproduction of any specific real-life environment but instead created using the design specifications stated in Table 8.5. Specifications and general guidance were taken from a number of official guidelines such as HBN 40: Public areas, HBN 12: Out-patients department (NHS Estates 1995, 2004). As the primary goal was to test design attributes on the perceived Pleasantness scale, inputs from Study 2b for Typical HC (Table 7.9) were used to create a standard healthcare appearance. This was done to help respondents understand the nature or primary function of the presented space. However, this may cause the ratings of Typical HC (Objective 3) to result in a narrow range with little differentiation. Details such as content behind reception were included to help the renderings to appear more realistic. A number of design aspects were set as fixed variables which formed part of the basic model Table 8.5. For example, the number of windows and external views were kept constant as they represent a light source to the indoor space, hence, can vary the fixed lighting. In addition, external views from windows were also set as a constant where all renderings would have the same view. This was decided based on the rationale that the views are often dictated by the location of healthcare settings which will be difficult to alter in reality. This study focussed specifically on design aspects that can be easily implemented at low cost, yet are impactful in their contribution towards pleasantness. The selection and visualisation of constant and variable design attributes were discussed with an experienced designer specialised in healthcare built-environment.

Fixed Attributes	Specifications	Rationale/Further Descriptions
Waiting room type	Dedicated	A self-contained room dedicated for waiting purpose. (Based on Input 8 from Study 2b)
Wall	Plain, off-white	Artwork and colours not in testing scope Off-white for a more realistic appearance
Ceiling	Tiled ceiling	Common for industrial usage and in healthcare facilities
Height	2.9m	Designer from Boex Ltd (a UK-based design company specialised in healthcare) advised that 2.6m are common for newer and higher for older facilities.
Lift	Standard metallic look	Contribute to realism
Size dimension	95sqm (8.5m x 11 m)	Based on HBN 40 (NHS Estates 1995). Calculation based on an approximate capacity of 50 people (including 20 spaces for disabled people). 0.5m per person without disability and 1.5m (with disability). Reception area = 15sqm. Corridor = 10sqm. Base = 20sqm.
Colour	Blue shade – Seats Floor – Beige/yellow shade for all materials Wall – Off-white	Selection based on the emotional-neutral position on the colour scales presented by (Ou et al. 2004a; Ou et al. 2004b)

Fixed Attributes	Specifications	Rationale/Further Descriptions
Lighting	Mix of fluorescent, soft and natural lighting Fixed light boxes for ceiling and in the reception area	Avoid extreme emotions Contribute to the level of realism
Windows	With a ‘neutral’ view: some free space/car park and some greenery visible	Relate to lights, hence, set as a fixed variable. The number, appearance and views from the windows are constant for all renderings.
Small tables	Same style and consistent layout for all seating arrangements	Reading materials and decorative pot plants placed on tables when Additional Features are provided.
Other specifications		
Reception	Included a wheelchair-accessible area with lowered height: 0.75m. Content behind reception: shelves including boxes and folders, computer screens, desk chairs. Wooden elements for doors used for reception wood panel	Based on HBN 40 (NHS Estates 1995). Contribute to the level of realism.
Space between chairs	Minimum of 0.15m	Based on HBN 40 (NHS Estates 1995).

Table 8.5: Overview of fixed design attributes for the basic room model

Design attributes with their differing levels were added to the basic model. The challenge was to avoid introducing additional, unintended variables during the design process. For example, testing the effect of seat capacity and type (single chair, bench or sofa) may be in reality testing the perception of forms and structure if they were differently shaped. The creation of design attributes therefore followed a structured approach which started with the creation of a basic frame from which, for example, all seats derived, so that they appeared like a product family. A similar approach was performed to resemble the colour of flooring material as close as possible. A beige/yellow tone was selected from which all three materials (wood/vinyl/carpet) were adapted. The texture for each design attribute was selected from the standard material library of the 3DS Max 2012 software (Autodesk, San Rafael, USA). Images from Study 1 were used as a visual guide to compare the level of realism of the design attributes and their materials. Examples of the created designs in Figure 8.3 show two different perspectives of the space: the entrance perspective (Perspective 1) and the view from inside the waiting area and facing the reception area (Perspective 2). These views were commonly used by participants in Study 1 to describe their encounter with the design. See Appendix E for the full set of the 3D renderings included in the survey.

Card ID 1 (Perspective 1) | **Card ID 1 (Perspective 2)**

Card ID 4 (Perspective 1) | **Card ID 4 (Perspective 2)**

Card ID 17 (Perspective 1) | **Card ID 4 (Perspective 2)**

Figure 8.3: Examples of design profiles converted into 3D renderings

8.4.3. Stage 3 – Developing an online questionnaire for the data collection

Renderings with systematically manipulated design attributes were produced and included in a questionnaire which was developed using the survey software package SNAP Surveys (Snap Surveys Ltd, London, UK). The survey consisted of a main section where participants evaluated the renderings on the perceived level of Pleasantness and Typical HC. The order of the images was not randomised as it could have only been achieved by manually re-sequencing the questions. This would have given rise to potential errors in matching the responses to the returned questionnaire. Additional information about participant demographics, their experience of healthcare waiting environments and rationale for their evaluations were also included in the questionnaire. Throughout the experiment, participants were given opportunities to explain their rationale or provide any other qualitative comments through the use of a free comment field. The purpose of the additional questions was to enrich the meaning of the data insight in order to support the interpretation of the quantitative results. Furthermore, the data may also be useful in gaining an understanding of the generalisability of the results and effectiveness of the applied method. Refer to Appendix E for the complete survey used in this study.

8.5. SAMPLE FRAME AND TARGET

This study followed the same sample frame as set out in Chapter 4. However, a broader audience from different geographic regions within the UK was sought by using the online survey platform. The web address was sent along with an invitation to participate to the departments WMG and Warwick Medical School of the University of Warwick. Invitations were also sent to staff from Jaguar Land Rover as they were based at WMG. Their recruitment was to encourage the participation of non-university populations.

Furthermore, the survey was promoted through personal and extended networks using social media and online discussion forums such as Twitter, Facebook and LinkedIn. Participants were encouraged to refer the study to their network to extend its reach.

Sample size – As mentioned in Chapter 4, recommendations for sample size in conjoint studies vary greatly where a small sample size below 100 in research (Akaah and Korgaonkar 1988; Green and DeSarbo 1978) or ranges between 300 and 550 in commercial applications (Cattin and Wittink 1982) is regarded as common practice. Drawing on sample size from past research, this study aimed to recruit approximately 100 participants.

8.6. DATA COLLECTION

8.6.1. Pilot study

The experiment was piloted with a total of 31 participants in different stages and underwent several iterations before the main data collection was launched. Participants were recruited for the pilot testing until all identified issues were regarded as solved or minimised as much as possible. The main two goals of the pilot study were to check the survey's face and construct validity and to ensure that the online interface worked according to the study design.

First, the survey was discussed with three experienced researchers based on instructions specified for structured expert reviews process by Biemer and Lyberg (2003). This initial step focused mainly on assessing the face validity of the survey and to identify potential issues. Participants from the general public were then recruited to carry out the experiment, followed by a debrief session where they provided their feedback. Following guidance by Biemer and Lyberg (2003), cognitive and behavioural questions were also prompted to learn more about participants' thought process as well as their interaction with the renderings while carrying out the evaluation. Learning from the debrief sessions helped to identify a number of content and technical issues which were addressed as follows:

Simplifying the language – The language of the introduction and the main parts of the survey was simplified to accommodate participants from different backgrounds with varying levels of the English language.

Duration of the experiment – The content and mechanism of the experiment were adjusted, so that the survey was able to be completed in 10-20 minutes. The number of qualitative questions was for instance reduced to keep the survey focussed and to enable the experiment to be completed within the time frame. This was to attract a larger audience and to minimise the number of non-completed questionnaires.

Light variation – Light was raised as one of the criteria that people based their ratings on even though it was designed to be a constant parameter as described in Section 8.4.2. The brightness in the renderings appeared to vary depending on a number of factors e.g. the type of flooring and the amount and arrangement of chairs. After careful considerations, this perceived difference of lighting was not modified in the design since the brightness of the room would be affected in the same way in reality.

Display format of renderings – Another major decision was to show the renderings in a static format, similar to photographs shown in the previous study. Video-based format and moveable panorama were the other alternatives. While both of them would allow participants to experience the design in a more realistic and holistic manner, potential bias and practical issues led to the decision of selecting static images. The large size of the video files imposed a prolonged download time for the online questionnaire which may discourage potential participants to take part. Static images would ensure that every participant was exposed to the same view as opposed to the yet unknown and diverse interactions between participants and the interactive panorama. This medium may lead the experiments towards testing the behaviour of how participants interact with the medium rather than the perceptual evaluations of the renderings. In order to limit the number of uncontrollable elements, static images were regarded to be the superior solution. However, images were shown from two different perspectives to provide participants a better overall view of the design as described in Section 8.4.2.

Display mode – It was also tested whether to show renderings at the same time or sequentially. All images were shown in an overview to allow participants to better rate them relatively to one another. It is easier for participants to make the evaluation based on comparison instead of giving absolute score.

Technical aspects – The final stage was to ensure that the web address and all connecting and displaying mechanisms in the survey functioned correctly. The size of the renderings was reduced while maintaining the resolution as a number of people reported a long uploading time.

8.6.2. Main data collection

The online survey was designed for participants to conduct autonomously, hence, unless explicitly requested, no direct interaction between researcher and participants took place. During the main data collection process, the researcher was primarily involved in promoting the experiment as well as monitoring the quality of the survey. Upon accessing the survey, participants were given a briefing which included information on the study's background and purpose. This introductory page also ensured that participants only proceeded to the experiment having provided informed consent.

Instructions on how the images were to be presented was provided (Figure 8.4) along with a link to access a video instruction. The video clip was uploaded onto the video sharing platform YouTube (Figure 8.6) as it automatically converts the clip into a format that is compatible to different browsers. The purpose of the video was to give participants an overview of the images and to draw their attention onto the otherwise subtle changes of tested design attributes.

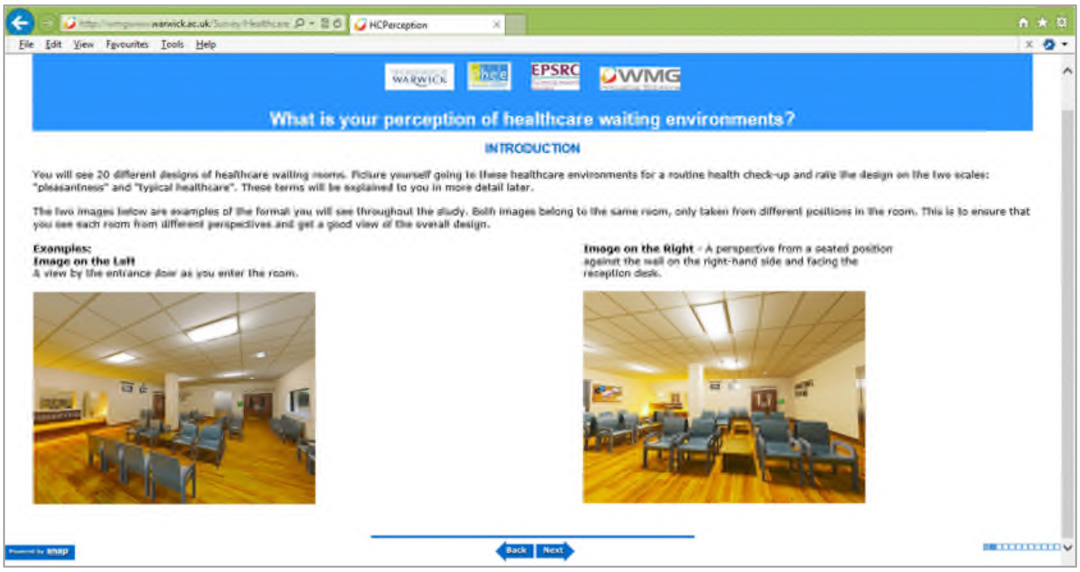


Figure 8.4: Snapshot of introduction on how images will be organised in the survey

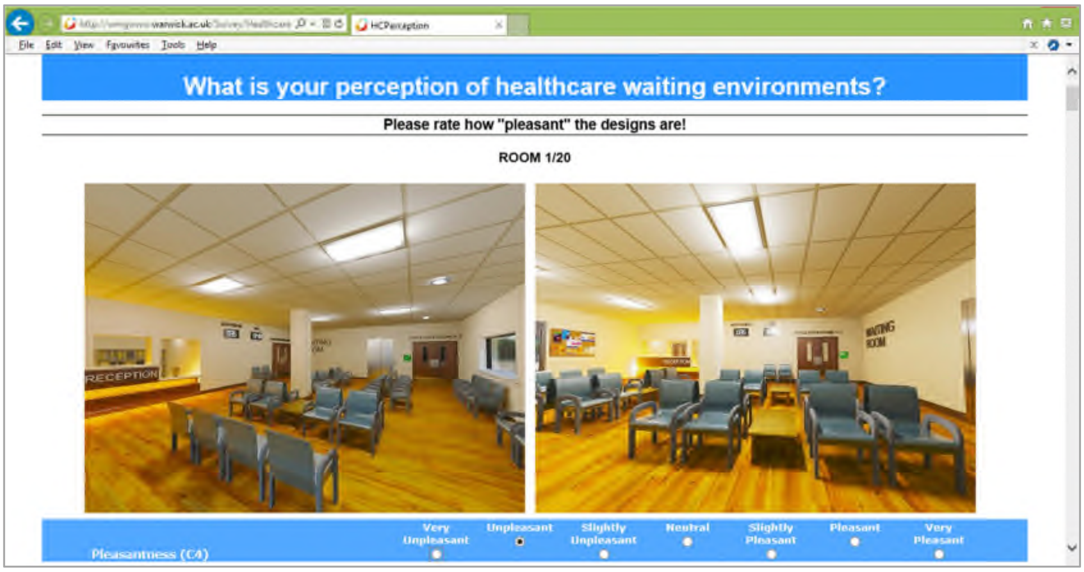


Figure 8.5: Snapshot of ratings on perceived level of pleasantness

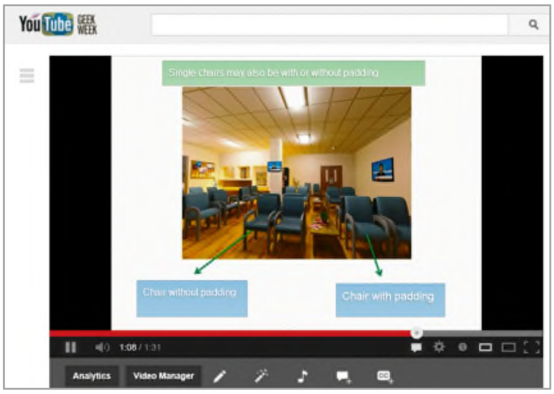
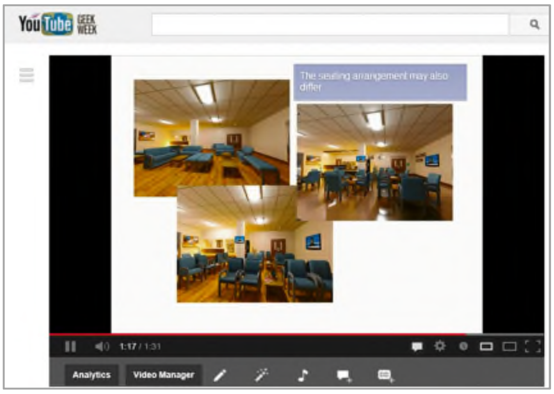
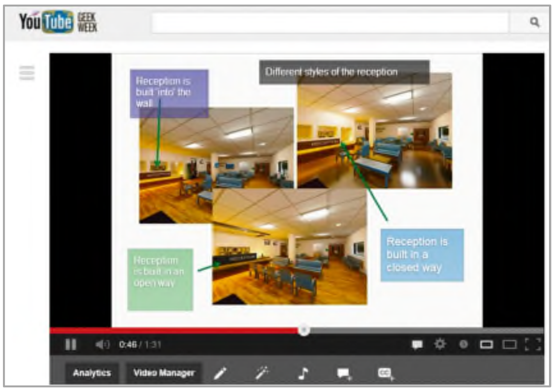
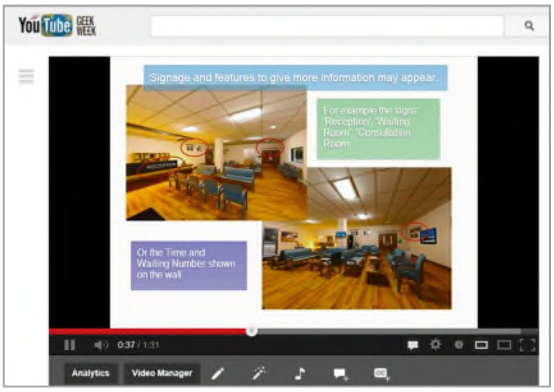
Padded versus Non-Padded Seats	Seating Arrangement
	
Receptions	**Signage**
	

Figure 8.6: Screenshots of video instructions to make participants aware of subtle changes of design attributes and levels

For the evaluation, participants were given the scenario of visiting an outpatient healthcare facility for a routine health check-up. First, participants were asked to rate all 20 renderings based on their perceived level of pleasantness on a 7-point semantic differential scale ranging from *very pleasant* to *very unpleasant* (Figure 8.5). Upon completion of the first ratings, different scenarios with regard to being accompanied and different lengths of waiting time were prompted.

In the second part of the evaluation, participants were asked to rate the renderings once again but this time on scales ranging from *very typical* to *very untypical* of healthcare. Even though rating all images twice can be laborious, the dimensions were kept separately as simultaneous evaluation may be cognitively challenging. Also, participants may subconsciously try to create a relationship between the two when rating both dimensions together. After rating all renderings on both perceptual dimensions, participants were asked to provide general information about themselves and their experience with the healthcare waiting environments.

Completed surveys were sent automatically to the researcher in the form of an email without revealing the questions. This is to ensure that the information would not be apparent in the unlikely event of the email being intercepted. Once received, responses were immediately imported into the SNAP server and feedback regularly monitored for quality purposes.

8.7. DATA ANALYSIS

Conjoint Analysis was carried out on empirically collected rating scores using SPSS 21.0 (IBM Corp., Armonk, USA). The relative importance of design attributes and levels were calculated and expressed in importance values and utility scores respectively. The basic Conjoint Analysis model is described in Equation (Eq.) (1) as follows:

$$U(X) = \mu + \sum_{i=1}^{m} \sum_{j=1}^{k_i} \alpha_{ij} x_{ij} \tag{1}$$

Where

U(X) = Overall utility of an alternative *X*, where *X* is a vector with entries x_ij

μ = Constant (base utility)

α_{ij} = the part-worth contribution or utility associated with the *j* th level (*j*, *j* = 1, 2, . . . k_i) of the *i* th attribute (*i*, *i* = 1, 2, . . . *m*)

$x_{ij} = 1$ if the j th level of the i th attribute is present ($x_{ij} = 0$ otherwise)

k_i = number of levels of attribute i

m = number of attributes

Utility scores for design levels were estimated using Conjoint Analysis while their range determined the contribution of design attributes. The importance value for a single attribute depended upon the range utility scores of its design levels. All design levels were defined as categorical (discrete) as no other assumptions about the relationship between the design and the rating scores were made. Table 8.6 gives an overview of the chosen discrete model with seven design attributes and between two and three design levels assigned to each of them.

Design Attributes*	N of Levels	Relation to Scores
Seating Arrangement	2	Discrete
Seat Capacity	3	Discrete
Seat Padding	3	Discrete
Reception	3	Discrete
Floor	3	Discrete
AddOn	2	Discrete
Signage	2	Discrete

**All factors are orthogonal.*

Table 8.6: Description of the discrete model

Additional information gathered from the survey were analysed according to their data type as illustrated in Figure 8.1. The qualitative data was analysed using content analysis while SPSS 21.0 (IBM Corp., Armonk, USA) was used for descriptive statistical analysis of quantitative information wherever appropriate.

8.8. FINDINGS

In this section, the contribution of design attributes and levels towards Pleasantness and Typical HC will be presented, followed by validity assessment of the model, hence its accuracy to predict the level of pleasantness in future.

8.8.1. Sample characteristics

The online survey was completed by 116 participants (39.7% males and 60.3% females) living in the United Kingdom. The proportion of gender was around 2:3 with female participants representing the larger share (60.3%) which led to the comparison of differences between their ratings. Levene's test showed that the variances of the two groups were not homogenous for the ratings of a number of renderings which violates assumptions of a t-test (Table E-2). Therefore, a non-parametric equivalent Mann-Whitney U-Test was consequently used to assess potential differences between genders. Apart from the image numbers 2 and 12, no statistical difference with regard to the perceived pleasantness ($p < 0.05$) was found between male and female participants (Table E-3, Appendix E). A larger sample size may be needed to determine the effect of gender on the perception of pleasantness. Refer to Figure 8.7, Section 8.8.2 to view these two images.

The average age was 39 years old (SD = 14.83) within a wide range between 20 to 82 years old. The age distribution shown in Appendix E is skewed to the left since participants between 20 and 39 years old formed the largest group with 60.9% of the overall. The majority of participants were British nationals (80.2%) while 19.2% were residents with different nationalities. Most participants also stated that they were lay people without a background in healthcare or design (83.6%). The survey also showed that 112 of 116 participants were NHS users, of which 25 of them combine their NHS registration with additional types of schemes such as private health insurance. An overview of all general sample characteristics is shown in Appendix E.

In order to gain insights on participants' experience and familiarity with healthcare waiting environments, their estimated waiting times (Figure E-3) and visit frequency (Figure E-4) were also captured. With a mean of 14.1 minutes, waiting times at the dentist is the shortest while at GPs and outpatient hospitals participants stated an average of 23.5 and 60.4 minutes respectively. The range of waiting times in outpatient hospitals also show the largest variation (SD = 57.8) with a maximum waiting time of five hours. Participants visited GPs most frequently while most outpatient visits (N=96) appear to take place once or twice per year, 20 people stated to go there on a quarterly (N=15) or monthly basis (N=5).

8.8.2. Contribution of design attributes towards end-user main perceptions Pleasantness and Typical Healthcare

The relative contribution of design attributes and levels in relation to the perceived Pleasantness and Typical HC of the overall is expressed in metric measures as importance values (I) and utility scores (U). Findings for both perceptual dimensions are presented in the following paragraphs.

Pleasantness – Rating scores gathered from the 116 residents living in the UK were analysed using Conjoint Analysis as explained in Section 8.7. An overview of the estimated importance values in percentage (left column) and utilities in standardised scores (right column) are presented in Table 8.7. Design attributes and levels are arranged by their priorities. Results suggest that wooden flooring (Floor, I = 19.54%; Wood, U = 0.10) and single (Seat Capacity, I = 17.80%; Single Seater, U = 0.05) padded seats (Seat Padding, I = 18.14%; Padded, U = 0.37) were most important for the perception of pleasantness. Reception and a seating arrangement also contributed to the perception of pleasantness with 14.50% and 10.90% respectively. Signage showed the lowest importance values with I = 7.91% due to its small range of utility scores. Even though to a less extent overall, the provision of additional design features (AddOn, I = 11.20%; Yes, U = 0.20) and information by means of signage (Signage, I = 7.91%; Yes, U = 0.17) were perceived more pleasant compared to design scenarios excluding them.

Importance Values (I)		Utilities (U)		
Design Attributes	Importance Values (%)	Design Levels	Utility Estimate	Std. Error
Floor	19.541	Wood	0.095	0.119
		Carpet	0.017	0.139
		Vinyl	-0.112	0.139
Padding	18.139	Padded	0.371	0.139
		With and Without Padding	-0.112	0.139
		Hard	-0.259	0.119
Capacity	17.801	Single Seater	0.047	0.139
		Both Seating Types	0.013	0.139
		Multiple Seater	-0.06	0.119
Reception	14.503	Open, Against the Wall	0.069	0.139
		Closed, Against the Wall	0.034	0.119
		Closed, In the Wall	-0.103	0.139
AddOn	11.195	Yes	0.196	0.089
		No	-0.196	0.089
Arrangement	10.914	Rows	0.216	0.089
		Groups	-0.216	0.089
Signage	7.907	Yes	0.166	0.089
		No	-0.166	0.089
Averaged Importance Score		*(Constant)*	3.806	0.107

Table 8.7: Importance values of design attributes and utility scores of design levels regarding Pleasantness

The combination of all design levels with the highest utility scores from Table 8.7 represents the most favourable design with regard to perceived pleasantness. The maximum achievable total utility (called 'Ideal') for the included design attributes would be 4.97 based on the calculation shown in Eq.(2). The calculation is based on the additive conjoint model shown in Eq. (1) where the sums of these standardised utility scores reflect the total utility for any combination of design levels.

$$U\ (Ideal) = 3.806 + .095 + .371 + .047 + .069 + .196 + .216 + .166 = 4.966 \quad \textbf{(2)}$$

Examples of tested renderings and their calculated utilities are shown in Figure 8.7.

Design Profile Number 2 (U = 3.819)

Design Profile Number 13 (U = 4.327)

Design Profile Number 12 (U = 3.762)

Design Profile Number 14 (U = 4.565)

Figure 8.7: Examples of tested designs and their utilities with regard to Pleasantness

Typical HC – Results in Table 8.8 suggest that individual chairs (Seat Capacity, I = 19.76%; Single Seater, U = 0.43) without upholstery (Seat Padding, I = 18.92%; Hard, U = 0.31) were most associated with the Typical HC appearance. Against the theoretical foundation established in Study 2b, wooden flooring was ranked third (Floor, I = 16.92%; Wood, U = 0.24) with regard to contribution towards Typical HC.

Importance Values (I)		Utilities (U)		
Design Attributes	Importance Values (%)	Design Levels	Utility Estimate	Std. Error
Capacity	19.756	Single Seater	0.428	0.133
		Both Seating Types	0.089	0.133
		Multiple Seater	-0.517	0.114
Padding	18.919	Hard	0.313	0.114
		With and Without Padding	0.241	0.133
		Padded	-0.554	0.133
Floor	16.917	Wood	0.024	0.114
		Vinyl	0.001	0.133
		Carpet	-0.025	0.133
Arrangement	14.961	Rows	0.392	0.085
		Groups	-0.392	0.085
Reception	13.304	Closed, In the Wall	0.225	0.133
		Open, Against the Wall	-0.111	0.133
		Closed, Against the Wall	-0.114	0.114
AddOn	9.589	No	0.077	0.085
		Yes	-0.077	0.085
Signage	6.554	No	0.056	0.085
		Yes	-0.056	0.085
Averaged Importance Score		*(Constant)*	3.865	0.102

Table 8.8: Importance values of design attributes and utility scores of design levels with regard to Typical HC

Other characteristics conveying the impression of a typical healthcare environment include row arrangement of seats (Seating Arrangement, I = 14.96%; Rows, U = 0.39), reception area or desk separated from the waiting area (Reception, I = 13.30%; Closed, in the wall, U = 0.23). The lack of additional design features and information in the form of signage was also perceived typical for healthcare environments. However, their contributions are the lowest compared to other included design attributes and levels in this study.

The same calculation using the conjoint model can be carried out for the utility of the most typical (labelled *'Most Typ.'*) of a healthcare design scenario as shown in Eq. (3).

$$U\ (Most\ Typ.) = 3.865 + .428 + .313 + .024 + .392 + .225 + .077 + .056 = 5.38 \qquad \textbf{(3)}$$

Examples of tested renderings and their total utility scores with regard to Typical HC are shown in Figure 8.8.

Figure 8.8: Examples of tested designs and their utilities with regard to Typical HC

8.8.3. End-user rationale and perceptions based on circumstantial context of the healthcare visit

This section presents participants' rationale for their evaluations of Pleasantness and Typical HC as well as how circumstantial context may influence their perceptions of the OHCWE. Circumstantial context in this research refers to the length of waiting time and whether being accompanied to the healthcare visit. Qualitative findings from Study 1 and Study 2a indicated that these two circumstantial factors may influence end-user perception of the design of OHCWEs, therefore, followed-up in this study. Further findings on participant experience and attitudes towards healthcare can be found in Appendix E.

8.8.3.1. Participants' rationale for the evaluations of Pleasantness and Typical Healthcare

The survey included questions about participants' rationale for their evaluations as well as the context they used during the rating process. These questions were prompted to ensure that participants complied with the given instructions and the demand task as well as to learn more about the used method.

Content analysis revealed that two participants used scenarios that differed from the instruction. As the quotes below show, they pictured themselves visiting the healthcare waiting environments for a medically more concerning reason as opposed to the instructed routine check-up.

'Local hospital, for non-routine examinations…Feeling of dread, nervousness, out of comfort zone' (P80)

'I imagined I was in hospital waiting to see a doctor about something semi-serious. Feelings of anxiety, worry, boredom, isolation…I imagined I was alone and didn't know the outcome, thinking the worst.' (P144)

As a consequence, their ratings were assessed for possible extreme values of all images using SPSS 21.0 (IBM Corp., Armonk, USA). However, rating scores from neither of these two cases was identified as extreme values and therefore maintained in the data pool.

All participants rated the images according to the task demand which was based on the overall perception created by the different combinations of design attributes and levels. However, content analysis found a number of additional factors that were mentioned and used as rating criteria as shown in Table 8.9. There was a perception of changing light even though it was held constant in the experiment. The change was perceived due to changes in other design related factors as discussed in Section 8.4.2. A number of participants stated to be influenced by this phenomenon in their ratings for Pleasantness (N=25) and Typical HC (N=8).

Additional Rationale	Pleasantness	Typical HC
Light	25	8
Space/Crowding	14	7
Hygiene	8	
High Seat Back	4	
Privacy	3	
Memories/Past experience		28

Table 8.9: Additional rationale for the evaluations and their frequencies

The perception of space and crowding influenced a number of responses with regard to Pleasantness (N=14) and Typical HC (N=7). This was mentioned in association with the layout and arrangement of seats. Other factors mentioned in the context of the rating for

Pleasantness were *Hygiene* (N=8) and *Privacy* (N=3). Design factors related to these two perceptions included seating type and arrangement but also the space between seats. Hygiene was also mentioned in connection with the material of seats and flooring (carpet). A number of people (N=4) mentioned the importance of seat back, especially those with back problems who looked specifically for seats with a high back. In line with the theoretical foundation established in Study 2b, the definition of specific attributes and levels for Typical HC is challenging as much depends on participants' personal benchmarks using their memories and past experiences (N=28). For this reason, participants were also asked to describe the healthcare facility they usually go to and what scenario they had in mind while evaluating the images (Appendix E).

8.8.3.2. The effect of being accompanied to the healthcare waiting environment on end-user perception of the design of OHCWEs

Participants expressed a number of design implications if attending the healthcare environment with a companion as shown in Table 8.10. Most participants considered seating arrangement (N=38), the availability of sufficient seats (N=14) and seat comfort (N=12) to be important when being accompanied to a healthcare visit. The desire of being able to sit together was also mentioned in the context of having personal space for privacy of conversations (N=16). Participants perceived ambience-facilitating design aspects to be more important as this may influence the experience together in the waiting room. These factors may include refreshment facilities, decorative plants, low noise levels and hygiene.

More important	N	Less important	N
Seating arrangement	38	Entertainment/Distraction	8
Personal space	16	Signage/Information	4
Seat availability	14	Demand on the design	3
Seat Comfort	12	Single chairs requirement	3
Comfort & distraction for accompanying person	10	Others (Seating comfort, Seating arrangement)	2
Facilities	4	Unaffected	13
Others e.g. noise, plants, hygiene	5		

Table 8.10: Implications of being accompanied to the healthcare visit on the importance of design aspects

A number of participants stated that the provision of entertainment and distractions may become less important as people can engage with their companion while waiting (N=8). This was summarised by a participant as follows:

'Additional features such as TVs would be less useful but plants would make it seem like a less awkward environment and more friendly which could affect the mood and encourage conversation. The seating and reception are less likely to be as important when someone else is with you […]notice [less] if the seats are uncomfortable.' (P66)

However, this was in conflict with the consideration that the companion would have to wait on their own during the consultation time. Participants would like their companion to feel comfortable and have some entertainment/distraction to avoid boredom (N=10).

'If the environment was uncomfortable or noisy I would worry about my companion's comfort while I was having my appointment. Carpet, upholstered seating and magazines would be more important' (P21)

Participants stated to feel more assured when being accompanied, so that the concern of lacking information was reduced (Signage/Information N= 4). A number of people (N=4) also pointed out that the requirements may also vary depending on their relationship with the companion. The age and health status of the companion may define the increased importance of arrangement, accessibility, entertainment etc., as expressed in the following quotes.

'It depends [on] whom I'm accompanied by. If it's [someone] with a pushchair, I would have more to think about, so the layout for example. If I'm accompanied by my sister for example, I'd just be so happy to be in her company…' (P133)

'…depends [on] whom with! Space and ease of manoeuvring a buggy – something for children to do or hold their interest, or padding for old bones to sit on and close enough seating to have a chat' (P71)

8.8.3.3. The effect of waiting time duration on end-user perception of the design of OHCWEs

The importance of several design aspects become increased or reduced depending on the length of waiting time (Table 8.12 and Table 8.13). However, a number of design and related aspects such as *Seat Comfort, Hygiene and Entertainment/Distractions* were expressed as important regardless of the waiting time as shown in Table 8.11.

Relevant aspects regardless of waiting time	N
Should be pleasant regardless of waiting time	11
Seat comfort	8
Improved perception of the service	3
Entertainment/Distractions	2
Hygiene	2
Others: Plants, safety, signage/information, facilities	4
First impression counts	6
Perception unaffected by length of waiting time	23

Table 8.11: Aspects unaffected from the length of waiting time

A number of participants (N=23) also stated that time duration would not have any impact on their perception of the design. Others mentioned that design of OHCWEs should be pleasant regardless of waiting time (N=11) while six participants stated that their first impression would be formed early on and determine their perception.

Short waiting time – Overall, short waiting time reduced the requirement for *Seat Comfort* (N=34) and *Entertainment/Distractions* (N=17) as shown in Table 8.12. Participants explained that the shorter interaction time with the design may lower their demand on the design (N=8) as they may be less affected by its quality (N=14). However, aspects that support the operational efficiency and flow of movement through the space become more important (N=3). Three participants also mentioned that their perception of the service would be improved if the waiting time was short. These aspects were summarised by a participant as follows:

'First impressions are fairly important to me, so waiting for a shorter time is likely to mean I will notice good/bad points less, but if the seating is uncomfortable then waiting for longer would make the room seem less pleasant. Reception is more important if you are waiting for a short time as you will be interacting with it/the receptionist for a longer proportion of your time in the room.' (P66)

This quote also pointed out that the interaction time with staff becomes more important in the instances of a shorter waiting time. Two participants also mentioned that information and signage as would become more crucial. One participant also mentioned that he/she would be less concerned about the car park expense if the waiting time was short. This aspect emphasised how the design of the external space can affect the waiting experience.

SHORT WAITING TIME			
More important	**N**	**Less important**	**N**
Efficiency to navigate and move through the space	3	Seat comfort	34
Improved perception of the service	3	Entertainment/Distraction	17
Entertainment/Distractions	2	Less affected by the design	14
Signage/Information	2	Less demand on the design	8
Seat availability	1	Facilities	6
		Interior/Furnishing	5
		Decoration	3
		Others e.g. car park fees, layout/arrangement, space	3

Table 8.12: Aspects becoming more/less important as a result of short waiting time

Long waiting time – Design aspects that become less important when waiting for a short time were also flagged as becoming more important in the event of a long waiting time. However, a number of additional design aspects were mentioned and participants appeared to be more specific about their design requirement as shown in Table 8.13. The majority of participants reinforced the importance of seat comfort (N=62), the provision of entertainment and distraction (N=34) in the event of a long waiting time. The need for personal space was mentioned by 15 participants, expressed through the importance of single chairs, space between the seats and their arrangement (P68). In contrast, two participants stated the desire to have a layout that facilitates or ease the communication with other people waiting (P107).

'The comfort of the seating, the quietness of the space and not having to sit next to or opposite someone in close proximity would become more important during a long wait.' (P68)

'Comfort [would be] more important. Interaction with fellow patients should be made easier. (Layout is important) (P107)

More Important	N	Example quotes
Seat comfort	62	*'Seat comfort would be more important, as would good lighting and having distractions e.g. visual displays'* (P4) *'I would be much more concerned about the comfort of the seating if I had to wait a long time'* (P70)
Entertainment/ Distractions	37	*'Yes. External views or some other distraction. Ideally not a TV programme. Magazines (not just second-hand magazines from staff on "Yacht News" or "Knitting Monthly").'* (P98)
Space/Personal Space	15	*'Spacing between chairs instead of being crowded together would become more important.'* (P13) *'The longer the waiting time, the more chance of feeling claustrophobic - so comfort and personal space become more important'* (P109)
Facility (Restroom, Refreshment)	15	*'…water becomes more important, as you have to sit in a hot room in some places, with nothing to drink.'* (P2)
More affected by the design	13	*'A long waiting time would probably make me reflect less positively than a short waiting time...'* (P58)
Signage/Information	12	*'I think the importance of good quantity of signage might increase with increasing waiting time as I might want to make sure/double check I am in the right place, right time etc.'* (P27)
Decoration (Plants, artwork, colour)	12	*'I would want more interesting [features] on the walls or tables, such as plants and artwork. Good and natural lighting makes a huge difference, especially after a while of having to put up with it.'* (P80)
Lighting	12	
Higher demand on the design	8	*'Waiting for longer means that the room will have to be more pleasant in order to remain so throughout my stay in it. Small features that I may not like would become magnified over time, and may affect my overall view of the room once I leave it. Seating and flooring need to be nice in longer waits, as it is likely they will be noticed a lot. TVs or magazines are also very important to distract attention from bad points.'* (P66) *'Yes, everything really e.g. comfort, openness, access to toilets and facilities, space to stretch if injured…'* (P145)
Flooring	5	*'…a restful ambience is more helpful so padded chairs, wooden floors and perhaps the carpet, plants.'* (P93)
Time affects the experience	4	*'…lack of TV intrusion. You notice more when you sit and look around for a longer period of time - more opportunity for things to annoy and stress you' (P10)*
Hygiene	4	*'Yes, a long waiting time may influence my perception of how pleasant the design is. The most important aspect would be the cleanliness…'* (P135)

More Important	N	Example quotes
Specifics about TV - Particular demand e.g. TV content - No TV	5 2 3	*'Again, I'd hate to stare at a TV, and I dread small carpeted rooms with low light in healthcare…'* (P105) *'…presence of a TV - but not looping the same info (my GP has not changed the programs in the last 3 years)'* (P118) *'If you were waiting for a long time 24hr news might drive you mad on a constant loop…'* (P128)
Quietness	3	*'The comfort of the seating, the quietness of the space and not having to sit next to or opposite someone in close proximity would become more important during a long wait.'* (P68)
Reception/Staff morale	3	*'Yes. I would feel that the staff are taking too long or are short-staffed. The longer I wait, the more impatient I will be to get treated. And this means that negativity will need to be balanced by the design and ambiance of the waiting room. The comfort of the chairs, the quality of the TV programmes or variety of new magazines/things to read. The staff would have to be approachable rather than coming across as short-tempered or curt in their interaction.'* (P11)
Waste bin Child play area	2 1	*'…waste bin to avoid rubbish…'* (P115) *'…having waste paper bins so that people didn't leave rubbish on the tables, a healthy vending machine would become important and a dedicated child waiting area.'* (P100)
Use after discharge/as a social place	1	*'…chatting with my friend about results and plans for a coffee'* (P131)
Air and temperature	1	*'…also other factors like air and room temperature'* (P2)

Table 8.13: Aspects becoming more important as a result of long waiting time

When waiting for a long time, participants put a higher demand on the overall design requirement (N=8) and expressed that they may care more about the design and notice more quality details due to the longer exposure time (N=13). This was reflected by the desire of having more decorative elements (N=12) in the waiting room such as lighting, artwork, colours and plants. Lighting was mentioned as an ambient factor as well as for functional and reading purposes. Participants provided a detailed account of the design aspects that become more important for them such as the content of entertainment facilities such as modern magazines, internet connection and TVs with subtitles. The quote below gives an example of the kind of specific details people describe as their requirements.

'*I would definitely need a comfy chair! I would love a TV, possibly a vending machine that has normal prices, not double as usual. A selection of good magazines and gadgets…The decoration of the room such as carpets, pictures, open view reception, arrangement of the chairs, etc. would start to become more important to the emotional experience within the room the longer I am there. If I am worried, and tired, this will likely aggravate my stress.* (P144)

When spending a considerable amount of time in the waiting room, being (or feeling) informed becomes more important (N=13). This was expressed through the desire of knowing about remaining waiting time, seeing reception staff for reassurance (P104). Participants may also use the waiting environment for other purposes, for example as a social, community place. The statement by participant 131 confirmed the importance of the design in OHCWEs for the overall experience of the healthcare journey from arrival to post-discharge.

'Seats that face away from the reception can be unhelpful if that's how you can see whether you are being called into your appointment, as personally I worry that I will be missed. (P104)

'…if the environment is pleasant I want to stay. In fact, I use to stay even after being discharged, just to arrange my bag or to rest for a while and to chat with my friends about results and to plan for a coffee' (P131)

8.9. DISCUSSION

This study set out to address the two primary (Objectives 1, 2) and two secondary objectives (Objectives 3, 4) as introduced in Section 8.2. This section will discuss Objectives 1 - 3 while findings derived from Objective 4 will contribute to the overall discussion on factors influencing the end-user perception of OHCWEs in Chapter 9, Section 9.4.

8.9.1. General discussion

Participants' socio-demographic data was collected as literature suggests their potential role in influencing people's choice of design (Dijkstra et al. 2008a; Sadalla et al. 1987). A good effort of reaching out to participants from different age groups was reflected in the wide age range between 20 and 82 years old. With nearly all participants (112/116) being users of the NHS, the common healthcare system shared across participants contributed to a standardised context. It is acknowledged that even within the NHS, the design of different facilities may still vary widely. However, qualitative responses showed that a large number of participants (N=70) described their usual healthcare facility with a similar level of design standard (Table E-1).

As shown in Appendix E, estimated waiting times were collected along with attendance frequency at GPs, outpatient hospitals and dentists. This was to gain a better understanding of participants' waiting experience, especially because waiting times for outpatient hospitals are not centrally collected. The responses revealed that outpatient hospitals were the second most visited facility after GPs with waiting times of up to five hours. Even though, waiting times reported at A&E departments appeared to be more severe (Triggle 2013), it is worth noting that as opposed to A&E facilities, outpatient hospitals operate on scheduled appointment system. The most attended healthcare facilities were GP practices with an average waiting time of 23.5 minutes. A national GP Patient Survey 2011/12 revealed that 24% of patients in England waited for longer than 15 minutes (Ipsos MORI 2012). However, the data does not reveal the additional amount of expected waiting time. The role of waiting times to influence the end-user perception and experience of OHCWEs will be discussed in Section 9.4.

8.9.2. The role of design attributes and levels on end-user main perceptions of outpatient healthcare waiting environments

This section discusses the contribution of design attributes towards the perceived level of pleasantness (Objective 1) and Typical HC (Objective 3). The results will also be discussed with regard to the theoretical foundation established in Study 2b which were used as inputs towards this study design. The perception of the dimension Typical HC was explored as a secondary aim as its design characteristics were not specifically included for testing. As established in Study 2b, a number of design attributes may, however, relate to both dimensions such as seating arrangement (Inputs 4 and 10). The relative importance of the seven selected design attributes and utility scores for their assigned design levels were estimated using Conjoint Analysis which was in fulfilment of Objective 1 and discussed below.

Flooring – Flooring was revealed as the most important attribute which may relate to its large spatial coverage according to Nanda et al. (2012b). Wooden flooring was rated most pleasant, followed by carpet and vinyl as least pleasant. The preference of wooden material or appearance may be attributed to the *biophilia theory* which was first hypothesised by Wilson (1984). As described in Section 3.3.2, the theory suggested an innate, evolution-based attraction of humans towards features associated with nature. This finding is also in agreement with *Input 7 – Natural Elements* which suggested that natural elements are perceived more pleasant. Carpet was often associated with hygiene issues amongst participants in Study 1 and Study 2b (*Input 1 – Hygiene*) which was also confirmed by literature such as Skoutelis et al. (1994). As described in Chapter 3, carpeted flooring was revealed to be more contaminated compared to non-carpeted material. However, carpet was also linked to positive characteristics including softness and comfort of the environment which is in line with previous research (Salonen et al. 2013b). This might explain the marginal difference between the utility score of wooden (U = 0.095) and carpeted flooring (U = 0.017). In agreement with qualitative findings from studies 1 and 2a, vinyl flooring was found to be more typical of healthcare compared to carpet. However, wooden flooring showed highest importance values, suggesting that they are perceived most typical of healthcare which is in contrast to previous results from this research.

Seat types – Upholstered seats were perceived most pleasant which confirms *Input 3 – Seat Specification* that people perceived comfortable seating as more pleasant. It was also found that people preferred single seats, followed by a combination of single and multiple seats which has also been suggested by the theoretical foundation from Study 2b (*Input 3 – Seat specification*). Also, multiple seats in the form of sofas were found least typical of healthcare as anticipated since they were mentioned in association with non-healthcare environments such as hotel or spa in Study 1.

Seating arrangement – Related to the aspect of being able to control the environment, flexible seating arrangements in the form of clusters or a combination of groups and rows were suggested to be more pleasant (Input 4). However, results suggest that people perceived the row seat arrangement more pleasant in this study. This may be related to the fact that rows of seats also contributed most to the perceived typical healthcare appearance which supports Input 8 that a clear function of the space is pleasant. People feel more assured if design cues signal that they are in the right place. Rows of hard seats were found most typical for healthcare environments which confirmed Input 10. The recommendation of groups and *sociable* seating arrangements e.g. by Mizan (2004) may need to be executed in consideration of other factors e.g. social context, reason the visit etc. In Study 1, it has been mentioned that the perception of a clinical appearance may depend on the visitor's medical severity. The preference of row arrangement in this study may also be related to the methodology and will be discussed in Section 8.9.4.

Reception desk – An open, accessible reception desk was found to be most pleasant, followed by the less open and accessible alternative. The least preferred variation was when the reception area was located in a separated room with only glass windows between the healthcare personnel and people waiting. This finding is in agreement with *Input 5 – Reception Desk* as established in Study 2b. Literature also found that open reception without glass separation was more preferred (Rice et al. 2008). However, the openness of the reception was also suggested to be associated with privacy issues which have been discussed in Chapter 3. The design of the reception area can affect not only the quality of interaction between staff and visitors (Rice et al. 2008) but also staff's mood and performance (Booker and Roseman 1995). Qualitative data in this study also confirmed that people preferred a clearly visible reception as this would make them feel more assured and that they could ask for information if needed.

The preference of waiting rooms with signage compared to those where nothing was labelled confirms people's previous comments that they would like to *'know what is going on'*. The anxiety caused by the lack of information or understanding of the environment was mentioned to be reduced when being accompanied to the healthcare visit (Section 8.8.3.2). Importance values for signage was lowest compared to the other six attributes, suggesting that it contributes least to pleasantness. However, the importance of signage should not be undermined since all seven attributes were previously selected due to their considerable relevance (Section 8.4.1). It must also be reminded that importance values are experiment-specific as their calculation derives from a range of utilities, hence, only comparable to other design attributes included in the study. The importance may also be related to the study design as the experiment placed participants directly in the room so that the effort of navigating to the destination and the linked anxiety became less relevant.

Closed reception that forms a separate area from the waiting room was perceived most typical of healthcare. This may not be a reflection of the true experienced design but rather their memory of how they perceived the openness and accessibility of the space. The same explanation may apply to the perception that the lack of signage and additional features in the waiting space were typical of healthcare. The perceived dimension of healthcare experience therefore needs to be considered and incorporated in official guidelines on e.g. *wayfinding* (NHS Estates 2005). The experience and lasting perception may also relate to staff support and attention as participants mentioned in Study 1 and Study 2a.

Additional Features – Additional Features including decorative elements, entertainment and refreshment facilities contributed to participants' perception of a pleasant design in OHCWEs. This confirms Input 6 which stated that additional features that demonstrate an attention to the detail would be perceived more pleasant as they make end-users feel 'valued'. The inclusion of decorative elements such as indoor plants was perceived more pleasant which confirmed *Input 7 – Natural Elements* and may be explained by people's innate affinity to nature (Dutton 2003). Indoor plants were reported in relation to stress reduction and providing restorative value (Dijkstra et al. 2008b). It may also contribute to the aesthetic value of the design which was found to be a mediating factor for relaxation and is used as a visual cue for design quality according to Ulrich (2011). Qualitative data revealed that not only the presence of these design attributes is important but also their specifications. A number of people have mentioned that not being able to control the TV channel or its volume can be unpleasant, so that it can be better if TVs are not present in the waiting room. As discussed in Chapter 3, the inability to influence the environment can be a source of stress in healthcare environments (Ulrich 1991). This also was mentioned in relationship to sound level in the waiting room as the majority of people desire a calming environment (Macnaughton et al. 2005). While acoustics in healthcare environments is subjected to established technical guidelines (Department of Health 2013b), understanding the subjective dimensions of positive *soundscape* also needs to be considered (Mackrill et al. 2013).

Overall, the differing contributions of design attributes on end-user main perceptions Pleasantness and Typical HC helped to confirm Hypothesis 1 (Study 1). It was hypothesised that certain design aspects may play a greater or lesser role in influencing end-user perceptions of the design of OHCWEs.

8.9.3. Validity of the predictive models for untested designs

The conjoint model was assessed with regard to its predictive quality and accuracy since the aim of Objective 2 was to be able to predict the level of pleasantness for untested design scenarios. The quality of the model was assessed using Pearson's R and Kendall's tau (τ) correlation coefficients between observed and predicted data as standard measures, following the instruction manual for SPSS Conjoint 21.0 (IBM Corp., Armonk, USA). Kendall's τ is a non-parametric measure between two ranked variables. Since it considers the difference between the probability that observed data are in the same order versus the probably that it is not, its value tends to be lower and more accurate than Pearson's R (Field 2009). An overview of Pearson's R and Kendall's τ correlations is shown in Table 8.14.

Correlations[a]	Pleasantness		Typical HC	
	Value	Sig.	Value	Sig.
Pearson's R	.927	.000	.971	.000
Kendall's τ	.728	.000	.862	.000
Kendall's τ for Holdouts	1.000	.021	.333	.248

a. Correlations between observed and estimated data

Table 8.14: Correlations between observed and estimated data for perceived Pleasantness and Typical HC

High correlations close to 1 confirmed the good fit of the described model. Pearson's R of 0.93 and Kendall's τ of 0.71 validated the quality of the model for Pleasantness at a statistical significance level of 0.1% ($p < 0.001$). Another measure shown in Table 8.14 is Kendall's τ computed only for Holdouts profiles. As described in Section 8.4.2, four designs were included in the experiment but not used for the estimation procedure. Their Kendall's τ helps cross-validating the internal consistency, hence, predictive accuracy of the models. A perfect correlation (Kendall's τ for Holdout = 1.00) was obtained for Pleasantness, confirming that the model also provides high predictive quality at a statistical significance level of 5% ($p < 0.05$).

It can be concluded that Objective 2 was met as the conjoint model can accurately predict the level of perceived pleasantness on untested design scenarios. This allows the estimation of the design's potential pleasantness prior to empirical testing or its development which in turn can save time and cost. An example of how the total utilities of design scenarios can be calculated was provided in Eq. (2), Section 8.8.2.

The quality of the model to predict Typical HC was also computed for exploratory purposes. Similar to perceived Pleasantness, high Pearson's R (0.97) and Kendall's τ (0.86) were obtained, also at 0.1% statistical significance level ($p < 0.001$). However, a low Kendall's τ for Holdouts (0.33) without statistical significance was found ($p > 0.05$) which means that the internal validity of the model could not be confirmed. While the high Pearson's R and Kendall's τ values indicate a good fit of the model and the observed data, it can be concluded that results will not go beyond the tested data. As the study primarily focused on the dimension of Pleasantness, the created designs did not include factors that potentially contribute to the description of Typical HC. For example, as found in Study 2b, modernity and colour activity (Input 11 and 13) may play a role in differentiating a typical from an untypical healthcare appearance. However, these aspects were not tested but included as fixed parameters. By including the inputs for Typical HC from Study 2b in the study design, future studies may be able to achieve a higher accuracy power for this dimension.

8.9.4. Strengths and limitations of the approach

This study used the combination of photo-realistic renderings with a traditional full-profile conjoint method. This approach represents a novel technique to assess the contribution of design attributes and levels to the pleasantness of OHCWEs. As mentioned in Chapter 2, despite the popularity in other fields, Conjoint Analysis has not been widely used to investigate end-user perception of the built-environment. The structured approach was presented in a systematic and replicable manner in order to inform designers and researchers about how the method can be applied to better understand end-user perception of OHCWEs.

Learning from the approach – The study used static images which is an established technique to represent the real-environment as mentioned in Section 4.5.4 (Mehrabian 1974; Stamps 1990). The more established understanding of how people perceive and interact with static images was, therefore, a reason for its selection instead of the interactive panorama or video alternatives. However, using the interactive panorama would have provided participants a more immersive and more detailed view of both the design and the space. Immersion has been suggested to influence end-user perceptions and outcomes as discussed in Section 3.3.1 (De Kort et al. 2006; Jaeger et al. 2001). The importance of being able to control the experiment design, however, overruled the possible gain on immersion.

Studies that are concerned with the aesthetics of products tend to use the conjoint approach combined with visual material as stimuli since verbal descriptors may not represent the product adequately (Page and Rosenbaum 1992). In a comparative study between verbal and pictorial stimuli, Vriens et al. (1998) found that higher accuracy is produced if pictorial stimuli were displayed prior to verbal stimuli. In addition, not using purely verbal description but visual methods and physical prototypes is in line with trends observed within conjoint methods (Green and Srinivasan 1990). Concluding from this experiment, pictorial stimuli were not only an additional benefit but represent the more superior and appropriate representation of the in-situ environment. The way people experience the built-environment is not through verbal but sensorial means. Since the degree of realism of the product has an effect on the models' validity (Jaeger et al. 2001), the use of visual image in this case is more likely to produce better data quality.

Conjoint survey and analysis provide the distinct advantage of allowing participants to rate the environment as a whole. This is not only more realistic but also methodologically more rigorous since Gestalt theory describes people perceiving attributes based on their patterns, symmetry and in relation to other attributes (Koffka 1922). By using this method combined with 3D renderings, end-user perceptions of specific design attributes were revealed which would not have been possible if using traditional, pure methods.

Limitations – Despite the mentioned benefits stemming from the combination of photo-realistic 3D renderings with the traditional Conjoint Analysis, the method also revealed a number of challenges as discussed below. While the creation of 3D renderings allowed testing specific design attributes, the control of untested variables can be challenging. The first challenge was, therefore, to avoid the creation of additional, unintended visual cues which can cause ambiguity. For example, despite the fixed light setting in the experiment design, the brightness can differ depending on a number of factors such as number of design attributes, the material and its degree of reflection. This condition was accepted for the experimental design under the consideration that the same effect of lighting would occur in the real environment. The implication of this effect for the perception of the design may need to be further investigated in laboratory and in-situ experiments. This example shows the sensitivity of the method to additional visual cues since the change of one aspect may impose consequences on other aspects of the design.

The second challenge deals with the conjoint method and its adaption into the use of assessing design attributes in built-environments. In the experiment, two types of seating arrangements were included: Rows and Groups. These two arrangements may, however, need to be investigated in the form a continuum of flexibility rather than discrete levels. The distinct definition of a row and group arrangement was also to a certain extent dictated by the types of seats. In design scenarios with only multiple seats, group arrangements become more stretched out due to the length of the seats, hence, resembling row arrangements.

Another challenge lies within the online data collection which limits the control over participants' environment and conditions during the experiment such as the usage of different screen sizes. However, according to Codispoti and De Cesarei (2007), the different screen size does not affect the *'task demands'* themselves. It should also be noted that conjoint studies are experiment-specific; therefore, further studies are needed with different types of constant variables in order to extend existing knowledge on the perception of design attributes.

8.10. SUMMARY

The study quantified end-user perceptions of seven selected design attributes and their assigned levels with regard to perceived Pleasantness. A waiting room with padded individual chairs, arranged in rows with an open and accessible reception that shows signage and additional design features was perceived most pleasant. The model was able to predict the level of pleasantness for hypothetical design scenarios with high accuracy. The perception of Typical HC was also explored as a secondary goal. Rows of hard, single chairs in a waiting room with closed, separate reception, no signage or additional features and having wooden flooring were perceived most typical of healthcare. This was in accordance with expected findings with the exception of wooden flooring which requires further investigation.

The relationship between the circumstantial context and its influence upon the perception of the design in OHCWEs was further explored and will be discussed in Chapter 9. The facility for social interaction, privacy of conversations and the comfort for the companion when waiting were regarded most important when being accompanied. Long waiting time shifts end-user focus to seat comfort and personal space as well as detailed specifications of the design due to their *analytical response* towards the design. Design that supports operational efficiency as well as a good communication with the reception staff were perceived more important in the event of a short waiting time. Participants also expressed that their first impression is formed rapidly and is not likely to change regardless of waiting times.

The combination of photo-realistic 3D renderings with Conjoint Analysis contributes to the development of methodologies to assess the perception of built-environment through visualisation techniques. Also, healthcare designers and researchers can use the presented method to better understand user perspectives of healthcare waiting environment designs. This will help them to focus on the design attributes that are relevant to users, which will contribute to a more pleasant experience of the healthcare service.

CHAPTER 9 – OVERALL DISCUSSION

9.1. INTRODUCTION

As findings from individual studies have been discussed in the relevant chapters, this overall discussion intends to point out implications of this research in the context of current changes and challenges within the healthcare industry. Key themes that emerged from different stages of the overall research are consolidated and discussed. This is followed by a reflection on the methodological approach, its strengths and potential limitations.

9.2. SIGNIFICANCE OF THE FINDINGS

As introduced in Chapter 1, the healthcare sector is undergoing enormous changes mainly as a consequence of rising demand for healthcare and the resulting expenditure. Patients are encouraged to become more involved in their healthcare decision-making (Department of Health 2012) which changes the traditional view of a passive patient on the receiving end of treatment. At the same time, people's lifestyle and attitude towards healthcare has shifted towards a more consumerist approach. As described in Chapter 2, Chalamon et al. (2009) found a balanced distribution of patients' attitudes *Hedonists, Functional skeptics, Trustful optimizers* and *Consumerists*. Study 3 found that while only 2.9% of participants referred to themselves as consumers in the healthcare context, a large share (28.3%) stated to have a holistic approach (based on *Hedonists*) towards healthcare (Appendix E). These developments should encourage the healthcare industry to reconsider the way they operate in order to become more competitive, similar to other service industries.

Consumer research has long suggested the significance of the physical spaces for service industries, as end-users interact with them prior to coming into contact with the core service or product (Bitner 1992; Kotler 1973). As an example, the hospitality sector includes design characteristics to provide a more homely environment (Siguaw and Enz 1999) or lighting effect to control the ambience of restaurants (Stroebele and De Castro 2004). As Pleasantness was identified as end-user main perception in Study 2a, recommendations from this research primarily focus on design aspects that make OHCWEs more pleasant (Chapter 10). Applying recommendations from this research can help to create more pleasant OHCWEs which take the design practice a step closer towards end-user well-being. Pleasantness as defined in Study 2a covers a range of emotional and cognitive perceptions such as comfort, beauty and relaxation. Due to the positive effect on end-user health and well-being which can result in cost benefits, healing environments are also referred to as *smart investments* (Huisman et al. 2012). In Chapter 2, the importance of providing a pleasant waiting experience supported by the design was discussed. This is particularly true for the outpatient healthcare sectors due to the increasing shift from inpatient to outpatient care as a way to reduce cost and the lack of research focussing on them (Becker and Douglass 2008; Joseph et al. 2009). Since healthcare waiting environments often act as the first and last interaction point (Figure 2.2, Section 2.2.2), their design contributes to the impression end-users form about the entire facility and provided services.

Pleasant spaces include not only functional but also aesthetic aspects which were suggested as cues for quality judgement (Ulrich 2011) and a mediating factor for stress-reducing effects. Ulrich (2011) also emphasised that aesthetic responses are formed within 100 seconds of interaction time which create a first impression that can persist over time. Depending on the type of healthcare facility and the context of the visit, multiple stages of the healthcare journey can be connected to the waiting environment (Figure 2.2, Section 2.2.2). In Study 3, a participant explained that *'…if the environment is pleasant I want to stay. In fact, I use to stay even after being discharged, just to arrange my bag or to rest for a while and to chat with my friends about results and to plan for a coffee'* (P131). The traditional purpose of the waiting room may need to be reconsidered as its potential goes beyond the provision of a space for merely waiting. As an example, artwork has been associated with a number of health and well-being benefits (Staricoff 2004), hence, widely applied across facilities. As mentioned in Chapter 3, nearly half of all healthcare facilities in the USA include artwork in their design (Hathorn and Nanda 2008). Waiting environments may therefore have potential value in being used as a space to display artwork. This could be implemented as a design intervention to promote well-being but also as a way to promote local artists and reinforce a community feel. A mind shift about the purpose of healthcare facilities and waiting environment may be the first step to provide a patient-supportive environment and pleasant healthcare experience.

9.3. UN-/TYPICAL HEALTHCARE AND PERCEIVED PLEASANTNESS

Findings from Study 1 led to the hypothesis that the un-/typical healthcare appearances were not a reliable indicator of end-user preferences of the design (Hypothesis 3, Section 5.5). While there are indications that untypical healthcare designs may distract people from illness or the fact that they are in a healthcare environment, negative views were also recorded. Opposing views were expressed concerning designs with a low quality standard and hygiene as well as those that diverted too far from what people would usually expect.

How un-/typical the appearance of the healthcare environment is perceived depends on the individuals' memories, experience and their schemata of a typical healthcare environment (Arneill and Devlin 2002). Most participants were NHS users and referred to these commonly experienced environments as *'typical'*. The images were intentionally selected to represent a range of design scenarios including the extreme cases. As found in studies 2a and 3, expectation plays a role in influencing end-user perception of the design of OHCWEs. This is illustrated in the suggested framework in Section 9.4 (Figure 9.1). PCA results from Study 2a showed that the perceptual scale *Expected - Unexpected* contributed to the extracted component Typical HC. The high factor loading (0.867) suggested that expectation is a reliable indicator of Typical HC. Qualitative results from Study 3 further suggested that the perception of Typical HC and Pleasantness depends on people's expectation. As discussed in Chapter 2, literature suggested that people's baseline expectation dictates their perception and evaluation of products and services (Bitner 1992; Bolton and Lemon 1999). This was for example demonstrated through the comparison between public and private healthcare facilities where not the absolute quality standard was the determining factor but rather people's expectations (Jabnoun and Chaker 2003).

Further confirmation of the non-direct relationship between the level of typical healthcare appearance and pleasantness was revealed through PCA results from Study 2a. The two components Typical HC and Pleasantness were found to be uncorrelated. Visual scales established in Study 2b (Figure 7.2) confirmed that designs rated most pleasant and unpleasant were not reflective of the ones rated most typical or untypical healthcare. Overall, findings from this research suggest that there is insufficient evidence to support a direct relationship between the level of typical healthcare appearance of OHCWEs and perceived pleasantness. The attempt to create a patient-supportive environment is often accompanied by the objective of avoiding the institutional, clinical appearance (Devlin and Arneill 2003). Leather et al. (2003) also suggested that *nouveau* healthcare waiting environments are more beneficial compared to the *traditional* setting with regard to a number of perceived measurements. However, the assumption that diverting from a healthcare appearance will contribute to pleasantness may be premature.

As discussed in Section 3.2, there is a lack in the understanding of what defines a certain style e.g. homely or hotel-like appearance in healthcare environments and their potential effect on end-user perceptions. The associations of healthcare environments with non-healthcare buildings such as shopping centres and hotels may result from the influence that these types of buildings have on the development of healthcare architecture (Verderber 2000). It was also noted by Verderber (2000) that atrium-inspired healthcare design concepts were popular in the late 1980s but the trend did not persist due to the resulting high costs. This may explain why modern, atrium-inspired designs are still associated with a premium or private healthcare facilities as found in Study 1. The association of healthcare environments with non-healthcare spaces may have different effects on end-user perceptions. As an example, participants from Study 1 made the distinction between *'homely'* and *'looking like someone's home'*. In the context of a healthcare environment, *'homely'* was used to refer to a positive emotion which is consistent with findings by Macnaughton et al. (2005), the latter mentioned was associated with negative perceptions. While the concept of a homely design may hold potential value for a pleasant design, the understanding of this concept is yet to be established. Apart from a few theoretical discussions such as by Kellett and Collins (2009), no attempts to investigate this result further can be found.

Arneill and Devlin (2002) suggested that people have set schemata of what a typical healthcare facility design looks like. If diverting too far from this schemata, designs might become unpleasant as confusion about the primary function of the space may arise. As described in Chapter 3, Macnaughton et al. (2005) found that people were confused about the purpose of an atrium-inspired healthcare space and unsure of their expected behaviour within that space. For example, subjects expressed were not sure if they were allowed to sit and eat in that area. Findings from this research revealed that the relationship between the healthcare appearance and end-user perception is complex and needs careful considerations in the implementation. As shown in Chapter 10, examples of pleasant and unpleasant design exist for both typical and untypical healthcare appearance. Other factors therefore appear to play a role in contributing to pleasantness which needs to be investigated in further research as described in the next section.

9.4. INFLUENCING FACTORS OF END-USER PERCEPTIONS OF OUTPATIENT HEALTHCARE WAITING ENVIRONMENTS

Findings from different stages of the research revealed that a number of factors apart from the design itself can influence end-user perceptions of the design of OHCWEs. Figure 9.1 provides a conceptual framework of this relationship including three influencing factors of end-user perceptions: the design itself (intrinsic), circumstantial (extrinsic) and individual factors.

The previously introduced framework from Section 4.2 (Figure 4.1) was extended through the inclusion of findings from this research. As an example, 'Perception of the built environment' was replaced by the end-user main perceptions of OHCWEs Pleasantness and Typical HC which was found in Study 2a. The concept of *intrinsic* and *extrinsic* factors contributing to the perception of products and services was based on the model in consumer research by Zeithaml (1988). The author suggested that intrinsic factors referred to the property within the product itself while external characteristics assigned to the product were termed *extrinsic*. Based on this concept, the design of OHCWEs represents intrinsic factors while external factors such as being accompanied to the healthcare visit and waiting time referred to extrinsic factors.

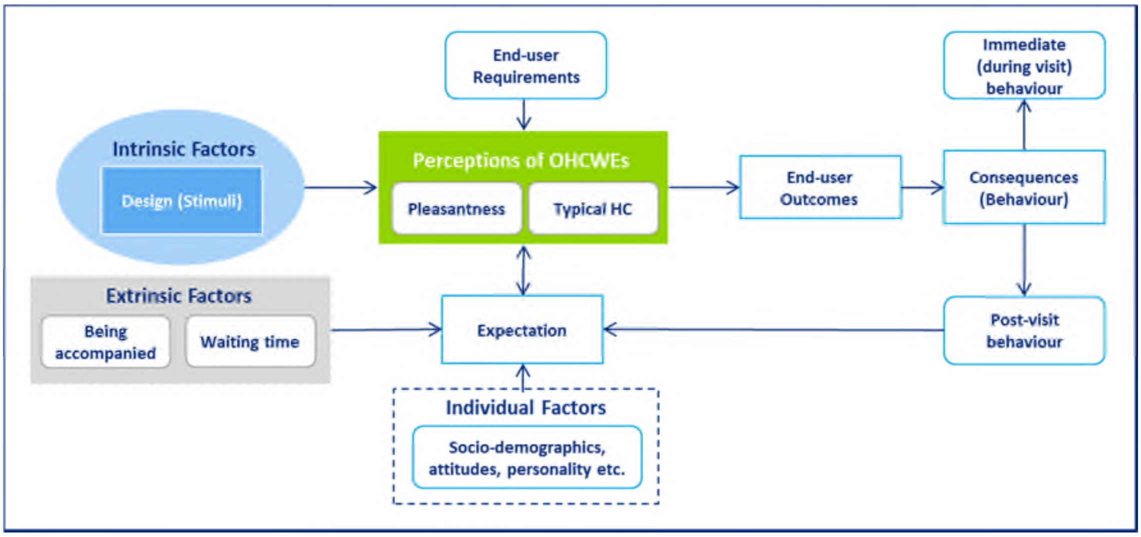


Figure 9.1: Framework showing influencing factors of end-user perceptions of OHCWEs

Intrinsic Factors *– The design of the environment itself*

Extrinsic Factors – *The circumstances and context of the visit. In this study, the factors refer specifically to the two factors: Being accompanied and Waiting time.*

Individual factors *– People's individual differences e.g. their background, personality, cultural beliefs etc. may also influence their perception of the design*

While this research focused on the effect of design on end-user perceptions, the role of extrinsic and individual factors was not primarily investigated but emerged during the research process. Literature suggested that individual differences impact upon the perception of healthcare environment designs (Tsai et al. 2007). Sadalla et al. (1987) pointed out that the end-user choice of design relates to their socio-demographics and the relationship between the reaction towards colour and individual differences was suggested by Dijkstra et al. (2008a). As discussed in Section 9.3 people's expectation also plays a role in influencing end-user perceptions of OHCWEs. As shown in Figure 9.1, expectation is suggested to act as a mediating factor between extrinsic factors, individual factors and end-user perceptions. Both factors may alter people's *normative* or baseline expectation (Bolton and Lemon 1999) which in turn can impact on end-user perception of OHCWEs. The potential role of extrinsic factors in influencing end-user perceptions of OHCWEs emerged from all empirical studies (Studies 1, 2a and 3), hence, will be discussed in more detail in the following paragraphs.

Being accompanied to the healthcare visit – In Study 2a, participants expressed that the evaluation of the scale *Social* **-** *Private* depends on the context of their visit and whether they were accompanied by someone or went alone. Privacy for a single visitor may have different design implications than for families. Douglas and Douglas (2004) found that patients expressed the desire for a comfortable and supporting environment for them as well as their families. Participants in Study 2a and Study 3 also pointed out that not only the fact of being accompanied influence their design perception but also their relationship with the companion. For example, those participants with children explained that their design requirements reflect their children's needs when taking them to the doctor. The social context of the healthcare visit can therefore contribute to their experience and perception of the design.

Waiting for a healthcare appointment with a companion changes the demand on the design and its perception. During the waiting time, entertainment facilities as well as seat comfort decrease in importance as people focus on socialising with their companion. In turn, seating arrangement and seat availability become more important. Hence, the environment needs to provide an ambience that enables social engagement and allows personal privacy which is in agreement with findings by Douglas and Douglas (2004). The aspect of providing comfort for not only patients but also their visitors has been researched more in inpatient facilities where family involvements are generally greater such as in maternity wards (Douglas and Douglas 2004). Ulrich (1991) also recommended that design interiors should support desired social behaviours while still considering the need for personal space and privacy. The challenge of accommodating multiple occupancy groups in healthcare waiting environments is that promoting social interaction may be as required as the provision of quiet spaces. For example, the provision of pleasant sound quality in OHCWEs to promote conversations and a nice atmosphere may be as important as the reduction of unpleasant noise. Guidelines regarding acoustics in healthcare environments (Department of Health 2013b) focus on reducing the sound and vibration level which needs to be respected. Music has been suggested to provide positive outcome for both patients and medical staff e.g. surgeons (Staricoff et al. 2003).

Anxiety related to disorientation or lack of information was mentioned to be reduced when being accompanied to the healthcare environment. Hence, design attributes related to providing information and reassurance such as the visibility of the reception area, signage and the display of waiting times appear to become less crucial. However, participants expressed considerable concerns for their companion's comfort while they were in the consultation as the companion may have to wait alone. Therefore, design aspects that may become less important due to the effect of being accompanied such as seat comfort and entertainment remain relevant. However, design requirements vary in their specifications depending on the relationship between the patient and their companion.

The role of waiting time on end-user perception – As discussed in Chapter 1 and Chapter 2, the perception of care quality is influenced by the design of waiting rooms (Arneill and Devlin 2002) while waiting times directly impact on end-user satisfaction level in service industries (Pruyn and Smidts 1998) such as the healthcare sector (Becker and Douglass 2008; Thompson et al. 1996).

Due to the suggested relationship between waiting time and end-user perception by literature, more detailed information on waiting times and their influence on end-user perception of the design were collected in Study 3. Self-reported data revealed that (perceived) waiting times were shortest at dental practices while outpatient hospitals showed the largest variation (Figure E-3; Appendix E). Overall, the design of waiting environments at dental practices along with those from private hospitals was often described more positively with a higher standard. This leads to the question of whether or not the consumer-driven approach and the fiercer competition amongst private healthcare providers play a role in better provision of design and service. While research shows that competition leads to improved hospital quality in England (Cooper et al. 2011), differences in quality and patient satisfaction cannot be attributed to the type of facility providers (Pérotin et al. 2013). In a comprehensive study, Pérotin et al. (2013) found that differences between specific settings and amongst patients were more likely to influence the quality and satisfaction measures. This is in agreement of Jabnoun and Chaker (2003) findings which indicate that patients in private healthcare facilities rated satisfaction more critically due to higher demand and expectation.

The potential change of end-user perception of the design given different waiting time durations was also further explored. In the event of a long waiting time, many desirable aspects were described in detail such as the type of desired magazines or specific content and channel on TVs. No design aspect was mentioned as less important when waiting for a considerable amount of time. Seat comfort, the provision of personal space and less crowding effect were amongst the most important features. This is in line with literature suggesting that crowding can affect the level of comfort and pleasantness in public spaces (McClelland and Auslander 1978; Yildirim and Akalin-Baskaya 2007). Refer to Chapter 3 for a discussion on the need for privacy in OHCWEs. Participants also mentioned that they would take more notice of the design if waiting for a long time. While the prolonged time may make them more aware of design details which Ulrich (2011) called *analytical response*, their impression of the overall design may not change. Ulrich (2011) explained that the *aesthetic response* is formed within the first 100 seconds of the encounter and likely to endure which was confirmed by a number of participants. They stated that their perceptions are formed quickly and based on the first impression. In the case of a short waiting time, people mentioned that seat comfort and entertainment may become less important. However, the efficiency of movement through the space becomes more important. The use of space boundaries such as circulation axes have been suggested to ease movement, reduce crowding effect, hence contribute to pleasantness in waiting rooms (Akalin-Baskaya and Yildirim 2007). Interestingly, several participants also mentioned the increasing importance of the interaction with reception staff as this time in proportion with the overall time spent in the healthcare facility increases.

The purpose of the suggested framework (Figure 9.1) was to conceptualise how intrinsic, extrinsic and individual factors influence the perception of the design of OHCWEs. As such, it may not represent an exhaustive view of all factors influencing end-user perceptions of the design of OHCWEs. For a more complete picture on potential factors that influence the end-user perception and experience of OHCWEs, other aspects such as staff attitude which are not within scope of this research may play a role. Staff attitude was mentioned to affect end-user experience of the healthcare journey by participants during the course of Study 1 and Study 2a. As mentioned in Section 2.3.2, the design of healthcare environments can affect staff performance and well-being (Zimring et al. 2005) which in turn can impact on end-user experience. Design factors such as lighting can impact on staff performance and cause medication errors which can harm patients (Boyce et al. 2003).

9.5. STRENGTHS AND LIMITATIONS OF THE RESEARCH APPROACH

This section discusses how the methodological approach has helped to understand end-user perceptions of the design of OHCWEs along with its challenges and limitations.

9.5.1. Challenges of investigating end-user perceptions and the developed mixed methods research framework

As discussed in Chapter 2, the literature reported a lack of rigorous studies in EBD which was attributed to the difficulty of investigating the effect of the design on end-users (Dijkstra et al. 2006; Huisman et al. 2012). According to Ulrich et al. (2008), the challenge lies within the control of fixed and variable parameters in the experiment design as the change of one design aspect can alter multiple other parameters. The on-going debates about the priority and mechanism of emotion and cognitive responses (Lin 2004), as discussed in Section 2.2.1, add further complexity to this type of research. For example, Zajonc (1980) suggested that emotion can occur independent from a prior cognitive response while the cognitive approach is supported by Reber (1989). The latter refers to the concept that cognition occurs regardless of people's awareness, hence, also referred to as *implicit processing*. The purpose of the discussion is to point out the complexity of researching and measuring perceptions as opposed to finding support for either of the mentioned schools of thought.

In response to the discussed challenges, this research developed a novel mixed methods design which combines a traditional research format with visual and applied techniques from other disciplines. This approach addressed a number of issues, including reducing the subjectivity of pure qualitative methods without compromising on the richness of the data. This was for example achieved by using initial interviews to explore end-user views, followed by evaluative techniques which delivered numerical data suitable for quantitative analysis. Furthermore, Study 3 introduced a new technique that combines photo-realistic renderings with traditional Conjoint Analysis to reveal end-user perception of selected design attributes and levels. This method demonstrated a systematic approach to control untested design parameters. At the same time, people were not exposed to the challenging task of evaluating design aspects individually and against one another. Instead, the method allowed people to make a judgement on the overall design concept which is in line with the way they perceive designs according to Gestalt theorists (Koffka 1922). According to Creswell (2009), the potential of using mixed methods in many fields including visual research is *'tremendous'*.

Deeper insight about the relationship between end-user perception and the design of OHCWEs – The use of applied methods including PCA and Conjoint Analysis in Study 2a and Study 3 helped to gain a deeper understanding of how end-users perceived the design of OHCWEs. In Study 2a, apart from identifying the main components representing end-user main perceptions, PCA also revealed the underlying structure of the overall data. Both of the extracted components Pleasantness and Typical HC contained a mixture of emotional, cognitive and/or associative perceptual scales. This close relationship makes their separation difficult so that the accuracy of using single scale measures may be challenged. By using the extracted components which represent end-user main perceptions of the design of OHCWEs as measures, the various highly correlated perceptions were captured.

Studies in EBD either focused on design interventions that include the alterations of a single parameter or multiple design aspects (Dijkstra et al. 2006). Neither of them allows a comparison of the effect of design parameters amongst one another. This was possible using Conjoint Analysis, as the contribution of each design attributes and their levels were provided in standardised quantitative manner. The ability of revealing end-user preference with regard to individual aspects of the product or service also explains its popularity amongst researchers from other fields such as marketing research (Wittink and Cattin 1989). The experiment allows the comparison amongst the selected design attributes which has previously been difficult as mentioned in Chapter 2. The conjoint model allows prediction of the potential level of pleasantness of untested design concepts. This, however, applies specifically to the design attributes and levels in the experiment so that estimations cannot be applied to design concepts consisting of other attributes.

The use of visual stimuli and its combination with other methods – As discussed in Chapter 4, the use of pictorial representations is a well-established technique to elicit people’s responses (Mehrabian 1974; Stamps 1990). A number of rigorous studies within EBD have used pictorial stimuli previously, for example by Ulrich (1981) and Dijkstra et al. (2008b). This technique was applied throughout this research, combined with other methods. In all studies, images helped verbal and/or visual communication of design scenario between participants and the researcher. Harper (2002) pointed out that photo elicitation enables collaboration where different people can view and discuss them together. This is a distinct advantage of the technique which has been used for the exploratory purposes of Study 1. Images were not only combined with interviews (Study 1) but also with PCA and Conjoint Analysis in Study 2a and Study 3 respectively. The communication using the addition of visual stimuli further reduced potential misinterpretation and ambiguity of people's associations and verbal descriptions. Visual research therefore enriches the investigation by collecting another source of data. In this study, results from visual analysis were mapped to the associated qualitative data (Study 2b) which represents methodological triangulation, hence, improved the rigour of the data (Morse 1991).

In Study 3, the incorporation of visual material in Conjoint Analysis is in line with the methodological development as pointed out by Green and Srinivasan (1990). However, while visual conjoint approach is commonly used to test the aesthetic dimension of products (Page and Rosenbaum 1992; Vriens et al. 1998), only few studies researching the perception of the built-environments have used this approach. In studies that use the approach such as Fawcett et al. (2008), untested design parameters were not rigorously controlled. The creation of photo-realistic 3D renderings in this research therefore offers a superior way of systematically manipulating design variables without altering constant parameters.

The use of representation instead of in-situ testing – For a number of reasons detailed in Chapter 4, this research chose to use visual representations of the real environment instead of in-situ testing. While the use of visual representations provided various advantages as explained earlier in this section, it also imposes limitations. The perception in the real environment is multi-sensory; hence, visual perceptions may be reduced or enhanced when combined with other senses. While the separation from other senses was desired for the control of the experiment in order to focus on the visual perceptions, in-situ testing might be more suitable for certain design aspects. For example, the effect of artwork and indoor plants has been suggested by various literatures (Bringslimark et al. 2009; Staricoff 2004). However, participants recruited for this research did not show a strong response towards their presence compared to other design attributes e.g. flooring. A potential explanation is that people may need to interact with these design attributes in a more immersive manner in order for them to have a larger impact, hence, more suitable for in-situ testing.

9.5.2. Discussion on the reliability, validity and generalisation of findings

Reliability and Validity – Different strategies were used to address reliability and validity of individual studies due to their differing methods. Inter-rater reliability between the researcher and an independent second coder was used to ensure the reliability of the qualitative data analysis. Cohen's κ of 0.95 was achieved after a discussion to clarify disagreements which is considered *'almost perfect'* according to Landis and Koch (1977). In Study 2a, PCA was used to extract the main components which represented end-user main perceptions. The two main components explained together 66.85% of the variance of the original data. To ensure that the scales belonging in each component were reliable indicators, a high cut-off point for factor loadings ($\geq$ 0.7) was applied.

High Cronbach's α were achieved for both components, α (Pleasantness) = 0.96 and α (Typical HC) = 0.87 ($\alpha \geq 0.8$ considered good according to Field (2009)), which further confirmed their high internal consistency. To ensure the face and construct validity of the questionnaires in Study 2a and Study 3, pilot studies and expert reviews were carried out (Biemer and Lyberg 2003). Feedback and open questions were also prompted during and upon completion of the experiments to ensure that participants complied with the measurement condition. As an example, to ensure that participants used the standardised scenario in the briefing, Study 3 asked respondents to provide the context they had in mind during the evaluation. People were also asked about their rationale for evaluation to ensure that responses referred to the measured construct. In Chapter 2, a number of studies within EBD have been discussed with regard to their validity issues, in particular regarding the measurement of light, windows and views. For example, the positive effect of the landscape view instead of brick walls found in a study by Ulrich (1984) may be attributed to the effect and amount of lights or temperature instead or in addition to the window views.

The quality of the models established in Study 3 was validated through high Pearson's R and Kendall's τ correlation measures. For Pleasantness, Pearson's R of 0.93 and Kendall's τ of 0.71 were achieved with high statistical significance ($p < 0.001$). The secondary dimension Typical HC showed similarly high internal consistency (Pearson's R = 0.97 and Kendall's τ = 0.86). Kendall's τ for Holdouts[6] was used to validate the accuracy of the predictive models. For perceived Pleasantness, Holdouts can be predicted with very high accuracy (Kendall's τ for Holdouts = 1) at a statistical significance of $p < 0.05$.

Generalisability – As described in Chapter 4, generalisability refers to the external validity of the findings (Graziano and Raulin 1999). This firstly concerns the validity of the results when applying them to the real environment. This was discussed above in the context of using visual representations instead of in-situ conditions. While different healthcare systems and design processes may result in different appearances (Chan 1992; Design Council 2007), most waiting environments share the common purpose of

[6] As explained in Chapter 8, Holdouts were design profiles evaluated by participants but not used for the estimation procedure.

providing spaces to wait. This will allow findings from this research to be generalised to all healthcare waiting environments given that (operational) requirements and regulations applicable for each facility are considered.

As this research focussed on OHCWEs, findings and design recommendations are directly and mostly applicable to these types of environments. Other public spaces in the healthcare environment may also benefit from these findings and recommendations depending on their primary purpose. The potential transferability of knowledge to other environments and situations, therefore, needs to be decided on a case by case basis. However, as a pleasant perception of the design may be a shared aim for many healthcare and non-healthcare spaces, selected design aspects can have transformative character. For example, lobby areas in larger hospitals are not explicitly designed for waiting, but the need for a visible and accessible reception area applies and becomes even more important.

While photographs from international settings were used as stimuli in Study 1 and Study 2a, the majority of participants were UK nationals or residents. The findings therefore reflect the views from mainly from NHS users. End-users with another background may have differing views due to their experiences and expectations (Figure 9.1, Section 9.4). The impact of individual differences was not in scope of this research and needs further investigation in order to provide recommendations to larger populations.

Sample – The majority of participants recruited for this research were UK nationals or residents using NHS services. The generalisation of their views to other areas with e.g. different healthcare system and economic situation will not be possible without further investigation. The purpose of the research is to understand end-users of OHCWEs for which the general public was considered suitable. The rationale behind this was that patients are not an unknown third person but everybody can be viewed as former, current or future end-user of OHCWEs. The recruitment was, however, primarily carried out within the University of Warwick (Study 1 and Study 2a) which may have arguably skewed the sample towards a certain socio-demographic groups. This effect was compensated through the purposive selection of non-academic staff and individuals employed outside the university.

The majority of the participants were between 20 and 45 years old which does not reflect the largest group of healthcare users (over 80 years old). However, the purpose of the research was not to investigate the elderly's perception in particular but to capture views from the members of the general public including future end-user groups. Efforts have been made to also include views of older participants by reaching out to a number of retired individuals. As Dijkstra et al. (2008b) mentioned, there are views that people's perception in-situ may differ as they are likely to be unwell when visiting the healthcare environment. However, they also explained that the perceptions are likely to remain valid but may be exaggerated when end-users are unwell. Also, when involving end-users as stakeholders in the early stages of the design process, participants are also more likely to be healthy.

By incorporating qualitative, visual and quantitative techniques into the mixed methods research design, a holistic view of end-user perceptions was gained. Furthermore, the use of methods that are traditionally applied in other disciplines provided end-user insights which were not available using traditional methods found in EBD. Limitations described above may benefit from further investigation as detailed in recommendations for future research in Section 11.3.

CHAPTER 10 – DESIGN RECOMMENDATIONS

10.1. INTRODUCTION

Findings from this research provided a better understanding of end-user perception of the design of OHCWEs and the methodology of how to investigate such a research inquiry. As discussed in Chapter 2, there is a challenge of translating results from academic research into the design practice. To address this challenge, this chapter provides learning about design aspects to make OHCWEs more pleasant through the interpretation of the research findings from the developed methodology. As Pleasantness was found to be the main component of OHCWE design, the recommendations are focussed upon this aspect of end-user perception. Since this component is made up by 15 emotional and cognitive perceptual scales (Table 6.7), creating a pleasant environment also contributes to making people feel more comfortable, assured, relaxed etc.

The research focused on the interior of OHCWEs as opposed to functional, technical or operational design aspects as they have been suggested to contribute to well-being (Ulrich 1991). Various researchers have demonstrated the health and well-being benefit of interior parameters including furniture, seating arrangements, lighting, plants and artwork as discussed in Chapter 3 (Hathorn and Nanda 2008; Leather et al. 2003; Mizan 2004; Staricoff 2004; Ulrich 1991). The provided recommendations, therefore, focused on design interventions that can be easily and cost-effectively incorporated into OHCWEs. This is reflective of considerations regarding on-going budget restraints in healthcare and the numerous modernisation and renovation projects taking place in healthcare constructions (Carpenter 2011).

The design recommendations may be used by any stakeholder who is concerned with patient-centred and EBD in OHCWEs. Design professionals can use them to increase the level of research-based knowledge in their design practice. However, as the design of healthcare facilities does not always involve design professionals, these recommendations also intend to inform healthcare and estate employees who are responsible for the design. For this reason, they are presented in an accessible manner using visual examples to illustrate concepts. This may help to reach a wider audience that goes beyond the academic community. The understanding and ease of application was discussed and confirmed by Boex Ltd, a UK-based design company, specialised in healthcare environment designs.

Existing frameworks e.g. by Huisman et al. (2012) and Ulrich et al. (2008) presented EBD findings by end-user outcomes which can be useful for beneficiaries to improve specific outcomes. However, the interference of individual design interventions with other aspects of the design is not transparent. For example, single occupancy rooms are recommended to reduce cross-contamination, however, other aspects such as isolation may also result from this change (Chaudhury et al. 2005; Ulrich et al. 2008). For this reason, recommendations presented in the following sections are organised by design aspects.

10.2. OVERVIEW OF DESIGN RECOMMENDATIONS

10.2.1. The overall design

While this research focused on the interior space of OHCWEs, it should be noted that the healthcare journey includes many touch points prior to their arrival in the waiting room (see Figure 2.2, Section 2.2.2). Therefore, design aspects outside the OHCWE such as parking facilities and accessible entrance also need to be considered as they can affect the healthcare experience. Recommendations for the overall space of the OHCWE are summarised below.

Dedicated waiting areas[7] **–** It is recommended to provide spaces that are specifically designed to be a waiting area instead of non-dedicated waiting space which participants in Study 1 referred to as *'Afterthoughts'* and *'Corridor waiting'* (Figure 10.1)

Dedicated waiting room/space	**Non-dedicated waiting space**

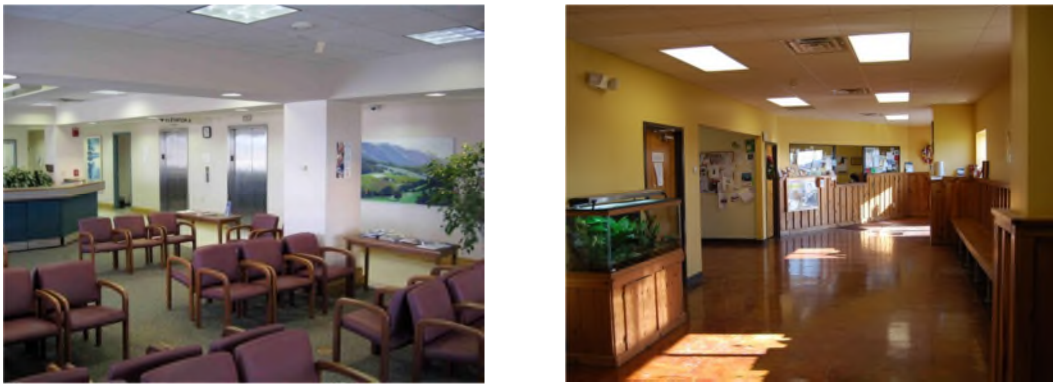


Figure 10.1: Examples of dedicated and non-dedicated waiting spaces

Healthcare appearance – Typical or untypical healthcare appearance alone will not ensure that end-users perceive the design as pleasant. Positive and negative examples of design exist for both typical and untypical healthcare appearance as shown in Figure 10.2 and Figure 10.3. The design needs to be aligned with end-user expectations and clearly communicate the main purpose of the space. It is recommended to integrate the overall design as part of the strategic plans of the facility. For example, a premium healthcare concept may provide an exclusive design in order to meet their end-user expectations while the same provision may confuse or intimidate end-users of a standard healthcare facility. Well-maintained and hygienic (appearing) spaces are important aspects for end-user comfort and pleasantness. For more examples on design appearances that

[7] Dedicated waiting areas are spaces that are specifically designed to function as a healthcare waiting room. Non-dedicated rooms include for example those that were created spontaneously due to overcapacity or corridor waiting spaces.

participants rated pleasant/unpleasant and typical/untypical of healthcare, refer to the visual scales in Figure 7.2, Section 7.4.

Good example of typical healthcare | **Bad example of typical healthcare**

Figure 10.2: Positive and negative designs with a typical healthcare appearance

Good example of non-typical healthcare | **Bad example of non-typical healthcare**

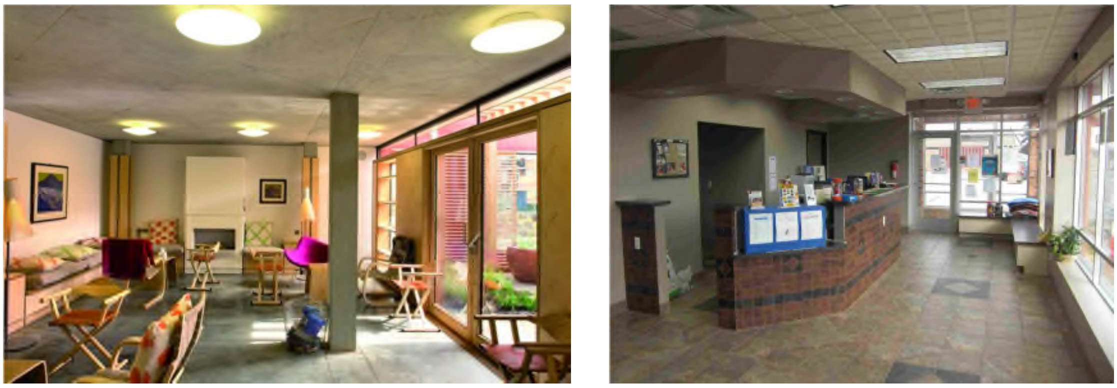


Figure 10.3: Positive and negative designs with a non-typical healthcare appearance

10.2.2. The interior of outpatient healthcare waiting environments

Seating specification and arrangement – Due to the nature and purpose of the waiting environments, seating plays a significant role for the waiting experience. The number of seats needs to match the capacity of the waiting room.

Seat types – Single, upholstered chairs are most recommended for OHCWEs. Sofas and other types of seats can be provided in addition to single, upholstered chairs but their exclusive use is not recommended for OHCWEs due to privacy and hygiene concerns. Uncomfortable seating such as benches was perceived most unpleasant. Examples of seating types ranging from most pleasant (left) to most unpleasant (right) are shown in Figure 10.4. Seat covers need to consider infection control concerns, for example vinyl is easier to clean compared to fabric covers according to Noskin et al. (2000).

Single, upholstered chairs | **Sofas** | **Non-padded benches**

Figure 10.4: Examples of seating types in OHCWEs ranging from most pleasant (left) to most unpleasant (right)

Space between seats – Sufficient space should be provided between seats to accommodate accessibility, spatial and acoustic privacy as well as avoid infection issues. Examples of comfortable as well as insufficient space between seats are shown in Figure 10.5. Refer to guidelines e.g. HBN 40 from the DH for measurement specifications (NHS Estates 1995).

Comfortable space between seats | **Insufficient personal space**

Figure 10.5: Space between seats

Seat arrangements – Combinations of different seat arrangements including structured rows and flexible clusters or groups are recommended. This will allow end-users to choose seats that suit their needs for privacy or social interaction. As discussed in Chapter 3, not being able to control or engage with the environment can be potential stressors. Providing end-users the flexibility to choose from different seating arrangements or to change them to suit their needs would make the experience more pleasant. In facilities where end-users are more likely to be with a companion e.g. maternity ward, clusters or circular seat arrangements would allow them to interact as a group. Examples of recommended seat arrangements (left) and those to be avoided (right) are shown in Figure 10.6.

Recommended arrangements	**Arrangements to be avoided**

Figure 10.6: Recommendations for seat arrangements

Reception desk and reception area – End-users perceived a clearly visible, open-built and accessible reception area to be more welcoming and assuring, hence, recommended for OHCWEs. The height of reception desks must accommodate and facilitate the communication between visitors (including wheelchair users) and the reception staff. Official guidelines e.g. HBN 40 by the DH provides specific height requirements for the reception desk area (NHS Estates 1995). Spatial and acoustic privacy needs to be considered as most privacy issues occur during the interaction with reception staff. Examples of different reception areas are shown in Figure 10.7.

Open, visible and accessible reception | **Not open or accessible, limited visibility**

Figure 10.7: Examples of reception areas in healthcare waiting environments

Natural elements – Indoor plants should be incorporated into the design of OHCWEs. They contribute to end-user well-being, for example by reducing stress, and add to the aesthetic dimension of the design. This is particularly recommended for spaces without windows or an external view to the outside space and could be combined with other design elements that convey a natural feel such as water elements and representational artwork.

10.2.3. Structural and functional design aspects

Space – Spaciousness is a desirable characteristic, however, large spaces can be intimidating and cause disorientation. It is recommended to divide larger spaces into smaller sub-units which would allow different activities and privacy needs. Examples of sub-units in larger spaces are shown in Figure 10.8.


Figure 10.8: Spatial division of larger spaces into sub-units

Flooring – The wooden appearance was slightly more preferred than carpet and vinyl flooring was perceived least pleasant. Carpets should only be considered in places where spillage is less likely to occur. While the aesthetics and comfort of flooring are important due to its large spatial coverage, the following aspects also need to be considered:

- Reduce light reflection that can cause glaring
- Level of grip to reduce the risk of patient falls but still allows the ease of pushing wheelchairs
- Consider infection control aspects that are related to the flooring material, for example carpet is associated with higher risk of contamination

Examples of flooring materials from most (wooden) to least recommended (vinyl) are shown in Figure 10.9.

Wooden Flooring	Carpet Flooring	Shiny (Vinyl) Flooring

Figure 10.9: Examples of different flooring material

Windows and Lights – The size and number of windows are linked to the provision of natural light and the view to the outside space which in turn can improve health and well-being (Chapter 3). A view of landscape and nature is suggested most beneficial for health and well-being. The use of natural lights is generally preferred due to the associated health benefits and as a cost-efficient solution. For more recommendations on lighting and colour in healthcare environments, refer to guidelines by Dalke et al. (2004) or Joseph (2006a).

10.2.4. Facilities

Apart from the basic required facilities such as bathrooms, OHCWEs should provide end-users with additional facilities especially when long waiting times are expected.

Entertainment and Distractions – It is recommended to provide end-users informing or entertaining reading materials e.g. leaflets and magazines. The provision of shared TVs in the waiting room is only recommended if end-users can control the channel and volume or have the option of sitting in another area. Flexible seating arrangements and spatial division into smaller sub-units can be useful to accommodate different end-user needs. Figure 10.10 shows an example of a waiting room with entertainment facilities on the left and one without on the right.

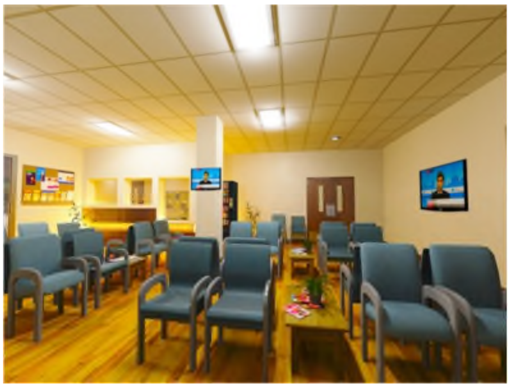
Waiting room with entertainment	Waiting room without entertainment
	

Figure 10.10: Waiting room with (left) and without entertainment facilities (right)

Refreshment – It is recommended to provide end-users access to refreshment facilities, especially in places where people are likely to be accompanied or where a long waiting time is anticipated. The provision of additional services must, however, not interfere with the primary function of the healthcare facility.

10.2.5. Other recommendations

Apart from the above mentioned factors that affect the pleasantness of the design, other factors such as staff attitude and clear *wayfinding* were amongst important aspects mentioned by literature. It is important that the design also supports staff health and well-being as their performance can have a direct impact on other end-users. The environment should be also designed in a manner that end-users are informed and feel assured. Solutions including an open reception area, clear signage and communications can be helpful with regard to this aspect.

Chapter 9 provided a framework that shows factors influencing end-user perceptions of the OHCWEs. These factors include the length of waiting time, being accompanied and individual differences amongst others. In facilities where a long waiting time is expected, seating comfort, privacy and the provision of entertainment and distractions become more important. In case of a short waiting time, the layout to enable operational efficiency, clear signage and wayfinding supports as well as good communications with the reception staff become more important. In facilities where end-users commonly arrive with a companion, design aspects that accommodate the end-user need as a group becomes more relevant. For example, grouped seating arrangements as mentioned in Section 10.2.2 can help to ensure their conversational privacy. The design needs to consider the companion's comfort while waiting on their own during the consultation time. When waiting with a companion, participants also mentioned the social aspect of being able to share a beverage during the waiting time. The provision of refreshment facilities, therefore, would also be beneficial in this scenario.

CHAPTER 11 – CONCLUSION

11.1. INTRODUCTION

The research set out to investigate the relationship between the design of OHCWEs and end-user perception. The research provided learning on how end-users perceive the design of OHCWEs and how to investigate such a research inquiry. A mixed methods approach containing four studies was designed to address the sub-objectives of this research. Empirical findings as well as additional learning about the design were summarised into practical design recommendations as presented in Chapter 10. This concluding chapter presents main outcomes and contributions stemming from this research, followed by recommendations for future research.

11.2. MAIN RESEARCH OUTCOMES AND CONTRIBUTIONS

Outcomes from this research make theoretical, methodological as well as practical contributions as shown in the overview below (Figure 11.1).

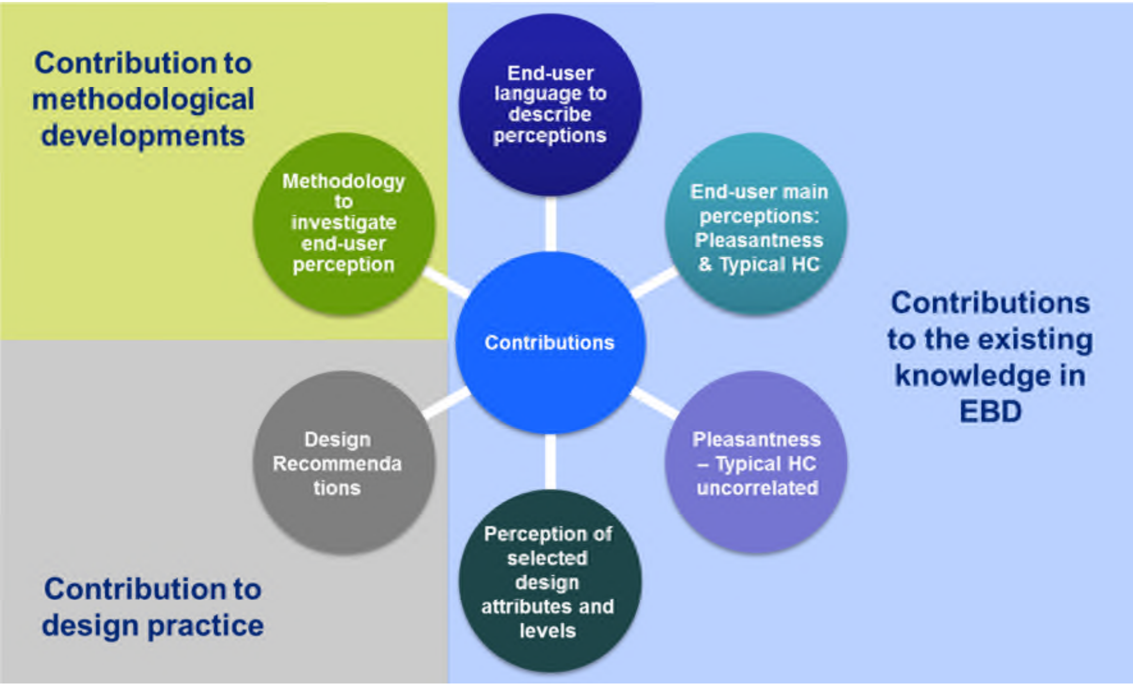


Figure 11.1: Main achievements and contributions stemming from this research

Conceptually, a better understanding of how end-users articulated their views about the design of OHCWEs was established **(a)**. Insight was gained about how end-users perceived the overall design **(a - c)** as well as specific design attributes **(d)**. The developed methodological framework allowed for a more complete view of end-user perception by using a novel mixed methods approach **(e)**. Empirical findings from the research process and additional learning about the design led to the development of recommendations to inform those concerned with the design of OHCWEs **(f)**.

a. **Understanding of how end-users articulate about the design of OHCWEs**

Photo-elicitation interviews with 24 participants revealed that end-users expressed their views about the design of OHCWEs using *Design Aspects* and *End-user Perceptions*. The first category referred to participants listing design descriptors from the displayed images or from their past memories. However, participants appeared to express their views about the design more intuitively using emotional, cognitive and associative perceptions. These findings contribute to the understanding of the content and language used by end-users to communicate about the design of OHCWEs which has not been well-established previously.

b. **Identified end-user main perceptions of the design of OHCWEs**

Using PCA, Pleasantness and Typical Healthcare were identified as end-user main dimensions which explain 66.85% of the original data set (Study 2a). The complexity of the relationship between the design and end-user perception is attributed to the large number of design variables and perceptions. The compressed yet representative PCA dimensions, therefore, reduced the complexity of this relationship and allowed for the assessment of design attributes. Since the component Pleasantness consists of 15 emotional and cognitive perceptual scales, its measure also reflects, for example, how comfortable, relaxed or assured the design is perceived.

c. **Un-/typical healthcare appearance and perceived pleasantness of the design**

Findings from this research suggested that there is insufficient evidence to assume a direct relationship between the level of typical healthcare appearance and its perceived pleasantness. In Study 2a, no correlations were found between the two main perceptions Typical Healthcare and Pleasantness which further rejects a potential causal-effect relationship. This challenges existing knowledge and design practice in support of positive end-user outcomes linked to the level of un-/typical healthcare appearance.

d. **Design attributes that contribute to a pleasant design in OHCWEs**

In Study 3, ratings of created 3D renderings were used to estimate the contribution of seven design attributes and their assigned levels towards perceived Pleasantness. Flooring showed the highest importance values, followed by seat padding and capacity, reception, additional features, seating arrangement and signage. The estimated utility scores from the Conjoint Analysis revealed that wooden flooring was perceived slightly more pleasant than carpet, followed by vinyl flooring. Other characteristics that were perceived as pleasant included an open reception area, upholstered, single chairs that are arranged in rows, clear signage and additional features such as indoor plants and reading material. The level of pleasantness of untested designs can also be accurately predicted using the conjoint model.

e. **Mixed methods framework to understand end-user perceptions of OHCWEs**

The developed mixed methods framework presents a structured and novel approach to investigate end-user perceptions of the design of OHCWEs. This framework included quantitative, qualitative and visual techniques which were adapted for the purposes of this study. Conjoint Analysis as an established method in consumer research was used in combination with created photo-realistic 3D renderings to assess design attributes. The role of design attributes towards perceived pleasantness was quantified in standardised measures which enabled the cross-comparison amongst design attributes. This approach has not been widely used in EBD and provided a more complete view of end-user perceptions which would not have been possible using traditional, pure methods.

f. **Developed design recommendations to inform EBD practice**

Empirical findings and additional learning about the design were summarised into practical design recommendations (Chapter 10). This was done to address the challenge of translating academic findings into the design practice which was identified in Chapter 2. Existing guidelines tend to focus on technical or functional specifications and often concern inpatient and long-term care. Recommendations from this research focus on the practical design interventions to create more pleasant OHCWEs. Making the environment more pleasant also influences the perception of comfort, relaxation and assurance amongst other aspects. However, further steps may be needed, as will be suggested in Section 11.3, to fully translate the recommendations from this research into the common design practice.

This research contributes to the existing knowledge, current design practice and methodological applications in the area of EBD. The improved understanding of how end-users perceive the overall design as well as design attributes of OHCWEs makes conceptual contributions. This added knowledge enables the revision and expansion of existing frameworks in EBD which in turn will inform future research. The mixed methods approach developed in this research further contributes to the methodological development to investigate end-user perceptions of the design of OHCWEs. Design recommendations derived from this research makes a practical contribution to the EBD practice as they support the creation of more pleasant OHCWEs.

11.3. RECOMMENDATIONS FOR FUTURE RESEARCH

Findings from this research led to the following themes which can be investigated in the future.

Un-/typical healthcare design appearance and end-user perceptions – Findings from this research suggested that there is no direct relationship between the typical healthcare appearance and perceived pleasantness. However, due to the general lack of understanding about this relationship, further investigation is needed. In order to understand how healthcare appearances may affect end-user perception, it is necessary to firstly establish a formal classification for the various healthcare styles. As shown in Chapter 10, positive and negative examples can be found for both, typical as well as untypical healthcare appearances. The question therefore may not be whether or not un-/typical healthcare appearances affect the end-user perception but to what degree an un-/typical healthcare appearance is desirable. This can for example be investigated by including inputs about design characteristics of Typical HC (Study 2b) in the research design of Study 3 in order to assess those untested design aspects.

Assessing the effect of further design attributes – In Study 3, end-user perceptions of flooring, seats, reception, signage and additional features such as reading material were assessed. However, literature indicated a number of other design variables with the potential to influence end-user perception, health and well-being. Colours, the perceptual dimension of lighting, outside view, indoor plants and artwork display are amongst these mentioned design attributes. Since EBD in healthcare is still in the emerging phase, further research and empirical evidence will be required to help establishing the field.

Involving multiple sensory aspects in testing end-user perceptions of the design of OHCWEs – This research focused primarily on the visual sensory input of OHCWEs. However, in reality every built-environment is experienced in a multi-sensory manner. Knowledge stemming from this research provides a platform for future investigations to incorporate other sensory inputs e.g. combining the perception of sound with visual input. This can be conducted following a similar approach to this research by using representations which can be used in conjunction with lab-controlled conditions. However, in-situ experiments would be more applicable to assess the impact of multiple senses on end-users due to the multi-sensory inputs of the real environment. Ethnography may for example be a suitable method to investigate end-user non-interrupted behaviour in a real context of being in an OHCWE. The end-user can be patients and visitors as well as staff depending on the research aims.

The effect of individual differences on end-user perception of the design – Healthcare public spaces like waiting environments are challenged with the accommodation of the different needs and preferences by multiple end-user groups. This research focused on members of the general public to represent patients and visitors. As shown in the framework presented in Figure 9.1, individual differences such as demographics, culture and personality can influence end-user expectations and perceptions of the design. Further investigation on the relationship between individual differences and end-user perception of OHCWEs is needed. Cross-sectional studies to compare the perception of end-users from different geographic regions or personality types can provide further insights. This knowledge will add to intelligence data enabling the provision of environments (and services) accommodating the needs of specific groups of individuals. As an example, perceptual differences due to gender may find practical implications in healthcare facilities where higher female attendances are expected such as gynaecology or breast cancer centres.

Route to design guidelines – Outcomes from this research and additional learning about the design were consolidated into recommendations (Chapter 10) to inform those concerned with the design of OHCWEs. However, it is acknowledged that findings from academic research may not easily transfer into design practices. Therefore, further steps to translate this knowledge may be required, for example by extending study findings into design specifications.

Representations in design research – Photographs and photo-realistic 3D renderings were used as representations of the real environments. Learning from using these visual stimuli leads to the question of how other types of representations may compare. Future research may investigate the effect of other representations such as videos, sketches, 3D printed prototypes and virtual reality. The understanding of how end-users interact with different types of representations may have potential value in the conceptual and early stages of the design process.

11.4. FINAL REMARKS

Ageing population amongst a number of socio-demographic developments leads to a greater need for health provision and facilities to provide healthcare services. The mutual relationship between the built-environments created by people and their occupants is reflected in a famous quote by Sir Winston Churchill (1874 - 1965): *'We shape our buildings and afterwards our buildings shape us'* (Figure 11.2).

Figure 11.2: Picture with Churchill's quote *'We shape our buildings and afterwards our buildings shape us'*, taken in Trieste August, 2011

Within academic research, end-user perception of OHCWEs was not well-understood despite the growing evidence suggesting a relationship between the built-environment and end-user health and well-being. This understanding is, however, important in light of the shift from inpatient to outpatient care, resulting in higher attendances in the outpatient sector. Since people spend a considerable amount of time in OHCWEs, its design should make the experience as pleasant as possible. This research has extended the knowledge in EBD by revealing how end-users perceive the overall design as well as specific design attributes. The developed methodology provided a framework to better understand end-user perception of the design of OHCWEs. Findings from this research will therefore help the creation of more pleasantly perceived OHCWEs which also contribute to making people feel more comfortable, relaxed, assured, safe etc. This in turn moves the research a step closer towards improved end-user well-being.

APPENDICES

APPENDIX A – ETHICAL APPROVAL AND CONSENT FORM

(i) Ethical approval

Ethical approval for studies involving human participants was granted by the Biomedical Research Ethics Subcommittee from the University of Warwick.

27 June 2012

Warwick
Medical School

PRIVATE
Miss Kieu Anh Vuong
International Digital Laboratory
Warwick Manufacturing Group
University of Warwick
Coventry
CV4 7AL

Dear Kieu

Study Title and BREC Reference: *Understanding end-users' main perceptual dimensions for the design of healthcare waiting environments 211-05-2012*

Thank you for submitting your revisions to the above-named project to the University of Warwick Biomedical Research Ethics Sub-Committee for Chair's Approval.

I am pleased to confirm that I am satisfied that you have met all of the conditions and your application meets the required standard, which means that full approval is granted and your study may commence.

I take this opportunity to wish you success with the study and to remind you any substantial amendments require approval from the committee before they can be made. Please keep a copy of the signed version of this letter with your study documentation. The committee also requires you to complete an End of Study Declaration Form when you reach the end of your study: this form has been e-mailed to you.

Yours sincerely,

Jane Barlow

Professor Jane Barlow
Chair
Biomedical Research
Ethics Sub-Committee

Copy:
File
Professor Paul Jennings

Biomedical Research Ethics Subcommittee
Enquiries: Clair Henrywood
B032 Medical School Building
Warwick Medical School,
Coventry, CV4 7AL
Tel: 02476-528207
Email: brec@warwick.ac.uk

THE UNIVERSITY OF WARWICK

(ii) Consent form

Consent forms were developed following guidance provided by BREC at the University of Warwick. An example of a consent form used in Study 2a is shown below.

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CONSENT FORM – Part A

Participant Identification Number for this study:

Title of Project: Understanding the main dimensions of end-user perceptions towards the design of healthcare waiting environments

Name of Researcher: Kieu Anh Vuong
Version Number: 3.5
Date:

Please initial box

1. I confirm that I have read and understand the information sheet dated................... (version...........) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected. ☐

3. I understand that I will be viewing and rating colour images of healthcare waiting environments. ☐

4. I give permission for the researcher to audiotape and take photographs during the experiment. ☐

5. I understand that the results will be looked at by Kieu Anh Vuong and academic supervisors Dr. Rebecca Cain, Professor Elizabeth Burton and Professor Paul Jennings. I give permission for these individuals to have access to my records. ☐

6. I agree to take part in the above study. ☐

Name of Participant	Date	Signature

Name of Researcher	Date	Signature

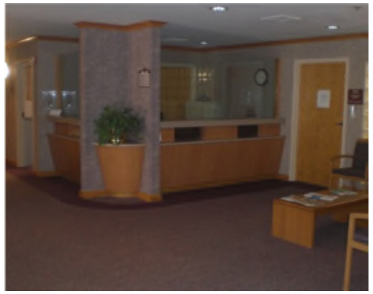
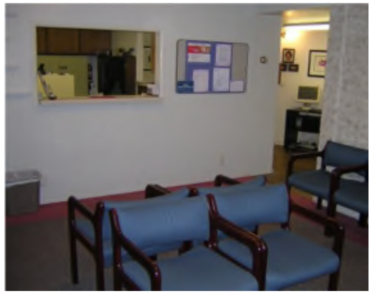
APPENDIX B – ADDITIONAL MATERIAL FOR STUDY 1

Appendix B comprises the full-set of images used as visual stimuli (i), information sheet (ii) and exit questionnaire (iii) to learn more about participants' background and their experience with the healthcare environment.

(i) Visual stimuli used in Study 1

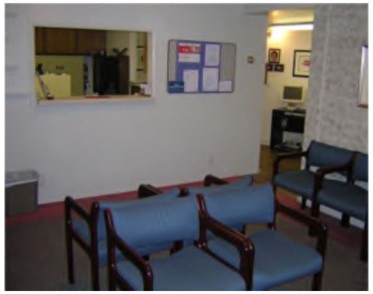
The following images were used for educational and non-commercial purpose as visual stimuli to encourage discussion between participants and the researcher.



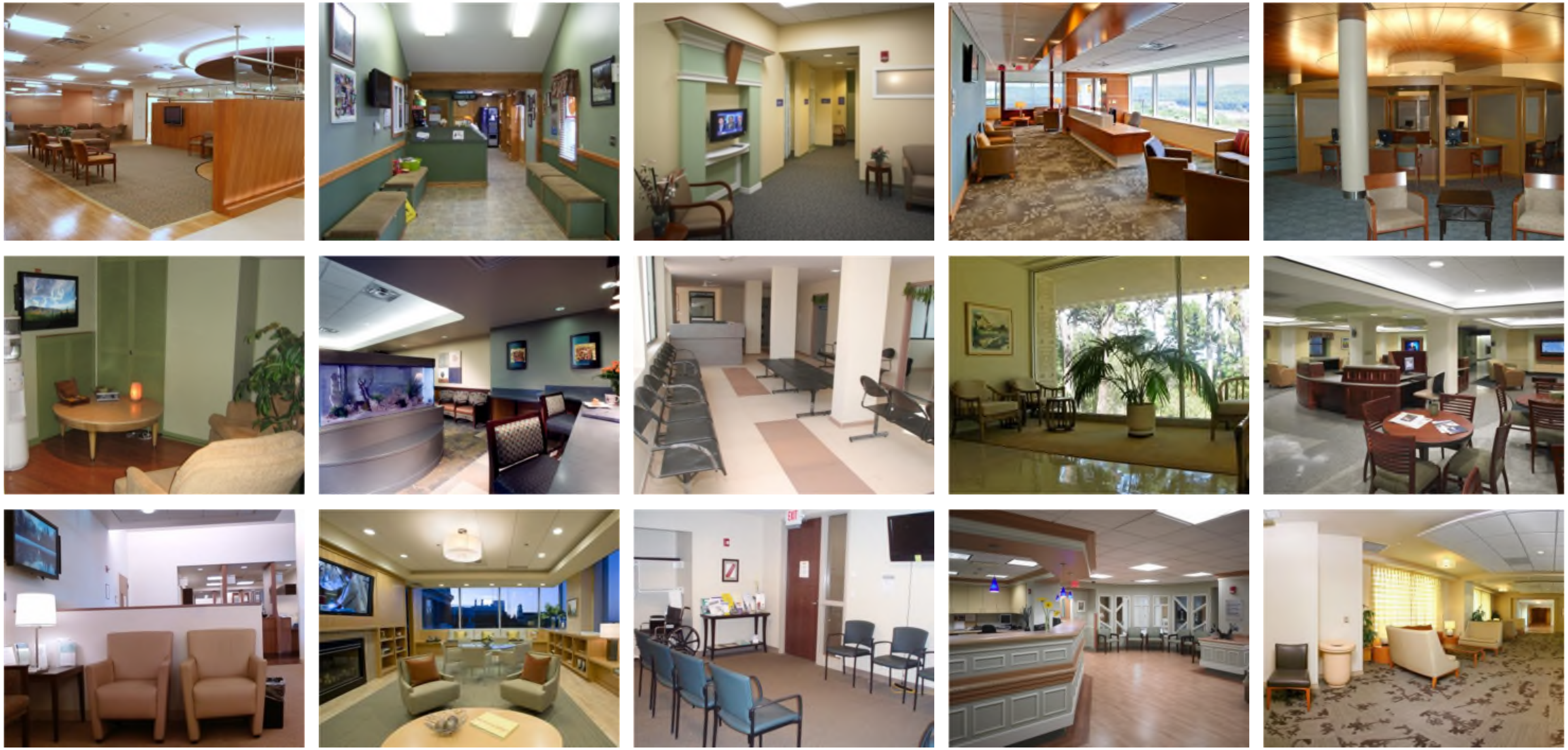





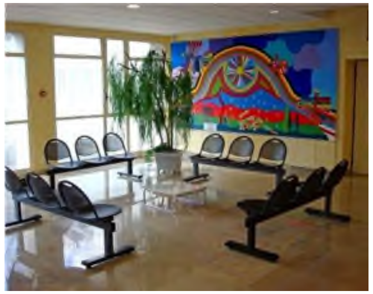


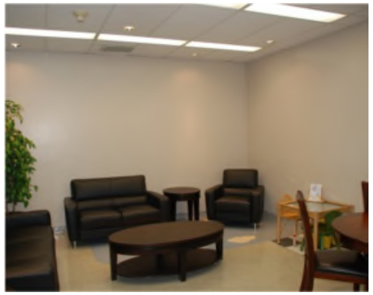












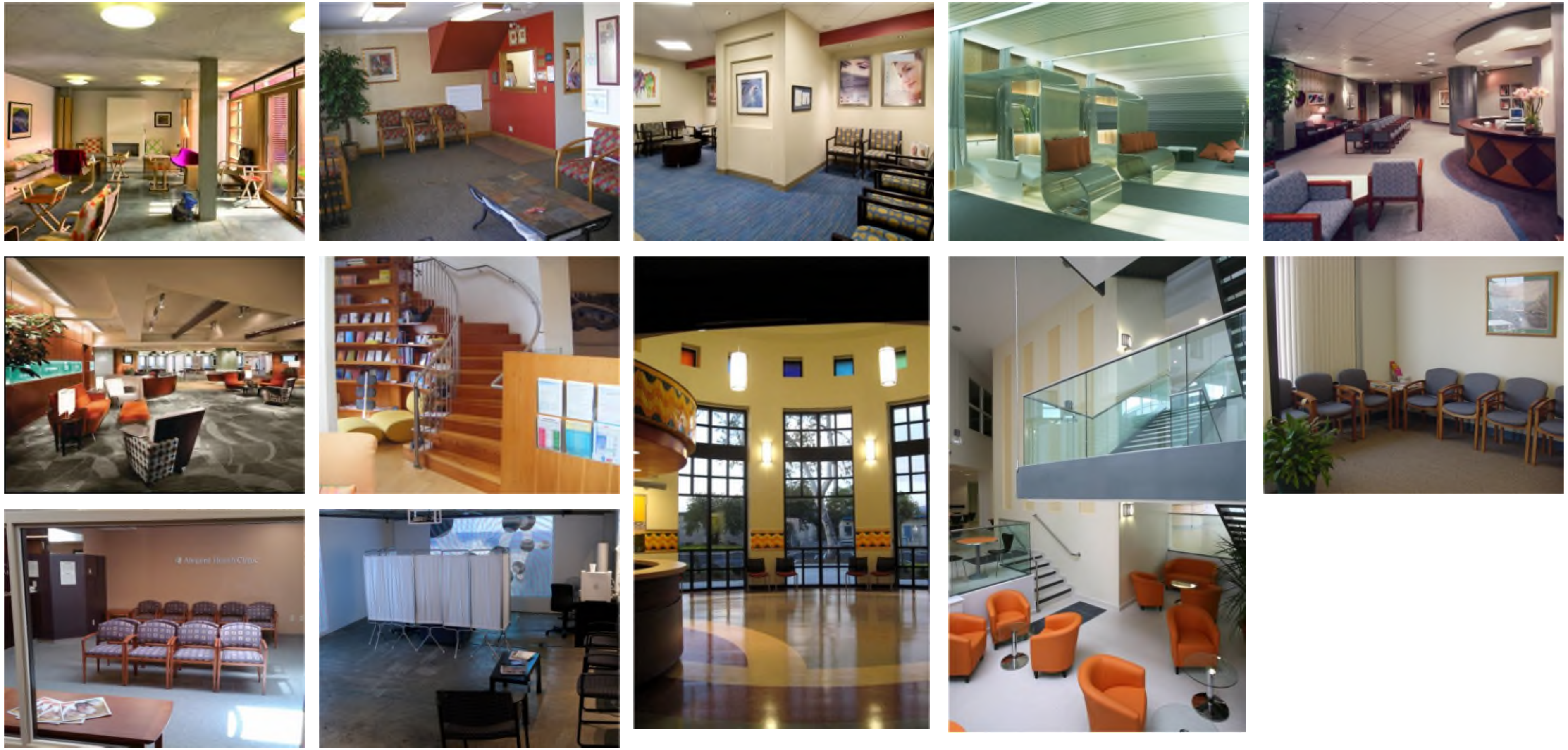


Figure B-1: Images of healthcare waiting environments used in Study 1

(ii) Information Sheet for Participants

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INFORMATION SHEET FOR RESEARCH PARTICIPANT
(Please keep a copy of this Information Sheet)

Study title: Exploring End-user Perception of Healthcare Waiting Environments

An invitation to take part in this research
An increasing body of evidence shows the relationship between the built-environment and health outcome. So far, end-user perceptions of the design of healthcare waiting environments are not well-understood. This study seeks to explore how end-users view and perceive the design of healthcare waiting environments.

Why have I been invited to take part?
I am approaching the general public within the University of Warwick and their referrals. Since general public represent past, existing and/or future end-user of healthcare environments, it is important to gather their semantics and understand how they define and distinguish amongst the styles. In order to be able to view and evaluate the images given in this study, patients have to be at least 16 years old and not suffering from any visual impairment.

What will happen if you agree to take part?
After a short briefing, you will be given images showing many different designs of healthcare waiting areas. You will be asked to sort them into similar groups based on your own concept of similarity, to explain your perspectives and sorting decisions in a semi-structured interview. Depending on the individuals, the experiment takes approximately 45 minutes.

Will there be any benefits from taking part?
Your contribution will add to scientific knowledge about how the design of healthcare waiting environments is perceived by members of the general public. This is the first step to understand how the design might influence on end-user perceptions and emotions. I will be happy to provide you with a summary report of the study's findings.

Do I have to take part?
No, you do not. If you decide to participate, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

Many thanks for your interest in the study. Please feel free to contact us if you have any questions or wish to discuss the study further.

Kieu Anh Vuong
079 12649777 | vuong_k@wmg.warwick.ac.uk
Warwick Manufacturing Group, International Digital Laboratory,
University Of Warwick

(iii) Exit questionnaire

Classification of Design Styles in Healthcare Environments

Your experience / interaction with healthcare environments

Q1 How often do you go to heathcare waiting rooms per year?

Q2 Which type of healthcare environment have you been to most?

- NHS - Primary Care (e.g. GP, dentist, NHS direct, walk-in centres..) ☐
- NHS - Secondary Care (e.g. Acute Trust - hospital, mental health trusts or emergency care) ☐
- Private healthcare providers - primary care (e.g. GP, dentist, walk-in centres..) ☐
- Private healthcare providers - secondary care (e.g. Acute Trust - hospital, mental health trusts or emergency care) ☐

Q3 When was the last time you visited a healthcare waiting room?

Q4 How long have you waited in the waiting room on average?

Q5 What is your health insurance status?

- NHS ☐
- Private health insurance ☐
- Self-payer ☐
- Other types of health insurance (e.g. insured abroad etc.) ☐

About Yourself

Q6 Are you male or female?

- Male ☐
- Female ☐

Q7 What is your age?

- 16 to 24 ☐
- 25 to 44 ☐
- 45 to 64 ☐
- 65 to 74 ☐
- 75 to 84 ☐
- 85+ ☐

Q8 What is your nationality?

Q9 What is your ethnic group?

White ☐
Black ☐
Asian ☐
Other ethnic groups ☐

Q10 Are you a student?

Yes *(Please proceed with Q11 and skip Q12 if not applicable)* ☐
No *(Please skip Q11 and proceed with Q12)* ☐

Q11 What is your field of study?

Q12 What is or was your profession?

Q13 Please state any experience you have related to art, design or architecture

Feedback on the Experiment

Q14 Any comments you would like to give regarding the procedure of this experiment?

Q15 I would like to discuss this topic further, please contact me on this email / phone number ...

Thank you for taking the time to tell us your views.

APPENDIX C – ADDITIONAL MATERIAL FOR STUDY 2A

This section entails material used to promote and to recruit for the study (i, ii), documents used during the data collection process (iii - v) as well as supporting statistics from the analysis (vi).

(i) Poster to advertise and recruit for Study 2a

(ii) Invitation letter

International Digital Laboratory
University of Warwick
Coventry CV4 7AL

Dear Sir/Madam,

I am writing to invite you to participate in a doctoral research project carried out by Kieu Anh Vuong based at the University of Warwick. The project, named "The design of healthcare waiting areas and their impact on end-user perceptions" aims to understand the role of design within healthcare waiting environments and how it is related to end-users' perception.

I would like to invite you to participate in a visual evaluation of healthcare waiting environment design. This will be held at the International Digital Laboratory at the University of Warwick. You will be shown various colour images showing different designs of healthcare waiting environments and to rate how you perceive them. This should last approximately 40 minutes.

All information which is collected about you during the course of the study will be kept strictly confidential, and any information about you which leaves the Warwick Manufacturing Group will have your name and contact details removed so that you cannot be recognised. If you decide to take part you are entitled to withdraw at any time without reason.

Please find attached the information sheet giving more details. If you would like to take part or require any further information please contact me on the details provided.

Yours sincerely,
Kieu Anh Vuong
PhD Student
Warwick Manufacturing Group,
University of Warwick
Email: Vuong_k@wmg.warwick.ac.uk
Mobile: +44 (0)7912649777

(iii) Information sheet used for Study 2a

Information Sheet for Research Participant – Part A

(Please keep a copy of this Information Sheet)

Study title: Understanding end-user's perceptions of the design of healthcare waiting environments

Project Summary

The aim of this project is to find main end-users' perceptions towards the design of healthcare environments. Part A of the project is focusing on reducing the number of end-users' perceptions to the most representative ones.

The amount of evidence suggesting a relationship between design of the built-environment and end-users emotions has increased over the past years but the exact cause-effect relationship remains unclear. The main reason for this is the large number of design features that can cause an effect on end-users. At the same time, there are also numerous possible effects end-users can show as their response towards the designs. In order to explore their relationship, the number of possible end-users' responses will be reduced to the most representative ones.

This part of the project (part A) involves participants from the general public to view 14 colour images showing different healthcare waiting environments and subsequently rate them on 7-point semantic scales.

The knowledge resulting from this experiment will be used towards the creation of a tool which will allow studying a larger number of design features in future studies.

Invitation

We would like to invite you to take part in our research. Before you decide we would like you to understand what the research is about and what it would involve for you. Feel free to talk to others about the study if you wish. Ask us if there is anything that is not clear. Our contact details are:

Name: Kieu Anh Vuong
Email: vuong_k@wmg.warwick.ac.uk
Telephone Number: 07912649777

What is the study about?

An increasing amount of research suggests that there is a relationship between the buildings we use and the effect they have on our well-being. However, each healthcare environment can have its own design and it is therefore difficult to understand which design criteria have an impact on our well-being and to what level. The purpose of this research project is to reveal end-users' main perceptions towards the design of healthcare waiting environments.

Project Title: Understanding end-users' main perceptual dimensions for the design of healthcare waiting environments
Version Number: 3.5
Date: 04/07/2012

Why have I been invited?

We are recruiting participants from the general public, primarily within the University of Warwick and their referrals. Since the general public represents past, existing and/or future end-user of healthcare environments, it is important to understand their perceptions towards the different designs in healthcare waiting environments.

In order to be able to view and evaluate the images given in this study, patients have to be at least 18 years old and not suffering from any visual impairment. We aim to recruit approximately 50 participants for this purpose.

Do I have to take part?

No, it is up to you to decide whether you would like to join the study. We will describe the study and go through this information sheet with you. If you agree to take part, we will then ask you to sign a consent form. You are free to withdraw at any time, without giving a reason.

What will happen to me if I take part?

After a short briefing, you will be given approximately 14 images showing the design of different healthcare waiting environments and a questionnaire with 7-point semantic scales.

You will be asked to look at images and start rating them on several 1-7 semantic scales. Each image will be shown for maximum time duration of 100 seconds. Depending on the individuals, the duration of the experiment takes approximately 40 minutes.

The experiment will take place in the audio-visual laboratory at Warwick Manufacturing Group, University Of Warwick.

Expenses and payments

The participation of this study is non-remunerated and expenses will not be covered.

What are the possible disadvantages and risks of taking part?

Time commitment of approximately 40 minutes

What are the possible benefits of taking part?

Your contribution will add to scientific knowledge about how end-users perceive the design of healthcare waiting environments. This is a step to further understand the relationship between the design of healthcare waiting environments and end-users well-being. I will be happy to provide you with a summary report of the study's findings.

Project Title: Understanding end-users' main perceptual dimensions for the design of healthcare waiting environments
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What if I want more information about the study?

If you have any questions about any aspect of the study or your participation in it please contact:

Kieu Anh Vuong, PhD Student
Warwick Manufacturing Group
Email: vuong_k@wmg.warwick.ac.uk
Telephone Number: 07912649777

OR

PhD Supervisor
Prof Paul Jennings
Warwick Manufacturing Group
Email: jennin_p@wmg.warwick.ac.uk

Who should I contact if I wish to make a complaint?

Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below who is a senior University official entirely independent of the study:

Nicola Owen
Deputy Registrar
Deputy Registrar's Office
University of Warwick
Coventry CV4 8UW
T: 024 7652 2713
E: Nicola.Owen@warwick.ac.uk

Will my taking part in the study be kept confidential?

Yes. All information which is collected about you during the course of the study will be kept strictly confidential, and any information about you which leaves the Warwick Manufacturing Group will have your name and contact details removed so that you cannot be recognised. During the study data will be stored in a locked drawer and will be accessed only by the principal researcher of this study Kieu Anh Vuong. After the study the data will be kept until June 2014 after which it will be destroyed. It will not be possible to identify you from any published material arising from the study.

What will happen if I don't want to carry on with the study?

Nothing, if you decide to take part you are still free to withdraw at any time and without giving a reason.

What will happen to the results of the research study?

All results and knowledge stemmed from this study can be used for publications. I will be happy to provide you with a summary report of the study's findings. However, please note that feedback on the individual basis will not be possible due to the anonymity of all participants' personal data.

Who is organising and funding the research?

This study is part of my PhD project which is funded by Engineering and Physical Science Research Council (EPSRC) within the Warwick Manufacturing Group, University of Warwick.

Who has reviewed the study?

This study has been reviewed and given favourable opinion by the University of Warwick's Biomedical Research Ethics Committee.

Many thanks for your interest in the study. Please feel free to contact us if you have any questions or wish to discuss the study further.

Kieu Anh Vuong
Warwick Manufacturing Group, International Digital Laboratory,
University Of Warwick
Mobile: 079 12649777
Email: vuong_k@wmg.warwick.ac.uk

(iv) Evaluation sheet

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Picture yourself going to a healthcare facilities waiting for a routine check-up. What is your perception of the design of the waiting environment shown to you?

Please circle the most appropriate rating on the following semantic differential scales!

Example Happy	1	2	3	4	5	6	7	Sad

Domestic	1	2	3	4	5	6	7	Non-Domestic/Business
Healthcare	1	2	3	4	5	6	7	Non-Healthcare
Good Medical Quality	1	2	3	4	5	6	7	Bad Medical Quality
Long waiting time	1	2	3	4	5	6	7	Short waiting time
Expected of Healthcare	1	2	3	4	5	6	7	Unexpected of Healthcare

Light	1	2	3	4	5	6	7	Dark
Flexible Arrangement	1	2	3	4	5	6	7	Rigid Arrangement
Expensive	1	2	3	4	5	6	7	Cheap
Beautiful	1	2	3	4	5	6	7	Ugly
Soft	1	2	3	4	5	6	7	Hard
Fashionable/Modern	1	2	3	4	5	6	7	Old-Fashioned/Outdated
Spacious	1	2	3	4	5	6	7	Cramped
Clean	1	2	3	4	5	6	7	Dirty
Clinical	1	2	3	4	5	6	7	Non-Clinical
Typical	1	2	3	4	5	6	7	Atypical (Untypical)

Social	1	2	3	4	5	6	7	Private
Exciting	1	2	3	4	5	6	7	Boring
Clear Purpose of Space	1	2	3	4	5	6	7	Unclear Purpose of Space
Comfortable	1	2	3	4	5	6	7	Uncomfortable
Uplifting	1	2	3	4	5	6	7	Depressing
Pleasant	1	2	3	4	5	6	7	Unpleasant
Calming	1	2	3	4	5	6	7	Annoying
Welcoming/Friendly	1	2	3	4	5	6	7	Not Welcoming/Unfriendly
Relaxing	1	2	3	4	5	6	7	Stressful
Assuring	1	2	3	4	5	6	7	Worrying
Safe	1	2	3	4	5	6	7	Unsafe

Evaluation Sheet
Participant Number: __

(v) Exit questionnaire to capture participant basic information

End-users' perceptions of healthcare environment designs

Your experience / interaction with healthcare environments

Q1 How often do you go to healthcare waiting rooms per year?

Q2 When was the last time you visited a healthcare waiting room?

Q3 How long have you waited in the waiting room on average?

About Yourself

Q4 Are you male or female?

Male ☐

Female ☐

Q5 How old are you?

Q6 What is your nationality?

Q7 Please state any experience you have related to art, design, architecture or healthcare!

Feedback on the Experiment

Q8 Any comments you would like to give regarding the procedure of this experiment?

Q9 Please provide your email address below if you would like to discuss this topic further!

Thank you for taking the time to tell us your views.

(vi) Correlation matrix including all 26 perceptual scales

The correlation matrix was used to ensure high correlations of the scales amongst one another, thus, their suitability for PCA. The two scales labelled *LongWait* **-** *ShortWait* and *Social* **-** *Private* showed lowest correlations with the rest of the data set.

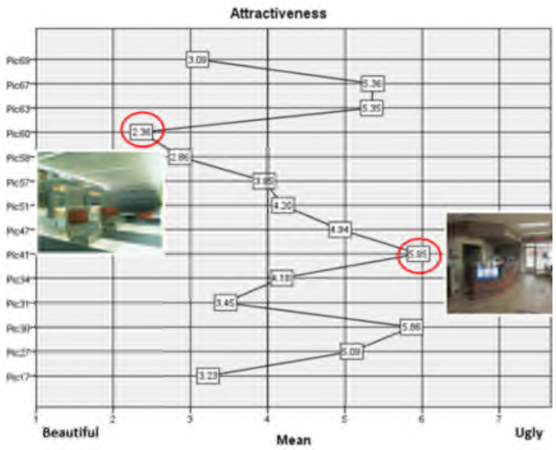
Correlation Matrix[a]

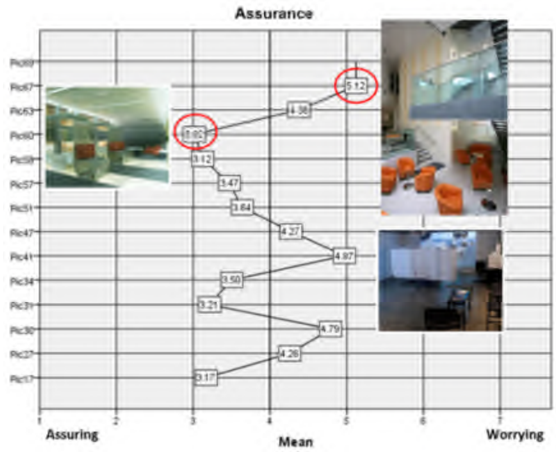
		Domestic - Non-Domestic	Healthcare - Non-Healthcare	GoodMedQ - BadMedQ	LongWait - ShortWait	Expected - Unexpected	Light - Dark	Flexible - Rigid	Expensive - Cheap	Beautiful - Ugly	Soft - Hard	Modern - Old-fashioned	Spacious - Cramped	Clean - Dirty	Clinical - Non-Clinical	Typical - Atypical	Exciting - Boring	ClearPur - UnclearPur	Comfortable - Uncomfortable	Uplifting - Depressing	Pleasant - Unpleasant	Calming - Annoying	Welcoming - Not Welcoming	Relaxing - Stressful	Assuring - Worrying	Safe - Unsafe	Social - Private
Correlation	Domestic - Non-Domestic	1.000	-.201	.145	-.063	.204	.219	.230	.205	.330	.391	.185	.117	.167	-.214	-.241	.338	-.159	.355	.344	.328	.284	.345	.314	.260	.197	.135
	Healthcare - Non-Healthcare	-.201	1.000	.110	.160	.712	-.098	-.115	-.227	-.168	-.143	-.175	-.217	-.072	.598	.542	-.223	.578	-.152	-.186	-.165	-.119	-.139	-.182	-.154	-.031	-.090
	GoodMedQ - BadMedQ	.145	.110	1.000	.062	.056	.418	.244	.607	.613	.476	.489	.436	.600	.129	-.126	.504	.162	.580	.577	.633	.575	.503	.519	.576	.612	.087
	LongWait - ShortWait	-.063	.160	.062	1.000	.280	-.011	-.006	-.049	-.043	.038	-.125	-.064	.004	.095	.280	-.106	.162	.046	-.069	-.025	-.031	.010	.004	.013	.081	.068
	Expected - Unexpected	.204	.712	.056	.280	1.000	-.091	-.171	-.319	-.247	-.168	-.281	-.268	-.099	.527	.689	-.369	.577	-.191	-.258	-.221	-.159	-.164	-.187	-.173	-.010	-.080
	Light - Dark	.219	-.098	.418	-.011	-.091	1.000	.194	.405	.502	.430	.432	.350	.438	-.024	-.162	.417	-.004	.442	.517	.504	.464	.401	.403	.380	.333	.156
	Flexible - Rigid	.230	-.115	.244	-.006	-.171	.194	1.000	.311	.336	.421	.278	.302	.243	-.138	-.206	.361	-.065	.437	.369	.368	.271	.334	.330	.299	.230	.206
	Expensive - Cheap	.205	-.227	.607	-.049	-.319	.405	.311	1.000	.757	.580	.660	.544	.602	-.137	-.453	.704	-.125	.688	.700	.726	.625	.601	.629	.562	.505	.121
	Beautiful - Ugly	.330	-.168	.613	-.043	-.247	.502	.336	.757	1.000	.682	.673	.533	.627	-.103	-.365	.756	-.049	.709	.820	.820	.716	.689	.693	.621	.558	.189
	Soft - Hard	.391	-.143	.476	.038	-.168	.430	.421	.580	.682	1.000	.437	.379	.453	-.181	-.227	.570	-.024	.777	.662	.678	.593	.643	.670	.547	.463	.230
	Modern - Old-fashioned	.185	-.175	.489	-.125	-.281	.432	.278	.660	.673	.437	1.000	.471	.548	-.062	-.415	.684	-.079	.510	.664	.612	.529	.477	.487	.484	.393	.127
	Spacious - Cramped	.117	-.217	.436	-.064	-.268	.350	.302	.544	.533	.379	.471	1.000	.541	-.126	-.343	.480	-.141	.500	.528	.551	.484	.456	.464	.468	.434	.062
	Clean - Dirty	.167	-.072	.600	.004	-.099	.438	.243	.602	.627	.453	.548	.541	1.000	.107	-.226	.492	.020	.554	.585	.634	.548	.521	.531	.525	.568	.110
	Clinical - Non-Clinical	-.214	.598	.129	.095	.527	-.024	-.138	-.137	-.103	-.181	-.062	-.126	.107	1.000	.421	-.126	.471	-.148	-.112	-.137	-.091	-.152	-.175	-.136	-.021	-.089
	Typical - Atypical	-.241	.542	-.126	.280	.689	-.162	-.206	-.453	-.365	-.227	-.415	-.343	-.226	.421	1.000	-.521	.517	-.277	-.391	-.350	-.258	-.282	-.275	-.227	-.086	-.083
	Exciting - Boring	.338	-.223	.504	-.106	-.369	.417	.361	.704	.756	.570	.684	.480	.492	-.126	-.521	1.000	-.118	.635	.796	.733	.615	.615	.603	.548	.419	.221
	ClearPur - UnclearPur	-.159	.578	.162	.162	.577	-.004	-.065	-.125	-.049	-.024	-.079	-.141	.020	.471	.517	-.118	1.000	-.007	-.055	-.027	.010	-.009	-.045	.007	.114	-.023
	Comfortable - Uncomfortable	.355	-.152	.580	.046	-.191	.442	.437	.688	.709	.777	.510	.500	.554	-.148	-.277	.635	-.007	1.000	.717	.798	.696	.695	.737	.635	.584	.193
	Uplifting - Depressing	.344	-.186	.577	-.069	-.258	.517	.369	.700	.820	.662	.664	.528	.585	-.112	-.391	.796	-.055	.717	1.000	.862	.744	.721	.704	.665	.557	.192
	Pleasant - Unpleasant	.328	-.165	.633	-.025	-.221	.504	.368	.726	.820	.678	.612	.551	.634	-.137	-.350	.733	-.027	.798	.862	1.000	.791	.755	.751	.707	.636	.166
	Calming - Annoying	.284	-.119	.575	-.031	-.159	.464	.271	.625	.716	.593	.529	.484	.548	-.091	-.258	.615	.010	.696	.744	.791	1.000	.685	.720	.727	.620	.124
	Welcoming - Not Welcoming	.345	-.139	.503	.010	-.164	.401	.334	.601	.689	.643	.477	.456	.521	-.152	-.282	.615	-.009	.695	.721	.755	.685	1.000	.761	.646	.590	.194
	Relaxing - Stressful	.314	-.182	.519	.004	-.187	.403	.330	.629	.693	.670	.487	.464	.531	-.175	-.275	.603	-.045	.737	.704	.751	.720	.761	1.000	.682	.601	.137
	Assuring - Worrying	.260	-.154	.576	.013	-.173	.380	.299	.562	.621	.547	.484	.468	.525	-.136	-.227	.548	.007	.635	.665	.707	.727	.646	.682	1.000	.654	.160
	Safe - Unsafe	.197	-.031	.612	.081	-.010	.333	.230	.505	.558	.463	.393	.434	.568	-.021	-.085	.419	.114	.584	.557	.636	.620	.590	.601	.654	1.000	.104
	Social - Private	.135	-.090	.087	.068	-.080	.156	.206	.121	.189	.230	.127	.062	.110	-.089	-.083	.221	-.023	.193	.192	.166	.124	.194	.137	.160	.104	1.000

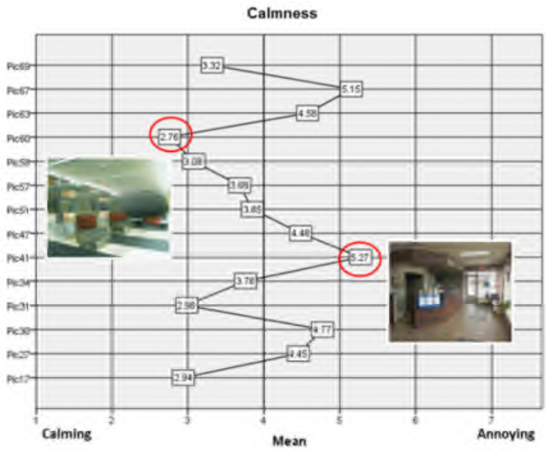
Table C-1: Correlation matrix including all 26 perceptual scales

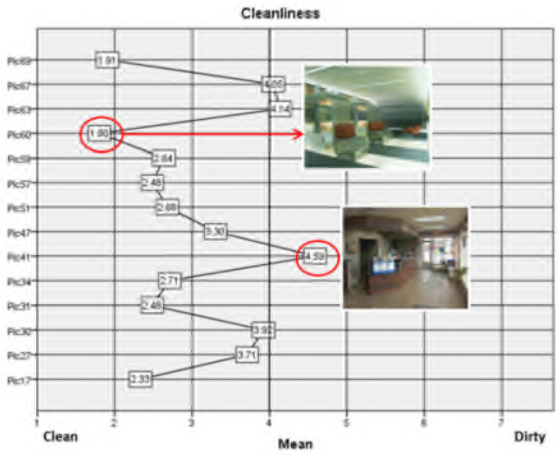
APPENDIX D – ADDITIONAL MATERIAL FOR STUDY 2B

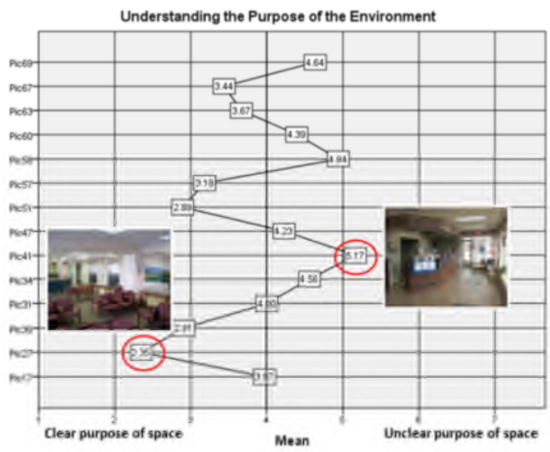
(i) D-3: Ratings of images on individual perceptual scales

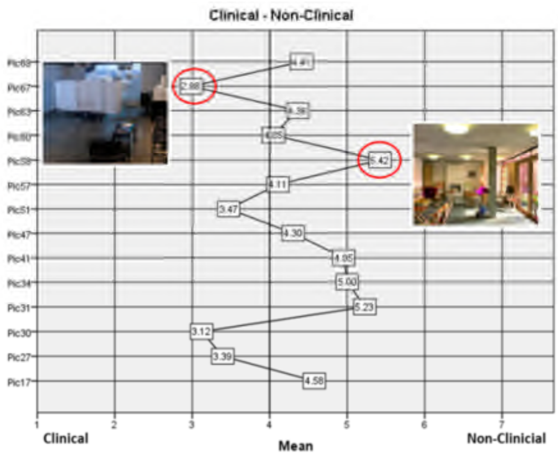


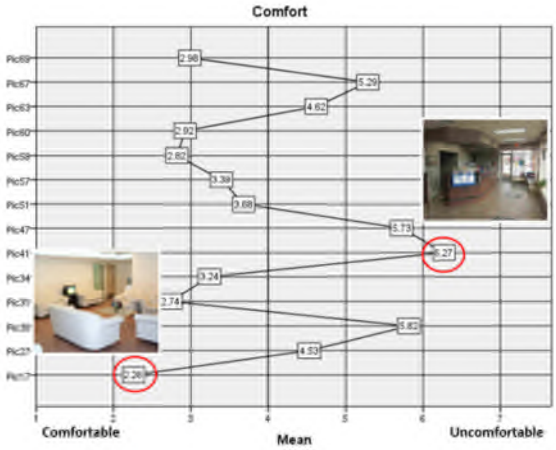


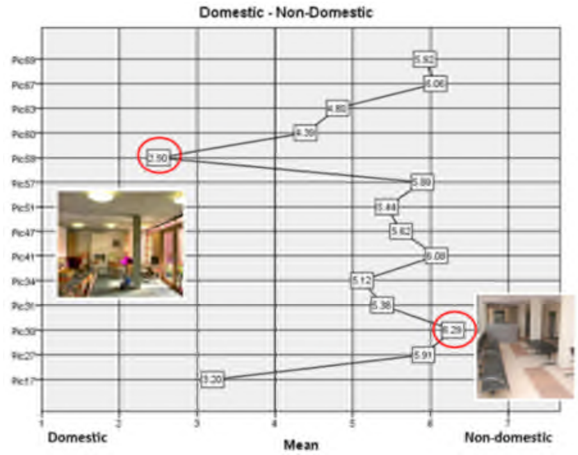


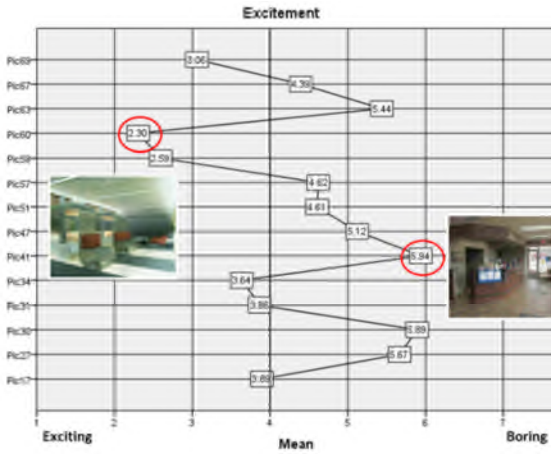


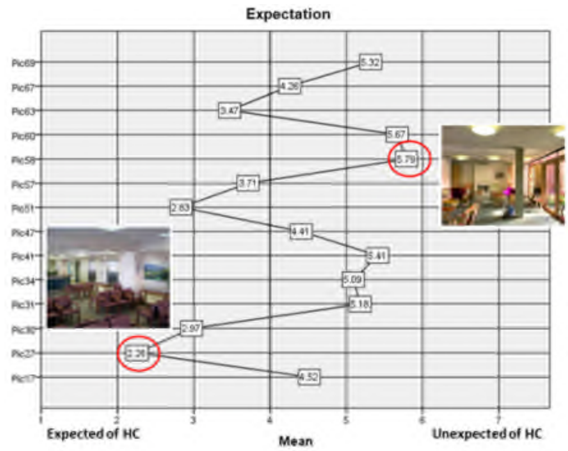


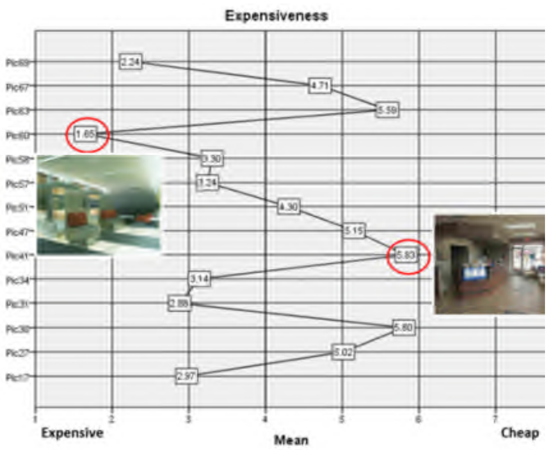



Comfort
Comfortable
Mean
Uncomfortable

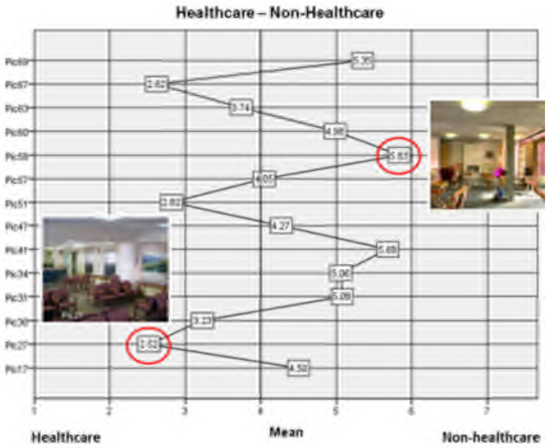

Domestic - Non-Domestic
Domestic
Mean
Non-domestic

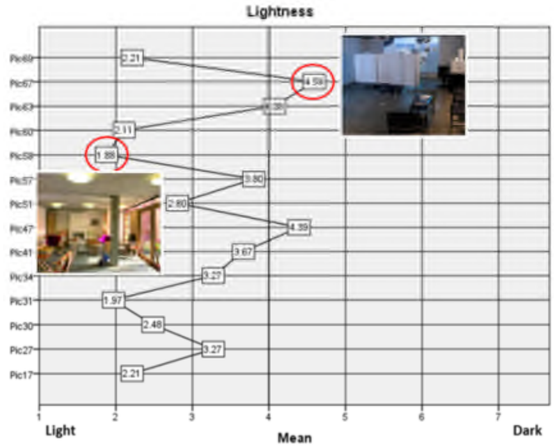

Excitement
Exciting
Mean
Boring

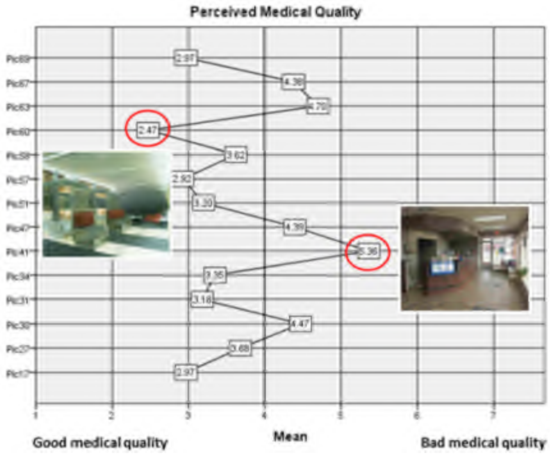

Expectation
Expected of HC
Mean
Unexpected of HC

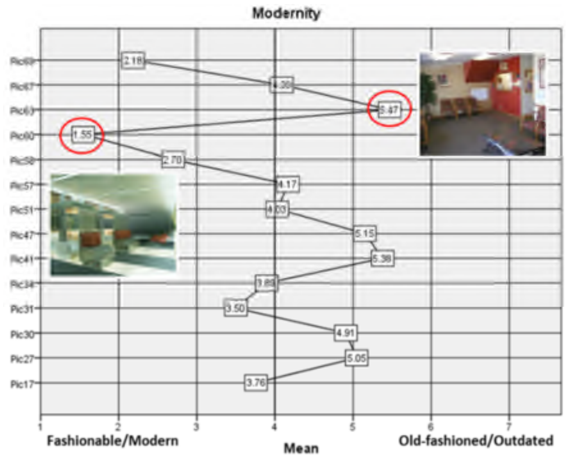

Expensiveness
Expensive
Mean
Cheap

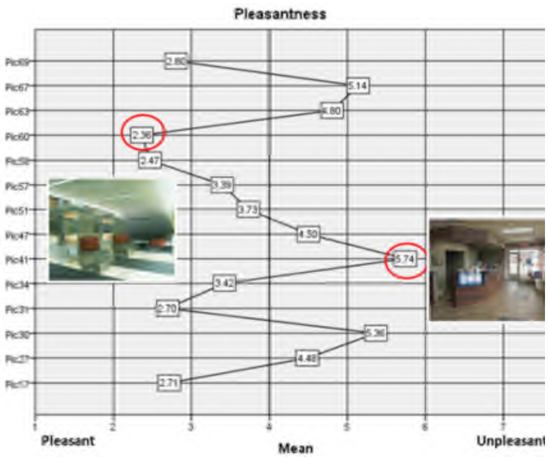

Flexibility
Flexible arrangement
Mean
Rigid arrangement

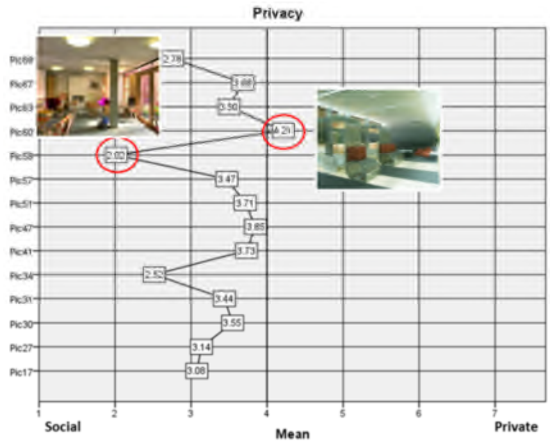

Healthcare – Non-Healthcare
Healthcare
Mean
Non-healthcare


Lightness
Light
Mean
Dark

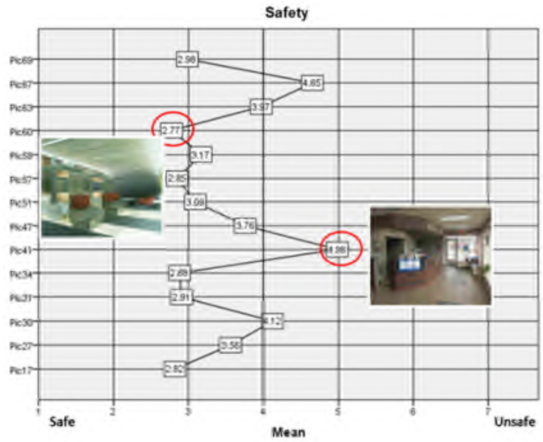

Perceived Medical Quality
Good medical quality
Mean
Bad medical quality

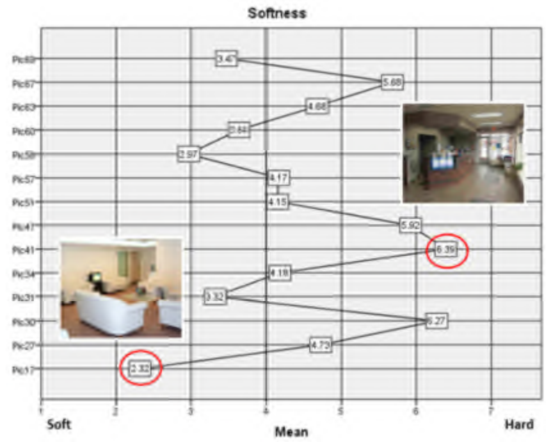

Modernity
Fashionable/Modern
Mean
Old-fashioned/Outdated

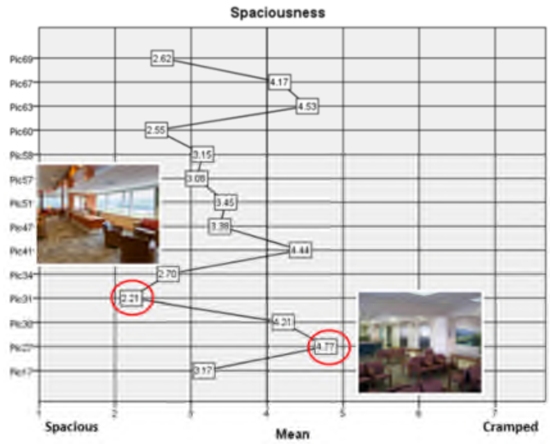

Pleasantness
Pleasant
Mean
Unpleasant

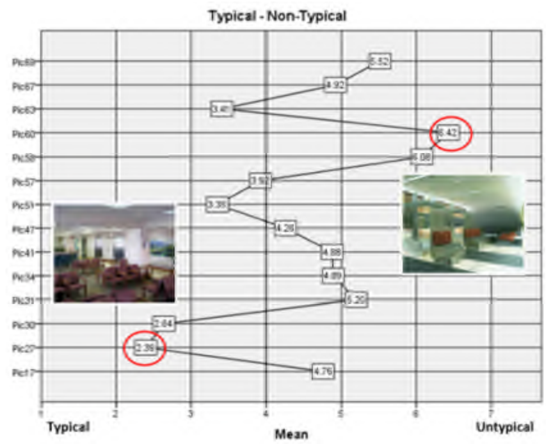

Privacy
Social
Mean
Private


Relaxation
Relaxing
Mean
Stressful


Safety
Safe
Mean
Unsafe


Softness
Soft
Mean
Hard


Spaciousness
Spacious
Mean
Cramped


Typical - Non-Typical
Typical
Mean
Untypical

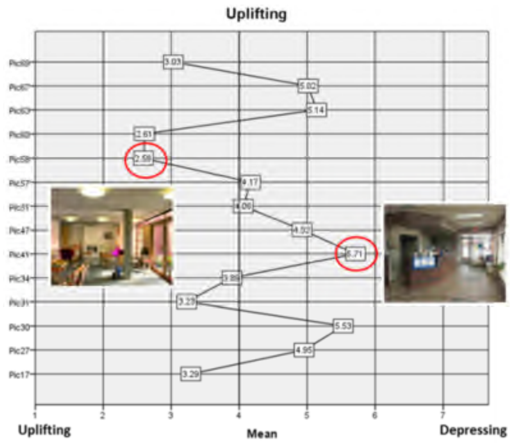

Uplifting
Uplifting
Mean
Depressing

Figure D-1: Ratings of images on individual semantic differential scales

(ii) Example of visual analysis using the developed template

Picture ID	Criteria / Description	Overall Design	Interior	Structure & Function	Decoration	Facilities
60	Style / Overall description	Modern, futuristic	Hard and comfy seats, no reception or table visible. Sit and lying possible. Row type arrangement, structured	Light, designed lighting system. Shiny flooring in two colours: white and black. Use of mirror on the walls	Cushions / Pillows Flowers Use of mirror on the wall, reflecting lights and formal flower arrangements	Infusion device in the corner and beside the lying soft bed/seats. Magazines underneath the designed hard seats
	Size	Small	Hard chair appears too high	Height typical for modern building (with energy-efficiency in mind) approx. 2.7m		
	Colour		Predominantly green, white and earthy brown / red	Flooring: two constrasting colour of white and dark grey		
	Arrangement / position		Some structured, some flexible allowing different seating arrangements and activities. Curtains allow dividing the space into smaller areas	Room itself is a simple rectangular shape without dividing walls or further structural elements. Ambience lighting as part of the interior design	Some pillows on the floor Flower arrangement formal, against the wall & in front of mirrors	
	Material/Surface		Hard & soft material. Shiny plastic / metallic type of hard seats.	Flooring: laminate, slightly reflective. Wall: wooden plate and mirror on the wall		

Table D-1: Example of visual analysis using the developed template

(iii) Quantifying qualitative data for images on the scales Pleasantness and Typical Healthcare

	Image ID	Hygiene	Seating comfort	Accommodating different needs	Natural elements	Condition / State	Clear function	Additional features	Welcoming reception desk	Modern style of interior
Pleasant	60	1	1	1	1	1	0	1	1	1
	17	1	1	1	0	1	1	1	1	0
	69	1	1	1	1	1	1	1	1	1
	58	1	1	1	1	1	1	1	1	1
	31	1	1	1	1	1	1	1	1	1
	Group	1	1	1	0.8	1	0.8	1	1	0.8
Mid – Scale (Pleasantness)	57	1	1	0	0	1	1	1	1	0
	34	1	1	1	0	1	1	1	1	1
	51	1	1	0	0	1	1	1	1	1
	27	0	1	0	1	0	1	1	1	0
	Group	0.75	1	0.25	0.25	0.75	1	1	1	0.5
Unpleasant	47	0	0	0	0	0	0	0	0	0
	63	0	1	0	0	0	1	0	0	0
	67	0	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	1	0	0	0
	41	0	0	0	0	0	0	0	0	0
	Group	0	0.2	0	0	0	0.4	0	0	0

Table D-2: Quantifying qualitative data for images on the Pleasantness scale

	Image ID	Flexbility of seating arrangement	Modern style of interior	Association with non-HC public spaces	Colour Activity
Typical HC	27	0	0	0	0
	30	0	0	0	0
	51	0	1	0	1
	67	0	0	1	0
	Group	0	0.25	0.25	0.25
Mid – Scale (Typical HC)	63	0	0	0	1
	57	0	0	0	0
	47	0	0	1	0
	17	1	0	1	0
	31	1	1	1	1
	34	1	1	1	0
	Group	0.5	0.33	0.67	0.33
Untypical HC	69	1	1	1	1
	60	1	1	1	1
	41	0	0	1	0
	58	1	1	1	1
	Group	0.75	0.75	1	0.75

Table D-3: Quantifying qualitative data for images on the Typical HC scale

APPENDIX E – ADDITIONAL MATERIAL FOR STUDY 3

(i) Full survey (Paper format)

What is your perception of healthcare waiting environments?

INFORMATION ABOUT THE STUDY AND PARTICIPATION

A few introductory words

Hi and welcome to my survey! My name is Kieu, I am a PhD researcher at the University of Warwick. This study is part of my overall research that aims to understand how the design of healthcare waiting environments can have an impact on people. In fact, research suggests that the buildings and spaces we use can influence our health and well-being. The reason why I focus on healthcare waiting rooms is because the time we spend there can often be both long and stressful. However, the relationship between the design of healthcare waiting rooms and its effect on end-users is not well understood.

My goal is, therefore, to understand the user perception better and to turn the findings into practical design guidance to inform the design and healthcare community. I believe that the waiting room can be more than "just waiting" and that design can help to improve our experience in healthcare.

Your participation is needed

I would like to invite you to take part in this research. Requirements for taking part are a minimum age of 18 years old and no visual impairment. The participation is voluntary and you are free to withdraw at any time, without giving a reason. All information will be kept strictly confidential and personal information will be anonymised.

What does the study involve?

You will see more detailed instructions in the following pages but in brief, you will see 20 images of healthcare waiting rooms with each showing slightly different design features. You will be asked to rate each of them based on two criteria: how pleasant you perceive the design and how much they look like a typical healthcare environment to you. People tend to complete the rating task at different pace so that the survey normally takes between 10 and 20 minutes.

Who should I contact if I have more questions?

Me! Feel free to contact me if there is anything unclear: Kieu Anh Vuong, vuong_k@wmg.warwick.ac.uk or give me a call on +44-2476-150754.

Note: Please contact the Deputy Registrar, on +44 (0) 24 7652 2713 or via email deputyregistrar@warwick.ac.uk if you wish to make any complaint about the way you have been dealt with during the study or any possible harm you might have suffered.

INTRODUCTION

You will see 20 different designs of healthcare waiting rooms. Picture yourself going to these healthcare environments for a routine health check-up and rate the design on the two scales: "pleasantness" and "typical healthcare". These terms will be explained to you in more detail later.

The two images below are examples of the format you will see throughout the study. Both images belong to the same room, only taken from different positions in the room. This is to ensure that you see each room from different perspectives and get a good view of the overall design.

Examples:
Image on the Left
A view by the entrance door as you enter the room.

Image on the Right - A view from a seated position against the wall on the right-hand side and facing the reception desk.

Evaluation of Healthcare Waiting Rooms

Part A - How pleasant is the design of healthcare waiting rooms?

Introduction - In this section, you will see 20 healthcare waiting rooms with different designs. Picture yourself going to these healthcare environments for a routine health check-up. You are going there by yourself and the waiting time is normal (whatever you perceive as normal based on your own experience). Please rate how pleasant you perceive each of the design.

What we mean by "*pleasant*" design:
A design that is enjoyable, attractive, friendly, or easy to like

How would you describe a pleasant design for healthcare waiting rooms using 3 words or more?

Please rate how "pleasant" the designs are!

ROOM 1/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (4)	○	○	○	○	○	○	○

ROOM 2/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (2)	○	○	○	○	○	○	○

ROOM 3/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (13)	○	○	○	○	○	○	○

ROOM 4/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (15)	○	○	○	○	○	○	○

ROOM 5/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (17)	○	○	○	○	○	○	○

ROOM 6/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (7)	○	○	○	○	○	○	○

ROOM 7/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (16)	○	○	○	○	○	○	○

ROOM 8/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (13)	○	○	○	○	○	○	○

ROOM 9/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (11)	○	○	○	○	○	○	○

ROOM 10/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (18)							

ROOM 11/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (5)							

ROOM 12/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (9)							

ROOM 13/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (10)							

ROOM 14/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (8)							

ROOM 15/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (19)							

ROOM 16/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (6)							

ROOM 17/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (14)							

ROOM 18/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (12)							

ROOM 19/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (11)							

ROOM 20/20

	Very Unpleasant	Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Pleasant	Very Pleasant
Pleasantness (20)							

Please expain how you have evaluated the pleasantness of these designs

Additional Questions about the Pleasantness of Designs

Which aspects of design may become more or less important to you if you are not going to the healthcare environment by yourself but <u>accompanied by someone</u> instead?

Would a <u>short waiting time</u> influence your perception of how pleasant the design is? If so, please describe how. Which aspects of design may become more or less important if you are waiting for a short time?

Would a <u>long waiting time</u> influence your perception of how pleasant the design is? If so, please describe how. Which aspects of design may become more or less important if you are waiting for a long time?

Additional Questions about the Pleasantness of Designs

Which aspects of design may become more or less important to you if you are not going to the healthcare environment by yourself but <u>accompanied by someone</u> instead?

Would a <u>short waiting time</u> influence your perception of how pleasant the design is? If so, please describe how. Which aspects of design may become more or less important if you are waiting for a short time?

Would a <u>long waiting time</u> influence your perception of how pleasant the design is? If so, please describe how. Which aspects of design may become more or less important if you are waiting for a long time?

Evaluation of Healthcare Waiting Rooms

Part B - Are the designs typical for healthcare waiting rooms?

Instruction
In this section, you will see the same images that were shown previously. The scenario is also the same - you are going to the healthcare waiting environment for a routine check-up. However, this time you are asked to evaluate the design based on whether or not they look like a typical healthcare waiting environment to you.

What we mean by "typical healthcare" design
A room that shows all the characteristics of what you would usually expect from a healthcare waiting room should be rated "*very typical*".

Tell us 3 words or more that you would associate with the term "typical healthcare design"

How typical of healthcare are the designs?

ROOM 1/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (4)	○	○	○	○	○	○	○

ROOM 2/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (2)	○	○	○	○	○	○	○

ROOM 3/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (13)	○	○	○	○	○	○	○

ROOM 4/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (15)	○	○	○	○	○	○	○

ROOM 5/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (17)	○	○	○	○	○	○	○

ROOM 6/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (7)	○	○	○	○	○	○	○

ROOM 7/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (16)	○	○	○	○	○	○	○

ROOM 8/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (3)	○	○	○	○	○	○	○

ROOM 9/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (11)	○	○	○	○	○	○	○

ROOM 10/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (18)	○	○	○	○	○	○	○

ROOM 11/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (5)	○	○	○	○	○	○	○

ROOM 12/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (9)	○	○	○	○	○	○	○

ROOM 13/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (10)	○	○	○	○	○	○	○

ROOM 14/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (8)	○	○	○	○	○	○	○

ROOM 15/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (19)							

ROOM 16/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (6)							

ROOM 17/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (14)							

ROOM 8/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (12)							

ROOM 19/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (1)							

ROOM 20/20

	Very Untypical	Untypical	Slightly Untypical	Neutral	Slightly Typical	Typical	Very Typical
Expected, typical of healthcare (20)	○	○	○	○	○	○	○

Please expain how you have rated these designs based on the criteria ' Expected, typical of healthcare'

Additional Questions about the Pleasantness of Designs

Please give us some idea of the situation and context you had in mind when going through these images. For example: what kind of place you had in your mind (GP, dentist, local hospital etc. or something completely different), the way you felt, the circumstances etc.

Please briefly describe the healthcare waiting rooms you usually go to. What are their designs like?

General Information

4.1. Are you male or female?

- Male
- Female

4.2. What is your age?

4.3. What is your nationality?

4.4. What is your country of residence?

4.5. What educational or professional background describes you best?

- Healthcare professional, working in a healthcare environment
- Interior designer / Architect
- None of the above

Other educational / professional background

Your Experience of Healthcare

4.6. How often do you visit the following healthcare environments as a patient?

	up to once a month	up to once every 3 months	up to once every 6 months	once per year or less
General Practitioner / Family Doctor				
Dentist				
Outpatient Hospital (Patients are not staying overnight)				

How long have you waited in the waiting room on average? (in minutes or hours)

4.7. At the General Practitioner or the Family Doctor?

At the Dentist

At an Outpatient Hospital (Patients are not staying overnight)

4.8. Which health insurance status describes yours best? *(multiple selection possible)*

- NHS - User (National Health System)
- National (Statutory) health insurance (also commonly called "Public health insurance")
- Private health insurance
- Self-Payer (Pay for health services yourself)
- Other

Please specify if "Other"

4.9. Which of the following statement/s best reflect/s your attitude, approach and expectation towards healthcare? *(please select all relevant statements)*

- [ ] Healthcare is more than just about the medical treatment. The visit is about the entire experience which should provide me pleasure, comfort and wellness as part of the healing.
- [ ] I tend to go to healthcare for prevention and regular check-ups
- [ ] My approach towards healthcare is quite practical. Healthcare facilities are purely treatment centres where I expect to get a solution to my health conditions.
- [ ] I tend to go to healthcare only when I am sick or have some health issues.
- [ ] Healthcare is like with shopping in the sense that it can be confusing and you have to compare the packages the providers offer. I inform myself about which services and products are for free and if it is not for free, I would try to get the best quote. This is to ensure that I get the best value for what I am entitled.
- [ ] Other

If 'Other', please describe your attitude / approach towards healthcare in your own words

4.10. What device did you use to do this study (PC, laptop, tablet etc.)? What is the size of the screen?

4.11. Would you like to give us some feedback regarding the study?

4.12. Please provide contact details in case any brief clarification is needed (e.g. email address)

Many thanks for taking part in this study!

Email me on vuong_k@wmg.warwick.ac.uk if you have any questions regarding the study.

(ii) Sample characteristics

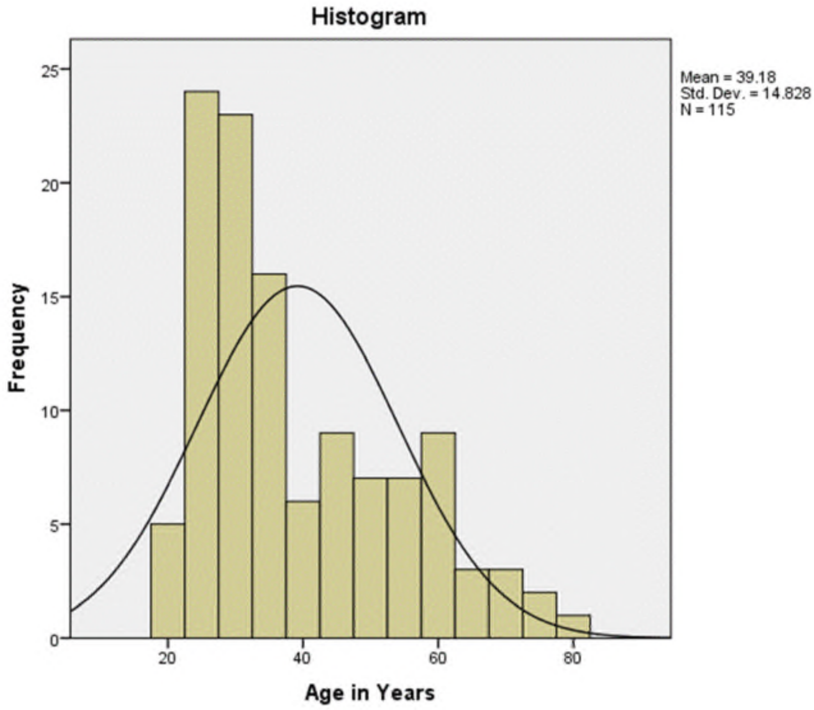


Figure E-1: Participants' age distribution

	Frequency	Percent
Age Groups		
20-29		34.5
30-39		25.9
40-49		14.7
50-59		11.2
60-69		8.6
70-79		3.4
80-89		.9
Total*		100.0
Nationality		
Non-British		19.8
British		80.2
Total		100.0
Gender		
Male		39.7
Female		60.3
Total		100.0
Background		
Healthcare		10.3
Interior Designer / Architect		6.0
Other		83.6
Total		100.0
Health Insurance Status		
Statutory		0.9
NHS+Statutory+Self-Payer		0.9
NHS+Statutory		0.9
Private Health Insurance		2.6
NHS+Self-Payer		5.2
NHS+Private		14.7
NHS		75.0
Total		100.0

Figure E-2: Overview of sample characteristics

(iii) Waiting times

In both figures, the colour codes are based on the principles of traffic lights with red indicating the longest waiting time and highest visiting frequency while green tones show the opposite.

With a mean of 14.1 minutes, waiting times at the dentist is the shortest while at GP's and outpatient hospitals participants stated an average on 23.5 and 60.4 minutes respectively. This is also reflected in Figure E-3 by means of dominantly green colour (short waiting time) for dentist, yellow for GP (middle) and red tones for outpatient hospitals (long waiting time). The range of waiting times in outpatient hospitals also show the largest variation (SD = 57.8) with a maximum waiting time of five hours.

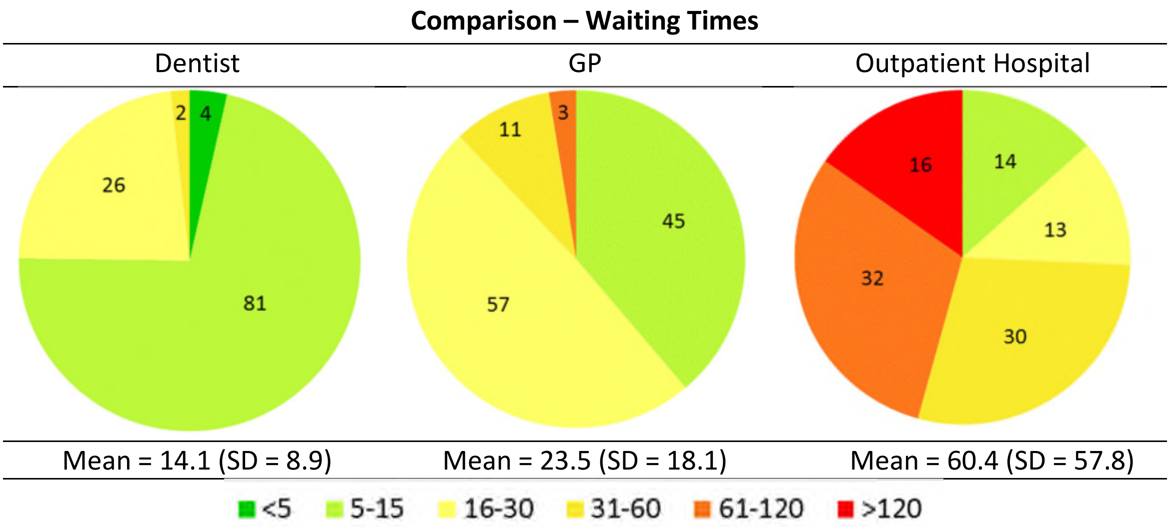


Figure E-3: Comparison of average waiting times at the dentist, GP and outpatient hospital

Figure E-4 shows that participants visited GPs most frequently as indicated by the red and yellow colours for once every month and once per quarter respectively. While most outpatient visits (96) appear to take place once or twice per year, 20 people stated to go there on the quarterly (15) and monthly (5) basis.

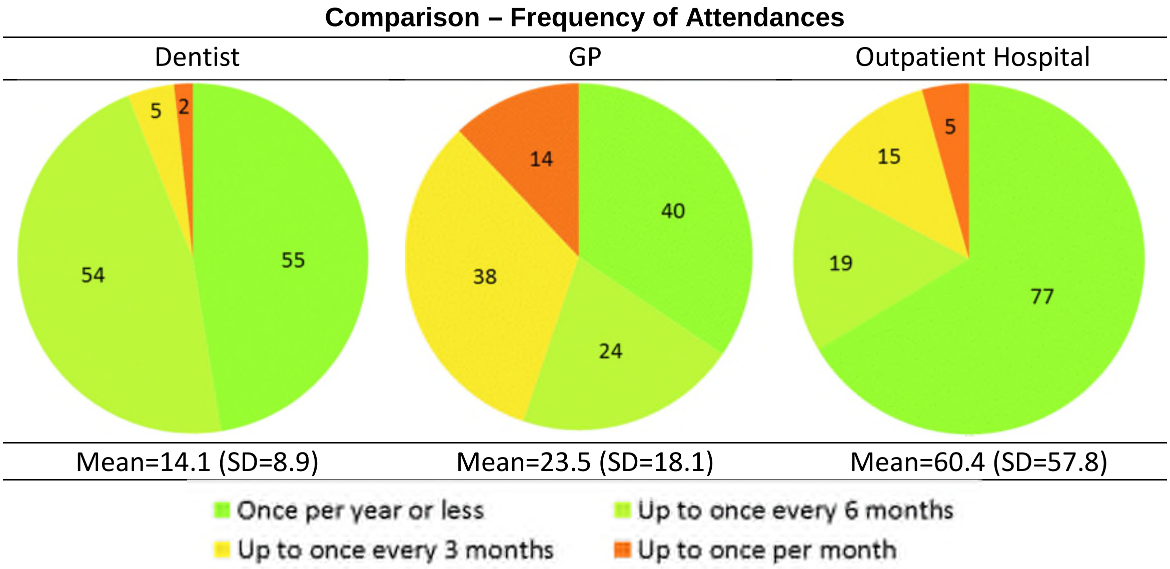


Figure E-4: Comparison of the frequency of attendances at the dentist, GP and outpatient hospital

(iv) Experiences, expectation and attitudes towards healthcare

As part of the survey in Study 3, participants were asked about the type and design of healthcare facilities they commonly visit or have experienced in the past. The aim was to appreciate how participants derived their ratings and to identify any possible extreme cases that may affect the rating outcome. To do so, participants' responses were coded into the main categories shown in Table E-1. The majority (N=70) described healthcare facilities that the majority of participants appeared to be familiar with. This was also found in Study 1, where these facilities were called 'Standard'. A small number of participants described more extreme experiences that fell either below (Low Standard, N=3) or above the 'Standard' (High Standard, N=3). The descriptions of facilities with a higher standard tended to apply to private providers. However, 26 participants also stated a range of designs that they have been exposed to which varies depending on the healthcare provider.

Category	Count	Example Quotes
Standard	70	*'They usually don't looked designed at all- mainly furniture thrown together in an adhoc fashion, judgemental posters on the wall, tatty magazines on the table, and encouraging people to sit as close together as possible'* (P67) *'Vinyl flooring, hard or semi hard seating, chairs around the outside of the space or facing away from others, quite cramped (lots of seats in a small space'* (P111) *'Old-fashioned furniture, chairs not sofas, rather no tables (although I've experienced waiting rooms with tables in the hospital), usually magazines/newspapers stand, rather no plants, rather closed reception room with patients bending their back to lower their head to the level of the receptionist sitting in a chair.'* (P140)
Mixed	26	*'Doctors and dentists - they usually make a bit of an effort with plants, magazines, try to give their patients a pleasant experience as they know they can choose to go elsewhere. Hospitals - more basic, mass-produced feel, more worried about cost than the patient's experience'* (P42)
Of which: • Better design at Macmillan cancer centre	1	*'Usually depressing with rows of seats and nothing to make you relax. Except Macmillan cancer centre at UCH which has better seating in places'* (P93)
• Better design at private facilities	7	*'In private hospitals: plants, newspapers, soft seats, separate seating area (i.e. not a major through road). In NHS hospitals: plants, newspapers, hard seats, seating in a corridor'* (P31) *'Private dentist is exception where care has been taken to design the waiting room with high quality features, espresso machine, furniture and magazines.'* (P64)
High Standard	3	*'clean, brighter, modern, colour coordinated'* (P117) *'They have real plants. Display and sound - where the person's name and which room no he has to go to is displayed (Automated sound says that for people who cannot read)'* (P9)
Low Standard	3	*'Poor condition, lack of any signage indicating how long the wait is, cramped, sitting in corridors, very old-fashioned'* (P110) *'Small, no windows, old furniture, dusty, carpets'* (P105)
Character	2	*'Chaotic but homely'* (P24)

Table E-1: Healthcare designs commonly experienced by participants

A multiple choice-question was given to participants to assess their expectation and attitudes of healthcare, based on the suggested patients' typology by Chalamon et al. (2009) as described in Chapter 2. Expectation was found in Study 1 as a concept that related to end-user perceptions (Figure 5.4). Figure E-5 shows the amount of participants in per cent that associated themselves with each type of attitude. The majority of participants (36.6%) stated that they visit healthcare environments in the event of feeling unwell and seeking for a treatment. A proportion (15%) of people also associated themselves with having a practical approach towards healthcare; hence, viewing healthcare facilities as a means to finding a quick solution for health issues. However, a large proportion of responses agreed with the holistic view of healthcare (28.3%) and visits healthcare facilities also for prevention purpose (13.2%). The holistic approach supports the view that healthcare facilities should be about the overall experience and go beyond the traditional treatment focus. Few participants also associated themselves as adopting the consumer approach (2.9%) and other attitudes (3.9%) towards healthcare.

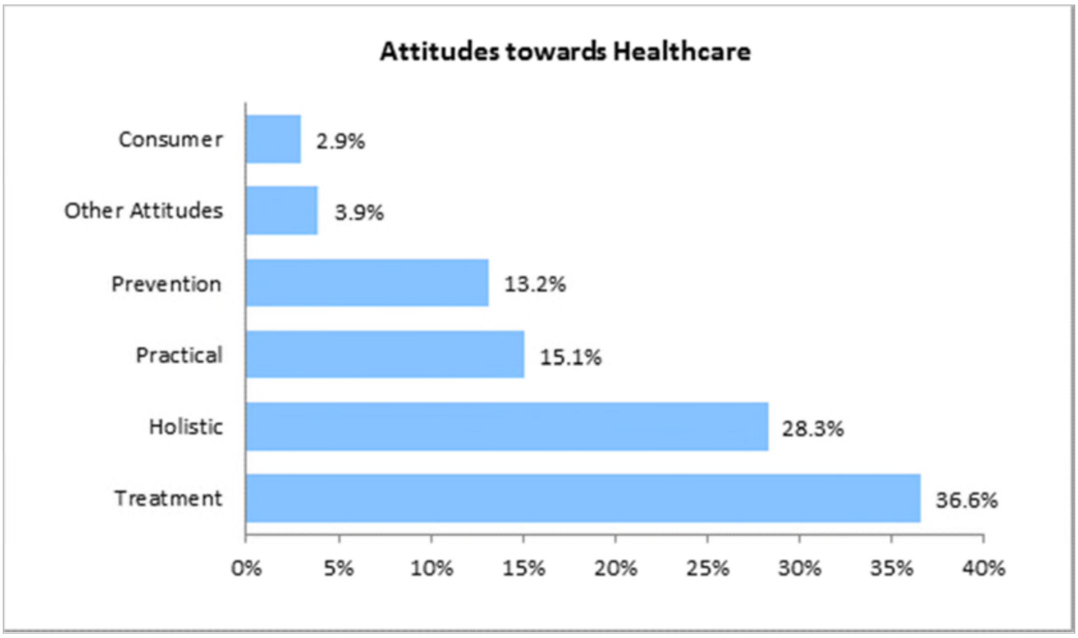


Figure E-5: Participants' attitudes towards healthcare (multiple selections possible)

(v) Supporting statistics

Levene's Test for Equality of Variances		
	F	Sig.
Pleasantness 1	.558	.457
Pleasantness 2	.352	.554
Pleasantness 3	.025	.875
Pleasantness 4	.063	.803
Pleasantness 5	1.544	.217
Pleasantness 6	.247	.620
Pleasantness 7	.279	.598
Pleasantness 8	.438	.509
Pleasantness 9	8.652	.004
Pleasantness 10	1.753	.188
Pleasantness 11	.383	.538
Pleasantness 12	.082	.776
Pleasantness 13	.704	.403
Pleasantness 14	.092	.762
Pleasantness 15	.123	.726
Pleasantness 16	3.007	.086
Pleasantness 17	1.425	.235
Pleasantness 18	.157	.693
Pleasantness 19	1.444	.232
Pleasantness 20	4.391	.038

Table E-2: Levene's Test to assess homogeneity of variances (produced as part of independent sample t-test)

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Pleasantness 1	1441.000	3926.000	-.979	.328
Pleasantness 2	1010.000	3495.000	-3.470	**.001**
Pleasantness 3	1349.000	3834.000	-1.502	.133
Pleasantness 4	1527.000	4012.000	-.480	.631
Pleasantness 5	1411.500	3896.500	-1.148	.251
Pleasantness 6	1482.000	2563.000	-.739	.460
Pleasantness 7	1606.000	2687.000	-.023	.982
Pleasantness 8	1383.500	3868.500	-1.305	.192
Pleasantness 9	1381.000	3866.000	-1.325	.185
Pleasantness 10	1358.000	3843.000	-1.458	.145
Pleasantness 11	1555.000	2636.000	-.319	.749
Pleasantness 12	1234.000	3719.000	-2.162	**.031**
Pleasantness 13	1523.500	2604.500	-.500	.617
Pleasantness 14	1536.000	2617.000	-.429	.668
Pleasantness 15	1480.000	3965.000	-.751	.453
Pleasantness 16	1428.500	3913.500	-1.062	.288
Pleasantness 17	1391.500	3876.500	-1.268	.205
Pleasantness 18	1555.500	2636.500	-.315	.753
Pleasantness 19	1359.000	3844.000	-1.464	.143
Pleasantness 20	1313.500	3798.500	-1.715	.086

Table E-3: Non-parametric test for distributions of ratings between genders

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