School of Education

Science and Mathematics Education Centre

The Influence of Building Features on Wayfinding by Adults with Intellectual Disability: Towards Achieving More Inclusive Building Design

Lindsay Maurice Castell

This thesis is presented for the Degree of

Doctor of Philosophy

of

Curtin University

June 2017

Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics (For projects involving human participants/tissue, etc) The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number: SMEC 20070021

Signature: ……

Date: …24/06/2017…

Acknowledgements

Thank you to all the participants who gave their time and effort to walk through the hospital and participate in the interviews. I am so grateful for your involvement because without your willingness to participate, this study could not have been possible. I hope that your enthusiastic support for this project will be rewarded.

Thank you to my supervisory team; Associate Professor Heather Jenkins, Professor Barry Fraser, Professor David Treagust and Associate Professor Monty Sutrisna.

Monty, thank you for taking on the supervision of my PhD and guiding me to completion. Your patience, insight and steadfastness were much appreciated. I think it is now my shout for coffee.

I would also like to acknowledge the generosity of people along the way who have given their time and guidance willingly; to Dewi Tjia, to Marika Guggisberg, to Steve Basson, to Diane Smith, to Kyle Chow; thank you.

Ross James, thank you for your formal edit of the PhD. Your efficient attention to detail is greatly appreciated.

Thank you to my very special family, without whom I could never have achieved this goal.

To Sarah and Karen; thank you for the joy you have given me in seeing you together and the unwavering love and support you have given whilst I have been undertaking this PhD.

To Matthew; thank you for being you. I am so proud to have you in my life. Your love of helping others is an inspiration to us all and your concern for and support for my PhD has been without bounds, not least for never forgetting to ask; “How’s it going?”

To Emily; I cannot thank you enough. You have helped me through this whole journey; from helping to arrange participants, to assisting in videoing every trip, to sharing your experience and understanding of intellectual disability and to those very special Saturday morning pre-study breakfasts. I could not have completed this PhD without your love and support.

To Simon, thank you for your support of my PhD. The joy that you and Emily have given to people with intellectual disability and the importance you place on making their lives richer has been an inspiration to me and has helped emphasise the need for this study.

To Jane; thank you for your immeasurable support and patience whilst I undertook this PhD. You have forgone so much to allow me this opportunity. You helped me when I was uncertain, you supported me when I was down, you were the angel who looked over my shoulder. Thank you with all my love.

Dedication

For Jane, Sarah, Matthew and Emily with love

Abstract

Wayfinding refers to the process used when a person needs to find the way from a known location to another location. It is an essential activity of daily living, enabling access to and within locations for food, work, education, recreation and medical care. For wayfinding to be successful, however, it requires cognitive processing ability to identify, process, store, and retrieve relevant information from the environment during the journey. Whilst this may be within the capacity of a typically developing person, it represents a challenge for a person with intellectual disability who has impaired cognitive processing ability resulting in deficits in adaptive functioning. It can be particularly challenging when seeking locations within large and complex buildings such as shopping malls, office buildings, schools or hospitals. A review of previous research found only limited attention had been given to issues facing people with intellectual disability when wayfinding within the built environment. The aim of this research, therefore, was to develop evidence-based guidance about the influence of building features on wayfinding success in order to support inclusive building design for people with intellectual disability.

Guidelines and regulation covering building design in Australia have paid considerable attention to ensuring buildings are appropriately designed for use by people with physical and sensory impairment. However, there has been limited evidence to suggest similar attention has being given to the needs of people with intellectual disability. The aim of this research, therefore, was to develop evidence-based guidance considering the influence of building features on wayfinding success in order to support inclusive building design for people with intellectual disability.

The study used a mixed methods research design to explore the effects of building features on wayfinding success by adults with intellectual disability in comparison to typically developing adults. 60 adult participants (30 with intellectual disability and 30 typically developing) were individually observed finding three separate locations within a hospital building in Perth and, immediately following each visit, participated in a semi-structured interview. Video recordings were coded to identify building features used, levels of success in using those features (based on either getting closer to or further away from the intended destination) and any other environmental issues that may have affected wayfinding. Interview responses were analysed to explore participant attitudes towards wayfinding and their use of and preference for individual features. Random forest classification provided an assessment of the influence of features on overall wayfinding success (based on time taken).

Findings from the analysis identified that participants with intellectual disability took longer, travelled further, made more wayfinding decisions on average than typically developing participants and were less successful overall in reaching the destinations (based on time taken). Levels of success in the use of each feature and the influence of each feature on overall wayfinding success have been presented in four wayfinding feature matrices representing the main component feature groups (spatial, visual, sensory and supportive).

This research contributes to the currently limited body of knowledge about building design for people with ID and has broad importance for the built environment by offering the means by which building designers can enhance design to accommodate the needs of people with intellectual disability and provide more inclusive building design.

Table of Contents

List of Tables

List of Figures

Chapter 1:

Introduction

1.1 Introduction

This first chapter provides the introduction to the research study. It explains the background to the research and describes the research problem. It also lists the aim and objectives of the research study, describes the methodology to be used and the overall scope of the research study. It concludes by describing the contribution that the research makes to knowledge and the structure of the following chapters.

1.2 Descriptors used for participant groups within this study

Two groups of people are regularly identified in the text and in tables throughout this dissertation: people with intellectual disability and people who are typically developing. Whenever each group is referenced, the titles have been abbreviated to "ID" for intellectual disability[1] and "TD" for typically developing[2]. Hence, references in the text are made to participants with ID or TD participants. Furthermore, in the reporting of statistics, the two groups may be referenced in table columns headed ID and TD and in describing frequency of responses in interviews as (3 ID, 2 TD) (meaning three responses from participants with intellectual disability and three from typically developing participants). These abbreviations are to avoid repetition of lengthy terms and intend no disrespect to either group.

1.3 Research background

To support daily living, humans have to be able to travel to and from various locations in order to meet their needs (Antonakos, Giordani and Ashton-Miller 2004; Wiener, Büchner and Hölscher 2009) and to ensure their survival (Spiers and Maguire 2008). Travel provides access to shops for food, clothing and other daily needs as well as to medical facilities in an emergency or for treatment; places of work; shelter from adverse weather; refuge if feeling

[1] Intellectual disability is described as a neurodevelopmental disorder in which a person has a reduced IQ level and demonstrates impairments in conceptual, social and practical domains (American Psychiatric Association 2013b)

[2] A typically developing person is someone who does not have an intellectual disability and meets the selection criteria for this study described in Chapter 4, Section 4.5.3

threatened; locations for socialising with family and friends; entertainment (e.g., a restaurant); and transport (e.g., airport, train station, bus stop). The ability to find the way is therefore, a fundamental role for humans (Devlin 2014). Not being able to travel to these destinations would severely impede daily living.

This process of looking for a destination is termed 'wayfinding'. Lynch (1960), acknowledged as the originator of the word (originally hyphenated: way-finding), described it as "a consistent use and organisation of definite sensory cues from the external environment" (Lynch 1960, 3). Since its introduction by Lynch, the notion of wayfinding has been debated and discussed, and is broadly considered to refer to the process of finding a path between an origin and a destination (Allen 1999b; Golledge 1999a; Queensland Health 1996; Raubal and Worboys 1999; Salmi 2006). It is a purposive action that is goal-directed, planned and motivated (Golledge 1999a), and requires the person who is wayfinding to both understand and interact with the environment. The domains in which wayfinding occurs include the urban environment, maritime navigation, computer interfaces (to find information on a website) and, specific to this current research study, the built environment. Since the original work by Lynch (1960), several authors have published research about general wayfinding, such as Allen (1999a) and Golledge (1999b), and more specifically about wayfinding in the built environment, such as Passini (1984b). Chapter two provides a detailed review of literature about wayfinding in the built environment.

Successful wayfinding in the built environment relies on three factors.

Adequacy of information to guide the person undertaking wayfinding

This refers generally to the provision of spatial, visual[3], sensory and supportive information as part of an overall wayfinding system that guides the person to the destination. Hunter (2010b, 1) suggests, however, that often "the investment in a wayfinding system is less than that devoted to amenities like art and furnishings" and Devlin (2014) suggests it is often only considered once a building is constructed. Carpman and Grant (2002) suggest that wayfinding design also lacks the vision it requires, by looking more at the individual components rather than a holistic system. These observations indicate a need for further development in the design of wayfinding for all building users. Chapter two, the literature review, gives a detailed analysis of the extent and scope of research about wayfinding and the provision of wayfinding information.

[3] Whilst the term 'visual' would normally be associated with the senses (sight), for the purposes of this study it has been treated as a separate component because visual features represent a significant proportion of all wayfinding features.

Physical and sensory ability

The person needs to be able to physically access the building and then see, hear, smell or touch the relevant wayfinding cues. As some building users may not have such abilities, building designers need to adopt an inclusive design approach that will remove the "barriers and obstacles that create disabling environments" (Casserley and Ormerod 2003, 143) and provide accessibility for all building users. Requirements to provide such accessibility in Australia are described in legislation such as the Disability (Access to Premises – Buildings) Standard (Commonwealth Government of Australia 2010b) and in design guidelines such as the Wayfinding Design Guidelines (CRC for Construction Innovation 2007). Other countries have similar controls; for instance regulation in the UK is enacted through the Building Regulations 2010 – Approved Document M: Access to and Use of Buildings (HM Government 2010).

Cognitive processing ability

A person undertaking wayfinding also needs to be able to identify, process, store and retrieve information and then transform that information into a clear set of actions to reach the destination (Algase et al. 2004; Allen 1999a; Arthur and Passini 1992; Passini 1984b; Spiers and Maguire 2008). Not having the cognitive processing ability to meet these demands, according to Passini (1984b), can cause difficulties for wayfinding.

The requirement for cognitive process ability, however, represents a significant challenge for people with ID. The American Psychiatric Association (2013b) states that an individual with ID will demonstrate "impairments of general mental abilities that impact adaptive functioning" (American Psychiatric Association 2013b, 1) in *conceptual, social and practical* domains. The conceptual domain "includes language, reading, writing, math, reasoning, knowledge, and memory" (American Psychiatric Association 2013b, 1). As wayfinding requires mental ability to cognitively process information, people with ID are more likely to experience greater difficulty in finding required destinations. Inclusive building design, therefore, needs to address the special needs of people with ID.

Recent introduction of the Disability (Access to premises – Buildings) Standard 2010 by the Australian Government is intended to guide designers to meet expectations for equitable access under the existing Disability Discrimination Act (Commonwealth Government of Australia 2010b). However, in releasing the standard, the government acknowledged that there was insufficient knowledge about wayfinding generally to adequately incorporate it within the current Standard and recommended that it be reconsidered as part of the first review of the Standard (Commonwealth Government of Australia 2009, 2010a). With an even smaller body of knowledge about wayfinding design for people with ID (Castell 2014), the inclusion of guidance to support people with ID seems less likely.

The concept of inclusive design, which originally emerged in the 1990s as a process to link design and social need (Clarkson and Coleman 2015), has now been embraced by contemporary building designers to help remove barriers in the design of the built environment and "enable everyone to participate equally, confidently and independently in everyday activities" (Fletcher 2006, 3). If building design is to be fully inclusive, then appropriate consideration must also be given to the needs of building users with ID; hence the setting of this research.

1.4 Statement of research problem

The preceding discussion has identified a lack of knowledge about the means to improve wayfinding for people with ID. If the means of improvement could be identified and incorporated in building design, inclusivity would improve for people with ID. The research problem therefore, asks:

> How can building designers enhance the inclusive design of wayfinding features for use by people with ID?

1.5 Aim and Objectives

Having stated the research problem, this section provides the overall aim that will address that problem and describes the objectives to achieve that aim.

1.5.1 Aim

The aim of this study is:

> To support inclusive building design for people with intellectual disability through development of evidence-based guidance about the influence of building features on wayfinding success.

1.5.2 Objectives

1. To identify and establish the fundamentals of wayfinding and current understanding of the extent of impact of the wayfinding environment on wayfinding by people with intellectual disability.

2. To investigate the extent and success in the use of different wayfinding features by adults with intellectual disability, including comparison with typically developing adults, and to assess the influence of those features on overall wayfinding success (based on time taken to reach destinations).

3. To investigate ways of enhancing inclusive design of wayfinding features to improve wayfinding success by adults with intellectual disability.

4. To develop a framework that incorporates wayfinding features and their influence on overall wayfinding success (based on time taken to reach destinations).

1.6 Research methodology

The research design in this study uses multiple research methods driven mainly by the nature of data to be collected and the format required to process and analyse the findings. Achieving objective 1 requires a qualitative methodology (thematic analysis) of available published data to identify the fundamentals of wayfinding emerging from the research. Achieving objective 2 requires a quantitative methodology to collate and analyse numeric data for frequencies of use and to assess the influence of features on wayfinding success. Achieving objective 3 requires mixed methodologies: quantitative to analyse Likert scale responses and qualitative to analyse themes arising from interview conversations about building features. Achieving objective 4 uses the quantitative and qualitative information from each of the previous objectives.

The analysis focuses on assessing the comparative success of each group (ID and TD) in using various building features and in relation to time taken. The analysis does not attempt to identify and compare cognitive abilities between the two groups.

1.7 Research design

The research design is dictated by the need to address both the aim and objectives and comprises four parts:

a) analysis of published literature to identify the extent and nature of previous studies about the topic

b) video observations of 60 people (30 with and 30 without ID) making trips to three different destinations in a hospital in Perth and recording semi-structured interviews with each participant in order to provide data for analysis

c) coding, transcription and analysis of collected data to identify research findings

d) preparation and presentation of results including recommendations and development of a wayfinding feature framework to meet the aim and objectives of the research study.

1.8 Contribution to Knowledge

Only a small number of evidence-based research studies have investigated wayfinding by people with ID. Salmi, Ginthner, and Guerin (2004) studied critical factors affecting wayfinding, Salmi (2007b) investigated environmental preference for environmental features and Smith (Smith and Adkins 2006) researched the wayfinding experience of people with ID when shopping.

This present research, therefore, contributes to a limited existing body of knowledge and, based on the in-depth review of previous reported research, it can be considered one of the largest studies in this specific field. Thirty participants with ID undertake three wayfinding trips in a complex real-world setting and, most importantly, participate in the conversations about what went well, what didn't and what they feel needs to be done to improve their access and use of buildings. The scope of this study is significant compared with the otherwise limited research available, it contributes to the body of knowledge about wayfinding and inclusive design, and gives further insights for the research community and those responsible for designing, operating and managing buildings used by people with ID.

1.9 Structure of Thesis

The structure of this thesis follows the sequence of activity in meeting both the aim and objectives.

Chapter 1 sets the parameters of the research study by providing a background to the subject, presenting the research problem, defining the aim and objectives, explaining the research methodology used and the scope of the study.

Chapter 2 describes the scope of previous publications about the topic and analyses the content in relation to the current study. The findings from this chapter inform the approach to data collection and analysis and contribute to the discussion and eventual framework presented in chapter 7.

Chapter 3 explains the researcher's philosophical stance to undertaking research and gives the reasons for the manner in which data was collected and analysed.

Chapter 4 explains and justifies the methods of data collection and analysis.

Chapter 5 presents the results of the data collected from observation and interviews.

Chapter 6 analyses the results in relation to previous research and provides suggestions for improving wayfinding features based on the outcomes of this study.

Chapter 7 explains components of, and then presents, the wayfinding feature framework, which achieves the objectives and research aim.

Chapter 8 concludes the study. It summarises the research findings, describes how the aims and objectives are met, explains the significance and importance of the research outcome for building professionals, notes limitations of the research and suggests areas for further research.

The appendices include a description of wayfinding abilities, copies of relevant documents (interview document, ethics, information sheets, consent forms), participant coding, the process of random forest classification; inter-rater reliability and supporting quantitative analysis of statistical data from the observations, the Likert scale questions and qualitative analysis of participant interviews.

1.10 Summary

This chapter has established the structure for the remainder of this research study. It has provided a detailed background and context for the development of the research study and identified the research problem to be addressed. It has listed the aim and objectives that guided the study and explained the research methodology. It has explained the scope of the research and its contribution to the limited existing body of knowledge and, finally, it has described the structure for the remaining chapters of the thesis. The next chapter provides an extensive review of published literature about wayfinding, in general, and about the components and features in a wayfinding system. It concludes by describing the limited scope of previous studies about wayfinding by people with ID.

Chapter 2:

Literature Review

2.1 Introduction

Chapter 2 investigates the nature and extent of previous investigation in this subject area and synthesises relevant literature to identify key issues relating to building access for adults with ID. The structure of the literature review follows Perry's (1995) three-stage framework for identifying a research problem in which each stage develops and further refines the research focus. The first stage describes and defines the general research problem area (in this case, wayfinding), the second stage explains the boundary of the research focus (adults with ID) and the third and final stage describes existing knowledge and research related to the specific research question (wayfinding for adults with ID). This structure allows the topic to be developed in a logical manner, facilitating a greater understanding of the context in which the research was undertaken and the extent to which this subject area has been researched.

2.2 Research problem area: Wayfinding in the built environment

There are few activities more fundamental to humans than finding their way from one place to another (Montello 2005). Human survival depends on finding mates, shelter and food whilst avoiding threats from predators (Montello 2005). In the past, men had to cover long distances in unfamiliar territory to hunt for food (Golledge 2003), so being able to understand where they were, how to return to where they had come from and how to get back to the same location on future occasions became fundamental for human existence. They had to develop the skill of finding their way: "way-finding". Over time, humans were able to develop navigational strategies to cope with their spatial environment (Allen 1999b). They developed cognitive processing skills for the task that included learning and memorising spatial characteristics whilst travelling so that they could return to the same location in future (Golledge 2003).

For humans, larger and more complex living environments with sprawling cities and extensive urban landscapes have necessitated enhanced wayfinding skills. It is essential for daily living (Wiener, Büchner and Hölscher 2009), allowing humans to find locations for food or work, and yet maintain their sense of location (Passini 1984a) so that they can return home afterwards. Some groups of humans have reduced capacity to cope with wayfinding in

these complex environments such as people with ID, thereby highlighting the need for urban and building designers to better understand and accommodate the needs of these groups in any future design.

Much of the ground-breaking work in the broader field of wayfinding was undertaken and described in published works between the 1970s to the 1990s and in the early 2000s. Although there have been periods of publication activity and research thereafter in the general field of wayfinding (particularly in specialised areas such as virtual reality), there is limited published work about wayfinding for those with ID. Thus, the literature identified for the concepts and general components of wayfinding tends to comprise older references.

Successful wayfinding relies on two main elements: obtaining appropriate information from the environment, and being able to interpret and process that information (Castell 2008b). This study examines the extent to which the building environment provides wayfinding information for people with ID and what design changes may be required.

2.2.1 Definition of wayfinding

a) Meaning of the term

Despite considerable discussion prior to 1960 about the processes that comprise wayfinding, the actual term *wayfinding* was not used until introduced by Lynch in his book entitled: *The Image of the City* (Lynch 1960). Prior to this, researchers referred to this process as spatial orientation (Huelat 2007).

Initially, the term wayfinding was used in the context of environmental psychology and geography (Allen 1999b), but has subsequently become used in relation to the design of the built environment (Arthur and Passini 1992; CRC for Construction Innovation 2007, 2008; O'Neill 1991a; ODPM 2006; Passini 1984a; Passini et al. 2000; Peponis, Zimring and Choi 1990; Raubal 2001a; Salmi, Ginthner and Guerin 2004; Weisman 1981).

Whilst there may be diverse opinions about aspects of wayfinding, there is consistency in the definition of wayfinding itself. Wayfinding refers to the process of finding a path between an origin and a destination (Allen 1999b; Golledge 1999a; Queensland Health 1996; Raubal and Worboys 1999; Salmi 2006). This process occurs within a spatial environment (Montello 2005; Queensland Health 1996) that may be either familiar or unfamiliar (Passini 1981). The movement between the two points is typically purposive, goal-directed, planned, motivated (Golledge 1999a) and commonly to a destination that cannot be seen from the point of origin by the person involved in the wayfinding (Allen 1999b; Golledge 1999a). Put simply, it is finding ‘one’s way in the world” (Davis and Weisbeck 2016, 1).

Wayfinding involves a complete engagement with the environment in both an immediate and macro sense (Carpman and Grant 2002; Passini 1984a). It requires the person who is undertaking wayfinding to both understand and communicate with the environment (Center for Inclusive Design and Environmental Access 2001; Passini 1984a). It is not just about finding and using signs (Wayfinding: Pointers for the Future 2011), but is about using a range of salient cues including sensory cues, obtained from the environment through which a person travels (Davis and Weisbeck 2016). The process occurs within an atmosphere of uncertainty, often under both spatial and temporal constraints (Allen 1999b) and is generally considered successful when the person reaches the final destination (Allen 1999b; Passini 1984a). No two wayfinding attempts are alike, because of the characteristics of the wayfinder and/or the environment through which he or she travels (Allen 1999b).

b) Is essential for daily living

Wayfinding is fundamental for many of the processes of modern daily living, such as searching for food, recreation, social activities, medical care, a new home to purchase, or travelling to and returning from a new holiday destination (Golledge 1999a, 2003). Wayfinding occurs when driving a car or walking in a city (Raubal and Winter 2002) and occurs at all levels of scale from large urban environments to the more enclosed building interior (Hunter 2010b; Raubal and Winter 2002). It is an essential ability for anyone trying to escape from a building in the event of fire, particularly given that such situations can be highly stressful and disorienting (Dogu and Erkip 2000).

c) Requires decision-making

During wayfinding, the wayfinder needs to make a series of decisions in response to the immediate environment (Arthur and Passini 1992). These decisions have varying complexity (Giannopoulos et al. 2014), the outcome of which affects the overall success of the wayfinding exercise (Passini 1984a). Decisions are made as a consequence of the information provided by the environment (Hunter 2010b). Given that these decisions are key to successful wayfinding, they will form the basis of the investigation with the participants in this current study.

d) Uses cues from the environment

The wayfinding environment provides various cues to aid the process of wayfinding. They are considered part of a wayfinding system (CRC for Construction Innovation 2008) and are discussed later in the literature review.

e) Interaction with the environment

Wayfinding requires people to interact with their environment (Allen 1999b). Successful wayfinding requires a person to collect information from the environment by noticing information about specific locations, differences between locations, distances travelled and direction or orientation information (CRC for Construction Innovation 2008; Golledge 2003; Raubal and Winter 2002). For the process to also be satisfying, the environment needs to offer something to the person undertaking wayfinding, possibly architectural complexity to add interest (Passini 1984a). Unfortunately, poor wayfinding can cause lost time, increased stress and reduced safety (Dogu and Erkip 2000).

f) Wayfinding ability

Although wayfinding may appear to be a simple process, it is in fact a highly complex task (Allen 1999a; Passini 1990), requiring use of memory for route learning and for retracing or reversing the journey (Golledge 2003; Passini 1984a). Wayfinding, therefore, requires a person to possess both cognitive and behavioural abilities (Golledge 1999a; Haq, Hill and Pramanik 2005; Passini 1981) to get to spatial destinations (Arthur and Passini 1992; Passini 1984a). The cognitive abilities help in developing and managing cognitive maps (Passini 1984a), which are mental representations of the wayfinding environment (Passini et al. 2000). These are then used in conjunction with other support from the environment (Golledge and Gärling 2004; Mondschein, Blumenberg and Taylor 2005) to solve location-based problems (Huelat 2007). Passini (1984a) suggests that wayfinding actually requires three abilities: cognitive mapping (to understand our spatial environment); decision-making (to allow a person to plan actions); and decision-execution (to turn decisions into actions). Successful wayfinding can also require a person to transfer information contained in a cognitive map for one location for use in another similar location (Golledge 2003).

Although most humans possess the capacity to find their way (Freksa 1999), research suggests this can be affected by age, gender, occupation, individual psychology and familiarity (O'Neill 1991a; Peponis, Zimring and Choi 1990; Weisman 1981) as well as emotional, value and belief considerations (Golledge and Gärling 2004) .

2.2.2 History of wayfinding

In publishing the book, *The Image of the City* in 1960 Lynch was one of the first authors to discuss cognitive maps in relation to human wayfinding (Passini et al. 1998) and specifically to link the image obtained by cognitive maps with design of the actual environment (Casakin et al. 2000; Passini 1984a). Lynch was also one of the first to investigate people’s feelings

about their environment and how those feelings might be integrated into specific environmental design (Bell et al. 2001). As the 1970s ended, the focus of research shifted from cognitive maps (the product) to cognitive mapping (the process) (Passini et al. 1998; Rainville, Passini and Marchand 2001), thereby broadening the perspective to encompass all the cognitive operations necessary for wayfinding (Passini et al. 1998). According to Passini (1984a), wayfinding actually comprises several cognitive activities including information processing, decision making and decision execution. Arthur and Passini (1992) suggest that there is more to wayfinding than the static mental map first suggested by Lynch.

Since the original work by Lynch, which had focussed mostly on design of the urban environment, several authors have expanded the subject to cover other areas such as architecture, interior design, environmental psychology, geography and wayfinding Appleyard (1969) Passini (1981) Dougherty and Bell (1993) Golledge, Loomis, and Klatzky (1997), Montello (2005) Salmi (2007a) Castell (2008a). More recently, Chang and Wang (2010a) have extended the topic to include research about wayfinding using different types of electronic assistive devices.

2.2.3 Fundamentals of wayfinding

Commentaries on wayfinding identify a wide range of fundamentals that contribute to the process. A review of published literature suggests there are three parts to wayfinding:

- the wayfinding environment (main interrelating elements, attributes of the environment and specific wayfinding components and features)
- the wayfinding process (initial wayfinding strategy, processing information and individual wayfinding preference)
- wayfinding capability.

a) The wayfinding environment

i) Interrelating elements of the wayfinding environment

Wayfinding environments, whether external (e.g., cityscapes) or internal (e.g., building interiors), comprise a combination of physical elements. Lynch (1960) originally identified five elements in a city that form the physical image of the environment: paths, landmarks, nodes, edges and districts. Passini (1984b, 1996) suggests that these terms could also be applied to the built environment and in particular to building interiors.

Paths are channels of movement along which an observer moves from one location to another (Darken 1996; Lynch 1960). They are single dimension-linked segments (Golledge 1999a) such as walkways, streets, railways, freeways (Lynch 1960). In relation to building interiors, Passini (1988) suggests that paths can be either horizontal or vertical. Horizontal paths comprise corridors, promenades or walkways and vertical paths comprise stairs, escalators and lifts. *Landmarks* can provide familiarity when wayfinding in large spaces (e.g., recognising a city by its skyline) (Darken 1996) and can help a person who is undertaking wayfinding to orient themselves in relation to the route to be taken (Frankenstein et al. 2012). Landmarks should be chosen or designed to be visible from a distance (Frankenstein et al. 2012), to be distinctive and provide directional information (Darken 1996). Passini (1984b) suggests a particular shop or bar, information booth, sculpture or landscape arrangement could be used as a landmark. *Nodes* are strategic points where paths connect (Darken 1996). In a building interior, Passini (1984b) suggests they might be represented by a circulation intersection, a hall or an indoor square. They must be distinctive from their surroundings and have a clearly delineated boundary (Darken 1996). *Edges* are linear in nature and similar to paths in concept (except that they do not facilitate movement) (Darken 1996). They often occur at the boundary between regions or districts (Darken 1996) and can represent a barrier (such as the external wall of a building) (Passini 1984b). *Districts* have a common identifying characteristic that differentiates them from the surrounding districts (Darken 1996). In a building context, Passini (1984b, 114) suggests a district may be represented by a "public shopping zone or an office zone or a residential zone".

ii) Legibility and imageability in the wayfinding environment

When entering and moving through the built environment a person develops an impression of that environment based on the level of success in navigating spaces, finding destinations and how the person felt along the way. Lynch (1960) suggests this impression, in relation to cityscapes, is affected by the quality of the built environment, particularly its legibility and imageability. Passini (1984b) suggests this can also be applied to building interiors. Legibility and imageability can affect a person's enjoyment of, or desire to be in a particular space and also the person's success in wayfinding (Li and Klippel 2016). Legibility refers to the extent to which an environment can be learned and remembered (Bell et al. 2001). In respect to a city, it refers to "the ease with which its parts can be recognised and organised into a coherent pattern" (Lynch 1960, 2-3) to facilitate the process of wayfinding (Abu-Ghazzeh 1996). Legibility is important because it helps people to organise the space through which they travel for wayfinding, even though this may be difficult to do (Darken 1996). An

experiment by Li and Klippel (2016) involving participants with Alzheimer's Disease[4] showed that environmental legibility improved wayfinding performance.

Imageability refers to the ease with which a place can be mentally represented (for instance, in a cognitive map) (Darken 1996). Passini (1984b, 110) refers to imageability as "the difficulty of spatially comprehending a place". Whilst legibility may be a prerequisite for imageability, it does not guarantee it (Darken 1996; Passini 1984b). For example, it may be reasonably easy to remember a sequence of turns or intersections as part of the legibility of the environment but it is not as easy to create an overall image of all these elements (Passini 1984b). According to Darken (1996), imageability encourages a person to want to be part of the environment by providing a heightened sense of exploration and awareness.

iii) Components and features of the wayfinding environment

This section describes the design of individual components and features within the environment that assist wayfinding generally. Design issues specific to building access by people with ID are addressed later.

Architectural design significantly affects the choice of wayfinding strategy (Arthur and Passini 1992), yet architects and designers have been slow to encompass wayfinding in their designs (Hunter 2010b). Hunter (2010b) suggests that wayfinding receives little attention in the planning, research and building evaluation process, often resulting in less money being spent on wayfinding than on art or furnishings. Whilst different buildings have differing wayfinding problems and plans that can change over time (Hunter 2010b; Montello 2005), wayfinding solutions should nonetheless suit all building users irrespective of abilities (Hunter 2010b) and mental state (e.g., tired, distracted, nervous or distressed) (VanderKlipp 2006). The wayfinding solution should use the built environment as a communicator of information to the person undertaking wayfinding (Raubal 2001a).

There are two main stages to wayfinding design: the overall approach and then the detailed design. The overall approach to wayfinding seeks to help building users find and organise environmental information into a meaningful framework that shows how the parts are related to each other (CRC for Construction Innovation 2007; Kaplan, Kaplan and Ryan 1998). It should allow a person to know where they are, where they are going and not have barriers that prevent a person from getting there (CRC for Construction Innovation 2007; Hunter 2010b). The system must be easy for anyone to use (Fletcher 2006; Passini 1996; Rainville,

[4] Alzheimer's disease is a form of dementia which changes brain tissue and affects "memory, language, learning, thinking, reasoning and undertaking everyday tasks" (The Centre for Genetics Education (online) 2017c). It may also be associated with other behavioural and psychological conditions such as irritability and wandering (American Psychiatric Association 2013b).

Passini and Marchand 2001; Werner and Schindler 2004), including by those with a wide range of sensory and intellectual abilities (Pollet and Haskell 2003).

Detailed design refers to the practical process of finding design solutions to meet the basic principles outlined above. Many wayfinding features collectively create a wayfinding system, including building layout, variations in colour, landmarks, signage and the like (Ng 2003). The following discussion groups wayfinding features into four main components; spatial (features relating to the layout and movement; e.g., building layout, lifts, junctions, exits and the like), visual (features providing visual images; e.g., signs, maps, landmarks), sensory (features that affect a person's sensory system; e.g., sound, smell, levels of lighting) and supportive (points where participants can ask someone or a person volunteered to provide information to the participant).

Spatial features

The spatial component comprises features that create the building layout and form part of the general process of moving both horizontally and vertically through a building (e.g., corridors, junctions, dead ends, lifts, stairs). Whilst much has been written about the effect of complex building layouts on wayfinding, there is limited information about the effect of individual building features on wayfinding.

Complexity of overall building layout

The plan of a building has the ability to negatively impact on wayfinding success (Devlin 2014). Complex floor plans, therefore, have the capacity to reduce wayfinding performance (Abu-Ghazzeh 1996; Baskaya, Wilson and Özcan 2004; Dogu and Erkip 2000; Ng 2003; O'Neill 1991a, 1992; Peponis, Zimring and Choi 1990; Werner and Schindler 2004) by affecting a person's ability to understand the spatial relationships and circulation systems within a building (Passini 1996).

Several authors have suggested methods for assessing overall complexity of a building layout. Montello (2005), for instance, measures complexity by comparing the layout with a single simple shape: "a square is easier than a rhombus, a circle is easier than a lopsided oval" (Montello 2005, 276). Peponis, Zimring, and Choi (1990), on the other hand, relate complexity to the number of lines of sight between spaces and O'Neill (1991a, 558) measures complexity according to the "average number of possible paths one can take from any choice point", called the inter-connection density (ICD).

A well-designed layout can assist wayfinding in the following ways:

- by providing cues to the internal spatial organisation of a building (Dogu and Erkip 2000)
- by giving order to the inside spaces (Abu-Ghazzeh 1996; Kaplan and Kaplan 1989) differentiating between areas within the building to help identify locations used in wayfinding (Abu-Ghazzeh 1996; Baskaya, Wilson and Özcan 2004; Dogu and Erkip 2000; Passini 1984b; Peponis, Zimring and Choi 1990)
- by allowing visual and some auditory access (Arthur and Passini 1992) and structuring the layout to comprise smaller parts such as zones, districts, quarters and blocks, which provide a framework to the layout (CRC for Construction Innovation 2007; Freksa 1999)
- by maintaining similar orientation of the layout for different parts of the building (Werner and Long (2003)
- by basing the layout around identifiable landmarks, nodes, paths, edges and districts to improve understanding of spatial relationships (Lynch 1960).

Weisman (1981) studied wayfinding by students in a university and found the students reported being lost less frequently when floor plans were considered simpler.

For people with ID, configuration of internal spaces needs to be logical (London Borough of Croydon 2000) and preferably symmetrical to decrease complexity (Salmi 2007a). Layouts should provide for prospect and refuge during wayfinding so that users can observe areas from vantage points (prospect), but without being seen (refuge) (Salmi 2007a).

Visual access within the building layout

Montello (2005, 276) defines visual access (or visibility) as “the degree to which different parts can be seen from various viewpoints” and suggests that greater visibility makes the processes of wayfinding easier. Visual access can help people to see through or out of a setting (Dogu and Erkip 2000), help shoppers find their way around a shopping centre (Ng 2003) and help passengers in an airport to orient themselves (Tam and Lam 2004). According to research by Carpman, Grant, and Simmons (1985), visual access can have greater influence on wayfinding than signage, when entering a hospital.

Visual access is not easy to accommodate in building design, but it may be enhanced by providing windows in corridors to allow greater visual access (Huelat 2007) and clear pathways that give better vision to visitor elevators (Huelat 2007). In addition, design needs

to enable people who are undertaking wayfinding to have a clear visual sweep on entering an environment, in order to view many elements and their relationships (Lynch 1960). A clear visual sweep provides the ability to oversee (and see through) areas and therefore provides opportunity for vantage points (prospect), whilst not being seen (refuge) (Salmi 2007a).

From a survey of students undertaking wayfinding in a university, Abu-Ghazzeh (1996) found that a perceived lack of visual access in campus buildings made participants feel lost because they did not know where they were headed.

Nodes to aid visual access

Nodes are places where paths come together (Pollet and Haskell 2003) and are used to provide information to assist travelling to the next node, particularly in route learning. Nodes need to be differentiated so that a person knows the node he or she is travelling to or has travelled from (Darken 1996). If nodes are part of an easily understood circulation system, they can help a person create a mental map of the environment (Pollet and Haskell 2003). However, as with landmarks, providing too many nodes can cause confusion and make a layout difficult to memorise (Pollet and Haskell 2003).

Division of internal spaces

Dividing internal building layouts with paths, edges, districts, nodes and landmarks helps to categorise internal space within buildings (Passini 1984b, 1996) and, if designed to maintain connectivity between spaces, can assist in wayfinding (CRC for Construction Innovation 2007). The division of space needs to be clear to the user (CRC for Construction Innovation 2007; Pollet and Haskell 2003). Clearly defined and distinctive zones help people become familiar with the layout of a building (Darken 1996; Kaplan, Kaplan and Ryan 1998). Paths, which can include walkways, hallways and corridors (Pollet and Haskell 2003), help define channels of movement (Darken 1996; Pollet and Haskell 2003), link nodes (Darken 1996) and assist with wayfinding (Beneicke, Biesek and Brandon 2003; Ng 2003). For complex buildings, paths may be categorised as either primary or secondary to help people memorise their journey (Kaplan, Kaplan and Ryan 1998; Pollet and Haskell 2003). Defining paths by changes in colour or texture and even placing of adjacent planting is also useful for wayfinding (Darken 1996; Kaplan, Kaplan and Ryan 1998; Malkin 1989).

Entry/Exit points

Arrival points should be easily identifiable (CRC for Construction Innovation 2007; Huelat 2007), be at the main point of entry, not at secondary points and be free from clutter (CRC

for Construction Innovation 2007). Emergency exits need to be placed where people pass by daily (Pollet and Haskell 2003).

Use of lifts

Pollet and Haskell (2003) suggest providing an easily identifiable circulation plan with vertical circulation such as lifts and stairs readily visible from entry points and in similar locations on each floor. Building design should reconcile layouts between facilities (such as toilets and cafes) and floor levels in order to make transitions easier (Nicholas 2000).

Visual features

Visual features provide a visual image that relates wayfinding information to the person undertaking wayfinding.

Architectural differentiation between areas

Differentiation in buildings refers to the "degree to which different parts of an environment look different" (Montello 2005, 275) and can help improve wayfinding ability (Bell et al. 2001; Peponis, Zimring and Choi 1990). Differentiation can be achieved by changes in size, shape, colour, light, architectural style and graphics (Arthur and Passini 1992; Montello 2005) or by using geometric forms in the layout such as an "L" or a "T" shape (Passini 1996). Abu-Ghazzeh (1996) found that students who were wayfinding in a university felt more lost and disoriented when there were few distinctive features in the wayfinding environment. Using unique objects for landmarks and avoiding too much symmetry will therefore enhance distinctiveness (Freksa 1999; Kaplan, Kaplan and Ryan 1998).

Colour

The use of colour to aid wayfinding needs to be treated with caution. Research indicates that colour blindness is common amongst the population. In America alone, "8% of men and 1% of women have some form of colour blindness" (Bennett 2009, 2483). Appropriately considered, colour can actually provide significant support for wayfinding (Beneicke, Biesek and Brandon 2003; Dalke et al. 2006; Salmi 2006; Smith 2008). A survey of practising architects by Smith (2003) found that 75% of respondents believed colour to be highly relevant for wayfinding.

Colour for wayfinding has many advantages (Beneicke, Biesek and Brandon 2003; Salmi 2006), particularly as it can be incorporated in a variety of design materials (Bell et al. 2001; Read 2003).

Colour can:

- provide a clue to the specific use of a space through association (e.g., theatrical, symbolic or educational settings)(Smith 2008)
- define what behaviour is expected of a person within a particular environment (Smith 2008)
- attract attention, particularly when fully saturated colours are used for both foreground and background (Salmi 2007a) although Dogu and Erkip (2000) caution against too many strong colour contrasts that could cause distraction and fatigued eyes
- aide awareness of and memorising of features such as landmarks (Dalke et al. 2006; Smith 2008) and signage (London Borough of Croydon 2000; Salmi 2006)
- provide distinctiveness for various spaces in a building (Arthur and Passini 1992; CRC for Construction Innovation 2007; Dalke et al. 2006; Dogu and Erkip 2000; Smith 2008)
- differentiate between elements such as walls, floors and ceilings or doors and walls (London Borough of Croydon 2000)
- highlight hazards such as edges of surfaces at stairs and the like (Dalke et al. 2006)
- provide essential signposting to help in entering a building (Dalke et al. 2006)
- help people remain on or find and use appropriate pathways to their required destination (CRC for Construction Innovation 2007; Dalke et al. 2006; Malkin 1989).

Farran, Courbois, VanHerwegen, Cruickshank, et al. (2012) found that environmental cues using colours that were easy to verbalise (focal colours such as red and green) rather than non-focal colours (such as murky yellow) improved the ability of both children and adults with ID to remember a representation of a route.

Dalke et al. (2006) notes, however, that the choice of colour, particularly in buildings such as hospitals, is often misguided and inconsistent and the colour coding poorly maintained. As a result of an in-depth evaluation of 20 hospitals in the UK, Dalke et al. (2006) provide recommendations for the appropriate use of colour in hospitals. Of interest to the current research, the authors provide the following comments and/or recommendations for colour associated with wayfinding in hospitals:

- strong colours behind reception counters help identify them as key points

- using colours that are known by their descriptive words such as blue, red, yellow, not turquoise, for instance, which can be subject to dispute as to whether it is green or blue
- using colour for simple zoning only (i.e., no more than four spaces in a building)
- choosing colours that are obvious and easy for visitors to remember under all circumstances (visitors may be under considerable stress when finding their way to a location in a hospital), and
- using colour on the floor to delineate boundaries of areas or highlight pathways to use in wayfinding.

Directories

Directories provide building users with information about various destinations within a building (CRC for Construction Innovation 2007; Pollet and Haskell 2003; Salmi 2006). According to Salmi (2006), they should be legible (avoiding uppercase letters), grouped into clusters, colour coded, avoid overly dense information, show the position of the person currently viewing the directory, use iconic or graphic symbols (particularly for the benefit of those with ID) and be well lit without veiling reflections. Salmi (2007a) also suggests that directory design should follow similar principles as those used in sign design (e.g., appropriate viewing distances, use of colour). CRC for Construction Innovation (2007) suggests that directory design should also incorporate tactile elements such as Braille or raised surface finishes to assist use by those with vision impairment. Results from research by Dogu and Erkip (2000) about directories and signage in a shopping mall in Turkey highlighted that participants found directories to be incoherent and confusing, lacking logical and consistent organisation. A study about wayfinding in an academic library found that directories were not used and needed updating (Kinsley, Schoonover and Spitler 2016).

Landmarks

Landmarks enhance visual access (Lynch 1960) and are extremely helpful for wayfinding (Caduf and Timpf 2006; Janzen 2006; Ritcher 2007; Salmi 2006). When offering directions to someone, a person will often refer to landmarks to help explain those directions (Ritcher 2007).

Landmarks can:

- give understanding and reasoning to large spaces (Caduf and Timpf 2006; Darken 1996)

- make spaces distinguishable (Baskaya, Wilson and Özcan 2004; Pollet and Haskell 2003)
- act as points of reference within a wayfinding environment (Huelat 2007; Malkin 1989; Montello 2005; Passini et al. 2000; Salmi 2007a; Stanton, Foreman and Wilson 1998) and provide a point to return to for reorienting (Stanton, Foreman and Wilson 1998)
- help create a useable image for future visits (Passini 1984b)
- identify a decision point along a journey (Huelat 2007; Malkin 1989; Ritcher 2007) or be a decision point in themselves (Mondschein, Blumenberg and Taylor 2005). (A detailed explanation of decision points is given later in this chapter.).

Hunt (1984) suggests older people create the most robust cognitive maps when decision points coincide with landmarks. However, Loomis et al. (1999) suggest that landmarks should not be considered essential for wayfinding, because some people, such as those with vision impairment, can find their way irrespective of the existence of such aids. For landmarks to be useful in wayfinding, they must:

- have a line of sight to be seen from a distance (Frankenstein et al. 2012)
- be sufficiently distinctive to locate a person within an environment (Abu-Ghazzeh 1996; Darken 1996; Huelat 2007; Kaplan, Kaplan and Ryan 1998; Pollet and Haskell 2003; Ritcher 2007; Salmi 2006; Stanton, Foreman and Wilson 1998)
- contrast with the environment within which they exist (Caduf and Timpf 2006)
- be recognisable as a landmark and memorable (Huelat 2007; Lynch 1960; Passini 1984b; Ritcher 2007)
- be multi-sensory wherever possible (Aboim Borges and Silva 2015; Pollet and Haskell 2003) (i.e., identifiable by touch, smell etc.) to cater for varying abilities of people wayfinding
- not be overly used as it undermines effectiveness (Kaplan, Kaplan and Ryan 1998; Pollet and Haskell 2003).

Landmarks need to be placed:

- where they are visible from a distance and from as many directions as possible (Darken 1996; Lynch 1960; Pollet and Haskell 2003)

- at the most important places in a building such as entrances, changes in direction and other highly visible locations (Pollet and Haskell 2003)
- at decision points to increase their effectiveness (Janzen 2006); research by Malkin (1989) suggests that placing landmarks at decision points in a hospital provides great assistance to people wayfinding, but must not interfere with the path of travel (Pollet and Haskell 2003)
- where they can be combined with talking directories or signs to help those users who cannot read or who feel unsafe asking for help (Salmi 2007a).

Many objects or features within an environment can be candidates for landmarks (Lynch 1960). They include:

- lighting features, specific materials or textures, a window, raised ceiling area, artwork, a special view, a water feature, or drinking fountain, etc. (Malkin 1989; Pollet and Haskell 2003; Salmi 2007a)
- a bold graphic on a wall, a place with unique sounds or smells, a reception counter or even a distinctive entrance to a building (Pollet and Haskell 2003)
- different themes on each floor of a building (Malkin 1989)
- shops, cinemas, information booths, sculptures and decorative elements (Passini 1984b).

Maps

Golledge (1999a, 13) describes a map as “the attempt by humans to record the absolute and relative location of places, features and spatial relation among phenomena”. They are frequently provided but often ignored and must, therefore, be made as easy as possible to read (Kaplan, Kaplan and Ryan 1998). They are found in most large places such as commercial centres, education and other facilities (Passini 1984a) but are not suitable for every situation (CRC for Construction Innovation 2007).

Maps for wayfinding can show either representative or non-representative distance, direction and perspective (Kaplan, Kaplan and Ryan 1998; Montello 2005; Tversky 2005). Representative maps show exact distances and directions and any features would be plotted to scale (Montello 2005; Tversky 2005). Non-representative maps are designed to give only an indication of the connections between points (sometimes called topological information) (Montello 2005; Tversky 2005) and can be “inaccurate” as they are only representative (i.e., a road map does not show the correct scale for the roads it contains) (Kaplan, Kaplan and

Ryan 1998). The map of the London underground is held as an outstanding example of a representative map, where distance and scale are balanced against the need to provide a schematised overview of the whole underground system (Tversky 2005).

Maps are useful for wayfinding as they:

- provide a wealth of information (Kaplan, Kaplan and Ryan 1998) that can be easily and quickly extracted (CRC for Construction Innovation 2007)
- show where a person is within the layout of the whole building and therefore help in orientation (Pollet and Haskell 2003)
- provide survey knowledge to a wayfinder that includes both distance and location (Bell et al. 2001; Darken 1996)
- provide only the information necessary for wayfinding within the area, thereby saving the wayfinder abortive time processing unnecessary information (Freksa 1999)
- allow the wayfinder to see all the optional routes they might take to get to a specific destination (Freksa 1999).

Thorndyke and Hayes-Roth (1982) suggest there is a difference between the information learned from a map and information learned while navigating a route. The map provides survey knowledge that is useful for assessing relative location and straight-line distances, whilst navigational or route knowledge is useful for orienting with respect to unseen objects.

Information provided by maps is extremely helpful for wayfinding (Dogu and Erkip 2000; Huelat 2007; Kaplan and Kaplan 2003; Passini 1984b), particularly if there is a staff member available to assist the visitor trace their required route on the map (Huelat 2007). Passini (1984b) suggests that the type of support a map provides will depend on a person's wayfinding strategy (explained later in this chapter). For those who use a linear strategy for wayfinding, a map can provide step-by-step information to get from an original position to a destination. However, the person will have to remember the necessary decision points and the places where they occurred, with one mistake meaning they could get lost. On the other hand, Passini (1984b) suggests for those who prefer a spatial wayfinding strategy, the map will be used to comprehend a place, as well as locate starting and destination points. Schmid, Richter, and Peters (2010) suggest a different type of map that could be used; a route aware map. This type of map focusses not only on providing a route to the destination but also on "depicting the information needed to anchor the route within its spatial and functional context" (Schmid, Richter and Peters 2010, 186).

Maps should be placed at entry points and key decision points or nodes (CRC for Construction Innovation 2007; Huelat 2007; Pollet and Haskell 2003; Salmi 2006). Huelat (2007) suggests they should also be placed at elevator banks and at transitions between buildings. Pollet and Haskell (2003) suggest they should be near information desks for staff to explain directions and also be placed on each level of a building with room numbers and tenants identified.

Placement and orientation of a map can affect its readability. Research by Levine, Marchon, and Hanley (1984) tested the effect of a contra-aligned map (i.e., a map that is turned 180 degrees out of alignment with the surroundings) and also a map that did not align in any way with the current surroundings. They found that both conditions affected wayfinding, with the contra-aligned maps causing the greatest difficulty. Findings of this and earlier studies concluded that users naively presume maps to be aligned with their surroundings and when misaligned it causes great difficulty in wayfinding. Findings from a number of studies confirm that maps should:

- use the forward-up equivalence' principle where the top of a map shows what is in front of the viewer (CRC for Construction Innovation 2007; Darken 1996; Levine, Marchon and Hanley 1984; Pollet and Haskell 2003)
- be placed perpendicular to the path of travel so they can be readily seen (Abu-Ghazzeh 1996; Dogu and Erkip 2000)
- be tilted forwards slightly, so users of all ages and abilities can view the map (Pollet and Haskell 2003)
- be able to allow the viewer to know their position (Allen 1999a; CRC for Construction Innovation 2007; Pollet and Haskell 2003)
- be placed where major decisions are to be made (Abu-Ghazzeh 1996) or routes that can be taken (Schmid, Richter and Peters 2010).

Montello (2005) suggests that once a person has realised a map is misaligned, they can either physically or mentally rotate the map. However, mental rotation requires considerable cognitive processing ability and can easily result in errors (Hund and Gill 2014; Montello 2005; Pazzaglia and Moè 2013).

Maps can be overly complex because they contain too much and often irrelevant information (Passini 1984b; Schmid, Richter and Peters 2010). The prospective wayfinder needs to get information quickly, often with just a glance at a map (Passini 1984b). The content of the map should:

- be well organised (CRC for Construction Innovation 2007)
- show the important paths, locations and connectivity between origin and destination (CRC for Construction Innovation 2007), ensuring also that the overall circulation system is clearly defined (Passini 1984b)
- have a 'you are here' label on the map to indicate the viewer's position (Pollet and Haskell 2003)
- identify key landmarks (Passini 1984b; Pollet and Haskell 2003; Salmi 2007a)
- clearly differentiate between regions on the map (i.e., using colour coding, etc.) (Kaplan, Kaplan and Ryan 1998)
- have unambiguous graphics, preferably using familiar pictograms (CRC for Construction Innovation 2007; Kaplan, Kaplan and Ryan 1998; Montello 2005; Pollet and Haskell 2003).

Much consideration has been given to the design of maps for people with physical and sensory impairment, but little research has been published about use of maps by people with ID. In a study of wayfinding in a shopping mall by people with ID (Salmi 2007a), only one out of thirteen participants was able to access information from a map, (including one who attempted seven times to use a map to find the way to a restroom). As Salmi (2007a) notes, many knew the purpose of the map but not how to use the information it contained. Salmi (2006, 2007a) has undertaken research about wayfinding by adults with ID and has the following observations about their map use:

- maps are rarely useful wayfinding aids for people with cognitive disability (Salmi 2006, 2007a)
- for best effect they should contain very clear basic graphics, limit the information they contain and "be paired with other wayfinding aids such as directories" (Salmi 2006, 2)

Although not related to a fixed feature of the building, nonetheless, findings from research by Cheng and Pérez-Kriz (2014) about the use of paper maps for navigating hospital environments highlight some important aspects of the hospital environment that make map use difficult, including building layout and not having an integrated wayfinding system that incorporates signs, floor layouts, information desks and the like.

Signage, directional information, cues and the like

Considerable research has been undertaken and published about signage, directional information and cues for the general population and for people with vision, hearing and physical impairment. However, limited published research relates to people with ID. The following discussion focuses on design considerations suitable for the general population. Design considerations for people with ID is discussed later in this chapter.

Signs are one of the most important components of any wayfinding system as they provide environmental cues (Huelat 2007; Kaplan and Kaplan 2003; O'Neill 1992; Salmi 2006) including information about direction and location (CRC for Construction Innovation 2007; Darken 1996; Passini 1984b). A research study by O'Neill (1991a) found that the addition of signage reduced wrong turns by 50%, reduced backtracking by 62% and increased the rate of travel by 13%.

Signs are the most common, and often only, element of a wayfinding system (CRC for Construction Innovation 2007; Pollet and Haskell 2003). Using signs in a wayfinding system has the benefit that they can; provide constantly updated information to the wayfinder, reducing the need to keep track of a location (Werner and Long 2003); add distinctiveness to different parts of a building (Arthur and Passini 1992); control or reduce crowding, discomfort, anger, confusion and, time spent in finding a location (Wener and Kaminoff 1983). As a result, signs may also reduce stress (Passini 1984b).

The three main types of signs affecting wayfinding are informational, directional and identifying (CRC for Construction Innovation 2007; Darken 1996; Huelat 2007; O'Neill 1991a; Passini 1984b; Pollet and Haskell 2003).

Informational: these signs can provide a checkpoint for wayfinding decisions so the wayfinder can know they are on the right path (Darken 1996; Passini 1984b), orient a user within a space and provide details about features and facilities within that space (CRC for Construction Innovation 2007).

Directional: these signs can be wall or ceiling mounted, preferably perpendicular to the path of travel (Pollet and Haskell 2003; Salmi 2006), and generally include arrows pointing the user in a specific direction (CRC for Construction Innovation 2007). If positioned along a route these signs may act as a decision plan, with each arrow pointing to the next decision point (Passini 1984b).

Identifying: these signs provide an elementary description of a location (Passini 1984b) such as the name of a street, building, room or special place (CRC for Construction Innovation 2007). A common example is the “i” for an information booth (Passini 1984b). Generally,

once the sign is spotted, the wayfinder would know they are either at or very close to his or her destination (Passini 1984b).

Huelat (2007) and CRC for Construction Innovation (2007) also refer to *Regulatory* signs, a fourth type that warns the wayfinder of safety and/or other regulatory conditions affecting the immediate place and/or permissible activities within the space. Whilst they may affect, or even restrict where a person travels, they do not, in themselves, assist in finding a destination; they merely warn of the possible consequences of travelling through a space. It is for this reason, perhaps, that neither Passini (1984b) nor Darken (1996) include this type of sign in their description of sign types for wayfinding.

Placement of signs can affect wayfinding (Arthur and Passini 1992; Huelat 2007). Marquez et al. (2017, 229) suggest signs must be "legible, systematic, and consistently available". They need to be placed:

- where wayfinding information is needed (Arthur and Passini 1992; Montello 2005; Passini 1984b; Pollet and Haskell 2003)
- at decision points (Montello 2005; Passini 1984b) where a person who is undertaking wayfinding is confronted with choices about the next direction of travel; studies by Best (1969), Corlett, Manenica, and Bishop (1972), O'Neill (1991a) and Brown, Wright, and Brown (1997) all found that wayfinding performance was improved by placing appropriate signage at decision points
- in the wayfinding path of vision for greatest effect (Abu-Ghazzeh 1996; Passini et al. 2000); Salmi (2006) suggests they can also be paired with landmarks
- at appropriate intervals along long corridors; the report on wayfinding by the CRC for Construction Innovation (2007) suggests that thirty metres should be the maximum distance between signs
- taking existing lighting conditions into consideration (CRC for Construction Innovation 2007)
- where there is sufficient artificial or naturally occurring light, whilst avoiding reflections and glare (CRC for Construction Innovation 2007; Pollet and Haskell 2003; Salmi 2006)
- at entry doors (CRC for Construction Innovation 2007)
- at intersections and visible no matter the direction from which the intersection is approached (Pollet and Haskell 2003)

- at changes in level (i.e., top and bottom of ramps and stairs), which both warns of the change and also advises where the feature leads (Pollet and Haskell 2003)
- where it is not obscured by other building elements such as lights or air vents (Pollet and Haskell 2003).

There are a number of considerations for the design of the actual signs.

- *Visibility from a distance* (Montello 2005; Passini 1996). In sign design this is called the 'viewing distance' and the ability to see the sign is termed 'visual legibility'. Visual legibility is affected by the amount of light and shade, construction material and position of the sign, image, and font size and resolution (CRC for Construction Innovation 2007; Pollet and Haskell 2003). In its report on wayfinding, the CRC for Construction Innovation (2007) undertook a survey of literature on viewing distances and font size and suggest for a fully sighted person based on a 15m viewing distance, that lettering should be 50mm minimum, 60mm for a vehicle direction sign, 60mm for an external pedestrian direction sign, 30mm for an internal direction sign, 20mm for a building directory listing and 17mm for door signs (CRC for Construction Innovation 2007, 11).
- *Simplicity* To be effective for all users during wayfinding, signs need to have a clear and simple appearance (Montello 2005) and have common rather than obscure or technical names (Pollet and Haskell 2003) or medical terms (Bell et al. 2001). Terminology should be consistent across all buildings, maps, directories ,etc. (Pollet and Haskell 2003). Where appropriate, signs should also use multiple languages and be accompanied by relevant pictograms (CRC for Construction Innovation 2007). Signs should not contain ambiguous information or directions. For instance, an upward pointing arrow may mean the feature is further along the corridor or, alternatively, on the next level (CRC for Construction Innovation 2007; Montello 2005; Pollet and Haskell 2003).
- *Clarity* Information on signs needs to be organised and grouped for added comprehension (Pollet and Haskell 2003). The report from the CRC for Construction Innovation (2007) suggests that clarity extends to organising a hierarchical structure to embrace all aspects of the sign's design including colour scheme, layout, text, graphics and directional information. There is a common view amongst authors that sign design should avoid visual clutter (Montello 2005; Pollet and Haskell 2003; Salmi 2006). For maximum legibility, signs should embrace universal design features, including providing messages in multiple formats such as text, symbols,

tactile surfaces and Braille (CRC for Construction Innovation 2007; Pollet and Haskell 2003; Salmi 2006).

- *Consistency* Consistency across the complete signage system in a building or facility. This consistency should include all components of the signage, in particular their "materials, construction, typeface, colours, logos, graphic layouts, overall appearance, standardised message design, nomenclature and room numbering and naming" (CRC for Construction Innovation 2007, 13). Above all, signs need to have consistency in placement (Passini 1984b, 1996; Salmi 2007a) that will provide predictability for the wayfinder (Passini 1984b).

- *Colour* Pollet and Haskell (2003) suggest colours should be chosen that can be easily described (e.g., red, blue, green) so that there is no confusion between different observers. Colours for the sign's background should contrast with colours in the environment surrounding the sign and the colours for text should contrast with the sign's background (Kowalska-Styczen et al. 2014). Pollet and Haskell (2003) suggest using "high contrast letters and symbols on visual signs" (65) and suggest that "light letters on a dark background appear larger than dark letters on a light background and therefore are recommended for directional signage" (66).

- *Font* The font used for signs should be consistent, easy to read, such as sans serif (CRC for Construction Innovation 2007) and have spacing between words "in proportion to the size of the sign and amount of information provided" (CRC for Construction Innovation 2007, 10). The report by CRC for Construction Innovation (2007, 10) also suggests that "a combination of uppercase and lowercase letters is easier to read than all uppercase".

- *Depictions* Huelat (2007, 12) uses the adage, "a picture is worth a thousand words" to reinforce the value of graphics for signage. Although they may not be as effective as textual information on signs, graphics can be used to reinforce a text message (Huelat 2007; O'Neill 1991a; Pollet and Haskell 2003) or for reassurance along the wayfinding route (O'Neill 1991a). Research by O'Neill (1991a) found that signs using graphics increased the rate of travel, whilst signs using text reduced wayfinding errors. He suggested that text or graphic signage could be used to improve "different aspects of wayfinding depending on the needs of the facility" (O'Neill 1991a, 571). For instance, as speedy wayfinding may be a priority in a hospital, signage using graphics may be a better choice than text. Unless symbolic representations on signs are recognisable, clear and concise, they may be of little value (Salmi 2006; Tversky 2005).

Even if all these considerations are adopted, people can still lose their way despite signs being provided (Dogu and Erkip 2000). According to O'Neill (1991a), simplifying a building layout could be just as beneficial for wayfinding as the use of signage, although he acknowledges that signage can be effective for complex buildings.

Using information from three research projects undertaken in five Montreal commercial centres, Passini (1984b) describes problems with signage for wayfinding under three headings:

a) *Difficulty in obtaining information.* It might be difficult to find a sign in a setting due to the density and intensity of stimulation competing with that sign, not being able to distinguish relevant information, the type and placement of signs, lack of consistency in location of signs, and the presentation of actual information on the sign.

b) *Difficulty in understanding the meaning of the sign*. Confusion can occur because signs do not indicate to whom the instructions refer, the message is not understandable (for instance ambiguous words), or an unintentional meaning is assigned to the sign's text or graphics (i.e., arrows pointing upwards).

c) *Difficulty in anticipating the information*. A lack of signs to provide continuity along a path of travel (i.e., signs misleading users, such that they have to hope they are heading in the right direction, until they find another sign) and a lack of signage along the way to reassure that previous decisions were correct.

Some authors have provided comments and considerations specifically relating to signage in a hospital environment. Rousek and Hallbeck (2011b) suggest that confusion with signage is likely to increase in the future because of the ever-changing layout and size of hospitals. According to a survey by Brown, Wright, and Brown (1997), 85% of people visiting a patient use signage to find their way. Signs in hospitals should be sequential, logical and rational with consistent naming protocols (CRC for Construction Innovation 2007) and be located with consistency so visitors can predict where to find them (Malkin 1989). Research by Carpman, Grant, and Simmons (1985) indicates a need to pay careful attention during design to correctly assessing the amount of signage required and the quality of the hospital signage system. Their studies showed an increase in signage in a hospital corridor actually decreased wayfinding performance and that visitors were complaining that signs did not lead them where they wanted to go. They also found that the wayfinding of visitors entering a hospital building was more influenced by visual access than by signage. However, where signage was used and adequate they found a perceived reduction in stress among hospital visitors. Malkin (1989) nonetheless notes that stress and anxiety may actually be the reason why signs are not read and are therefore ineffectual. Malkin (1989) also found that signs

with pictures were more easily remembered, that hospital signs need to avoid jargon and be able to differentiate relevant from irrelevant information.

Variations in texture, material or finishes used on surfaces within the building

The choice of materials can assist wayfinding (Beneicke, Biesek and Brandon 2003) by making an environment easier to understand (Fletcher 2006) and more memorable (Passini et al. 2000). Integrating lighting, artwork and finishes into a comprehensive system can help people make decisions at critical points en route (Malkin 1989). Using contrasting textures can guide a person not to stray from appropriate pathways (CRC for Construction Innovation 2007; Huelat 2007).

Creation of contrast

Contrasts can be created by the use of lighting (light and dark), colour (based on varying combinations of colour) and by material textures or finish (e.g., concrete, tiles, etc.) as discussed in the preceding section. A boundary can orient a person and keep them moving in the right direction (Murakoshi and Kawai 2000; Pollet and Haskell 2003). It can also identify areas to be kept separate (Dalke et al. 2006; Pollet and Haskell 2003) such as the boundary of areas within which the public in a hospital is allowed to circulate. Edges also need differentiation through contrast because they may delineate different levels in a floor surface, such as the edge of a landing, or the edge of paving before a reflecting pool (Pollet and Haskell 2003). There are prescriptive guidelines governing design and maintenance of edges for this purpose.

Sensory features

According to the Merriam-Webster online Dictionary (Merriam-Webster Online Dictionary 2012), sensory means “relating to your physical senses”. Although a person may experience sensory environmental cues such as noise, light, smell, heat, crowdedness, and, taste, there is limited research about their effect on wayfinding (Salmi 2007a). Sensory cues such as smell and taste are of less value in wayfinding as they require local sensation (i.e., actual contact with or close proximity to the source of smell or taste) and are not therefore, useful in long range wayfinding prior to reaching the point where the smell or taste occurs (Darken 1996). Sensory wayfinding cues can influence preference for certain environments and affect wayfinding activity.

Noise

Familiar sounds, such as a bell ringing to indicate a lift has arrived, can help direct a person to points in a building that may otherwise be out of sight (NHS-Estates 1999). As research

by Knez and Hygge (2002) found, noise can attract attention and make short term (working) memory work faster but with less accuracy. However, increasing noise levels had no effect on problem solving ability, but reducing noise levels improved long term memory recall. Interestingly, rather than seeing noise as a potential distraction for wayfinding, Secchi, Lauria, and Cellai (2017) consider it useful, as it can help those with hearing impairment to identify where they are.

Amount and quality of light

Effective lighting helps support better wayfinding (Dalke et al. 2006; Fletcher 2006; Malkin 1989; Salmi 2007a). It can encourage the wayfinder to travel in a specific direction (Salmi 2006; Schreibe 2007) and also "promotes faster access and reduces labour frustration and wasted time" (Dalke et al. 2006, 344). However, designers have not fully understood its value for wayfinding, particularly its effect on a feeling of safety within an environment (Salmi 2007a).

The quality of light within an environment is determined by how well the lighting conditions meet the requirements of the users of that environment (Veitch 2001). Appropriately designed lighting can provide directional guidance (CRC for Construction Innovation 2007; Huelat 2007), enhance a feeling of safety (JMU Access Partnership 2007; London Borough of Croydon 2000; Salmi 2007a; Stamps III 2007) and provide confidence in the environment (Dalke et al. 2006). It helps in identifying routes and any obstacles along those routes (JMU Access Partnership 2007) as well as highlighting hazards such as stairs (London Borough of Croydon 2000). It can be used to highlight signs and other directional information (Huelat 2007; JMU Access Partnership 2007; Salmi 2006; Veitch 2001) and to enhance other elements of an environment such as colour (London Borough of Croydon 2000; Salmi 2007a) or tone and texture of surfaces (London Borough of Croydon 2000). Lighting may be designed to help support and highlight activities during wayfinding by "minimising distortions and irrelevant clutter" (Gordon 2003, 210). Research by Knez (2001) has also highlighted the quality of the actual light (warm, cool, natural or artificial) within a space as possibly affecting cognitive processing of information.

There are a number of factors to consider when designing lighting that will aid wayfinding:

- Lighting design should not disorient or confuse a wayfinder (e.g., creating a lighting pattern that conflicts with other spatial information (JMU Access Partnership 2007; Salmi 2007a).
- Care should be taken when choosing lighting sources (e.g., incandescent, fluorescent and halogen) and light characteristics (e.g., colour temperature and colour rendering)

as these can affect a person's feeling about a space and hence their desire to either transition or remain within that space (Salmi 2007a). Building reception areas, for instance, need to be welcoming and friendly and well lit to make them prominent (Dalke et al. 2006) whilst dimly lit hallways may not be inviting for people to use (Brown, Wright and Brown 1997).

- The design of lighting needs to avoid creating reflections or glare from surfaces that could distract or confuse a person, particularly older people who have reduced visual acuity (London Borough of Croydon 2000; Pinto et al. 1997; Rousek and Hallbeck 2011a).
- It is also recommended that features such as reception counters not be placed in front of windows due to the extreme contrast in light levels between the background and the feature (CRC for Construction Innovation 2007; London Borough of Croydon 2000).
- Care must be taken with the type of lighting as humming created by fluorescent lighting can interfere with hearing aids (London Borough of Croydon 2000) and can distract people with autism[5] (Bogdashina 2016).

Smell

Aromas emanating from food shops, cafes or restaurants can help in navigation by linking memorable smells with specific locations within an environment (CRC for Construction Innovation 2007; Darken 1996).

Heat

Research by Knez and Hygge (2002) found that reducing heat levels improved short term memory. As short term memory (working memory) is used for wayfinding, excess heat may impact on wayfinding ability (Meilinger, Knauff and Bulthoff 2008).

Crowdedness

Crowdedness can impact on a person's ability to recall a building and its location (Dogu and Erkip 2000). Evans, Smith, and Pezdek (1982) contend that buildings in high use are highly memorable. Ramanujam (2006) argues otherwise, suggesting that such crowdedness can

[5] Autism is a disorder in which there are impairments in social communication and interaction, as well as repetitive patterns of behaviour. It is often associated with intellectual impairment and motor deficits that include odd gait and clumsiness (American Psychiatric Association 2013a). A person with autism may also take longer to learn and understand language and have sensitivity to sound and/or texture (The Centre for Genetics Education (online) 2017b).

negatively influence a person's wayfinding behaviour by encouraging a person to want to sit in a corner or avoid eye contact with the crowd. A crowded, noisy environment may be too complex and provide too much visual or sensory stimulation, causing difficulty in paying attention to appropriate information. The additional delay in understanding a poorly designed building layout may cause discomfort when a person is trying to escape from crowded areas (Salmi 2007a).

Supportive features

Asking

A person undertaking wayfinding may choose to ask other occupants of the same environment for directions and the wayfinding design should provide sufficient opportunity to allow this. Whilst this type of wayfinding is derived from human interaction rather than from components of the built environment, it should not be ignored as part of the overall wayfinding system.

Although potentially helpful, obtaining information in this way can often be problematic according to Salmi (2006). The directions provided as a result of asking may not be appropriate for the person who is asking, because the respondent will give directions based on his or her own perception of the easiest or most memorable route, not one that would suite the person asking (Holscher, Tenbrink and Wiener 2011). Wayfinding design should provide sufficient opportunity to allow for this human interaction. Passini (1984b) suggests there are two types of information provided by human interaction: a) where the destination is (i.e., describing a specific location), or b) how to get to the destination — a series of processes that guide the wayfinder to the requested destination, termed a decision plan by Passini (1984b). Passini (1984b) notes a person typically can retain no more than three to five decisions as part of a decision plan where the plan is given verbally. Complex and numerous directions to reach locations may, therefore, prove very difficult to remember and of little ultimate value to the wayfinder (Passini 1984b).

Literature suggests two ways in which a person may obtain information from other people.

- *By visiting a reception/information desk or visitor information centre* staffed by suitably informed employees or volunteers (CRC for Construction Innovation 2007; Passini 1984b). Layouts should provide reception counters and foyers so they are visible and close to "you are here" maps (CRC for Construction Innovation 2007). Research by Passini (1984b) identified that many questions asked at a reception counter were related to wayfinding and that both written information and verbal instructions made a considerable contribution in helping people with their

wayfinding. According to Huelat (2007), information centres are very useful in hospital locations where staff can provide information in a calming, cheerful manner in an otherwise stressful environment. Information desks/counters/booths need to be visible and identifiable to visitors and capable of providing the necessary basic information about services, locations, people and the like (Huelat 2007). Preferably, they should be centrally located so that they are the first thing a visitor sees (Huelat 2007; Ng 2003).

- *By direct conversation with regular occupants of the wayfinding environment*. Research by Huelat (2007) found that visitors in a hospital environment felt quite comfortable asking staff for wayfinding advice and that asking people was a good option as the person giving the information could show care and compassion to the person asking. Huelat (2007) noted that staff needed to wear conspicuous identification so that visitors would know who to ask.

Person volunteers to help

A person can be supported in their wayfinding, not only by asking, but also by others volunteering to assist. Staff should be encouraged to instigate the communication by identifying and assisting lost visitors with clear directions (Huelat 2007; Ng 2003)

b) The wayfinding process

Having described the wayfinding environment, this section of the literature review considers the processes involved in wayfinding.

i) Strategies in the wayfinding process

People utilise various strategies to reach their destination, although often unaware they are using a specific strategy (Golledge 1999a). There is usually little personal choice, however, in the strategy used for wayfinding as it is generally dictated by:

- what seems most natural (Salmi 2007a)
- the scale of the environment (e.g., if the wayfinding is being undertaken inside a building, then a route-based strategy might be employed, whereas if outside, the scale of the environment might dictate that spatial layout strategies need to be used) (Hunter 2010b)
- the information available (Golledge 1999a; Hunter 2010b)

- the nature of that information (Montello 2005)
- how the information is organised (Dogu and Erkip 2000)
- what is most effective in terms of time, cost and distance (Golledge 1999a).

Strategies can be divided broadly into two categories: a) linear/route-based and b) spatial/orientation based (Golledge 1999a; Hunt and Waller 1999; Passini 1984b; Salmi 2007a; Tversky 2005). Each is dependent on the availability of differing types of environmental knowledge (Freksa 1999; Golledge 2003; Passini 1984b).

Table 2.1 shows the terms used by authors to describe these strategies and the associated environmental knowledge required.

Linear/route wayfinding

Makela and Prusi (2001) suggest that linear/route strategies are fundamental to wayfinding. They involve learning the structure of a route rather than the environment through which a route passes (Golledge 1999a) and develop as the wayfinder travels through the environment (Hund and Gill 2014; Janzen 2006). The route is self-contained and comprises a series of choice points and en route landmarks connected by consecutive links (Golledge and Gärling 2004). New bearings can be selected at each choice point (Hunt and Waller 1999).

Table 2.1. Wayfinding Strategies and Environmental Information Required

Strategies for wayfinding	Linear/route based	Spatial/orientation	Tversky (2005) Golledge (1999a) Passini (1984b) Salmi (2007a)
Environmental knowledge required	Common sense (maps, signs, asking, etc.)	Expert (from language of geography)	Golledge (1993)
	Direct information (signs, etc.)	Relational information (layout, configuration of corridors)	Freksa (1999)
Information used	Landmark (nodes, lines, districts, etc.) or Route/procedural knowledge (sequential choice points: knowledge for everyday use)	Survey/configurational knowledge (encodes distances and locations into some form of fixed frame of reference: essential for making a shortcut)	Thorndyke and Hayes-Roth (1982), Golledge (1992), Golledge (1993)

Linear/route wayfinding

Makela and Prusi (2001) suggest that linear/route strategies are fundamental to wayfinding. They involve learning the structure of a route rather than the environment through which a route passes (Golledge 1999a) and develop as the wayfinder travels through the environment (Hund and Gill 2014; Janzen 2006). The route is self-contained and comprises a series of choice points and en route landmarks connected by consecutive links (Golledge and Gärling 2004). New bearings can be selected at each choice point (Hunt and Waller 1999). Travelling from point-to-point, a person is guided by a set of procedural rules (i.e., a route map) (Golledge 1999a; Hunt and Waller 1999; Salmi 2007a). Linear/ route strategies suit large scale environments where it is difficult to oversee the complete environment from one vantage point (Salmi 2007a). However, routes can often overlap each other making wayfinding more difficult (Golledge 1999b).

Linear/route wayfinding relies on having landmark or route/procedural knowledge including route instructions, route information, route guiding messages and other environmental clues (Darken 1996; Makela and Prusi 2001; Salmi 2007a) to move from choice point to choice point. Route knowledge takes precedence over off-route knowledge (Golledge 1999a). Ongoing use of landmarks helps to increase understanding of the greater environment and helps the wayfinder to move from using an egocentric linear/route strategy to the exocentric spatial strategy (Stanton, Foreman and Wilson 1998). As well as landmarks, other environmental information used in the linear/route strategy includes signs and arrows (Salmi 2007a), continuously marked trails (such as colour coded lines painted on floors or identified freeways) (Golledge 1999a) and human sources of information (someone to ask) (Salmi 2006, 2007a). It is important, in order to create route knowledge, that the person is aware of what is or is not relevant information (Makela and Prusi 2001).

Spatial/orientation wayfinding

A spatial/orientation strategy, on the other hand, utilises spatially organised information (survey or configurational knowledge) to create an understanding of the wayfinding environment as a complete spatial system (Passini 1984b), “from which distance and bearing (i.e., configurational information) can be computed” (Hunt and Waller 1999, 33). A spatial/orientation strategy uses either a global framework of reference points (such as north, south, east or west) to identify the distance and bearing of specific points (Hunt and Waller 1999; Lawton, Charleston and Zieles 1996; Lawton and Kallai 2002) or a more localised framework, which can be compiled from either vantage points that overlook the environment to be travelled or by using some other form of symbolic representation of the space (e.g., maps, photographs) (Darken 1996; Golledge 1999a).

Staged approach to wayfinding

The approach to wayfinding, however, changes with increasing knowledge of the environment (Mondschein, Blumenberg and Taylor 2005). Initially, a linear/route strategy (using route information) is used, but as travel experience within an environment increases, the route information is consolidated into a more systematic framework (survey knowledge), allowing a spatial/orientation strategy to be adopted (Golledge 1999a). In so doing, it makes the environment more legible (Golledge 2003) and wayfinding more efficient (O'Neill 1991b). In terms of the built environment, Salmi (2007a) notes that obtaining configurational information may be affected by the visual accessibility and/or floor plan complexity of the environment. Research by Hund and Gill (2014, 222) indicated that "route cues elicited higher effectiveness ratings than survey cues" and that people using route cues were able to find destinations faster.

Darken (1996) offers an example of how each type of knowledge builds on the other. If a person shows a friend photographs of three monuments in Washington it gives a form of landmark knowledge but there is no information to link the monuments. If the friend then visits Washington and, during a walk around Washington, sees all three monuments, then the friend has acquired procedural knowledge as the three have been linked (landmarks can now not only be identified, but paths between them can be determined). If the friend eventually leaves by airplane and, in looking out the window, sees all three monuments below, then the friend has acquired survey knowledge, which allows the monuments to be positioned within a coordinated frame of reference in relation to each other and also to other places in Washington that are visible from the airplane window.

Using schemata to assist wayfinding

Apart from the abovementioned strategies, a wayfinder may also use schemata to assist in finding his or her destination. Schemata are "recurring mental patterns that help people to structure and operate within geographic spaces" (Raubal and Worboys 1999, 1).

The patterns are highly structured and based on knowledge that has been gained from people's previous experience (Passini 1984b; Raubal and Worboys 1999) and can be used during wayfinding (Johnson 2007). Schemata are matched with real-world features to help a person make sense of the environment and find his or her way, particularly in new settings (Baskaya, Wilson and Özcan 2004; Raubal 2001a). The patterns contained within schemata need not necessarily be about a specific location but may be of generic objects or situations. As Golledge (2003, 6) suggests, they are "structured general knowledge of the world". They provide a person with an expectation of how a particular object or location may look so that the person can use this image or pattern to search for a similar object or location and, when

sighted, understand that what was being sought has actually been found. Golledge (2003) suggests that schemata can even be used to supplement or replace missing information about locations that may be beyond the immediate surroundings but that would be useful to know in deciding which route to take. In a study of the spatial settings in two polyclinics, Baskaya, Wilson, and Özcan (2004) found that wayfinding was easier where buildings matched a well-known schema.

Salmi (2007a) uses the term ‘association cues’ to describe where a person, based on previous experience, links recurring patterns within an environment. Salmi (2007a) found that when seeking a toilet in a shopping centre, participants looked specifically for another type of cue (such as a restaurant or drinking fountain) because they “associated” the location of drinking fountains with nearby toilets. In other examples from Salmi (2006), participants associated hotel lobbies with the front entrance of a hotel, and public telephones with the location of restrooms in a shopping mall.

ii) Wayfinding sequences used in the wayfinding process

Using either of the previously described wayfinding strategies requires a person to move through an environment progressively processing information. The sequence in handling and processing this information will depend on several factors including whether the journey is only to find a destination or to be able to return back to a home base (Golledge 1999a), the type of information available to the wayfinder (Montello 2005), the attributes of the wayfinder (i.e., well-informed or uninformed) and his or her abilities (e.g., sensory ability, orientation ability, mobility) (Freksa 1999).

To successfully reach a destination, the wayfinder must be able to adequately identify both origin and destination, determine the movements and distances between turns and make use of either route or spatial information that may subsequently be embedded into a larger framework (Golledge 1999a; Huelat 2007). If the wayfinder is also required to return to a point of origin, information processing must provide the wayfinder with the means to not only use, but reverse, route knowledge and/or be able to spatially orient himself or herself in order to dead-reckon back to the origin or use appropriate short-cuts (Golledge 2003).

Authors have identified four different sequences for processing environmental knowledge. The first three are briefly introduced in this review to allow comparison of approaches. The fourth sequence, however, is described in more detail as it is the one predominantly used by the participants in the current study and forms the basis for coding participant actions and outcomes.

View – Action – View (Raubal and Worboys 1999)

Raubal and Worboys (1999) describe this sequence as being based on real world knowledge obtained directly from objects and places and people's perception of those features. Their suggested sequence involves making appropriate and quick decisions based on several elements. The sequence commences with imperfect observation of the environment (the initial "view" component), from which the wayfinder derives incomplete and inaccurate knowledge. An action is taken (the initial "action" component) and this action leads the wayfinder to another view, from which he or she will then derive the need for a subsequent action. The process repeats until the destination is reached.

Commute – explore – quest (Allen 1999a; Golledge 1999a)

This approach, rather than offering a single sequence, categorises the wayfinding process as a combination of tasks. Allen (1999a) suggests there are three categories of wayfinding tasks: the commute, the explore and the quest.

The *commute* occurs when people travel along a familiar path between two places, both of which are known to them. This is the most common form of wayfinding task (Allen 1999a; Golledge 1999a) and may be demonstrated by the journey home from work.

The *explore* occurs when people travel into unfamiliar territory to learn about the surrounding environment (Allen 1999a). It usually starts and ends at a familiar point, which is often the same place, and is used to discover new links between known places.

The *quest* occurs when people travel from a familiar place to an unfamiliar destination that is known to exist, but has not previously been visited (Allen 1999a). To undertake this type of wayfinding requires symbolic knowledge about the destination (e.g., maps or verbal descriptions) and could be enhanced by use of landmarks or other wayfinding cues (Allen 1999a; Golledge 1999a; Raubal and Winter 2002).

Combining orientation, route and configuration tasks

Lawton (1996) suggests this wayfinding sequence tailors the process to the actual environment and therefore relies on several strategies for wayfinding rather than just one. For instance a person who normally prefers using an orientation strategy may find a particular location is rich in landmarks, which is better suited to using a route strategy for wayfinding (Salmi 2007a).

Decision making – decision execution – information processing (Passini 1981)

This sequence for information processing was first discussed by Passini in 1981 as part of a conceptual framework for wayfinding. Passini (1984b) contends that wayfinding comprises making decisions in response to a series of problems and suggests using a decision-based framework in wayfinding design to provide information at decision points to enable decision making and decision execution. This is pertinent to the current study as the coding of video discussed in chapter 4 is based on identifying wayfinding information and success at decision points.

A decision point occurs where a person is required to make a decision about which way to go (Janzen 2006; Malkin 1989; Mondschein, Blumenberg and Taylor 2005; O'Neill 1991b; Passini 1984a) and information is available that needs to be obtained, interpreted, understood and used and retained for further use (Passini 1984b). Lovelace, Hegarty, and Montello (1999) subdivide decision points into *basic* (where re-orientation is required), *potential* (where re-orientation would be possible, but inappropriate for the current journey) and *confirmatory* (reaffirming that the wayfinder is on the right path). Their placement, therefore, and the information they contain, needs to be both logical and rational (CRC for Construction Innovation 2007). Because of their importance for wayfinding, their locations may become salient places in a person's memory (O'Neill 1991b) and are, therefore, good places to situate wayfinding information so that it is seen, used and remembered (Golledge 1999a; Golledge and Stimson 1997; Janzen 2006).

Passini (1984b); Passini, Rainville, and Habib (2000) suggest that this wayfinding sequence comprises three components: decision making, decision execution and information processing.

Decision making

In wayfinding, a decision is made as soon as a person chooses to travel to a destination (Passini 1984a). This decision is based on environmental information obtained from either the current location or from previous experience and may require a series of further decisions before the destination is reached (Passini 1984a). Sometimes, a decision will not automatically result in an action but may lead to further decision/s before an action is taken (Darken 1996). Whilst every action taken during wayfinding is the result of a decision (Passini 1981, 1996), not every decision results in an action (Darken 1996).

The sequence of decision making can be represented as a decision tree (or hierarchy)(Passini 1996), which reveals the links between all the individual decisions that culminate in the wayfinding solution (Passini 1984b; Passini et al. 1998). Passini (1984b) suggests that these

decision points help provide a linear, sequential structure to guide a person during wayfinding. At the top of the tree is the first decision to undertake the wayfinding exercise, whilst at the bottom of the tree are the final decisions that lead to behavioural actions (Passini 1996).

Passini (1984b) notes that his research indicates a much stronger preference towards dealing with problems sequentially rather than simultaneously. The fact that the problems are generally solved in sequence means that designers can locate relevant wayfinding information along the route (Passini 1981).

Decision execution

Decision execution requires turning decisions into behavioural actions and involves two components: an action part and an object part (Passini 1981). As an example, if the decision is “to go to the bathroom”, then the action is “to go” and the object is “the bathroom”.

Information processing for decision making and execution

There are three types of information required to develop and use a decision plan: a) information about the actual environment gained from the person’s senses, b) memory information obtained from previous experience and c) inferred information based on using both sensory and memory information (Passini 1981). As an example of inferred information, a person may be able to infer that he or she is on a particular street because the name of shop can be seen nearby (sensory information) and the person knows (memory information) that the shop is on that street (Passini 1981).

Wayfinding systems such as those used in underground transport networks, often rely on selectively releasing information to encourage a hierarchy of decisions from the most fundamental (such as which rail line to take) down to the minute detail about which platform and which carriage to take. For this reason, transport systems are often based around nodes (where decisions are necessary) to provide information useful in make further travel decisions (Mondschein, Blumenberg and Taylor 2005).

Information provided at decision points, such as signs, maps, landmarks and the like, must relate to the immediate environment and be sufficient to assist in making an appropriate wayfinding decision (CRC for Construction Innovation 2007; Malkin 1989; Passini 1984b; Raubal 2001b). Malkin (1989) cautions giving too much information and suggests only giving that which is sufficient to get to the next decision point. Research by Arthur and Passini (1992), O'Neill (1991a) and Raubal and Egenhofer (1998a) also indicates that too many points may have a negative effect on wayfinding performance. This finding has

implications for the current research study, which specifically relates difficulties in wayfinding by people with ID, to the number of decision points and information provided within a hospital setting.

Too many decision points can create complexity in the environment (Weisman 1981). In research about wayfinding on a university campus, Abu-Ghazzeh (1996) noted that students felt lost or disoriented when confronted with too many routes or choice (decision) points.

iii) Personal preferences affecting the wayfinding process

The discussion so far has addressed elements, attributes, components and features of the environment and the processes to negotiate through the environment. However, there is one further consideration for successful wayfinding: personal preference for particular environments (Salmi 2007a). There are two theories that address personal preference; environmental preference theory and prospect-refuge theory. Whilst the theories are briefly discussed and acknowledged as contributing to the overall wayfinding experience, they are not the focus of the current study.

Environmental preference

The theory of environmental preference has been researched by R. Kaplan and S. Kaplan, over a period spanning the 1970s, 1980s and 1990s. Their early work focussed on preferences and complexity in natural and urban landscapes (Kaplan, Kaplan and Wendt 1972) and led them to develop the informational model of environmental preference (Kaplan 1973, 1977; Kaplan, Kaplan and Brown 1989; Kaplan, Kaplan and Ryan 1998; Kaplan and Kaplan 1978, 1982). This model has been one of the most widely studied theories in environmental psychology (Stamps III 2004). The model is based on a preference matrix table (see Figure 2.2) comprising four key informational variables: complexity, mystery, coherence and legibility (Kaplan, Kaplan and Brown 1989), which have been suggested as predictors of preference for given environments. Whilst most researchers have supported the theory, not everyone has agreed (Herzog and Bryce 2007), including Stamps III (2004) who produced a meta-analysis of articles about the theory and concluded that results may not be reproducible.

Coherence and legibility variables relate to the presence of information (Veitch 2001) and address the understanding component (Herzog and Flynn-Smith 2001; Herzog and Kropscott 2004). Complexity and mystery variables require interpretation of the information (Veitch 2001) and address the exploration component (Herzog and Flynn-Smith 2001; Herzog and Kropscott 2004).

Degree of inference	**Understanding** (scenes that are not confusing and allow wandering without getting lost)	**Exploration** (scenes that provide the possibility of discovery and learning)
Immediate Information is immediately perceptible	Coherence	Complexity
Inferred Information is available by moving through the scene or another area	Legibility	Mystery

Figure 2.1. Environmental preference matrix (Adapted from Herzog (1992), Herzog and Kropscott (2004), Herzog and Leverich (2003) and R. Kaplan et al. (1989).

Prospect - Refuge Theory

The second of the two theories that help define aspects of a person's preferences for the environment is called the prospect-refuge theory. This theory was first proposed by Appleton in 1975 in his book, *The Experience of Landscape* (Appleton 1975) and subsequently revisited and reviewed in 1996 (Appleton 1996). Appleton bases his prospect-refuge theory on two activities; *prospect,* which is an unimpeded opportunity to see and *refuge,* which is an opportunity to hide (Appleton 1996, 66). These two activities, at first, appear to represent a "dichotomy of opposites" (Appleton 1996, 66), but he explains they are actually complimentary in providing safety for the person interacting with the environment. People may prefer environments in which they have the ability to see but not be seen. For instance, research by S. Kaplan and Kaplan (1982) noted that people will seek situations where they can seek information but prevent information being obtained about themselves. This could be achieved by features such as balconies (McMullen 2001; Salmi 2007a). Results of research by Salmi (2007a, 133) about wayfinding by people with ID, noted that "opportunities for prospecting without being part of the scene (refuge) must also be present".

c) Wayfinding capabilities

The current study compares wayfinding success between participants with ID and TD participants, based on success in using wayfinding features within the built environment. There are two aspects to the level of success: the extent to which the feature is designed for use by either group and the extent to which individuals in either group have the capacity to process the information provided. This study focusses on how the design of the built

environment does or does not support wayfinding by people with ID, rather than investigating the varying cognitive capabilities of either group. For background information, Appendix A provides details of the cognitive processing requirements an individual would need for wayfinding.

Having knowledge of wayfinding activities that require cognitive processing, on the other hand, would help designers understand the adaptations required to compensate for deficits in cognitive processing ability. The following sections describe these activities and implications for specific user groups and conclude with comments about the effects of age and gender on wayfinding.

i) Wayfinding activities requiring cognitive processing ability

There are a number of activities relating to wayfinding that demand cognitive processing capability:

Cognitive mapping. This refers to a process by which a person creates a mental representation of space (Darken 1996; Mondschein, Blumenberg and Taylor 2005; Passini et al. 2000) called a cognitive map (Mondschein, Blumenberg and Taylor 2005). Cognitive maps can help people not only to recognise where they are but also to store the information required to allow them to retrace their steps (Bell et al. 2001; Golledge 2003).

Navigation. This is a "coordinated and goal-directed movement through the environment" (Montello 2005, 257), which requires interaction with the environment (Golledge 1999a) and updating orientation and position as the journey proceeds (Bradley and Dunlop 2005; Loomis et al. 1999). It is differentiated from wayfinding because navigation is usually pre-planned, whereas wayfinding is considered more adventurous and exploratory (Golledge and Gärling 2004).

Spatial orientation. Spatial orientation refers to a person's ability to mentally imagine an environment and situate himself or herself within it (Arthur and Passini 1992; Casakin et al. 2000; Passini 1984a, 1996). Cappelletti et al. (2005) suggest that spatial orientation answers the question "where am I?", whereas wayfinding answers the question "how do I get to my destination?".

Making use of familiarity. Familiarity with a particular environment is a powerful influence on successful wayfinding (Dogu and Erkip 2000). This occurs because greater familiarity with a particular environment enables people to recognise places, landmarks and paths, which in turn reinforces the path/s to be taken (Dogu and Erkip 2000; Gärling et al. 1986; Kirasic 1984; Malkin 1989). Research suggests that accuracy in

locating buildings correlates with familiarity (Gärling, Lindberg and Mantyla 1983). Familiarity can encompass both spatial (being able to visualise the environment within which a location is placed) and non-spatial components (by simply knowing that a landmark exists, but not knowing its context) (Golledge 1992). General opinion in the literature supports the notion that familiarity with an environment assists wayfinding (Baskaya, Wilson and Özcan 2004; Dogu and Erkip 2000; Gärling, Lindberg and Mantyla 1983; Golledge 1999a; Hölscher et al. 2007; Ng 2003; O'Neill 1992; Raubal 2001a; Weisman 1981)

ii) **Wayfinding errors due to a lack of processing capability**

Most human travel that is unassisted by technical aids is error prone in both encoding and decoding of information (Golledge 1992). Darken (1996) suggests that the nature of the environment can also contribute to causing wayfinding errors, particularly where large and complex environments make it difficult to store all possible spatial relationships and therefore distort judgement of direction.

Golledge (1992) suggests that errors in information processing fall into three categories: movement errors, encoding errors and decoding errors. Movement errors result in under- or over-estimation of distance and can be due to miscalculation of velocity, time or distance (Böök and Garling 1981), incorrectly estimating forward speed (Golledge 1992) or being overly familiar with the particular environment. Encoding errors can cause disorientation or miscalculation of direction or turn angles due to the use of inappropriate frames of reference (Böök and Garling 1981) or incorrect understanding of the extent of a turn angle (Golledge 1992). Decoding errors are caused by making decisions based on a distorted representation of an environment or cognitive map (Golledge 1992, 1999a).

iii) **Implications for people with intellectual disability**

In the early 1990s, researchers investigated the effects of spatial knowledge on wayfinding by people with ID (Golledge 1992). Riley (1995) followed this with research focussing on the ability of persons with ID to learn and utilise configurational knowledge in wayfinding. The research indicated that people with mild to severe ID could utilise route knowledge and that configurational knowledge could be used by people with ID but would not be necessary for wayfinding (Riley 1995). More recently, studies by both Farran et al. (2010) and Mengue-Topio et al. (2011) further confirmed that people with ID have difficulty with learning and/or using configurational knowledge.

iv) **Implications of age and gender on wayfinding capabilities**

Studies by Dogu and Erkip (2000), O'Neill (1991a), Peponis, Zimring and Choi, (1990) and Weisman (1981) found that both age and gender affect wayfinding.

Age. Age does not automatically imply cognitive impairment, but the process of aging creates a situation that correlates with cognitive impairment (World Insitute on Disability 1999). Cognitive impairment affects processes such as attention, working memory, discourse comprehension, problem solving, interpretation and encoding and retrieval processes, and have all been shown to decline to some extent with age (World Insitute on Disability 1999) with possible consequences for wayfinding. The current study acknowledges the potential effect of aging by including an upper age limit in the criteria for participant selection.

Gender. Malinowski and Gillespie (2001) undertook an extensive study of 978 college students to assess spatial ability in large real-world environments. Their research identified that gender was one of a number of significant factors affecting wayfinding performance. Gender has been identified as a factor in a number of other studies including those by Dogu (2000), (Kueh 2006), O'Neill (1991a), Peponis, Zimring and Choi (1990), Sjolinder (1998) and Weisman (1981). Golledge (2003) suggests that the effect of gender may be due to the difference in roles between males and females throughout history. However, Bell, Greene, Fisher and Baume (2001) undertook an analysis of existing research and offered a more guarded opinion as to the extent to which gender affects spatial ability. They suggest that, "males and females are probably equally capable of mapping their surroundings, but some stylistic differences await further investigation" (Bell et al. 2001, 82). Nonetheless, there appears to be a common view that gender has some effect on wayfinding.

In the current research study, sample populations were matched for gender and broadly for age range to limit the effect of these characteristics when comparing participant groups.

2.3 Boundary of the research problem

Perry (1995) suggests the second stage in identifying a research problem is to describe the boundary of the research focus. For this current research study, the boundary of the research focus comprises wayfinding within the internal space of a built environment by people who have an intellectual disability. The following descriptions further explain this research focus.

2.3.1 Built environment

For the purposes of this research, 'built environment' is defined as "the human-made space in which people live, work, and recreate on a day-to-day basis" (Roof and Oleru 2008, 24) and 'internal space' refers to the space within a building through which a person might traverse horizontally or vertically, including those external and/or covered spaces that may need to be traversed in moving from one internal building space to a closely adjoining internal building space.

2.3.2 Intellectual disability

The following explanation of intellectual disability is provided to define the general attributes of the population from which the sample participant group with ID was obtained for this study. It does not purport to be a comprehensive explanation of intellectual disability.

a) Definition

The American Psychiatric Association (APA) publishes a diagnostic and statistical manual of mental disorders, the latest of which is the fifth edition (DSM-5), updated in 2013 (American Psychiatric Association 2013a). The latest revision has taken over twelve years to develop and has prompted considerable public comment and feedback (Giles 2012). Despite ongoing controversy, this document continues to be "the manual used by clinicians and researchers to diagnose and classify mental disorders" (American Psychiatric Association 2013b, 2) and its definition of intellectual disability has, therefore, been used as the basis for defining the term 'intellectual disability' in this current study.

The DSM-5 defines intellectual disability as a neurodevelopmental disorder (American Psychiatric Association 2013a). An individual with intellectual disability, therefore, will have a reduced IQ level and demonstrate, "impairments of general mental abilities that impact adaptive functioning in three domains" (American Psychiatric Association 2013b, 1): *conceptual* ("language, reading, writing, maths, reasoning, knowledge, memory"); *social* ("empathy, social judgment, interpersonal communication, the ability to make and retain friendships"); and *practical* ("self-management in areas such as personal care, job responsibilities, money management, recreation, and organising school and work tasks").

b) Diagnosis criteria for ID

Specific diagnosis of ID under DSM-5 is based on both "clinical assessment and standardised testing of intelligence" (American Psychiatric Association 2013b, 1) with the "severity of impairment based on adaptive functioning in the conceptual, social and practical

domains rather than IQ scores alone" (American Psychiatric Association 2013b). IQ tests are included in the assessment, with an IQ score at or below 70 indicating ID.

At the time of data collection for this current study, however, DSM-5 had not been issued and therefore IQ selection criteria for participants with ID were based on DSM-IV. Diagnosis of ID under DSM-IV was based primarily on IQ scores, with IQ levels at or below 70 being the basis of a diagnosis of ID and between 50 and 70, the basis for terming the level of ID as "mild" (Harris 2006). At the time of data collection, having an IQ score at or below 70 was also a requirement for registration with the Disability Services Commission in Western Australia on the basis of having an ID.

c) The term used in this study to describe people with intellectual disability

Several terms have been used in the past to describe "intellectual disability" including "mental retardation" by the previously named American Institute of Mental Retardation (before they changed their name to the American Association of Intellectual and Developmental Disability and changed their definition to intellectual disability). Other terms have included intellectually handicapped, mentally handicapped and developmental disability. Cocks (1998) provides an explanation for the use of varying terms by different Australian government departments. Given that the term intellectual disability is considered the least disrespectful and the preferred term in Australia, it has been used for this current research study.

2.4 Existing research about the research problem

The third and final stage in developing an understanding of the research problem, according to Perry's (1995) framework, identifies existing research in the area of the current research study. This section of the literature review, therefore, locates and describes the various previous research activities about building access and wayfinding by adults with ID and any research that may have similarities (e.g., about wayfinding by people with Alzheimer's disease or dementia[6]) to the current research study.

This review, however, cannot be considered an exhaustive list of research about the topic as many advocacy and allied groups do not publish in widely available media. Nonetheless, alongside a review of published research, a search of the Internet was also undertaken to find publications appearing on organisation websites that might relate to wayfinding by people

[6] Dementia is a term used to describe more than 100 different diseases, including Alzheimer disease and vascular disease and is "characterised by impairments of brain function, including language, memory, perception, personality and cognitive skills" (Australian Institute of Health and Welfare 2012, 2)

with ID. The database survey also sought research that, whilst not specific to the current research study, nonetheless might be pertinent to wayfinding by people with ID. Search terms used for the survey included the following broad range of possible descriptors[7]:

> building access, wayfinding, navigation, spatial orientation, intellectual disability, learning disability or difficulty, developmental disability, cognitive impairment or dysfunction (including dementia and acquired brain injury), cognitive disability or disorder, cognitive ageing, mental handicap or retardation, less visible impairments, autism, Asperger syndrome, ADHD, Williams syndrome, temporal lobe epilepsy, Down syndrome, Turner syndrome and Fragile X syndrome.

As previously indicated, research in this area is limited and is often the work of individuals who publish several papers in the area (e.g., Golledge and Passini) or small research groups who publish aspects of a topic (e.g., Chang et al. about assistive devices). Not only are there limited numbers of publications, therefore, but those publications are often from the same small number of researchers. In its report entitled "Good signs - improving signs for people with a learning disability", the Disability Rights Commission (Disability Rights Commission 2004a) noted that little had been done to identify mobility needs or make the environment user friendly for people with ID. As this present review will indicate, even in the ensuing years, limited further attention has been paid to this important social equity issue.

The following discussion about previous research is grouped under three headings:

- research relating to the effects of ID on the wayfinding processes
- research relating to the use of handheld assistive technology for wayfinding
- research relating to building design that supports wayfinding by people with ID (i.e., the specific focus of this current research study).

2.4.1 Research relating to the effect of ID on the wayfinding processes

Research in this section has been included to help explain how intellectual disability affects wayfinding and why there is a need to consider adaptations to building design to assist people with ID.

[7] These terms were used for searching and may not appear elsewhere in the text. Where a term is first used in the body of the thesis it is either explained within the text or by footnote.

a) About general wayfinding

i) Challenges

Yalon-Chamovitz (2009) analysed previous research about wayfinding by people with ID and identified four key challenges; the pace with which wayfinding information needs to be cognitively processed, the level of complexity of wayfinding instructions (often leading to people talking louder or in a childish way when assisting someone with an intellectual disability), the required literacy level and lastly the stigma associated with being identified as having intellectual disability (resulting in being treated as if a patient or needing protection).

ii) Wayfinding strategies

Riley (1995) found, however, that people with ID could utilise configurational knowledge with around 40% accuracy and suggested that inclusion of landmarks and other cues that offer configurational knowledge could enhance wayfinding success. A report by The Office of the UK Deputy Prime Minister (2006) indicates that people with learning disabilities utilise a wide range of wayfinding strategies and each person may have their own distinct approach and therefore need different information to assist in wayfinding. In observing the wayfinding behaviour of 10 people with ID in a shopping mall and office building, Salmi (2007a) noted that participants combined both linear and orientation strategies, which emphasises the need for building designers to provide an environment that suits these strategies. Foti et al. (2011) investigated wayfinding by people with Williams syndrome[8] and found that they had a significantly different exploratory strategy than TD participants, being disorganised, explorative and less structured.

iii) Decision making

Passini et al. (2000) undertook research about wayfinding by people with dementia of the Alzheimer's type (DAT) and found that people with severe cognitive degeneration could still make decisions and reach destinations, but needed readily accessible environmental information to make appropriate decisions. These studies are pertinent for people with ID as both populations may experience similar cognitive processing difficulties.

Salmi, Ginthner, and Guerin (2004) studied wayfinding decisions by people with ID who were attempting to find restrooms in a shopping centre. The study, using Passini's (1998) decision-tree analysis of wayfinding, found that only 15% of participants with ID compared to 70% of TD participants could make wayfinding decisions based on inference, whilst 85%

[8] Williams syndrome affects a person's physical appearance, particularly facial features and stature, and affects physical development, intellectual ability and personality (Morris 2010) .

of participants with ID compared to 100% of TD participants could make wayfinding decisions relying on memory.

iv) Learning to use landmarks and locations

Roskos-Ewolsen et al. (2006) found that people with ID needed slightly more time to learn landmark locations and move between them and that people with ID could be assisted in wayfinding by "learning landmarks and then imagining going from landmark to landmark" (Roskos-Ewolsen et al. 2006, 45). Nardini et al. (2008) undertook an experiment in a real world setting to investigate the spatial frames of reference used in wayfinding by people with Williams syndrome. Their results showed only marginal use of object-based information (e.g., landmarks). Benson (2010) undertook a study of wayfinding by people with Down syndrome[9] to assess the effect learning landmarks would have on wayfinding success and found that, compared to TD participants, participants with Down syndrome performed significantly worse on the wayfinding task.

v) Visual information processing

Using a computer-based research experiment, Boot et al. (2012, 1670) showed that children with ID have "an increased risk of impaired visual information processing, related to a low IQ level". Bogdashina (2016) suggests that a person with autism does not necessarily have the same perception of their world and objects within it as a TD person. This may result in having difficulty with distinguishing backgrounds and foregrounds or, in the case of fragmented perception, seeing the component parts of an object before seeing the whole. Mitchell and Ropar (2004) undertook research that showed people with autism are susceptible to creating visual illusions.

b) About movement through the wayfinding environment

i) Spatial wayfinding

Research by Silbert, Wolff, and Lilienthal (1977) found that females with Turner syndrome[10] had poorer spatial wayfinding ability. Golledge, Rayner, and Parnicky (1983) used a laboratory-based experiment to assess spatial wayfinding by people with ID and found that people with ID achieved a satisfactory level of route sequencing knowledge but did not

[9] Down syndrome, also known as Trisomy 21, is the most common chromosome condition in babies is indicated by distinctive facial features, some intellectual disability and heart or digestive tract conditions (The Centre for Genetics Education (online))

[10] Turner syndrome is caused by a chromosome deficiency which only affects females and impacts on stature and appearance and can affect spatial ability (Silbert, Wolff and Lilienthal 1977). It can also cause "developmental delays, non-verbal learning disabilities and behavioural problems" (National Library of Medicine 2017, 1).

appear to have obtained survey level knowledge. Riley (1995) found that people with ID had more spatial ability than previously demonstrated in a large-scale environment, but there was evidence that the cognitive demands of the learning task may influence the acquisition of spatial knowledge. Caron et al. (2004) undertook a laboratory-based experiment to assess the spatial wayfinding of persons with high functioning autism and found that they performed at least equivalent to typically developing participants and were superior in the use of maps. Research by Foti et al. (2011, 972) also found people with Williams syndrome "were impaired in efficiently exploring the environment and in building cognitive spatial maps". Smith (2015) undertook a review of current published research in an attempt to confirm that people with autism had excellent spatial navigation abilities. However, the outcome was inconclusive and suggested a need for more comprehensive investigation.

ii) Navigation

A study by Sohlberg et al. (2005) about people with acquired brain injury found that community access is severely restricted because of limited navigation ability, leading them to only travel to the same places with the same people assisting.

c) Route learning

Research by Farran et al. (2010) and Farran, Courbois, Vanherwegen, and Blades (2012) investigated route learning by people with Williams syndrome and found they were able to navigate through a natural environment and could improve wayfinding by using verbal coding and repeating the journey. However, identifying spatial relationships between landmarks was poor. Further research by Farran et al. (2015) using virtual environments found impairment of both route and configurational knowledge in children with Down syndrome and Williams syndrome, which indicates a potential ongoing difficulty in wayfinding for those children.

d) Memorising wayfinding information

Memory is an essential component of successful wayfinding according to research by Reck, Hund, and Landau (2010). Foti et al. (2011) further identified a possible link between explorative deficits and spatial working memory deficits in individuals with Williams syndrome. Purser et al. (2012) and Purser et al. (2015) further reinforced the importance of memory in research about route learning and landmark use by people with either Down syndrome or Williams syndrome.

i) Environmental preference and prospect and refuge

Considerable research has been undertaken about the concept of environmental preference, particularly by Stephen and Rachel Kaplan (Kaplan 1977; Kaplan, Kaplan and Brown 1989). Salmi (2007a) used the environment preference theory as a framework to assess the impact of various environmental features on wayfinding by people with ID and also investigated the effect of environmental preference on wayfinding success. As a result, Salmi (2007a) produced a wayfinding processing model that linked wayfinding to the elements of environmental preference (complexity, coherence, legibility and mystery) and described how those elements could also be used to inform design of environmental features within a building.

Prospect and refuge refers to a person's desire to be able to look over a scene whilst being protected within a "refuge'. This may be pertinent for people with ID whose disability may give rise to feelings of insecurity, shyness, or sensitivity to crowds and noise (Salmi 2007a). For example, a person wanting to see where to go in a building might prefer looking at a map of the building that is sited in a corner of the foyer, rather than on a podium in the middle of the open foyer area. Accommodating prospect and refuge may, therefore, impact on building design.

ii) Familiarity and past experience

Previous unpleasant experiences of buildings where wayfinding information was not clear or where poor wayfinding advice was given may impact on a person's feelings if and when needing to visit a similar building.

Salmi (2005) noted that when participants with ID were asked to look for restrooms they were able to rationalise that this facility would most likely be close to restaurants, drinking fountains or telephones. Salmi (2005) describes these as association cues (where a person identifies a specific place as always associated with a specific cue) and suggests that building owners and operators could use this concept to appropriately locate features in a building.

People with ID contributing to the report "Good signs - Improving signs for people with learning disability" (Disability Rights Commission 2004a), identified familiarity with routes and journeys as a key factor in becoming independent. Research by the Office of the UK Deputy Prime Minister (ODPM 2006) also suggested that supported initial journeys to become familiar with locations was useful to people with ID for future visits.

e) About distractions

Distraction may come in the form of noise, light, or visual imagery. People with autistic spectrum disorder, for instance, can have difficulty with distractions and extraneous stimuli within the environment and need "a simple layout; calm, ordered, low stimulus spaces; no confusing large spaces; indirect lighting; no glare; subdued colours; good acoustics; avoiding sudden/background noise" (UK Department for Children Schools and Families 2008, 198). There are several publications that advise on design of buildings specifically for use by people with autism (e.g., special needs schools, shared living accommodation) but not necessarily relating to wayfinding design in general use buildings.

f) About training

Whilst this research study focuses on design of buildings, it is important to recognise that training of building users can also be a useful supplementary or alternative method for enhancing wayfinding by people with ID, either directly to learn a route (LaGrow, Wiener and LaDuke 1990; ODPM 2006) or by using virtual or gaming environments prior to actual wayfinding (Brown et al. 2011; Cromby, Standen and Brown 1996; Mengue-Topio et al. 2011). These are useful options for predetermined journeys, but have limited value if a person needs to travel to new destinations.

2.4.2 Research relating to the use of handheld assistive technology

This section lists research about the use of handheld technology to assist in wayfinding by people with ID. The focus of the research was on technology to assist people with ID to use the environment rather than the design of the environment. However, the studies have been included in this review as they explore interaction with features of the environment that are considered essential for self-directed wayfinding. Generally, the handheld technology relies on some form of personal digital assistant and differentiation of design generally only focuses on the manner in which prompting information is triggered (i.e., by Bluetooth, RFID, QR-Code, WSN). Interestingly, Livingstone-Lee, Skelton, and Livingston (2014) undertook a survey to find technology suited to use on public transportation and, out of 159, only found seven suitable for public transportation for people with cognitive impairment. Table 2.3 lists some of the research undertaken in this area that affects wayfinding by people with ID.

Table 2.2. Research Based on Use of Handheld Devices

Topic	Research
RFID tags	Systems based on passive RFID tags prompting with photos at the right time (Chang, Chen, et al. 2008; Chang et al. 2010; Chang, Wang, et al. 2007)
IPAQ (with temporary wizard of-oz assistance)	Indoor wayfinding applications tested with varying modalities (text-based, images, audio) (Liu, Hile, Kautz, et al. 2006; Liu et al. 2008; Liu, Hile, Borriello, et al. 2006)
	Outdoor wayfinding assistance delivered to mobile phone by wizard walking behind controlling a tablet pc (Liu et al. 2009)
GPS and camera	Device based on GPS for use in transport (Boriello et al. 2006)
	Real-time anomaly detection system for travelling individuals based on expected trajectories (Chang 2010)
QR-Codes	Handheld system based on geo-coded QR codes (Chang, Tsai, et al. 2007; Chang, Tsai and Wang 2008)
	WADER system based on QR-Codes (Tsai 2007)
	Navigation system using a smartphone application and QR codes (Torrado, Montoro and Gomez 2016)
Wrist-worn navigation devices	Prompt modes delivered by device (Fickas, Sohlberg and Hung 2008; Sohlberg et al. 2007)
Bluetooth	System based on using Bluetooth sensors (Chang, Chang and Wang 2009; Chang et al. 2009; Chang, Chu, et al. 2008; Chang and Wang 2010a; Chang, Wang and Chen 2011)
Wireless sensor network	Testing WSN with a prototype decision-based assessment scheme (Assistmote) to guide cognitively impaired persons using a PDA (Chang and Wang 2010b).
Light and sound emitting devices	Basic system tested with sound emitted at destination points and lights along the journey (Lancioni et al. 2009; Lancioni, Singh, O'Reilly, Sigafoos, Alberti, et al. 2010; Lancioni, Singh, O'Reilly, Sigafoos, Campodonico, et al. 2010)

2.4.3 Research relating to building design for wayfinding by people with ID

This section is divided into three parts:

- publications addressing general building accessibility that may affect, but do not specifically mention, people with ID
- publications generally relating to wayfinding by people with ID, and
- publications specifically relating to the use of the four wayfinding components (i.e., spatial, visual, sensory and supportive) by people with ID.

a) General accessibility of buildings

Adaptive Environments (1995) published a general guide to designing buildings for people with disability. The guide contains a checklist for achievable barrier removal to comply with the Americans with Disabilities (ADA) Act and also provides advice about ensuring existing facilities meet legal requirements for accessibility including approaches to buildings, ramps, signage, etc. The Equality Commission for Northern Ireland (2014) published advice for service providers about making their goods and services accessible in advance of new Disability Discrimination legislation being introduced, describing physical barriers but no specific accessibility issues for people with ID. The CRC for Construction Innovation (2007) produced Wayfinding Design guidelines based on contributions from architects, lawyers, engineers, building surveyors, building regulators, access consultants, local expertise and people with disability. Whilst the guidelines mention ID as part of the definition of disability, there is no specific mention of guidelines pertaining to the needs of people with ID. NSW Health (2009) published a technical bulletin discussing wayfinding in health facilities and, whilst it addressed issues including the provision of pre-visit information, strategies for effective signage and meaningful symbols, it did not mention any issues specifically for people with ID. Nijs and Heylighen (2015) also undertook research that looked at the process by which a European city's Accessibility Advisory Committee obtained information about accessibility in their built environment. The authors intent was to see how "citizens with an impairment can impact their city's built environment and vice versa" (Nijs and Heylighen 2015, 144).

b) Publications generally relating to wayfinding by people with intellectual disability

The London Borough of Croydon (2000) produced a guide to building accessibility for general disability. Several local councils and boroughs in the UK produced similar brochures to advise on designing for accessibility. Whilst they describe in detail the accessibility requirements that would suit all people with disability (including ID), they only specifically refer to ID (using the term learning difficulties) when describing the need for logical building layouts to help with wayfinding. Pollet and Haskell (2003) produced the New York NYC Guidebook to accessibility and universal design and, whilst not specifically referring to issues affecting people with ID, acknowledges that "strategies used for wayfinding should include people with intellectual abilities" (Pollet and Haskell 2003, 54). The Construction Industry Research and Information Association (CIRIA) published a comprehensive guide edited by Bright, Flanagan, Embleton, Selbekk and Cook (2004) about improving the accessibility of public buildings and environments. The guide focuses mainly on physical,

auditory and visual impairments, but also discusses adaptations that may also assist people with ID.

The UK Disability Rights Commission (2004a) produced a report entitled *Good Signs: Improving signs for people with a learning disability* that recorded what was already known, evaluated current research, heard views from people with learning disability and made recommendations. The investigation was based on evaluation of existing facilities, holding focus groups and holding workshops, but did not observe any actual wayfinding.

The report notes that much of the principles of good signage for people with ID would be pertinent to the general population and suggests that more pictures and attention to colour are required in sign design. It also mentions that people with ID use the following to help with wayfinding:

- learning journeys and places by going with another person until they are confident enough to make the journey alone
- looking out for familiar landmarks to help know where they are and where they need to go
- asking people for directions
- locating reception and information points in buildings
- using simple maps or written directions
- using photographs of different parts of journeys to help remember where they need to go (Disability Rights Commission 2004a, 10).

Salmi, Ginthner, and Guerin (2004) undertook research to identify and evaluate critical wayfinding factors for adults with ID. The research, based on a previous study by Passini, Rainville, Marchand and Joanette (1998), investigated wayfinding behaviour by 13 participants with ID and 10 TD participants whilst looking for restrooms in a public shopping mall. The findings indicated that TD participants were more efficient than those with ID and variables affecting wayfinding included: signage, landmarks, spatial layout, and extent of previous knowledge. The research also identified that decision making for wayfinding was affected by environmental factors (e.g., spatial layout, signs) and cognitive abilities (e.g., pattern recognition, spatial processing, cognitive mapping).

Olsen (2005) produced a set of guidelines for designing schools for children with intellectual disabilities. Primarily, he focussed on their susceptibility to distractions, both from inside and outside the classroom and suggested that schools should be designed to minimise background noises, enhance audibility of teachers, reduce distances between classrooms and

toilets to avoid opportunities for distraction, provide lighting and window treatments that would filter out visual sources of distraction and situate classrooms away from other sources of distraction.

Ormerod and Newton (2005) investigated the extent to which accessible environments are considered during the briefing phase for public buildings, analysing data from over 900 questionnaires from building design companies. Findings indicated that designers were keen to ensure social inclusion as part of their building design, but that significant barriers still existed due to "a lack of understanding of disability and how a person with a disability interacts with a building" (Ormerod and Newton 2005, 285). They also found that "less priority is given by designers to features that would benefit people with sensory impairment and learning disabilities" (Ormerod and Newton 2005, 290). These findings further emphasise the importance of this current research study in developing guidance about features affecting wayfinding success for people with ID.

The ODPM (2006) published a report entitled: *Final report for signage and wayfinding for people with learning difficulties* that extensively reviewed signage, but also other issues relating to wayfinding by people with ID (learning difficulties). The investigation involved a literature search, undertaking two case studies of existing facilities, interviewing staff from organisations representing people with ID and workshops with end-users. The report found that a wide range of abilities presented difficulty in finding a single solution for signage. People involved in the research detailed a list of issues, other than signage, that also impact on wayfinding, including the "layout of the building, use of landmarks, familiarity with the environment, travel training, clear sight lines and assistance from staff" (ODPM 2006, 13). The research did not include actual observation of wayfinding.

Castell (2006) undertook an exploratory review to identify the extent of research about building accessibility for people with ID and found that, whilst several published works discussed building accessibility generally, little practical research about building access for people with ID had been undertaken. Smith and Adkins (2006) published research about the experience of shopping by four participants with ID, with particular interest in the role of the physical environment in the experience. In their research, Smith and Adkins (2006, 72) identified "spatial layout, environmental containment, spatial positioning, environmental triggers, and signage are all revealed to influence the environmental experience. In addition, spatial understanding, environmental constancy, environmental stimulation, and a sense-of knowing were also revealed to be important". The environment helped wayfinding in some cases, but limited wayfinding activity in others. Mencap (2004) commissioned a report about accessibility and wayfinding issues for people with ID (learning disabilities) when attending art and entertainment venues. The report identifies barriers including money, transport, lack

of help at venues and inappropriate information. Suggestions for improvement include providing information in multiple formats, particularly signs at venues that could be presented using both words and pictures.

Following on from earlier research in 2004, 2005 and 2006, Salmi (2007a) undertook a research study to assess the extent to which people with ID were able to use features of the built environment for wayfinding. The project involved 47 participants who were adult students and 10 participants with ID. The 47 students visited two locations (a shopping mall and a government office building) and evaluated physical and sensory wayfinding cues and the potential ease of wayfinding in both buildings. The 10 participants with ID were then given the task to find locations in the two buildings and their actions and wayfinding activity were observed and manually recorded. Use of environmental cues was noted and participants were asked about their preferred wayfinding strategy. The research found spatial organisation, signage, landmarks and smells/odours were important for wayfinding by the people with ID. Participants with ID used a combination of both linear and orientation wayfinding strategies. Wayfinding success for people with ID at the mall was 70% whilst at the office building only 30%. This was suggested to be due to prior experience by participants who frequented shopping malls more than they did the office building. The study did not observe the students undertaking their wayfinding and therefore could not include data comparing actual wayfinding performance between the two groups.

The UK Department for Children Schools and Families (2008) produced a bulletin to identify the building design requirements for children with special educational needs (i.e., needs and requirements relating to cognition, learning, behaviour, communication, interaction and sensory and/or physical impairment). The bulletin recommends the following in relation to wayfinding design (UK Department for Children Schools and Families 2008):

- creating environments that are easily understood and contain low levels of distraction and sensory stimulus
- using clear and easily understood signs that differentiate between arrival and directional information, indicate direction and/or position at junctions or in long well lit passageways, and contain appropriate lettering and/or simple symbols on contrasting backgrounds
- using colour and contrast on walls and floors to define routes and/or colour code areas of different activity that does not confuse or over-stimulate

- avoid excessive background noise to avoid distraction or distress (particularly for children with autism).

Seale and Nind (2009) published a book about access for people with learning difficulties and noted the lack of discussion about the topic. Much of the content relates to the wider view of accessibility in the community (e.g., use of multimedia, rights and responsibilities), but there is only brief mention given to the provision of accessible information, symbols for public spaces and access to heritage sites.

Apart from research by Salmi, Ginthner, and Guerin (2004), Smith and Adkins (2006) and (Salmi 2007a), most of the findings in this section have been based on anecdotal or self-reported information. They do not include actual observation of people with ID when wayfinding in a real-world setting nor offer comparative performance with TD participants. The lack of comparative analyses in the above literature contributed to the imperative for the current research study.

c) Publications about specific components and features of the wayfinding environment

This section describes research that specifically addresses design of wayfinding components and features for use by people with ID. The content has been structured based on the four wayfinding components: spatial, visual, sensory and supportive and then features that each contains.

i) Spatial features

Building layout

Plan configuration (i.e., the way a building is laid out) can affect wayfinding in a building (Devlin 2014; ODPM 2006). It can disorientate (ODPM 2006), distract from the wayfinding task (Smith and Adkins 2006) and create a barrier to using the buildings as intended (Yalon-Chamovitz 2009). For someone with autism, it can also create unnecessary confusion (Harker and King 2002). To avoid these issues, building layouts need to be clear and uncomplicated (UK Department for Children Schools and Families 2008) with a logical design that is easy to get around (ODPM 2006; Salmi 2007a). Sawyer and Bright (2007) suggest entry and exit points should also be made clear in the layout. Yalon-Chamovitz (2009) suggests that building layouts should be repetitive wherever possible (e.g., placing toilets in similar locations on each floor of a building), so that they make finding such facilities easier for people with ID.

A well-designed building layout will help users to know how to find required destinations (Salmi 2007a; Sawyer and Bright 2007), will help identify key features (e.g., reception counters) (ODPM 2006), provide opportunity to visually survey greater distances (Salmi 2005), provide predictability of locations (Smith and Adkins 2006), help avoid distracting users from their task (Olsen 2005) and generally provide for a more relaxed experience (Harker and King 2002).

Dead-ends, Junctions (including rooms branching off main corridors)

No direct research was identified for these specific locations, but research about the broader building layout and/or configurational knowledge, such as Sawyer and Bright (2007), incorporate these features in their overall discourse.

Corridors

There is limited research that specifically addresses the design of corridors for people with ID. In a report about homes for people with learning disabilities and sight loss, the Royal National Institute of Blind People (2016) suggests that corridors need to be designed to provide sufficient natural light and/or adequate and consistent electric lighting. The Access Manual produced by Sawyer and Bright (2007) also suggests that circulation areas (e.g., corridors) should be free from obstacles, provide clear colour and contrast to allow easy identification of routes and provide appropriate direction signs and resting points.

Entry-Exit points

Similarly, limited literature focuses on building entry and exit point design for use by people with ID. The ODPM (2006) advises that the design of entrances should ensure they are straightforward to use and logically placed. If not, they may create confusion and feelings of uncertainty. Furthermore, the report suggests a clear and consistent signage strategy be used at entrances so that people entering know where to go (ODPM 2006). The Access Manual (Sawyer and Bright 2007) emphasises that entrances should be placed where they can easily be found.

Use of lifts and stairs

Whilst there are publications that describe disability lifts (e.g., lifts for moving people with a physical impairment) and also the design of lifts and stairs for use by people with other types of impairment (Sawyer and Bright 2007), this literature survey did not find any published research about use of lifts specifically by people with ID.

Barrier controlled doors

These doors have been included in the spatial features component as their purpose is to control access and movement through a building. The Access Manual by Sawyer and Bright (2007) discusses such doors in relation to general disabilities and advises manual activators should be properly signed and positioned appropriately. Other than this manual, research relating to use of this feature may be covered by general research relating to building layouts and configurational knowledge.

Prospecting point

In terms of the current research study, this feature occurs whenever a participant who is uncertain where to go, pauses and surveys the surroundings for any indication about the direction to take. There is no identifiable literature specifically about these decision points themselves but the activity may fall within the scope of general discussion about decision-making (Passini 1984b) or the process of prospect and refuge described by Salmi (2007a).

ii) Visual features

Signs

There is a significant amount of research about signs and signage used by the general population, much of which would be applicable to people with ID. However, the following review discusses research about signage design specifically for people with ID.

People with ID have difficulty using signs (ODPM 2006) which is a major barrier to independence and participation (Yalon-Chamovitz 2009). People with autism, in particular, find it difficult to filter out irrelevant information (Bogdashina 2016). These difficulties are often due to a number of problems with sign design including overcrowded, jumbled or redundant information (Disability Rights Commission 2004a; Seale and Nind 2009), inconsistency in information and design (Disability Rights Commission 2004a; ODPM 2006; Seale and Nind 2009), incorrectly sized text (Salmi, Ginthner and Guerin 2004), and too many colours (Seale and Nind 2009). It may also be due to their location in a building being inappropriate for the purpose (Salmi, Ginthner and Guerin 2004); at the wrong height, meaning they are missed (Smith and Adkins 2006); providing insufficient or poor lighting (Salmi 2006; Salmi, Ginthner and Guerin 2004); providing too many signs; causing confusion (Sawyer and Bright 2007) or not showing clearly when a person is near their destination (Royal National Institute of Blind People 2016).

The lack of guidance to ensure consistent sign design for people with ID (Disability Rights Commission 2004a; Seale and Nind 2009) is concerning, because they may not be able to

find their way through buildings or escape in an emergency (National Disability Authority 2008). According to the ODPM (2006), the best way to solve sign design for people with ID is to seek their advice, which seems common sense, but is not always done (Disability Rights Commission 2004a).

The placement of signs, according to Sawyer and Bright (2007), affects their use and efficiency so signs need to be placed where they are clearly visible (Sawyer and Bright 2007), perpendicular to path of travel (Salmi 2005), at decision points (Salmi 2006), at eye level (Sawyer and Bright 2007), in well-lit locations (Sawyer and Bright 2007) and where there is limited glare (ODPM 2006; Sawyer and Bright 2007).

To encourage familiarity with types of signs there needs to be consistency in both placement and design (Disability Rights Commission 2004a; ODPM 2006; Sawyer and Bright 2007). The use of icons and colour needs to be consistent otherwise signs may confuse or not be used (Disability Rights Commission 2004a; ODPM 2006; Seale and Nind 2009). The type of information they present should be:

- clear (Beneicke, Biesek and Brandon 2003; Disability Rights Commission 2004a; Disability Services Commission 2004; ODPM 2006)
- concise (Disability Rights Commission 2004a; ODPM 2006)
- intuitive (Yalon-Chamovitz 2009)
- simple (ODPM 2006; Sawyer and Bright 2007; Yalon-Chamovitz 2009)
- easy to understand (ODPM 2006)
- easy to read (ODPM 2006)
- free of jargon (Beneicke, Biesek and Brandon 2003).

The ODPM (2006) suggest that talking signs may be more appropriate where users are unable to read. Various publications also advise on the specific design of signs. Generally, it is considered that signs should:

- contain no more than three items per sign (Salmi 2006)
- limit the extent of text and graphics (Salmi 2005)

With respect to text, they should:

- use capitalised lower case (Sawyer and Bright 2007)

- have appropriately sized letters (Sawyer and Bright 2007)
- use a consistent font (Sawyer and Bright 2007)
- use a clear type face (ODPM 2006)

People with ID may benefit from greater use of pictograms, symbols and icons (Disability Rights Commission 2004a; ODPM 2006; Yalon-Chamovitz 2009) and, where used, should:

- comprise common images, not specialised for each location (Disability Rights Commission 2004a; ODPM 2006)
- have a text alternative provided (ODPM 2006; Sawyer and Bright 2007)
- comprise clear, large symbols (Seale and Nind 2009).

Images instead of text signs may be useful for people with ID to help them understand the directions or where something special needs to be highlighted (Disability Rights Commission 2004a; ODPM 2006). Colour in signs is important but the design must provide good contrast between text and background (ODPM 2006; Sawyer and Bright 2007; Seale and Nind 2009). The number of different colours used should be minimised (Bogdashina 2016). Colour should be used along with text and not as the only information on a sign (Beneicke, Biesek and Brandon 2003). Importantly, sign design needs to be aware of and accommodate people with colour blindness (Beneicke, Biesek and Brandon 2003).

Interestingly, Beneicke, Biesek, and Brandon (2003) suggest that staff should be trained on how a building's signage system is supposed to work so they can relay this to users who may not understand the system.

There are a number of benefits in providing good sign design for use of buildings by people with ID. It can help provide reassurance (Sawyer and Bright 2007) and minimise anxiety (Disability Rights Commission 2004a; ODPM 2006), reduce confusion (Disability Rights Commission 2004a; ODPM 2006) and reduce getting lost (Disability Rights Commission 2004a). Ultimately, good signage for people with ID can help with wayfinding (Beneicke, Biesek and Brandon 2003) and hence independence (Disability Rights Commission 2004b), and contribute to overall wellbeing, safety, and security (Yalon-Chamovitz 2009). Sawyer and Bright (2007) suggest that the need for signs would be greatly diminished if buildings were designed logically.

Maps

The Disability Rights Commission (2004a) indicate that some people with ID use maps but have problems unless the maps are straightforward. Salmi (2007a) found, in a study of wayfinding by people with ID, that only one out of 10 participants with ID used maps whilst the others took “from two to seven attempts to access the information” (Salmi 2007a, 70). According to research by Sohlberg et al. (2007), some people with ID found maps helpful, but others found them really confusing.

Literature about map use by people with ID seems to indicate the problem is related to the level of cognitive processing required. The report by Salmi (2005) on wayfinding by people with ID, indicates difficulty in translating information from a two-dimensional map into a three-dimensional actual location and the report by the ODPM (2006) notes that people with ID could only use maps if they were very simple.

As a result, literature about map use by people with ID suggests that maps should comprise only simple diagrams (Beneicke, Biesek and Brandon 2003) and that the field of view should match the map’s orientation (Beneicke, Biesek and Brandon 2003). After observing participants with ID using maps in both a shopping centre and government office building, Salmi (2007a, 176) suggested maps should:

- be less cluttered
- highlight major anchor points
- note which level the person viewing is on
- be provided for the floor to which they relate
- link to directories for facilities such as toilets, restaurants, telephones and information
- have numbering or pictographic systems
- be large enough and easy to understand
- be placed to avoid glare on the map
- use "You are here" markings
- be placed near entry and decision points within a building.

The London Underground map is held to be an example of a map that is well designed due to being consistent across the underground system and well established (ODPM 2006). Seale

and Nind (2009) refer to a map produced for Exmoor Zoo in the UK, which uses animal patterns on the map to highlight main routes in the zoo.

Directories

Directories can provide a concentrated mass of information, which is a challenge for people with ID. Finding just one location amongst all this information is very difficult (Salmi 2005, 2007a) and would be of no value to someone who cannot read or who has dyslexia[11] (Salmi 2005). In Salmi's research about wayfinding in a shopping mall and government office building (Salmi 2007a), none of the participants with ID were able to use the directories to help find the destination, which Salmi attributes to the density of the information presented. Salmi (2006) suggests directories should:

- group information into categories/areas
- be kept simple, not-overcrowded
- indicate the floor the directory is on
- use graphics to enhance the meaning of locations
- be well lit and avoid reflections masking the text.

Nind and Seale (2009) suggest the use of symbols to enhance understanding of the directory names.

Landmarks

Research has identified that people with ID are less efficient than typically developing people in landmark selection, which may delay obtaining configurational knowledge and reduce their wayfinding ability (Courbois et al. 2012). In research using a computer-based virtual environment, Purser et al. (2015) found that participants with ID had difficulty understanding the purpose for landmarks and Farran, Courbois, Vanherwegen, and Blades (2012) found that people with Williams syndrome could learn the landmarks but made errors finding the destination. Despite these identified difficulties, however, research by both Mokhov (2014) and the ODPM (2006) suggested a lack of any landmarks would make wayfinding very difficult for people with ID.

[11] Dyslexia is a type of specific learning difficulty in which a person has difficulty in reading and spelling. There may also be other contributing factors such as behavioural and developmental disorders (Better Health Channel 2017).

Accessible and readily identifiable landmarks, therefore, provide an excellent wayfinding aid (ODPM 2006; Salmi 2007a). Landmarks provide an opportunity to mark and remember a route (Salmi 2005) and give repeat building users a welcome sense of familiarity (Disability Rights Commission 2004a). They enable someone giving directions to describe or point out distinct features to the person needing directions (Salmi 2006; Sawyer and Bright 2007; Sohlberg et al. 2005) and can identify how far along a route a person has travelled (ODPM 2006). Furthermore, they provide support in wayfinding for people who may be unable to read or speak (Salmi 2007a).

For best outcomes, landmarks need to be permanent features that can be remembered for future journeys. Temporary features, such as smells and sounds, can also be suitable (Royal National Institute of Blind People 2016). They all need to be memorable in order to provide anchors for future wayfinding (Sohlberg et al. 2005). Various authors have offered some suggestions for appropriate landmarks:

- famous logos (e.g., McDonalds) (Disability Rights Commission 2004a)
- walls, front doors or other significant building features (Royal National Institute of Blind People 2016)
- escalators, store fronts, building zones (e.g., a food court in retail centres) (Salmi 2007a)
- seating and plants at schools (UK Department for Children Schools and Families 2008)

Studies by Salmi about wayfinding by people with ID (Salmi 2005, 2006, 2007a) suggest landmarks should be located at key intersections and decision points in combination with signage and be distinct, colourful, unique and possibly interactive. Overall, research by Mondschein, Blumenberg, and Taylor (2005) suggests that the more dominant the landmark, the more dominant it would feature in a person's cognitive map and contribute to successful wayfinding.

Colour

The use of colour in building interiors can help wayfinding by all users (ODPM 2006). It can help provide separation between different functional areas of a building and identify key features (ODPM 2006). For example, a door and frame may be colour coded to guide people towards a specific direction (Mencap 2004; ODPM 2006). It can help a building user, particularly someone with ID, understand the environment (Royal National Institute of Blind People 2016), find their way (Farran, Courbois, VanHerwegen, Cruickshank, et al. 2012;

Royal National Institute of Blind People 2016), make choices (Royal National Institute of Blind People 2016) and stay on track (Sawyer and Bright 2007).

Colour impairment (colour blindness) is a major issue when choosing colours and colour coding for wayfinding. “Around 8% of men and 1% of women” (NHS-Estates 1999, 46) have some form of difficulty in recognising or differentiating colour (NHS-Estates 1999). Furthermore, the use of too many different colours can be problematic because people have difficulty in remembering and/or differentiating more than five (Arthur and Passini 1992).

Poor colour contrast (e.g., all-white walls and features) can affect a person’s ability to function safely and independently (Royal National Institute of Blind People 2016). On the other hand, too much colour can cause overload (Royal National Institute of Blind People 2016). Bogdashina (2016) suggests judicious choice of colour in areas used by people with autism because high colour contrast, busy patterns and overly bright colours can cause disturbance and pain.

Farran, Courbois, VanHerwegen, Cruickshank, et al. (2012) also suggest using ‘focal” colours (e.g., those easy to describe, such as red, green, blue) rather than non-focal colours (e.g., those more complicated to describe and visualise such as mustard, creamy white) as the focal colours are easier to reference by others and easier to remember for people with ID.

The UK Department for Children Schools and Families (2008) offer the following design guidelines for use of colour:

- consider the psychological effect
- avoid too much contrast
- avoid colours and patterns that over overstimulate (or create a strobe effect)
- avoid using too many colours or colour changes, which can cause confusion
- use soothing colours (such as pastels)
- take account of colour impairment
- consider using colour to identify changes in use or function of parts of a building
- consider using coloured trails to identify routes through buildings.

Salmi (2006) recommends using colour in association with other wayfinding cues, such as signs, and landmarks.

iii) Sensory features

Some people with ID, for instance those with autism or Fragile X[12] syndrome, have heightened sensitivity to sensory stimuli occurring within the wayfinding environment (Salmi 2007a; Smith and Adkins 2006). An overstimulating environment increases self-stimulation, which affects behaviour (Duker and Rasing 1989). To ensure appropriate wayfinding behaviour therefore, environmental stimuli need to be identified and moderated (Duker and Rasing 1989; UK Department for Children Schools and Families 2008). To do so may require rethinking building design (Duker and Rasing 1989).

As part of a research study about the design of learning environments, Mokhov (2014) provided a list of potential stimuli:

- low-level stimulation from bright colours, light and complex textures (affecting people with autism)
- visual stimuli causing sensory overload
- glare, flashing or very bright lights
- complex object shapes or textures
- sharp contrasts between light and dark
- bright and intense colours.

The following sections review publications that investigate these sensory stimuli and offer suggestions for improving design.

Lighting

The Australian/New Zealand Standard: AS/NZS 1680.0:2009 – Interior lighting: Safe movement (SAI Global 2009), defines the "minimum requirements for electric lighting systems within publicly accessible areas of buildings so as to provide visual conditions that facilitate the safe movement of people in the normal; use of the building" (4). It also notes that "electric lighting needs to be supplemented by well designed interior surface finishes, appropriate colour, reflectance and avoidance of excessive contrasts in brightness" (4). The standard requires a minimum illuminance throughout the space of at least 20 lux.

[12] Fragile X syndrome is caused by a change in genetic information. It affects physical features and causes intellectual problems varying from mild to severe (The Centre for Genetics Education (online) 2017d).

The wayfinding design guidelines (CRC for Construction Innovation 2007), do not describe specific figures for lighting levels appropriate for wayfinding, but do refer to the AS/NZS standards for appropriate minimum levels of lighting for public areas.

Hidayetoglu, Yildirim, and Akalin (2012) used virtual space scenarios to test preferred lighting levels and colour for wayfinding. They used 120 interior design university students to assess preference for light levels and colour, and found the most favoured lighting level for wayfinding for both male and female students was 500 lux. This is significantly higher than the AS/NZS standard minimum requirement of 20 lux.

Some building users, including those with ID, need special consideration when designing lighting because areas where there is limited lighting can cause concern, discomfort and stress (Greater London Authority 2004). Conversely, too much light, either directly or through glare reflecting off surfaces, can be distracting and cause discomfort (Bogdashina 2016). Research has also found that fluorescent lighting can cause discomfort and overstimulation (Bogdashina 2016) for people with ID.

Good lighting has several benefits for wayfinding. Having appropriate lighting can provide greater visibility throughout the building in which the wayfinding is occurring (Sawyer and Bright 2007) and, in so doing, helps in finding required features and landmarks, the reading of signs and easier interaction with occupants of the building (Salmi 2006). Modern technology, with the varying types and designs for lighting, can help maintain lighting at appropriate levels for the types of activities undertaken within a building (Sawyer and Bright 2007).

Lighting design to assist wayfinding by people with ID must ensure there is no glare reflecting on or from surfaces that makes using wayfinding features (such as signs, maps, etc.) difficult or impossible (Royal National Institute of Blind People 2016; Sawyer and Bright 2007; UK Department for Children Schools and Families 2008). It is also recommended to avoid any sharp changes in levels of lighting when moving from one area to another as this can lead to stress and confusion (Royal National Institute of Blind People 2016).

Acoustics (sound and noise)

Some sound is useful (Royal National Institute of Blind People 2016) as it can provide both locational and directional information (Royal National Institute of Blind People 2016; UK Department for Children Schools and Families 2008). However, some sounds are intermittent or short-lived, in which case they cannot be relied upon for wayfinding guidance (Royal National Institute of Blind People 2016). Some people, particularly those with

autism, can find noise extremely distressing and therefore need consideration in the overall building and specific wayfinding design (UK Department for Children Schools and Families 2008).

Rooms with acoustically highly reflective surfaces could cause distress to occupants with autism and may require increased sound insulation to remove or reduce the distracting noise (UK Department for Children Schools and Families 2008). Smith's (2006) study of shopping by people with ID describes how one participant with ID would filter out distracting sounds whilst shopping by focussing attention on the visual surroundings.

Smell

The Royal National Institute of Blind People (2016) suggests that smells within the environment can provide useful information about where you are, but can be short-lived, so are not necessarily useful as a permanent landmark. However, there are some locations where smells would remain constant for some time (e.g., a café in a hospital, a bakery in a shopping centre or a petrol station).

Heat

An extensive search of the literature was unable to identify information about the effect of heat specifically on wayfinding by people with ID. In terms of the effect of heat generally, research by Hygge and Knez (2001) suggests there is a link between heat and long-term recall of text. A bulletin by the UK Department for Children Schools and Families (2008) about design of schools for children with special needs indicates a need for control of heating in classroom environments. Smith (2009) refers to an unpublished workshop presentation by Smith and Foy in 2006 in which they suggest heat caused children with cognitive impairment to become tired and lethargic with reduced levels of attention.

Variations in texture

Use of texture has not received as much research attention as other building features used for wayfinding. Nonetheless, there are a few publications that identified problems, benefits and solutions in using texture as part of a wayfinding system.

According to the Royal National Institute of Blind People (2016), reflection from surfaces as a result of material and texture choice may cause problems for wayfinding. Whilst they are primarily concerned with designs for people with vision impairment, it would also impact on wayfinding by people with ID, in so far as the reflection may cause confusion and even overstimulation (UK Department for Children Schools and Families 2008).

The use of hard, dense surfaces can also create and/or enhance noise which might cause distraction (Royal National Institute of Blind People 2016) for people with ID and again potentially cause overstimulation. Furthermore, using a single textured floor finish throughout a building, be it tiling, carpet or vinyl, fails to provide differentiation between functional areas (Royal National Institute of Blind People 2016).

Previous research has suggested the following design criteria when considering different textures that may assist people with ID in wayfinding:

- avoid using materials that would produce glare or reflections causing confusion (Royal National Institute of Blind People 2016) (UK Department for Children Schools and Families 2008)
- use materials that would be sound absorbing in high noise areas, rather than choosing materials that would produce high levels of impact noise and/or reverberation (Royal National Institute of Blind People 2016; UK Department for Children Schools and Families 2008)
- use different materials and texures to differentiate functional areas (Royal National Institute of Blind People 2016).

iv) Supportive features

Supportive features occur where the person undertaking wayfinding has sought or been provided with guidance to help them with wayfinding. The feature can be at a static point where a person seeks information (e.g., at a reception counter) or moveable (e.g., asking someone along the route) or can be unsolicited assistance (e.g., from someone who volunteers to assist the person who is wayfinding).

Reception facilities

It is important that a person with ID can find and use a reception counter, if provided (Disability Rights Commission 2004a). The counter, therefore, must be appropriately positioned, preferably close to a main entrance and close to circulation routes that would be used to find the requested location/s (Sawyer and Bright 2007). There must be adequate and consistent signage (i.e., using the same name) directing visitors to this point of information (Disability Rights Commission 2004a). The staff at the counter should be aware of their responsibilities towards people with disabilities (Mencap 2004) and be trained to help and advise people with any type of disability on how best to reach requested destinations.

Asking people

According to several research studies (Disability Rights Commission 2004a; ODPM 2006; Sohlberg et al. 2005), most people with ID are able and willing to ask someone for help. Participants in the Disability Rights Commission (2004a) study indicated they would ask a policeman, steward (if they recognised the uniform) or go into a shop. However, they would not ask a member of the public as they had been warned about talking to strangers. The participant responses in the study indicate that people with ID prefer asking a person who has some form of recognisable uniform or someone in authority (Disability Rights Commission 2004a).

Some participants in the study by the Office of the Deputy Prime Minister ODPM (2006) indicated they were reluctant to ask at a reception counter due to previous discrimination when attempting the same activity. They suggested that staff should have training to be aware of the issues facing people with ID in finding locations, so they could provide information and describe routes that are appropriate for them to use. Some participants suggested that counter staff should go on a tour through the facility to better understand the issues facing people with ID.

Staff training

All staff need to be trained about disability awareness and building accessibility (UK Department for Children Schools and Families 2008) to help improve wayfinding experiences for people with ID.

Training should ensure a better understanding of communication and etiquette needs (UK Department for Children Schools and Families 2008), how to recognise and respond to someone with a disability (Mencap 2007) and encourage better attitudes from staff within a facility towards building users who have a disability (Sawyer and Bright 2007). The training should specifically address use of equipment, sign language and how to recognise and interact with people with disabilities (ODPM 2006; Sawyer and Bright 2007).

As previously mentioned (ODPM 2003), the choice by a person with a disability to revisit a facility can be severely affected by their previous experiences at that facility and the attitudes of the staff. Training needs to address these attitudinal issues (ODPM 2006; Sawyer and Bright 2007).

Trained staff should be located at convenient points around a building complex and should be able to advise people with disabilities on any potential dangers, the most suitable routes to a destination according to the nature of the disability and the locations of accessible features such as toilets (Sawyer and Bright 2007).

Once organisation staff have undergone training and/or a building has been upgraded the organisation needs to publicise its upgraded facilities and services so that people with disability will know that they will be treated with respect and be supported in any forthcoming visit (Sawyer and Bright 2007).

d) Research specifically about wayfinding in hospitals

The preceding discussion identifies key components of the built environment in general that affect wayfinding. Hospitals and health care facilities, however, present particular wayfinding difficulties as they are "complex, confusing and difficult to navigate" (Cheng and Pérez-Kriz 2014, 6) in both layout and design (Brown 1997; Carpman, Grant and Simmons 1985; Dogu and Erkip 2000; Haq and Zimring 2003; O'Neill 1991a) and present special design challenges (Hunter 2010a). Given that research indicates they are visited regularly by people with ID (Iacono et al. 2014; Janicki et al. 2002; Lin, Wu and Lee 2003; Lunsky et al. 2012), issues of wayfinding in these environments warrant specific investigation. As no research has been identified relating to wayfinding specifically by people with ID in healthcare environments, the following review of research about hospital environments focusses on wayfinding by the general population.

Prior to a survey undertaken by Dalke et al. (2006)(commissioned by the UK NHS Estates) little was understood of the impacts of various aspects of a hospital visual environmental on wayfinding. Their research involved a survey of staff and patient expectations in 20 hospitals and identified a need for a guide for non-professionals who were often responsible for refurbishment strategies. Their survey also highlighted that hospital design needed to be improved if it were to comply with the Disability Discrimination Act, including addressing optimisation of colour and light and giving special attention when refurbishing older existing buildings.

i) General elements that contribute to wayfinding

In undertaking a study to identify elements of a healthcare environment that affect wayfinding, Pati, Harvey, Willis and Pati (2015) noted that few studies had identified factors influencing wayfinding in hospitals. In their study, 10 participants visited a hospital and verbalised information while wayfinding, then responded to a questionnaire. They found that physical design elements (e.g., signs) contributed to wayfinding by providing navigational information and familiarity markers and concluded that the physical environment has a critical role in aiding navigation.

Morag, Heylighen, and Pintelon (2016) suggest that poor wayfinding is not only stressful for people visiting a hospital but also adds additional costs due to lost time helping people, missed appointments and additional security to stop people going into the wrong areas. They felt that previous exercises to identify wayfinding problems had been unsuccessful and therefore undertook a study using a questionnaire about wayfinding to see if that would better highlight problem areas. Nine hospital sites were given the questionnaires and results revealed many problems that other approaches had missed including problems with main entrances, hallways, directional signs, elevators and other spaces.

ii) Accommodating varying levels of user stress

Wayfinding design in hospitals needs to accommodate use by staff, visitors and patients who may be experiencing vastly differing levels of stress (NHS-Estates 1999). Stress can affect a person's ability to handle information and therefore undertake wayfinding (Baskaya, Wilson and Özcan 2004). Staff may be under stress due to the need to get work completed to schedule or the need to be rapidly available in the event of emergencies (NHS-Estates 1999). For visitors and patients, levels of stress may depend on the reason for their visit (NHS-Estates 1999). Solutions may include:

- making sure buildings do not cause confusion and add to levels of stress (Aspinall 2001)
- using appropriate colours and lighting to reduce stress (Dalke et al. 2006)
- ensuring people know where they are and how to get to the destination (Dalke et al. 2006).

iii) Managing and controlling the complexity of building layouts as the hospital develops over time

Hospitals often comprise a number of interconnecting buildings that can make them difficult to understand (Passini 1996). However, as they develop over time, recognisable landmarks can be lost, new inter-connections are established and older buildings are removed leaving the original wayfinding scheme totally inadequate (Dalke et al. 2006; Huelat 2007). Solutions may include:

- designing a hospital to a master plan that can be upgraded (Huelat 2007)
- ensuring buildings layouts remain easy to understand (Baskaya, Wilson and Özcan 2004; Huelat 2007)

- ensuring ongoing design maintains adequate visual access between and within buildings (Dalke et al. 2006)
- ensuring adequate and appropriate lighting is maintained (Dalke et al. 2006).

iv) Providing appropriate lighting levels for the diversity of uses and users

Research by Dalke et al. (2006) found that hospital lighting was often poorly maintained, focussing more on task than overall use and suggested some solutions:

- ensuring lighting design made people feel confident to enter the hospital buildings and or certain areas (Brown, Wright and Brown 1997; Dalke et al. 2006)
- designing for variations in light levels that occur across day and night (Dalke et al. 2006).

2.5 Summary

Using Perry's (1995) structured approach, this chapter has provided a review of publications and research relating to:

- the general research problem area: wayfinding and building access
- the boundary of the research problem: people with intellectual disability, and
- the specific research problem: wayfinding by people with intellectual disability.

From this review, it is apparent that despite a range of detailed research studies in allied areas (e.g., wayfinding skills and abilities, cognitive mapping, route learning), the evidence to encourage improvement in wayfinding features within buildings, specifically to allow access by people with ID, is based on self-reporting and anecdotal information. Some studies about wayfinding by people with ID have used virtual environments to simulate wayfinding (Farran et al. 2015), but very few have studied participants using building features whilst wayfinding inside a real building, notably; Riley (1995); Salmi, Ginthner, and Guerin (2004); Smith and Adkins (2006) and Salmi (2007a). Interestingly, Riley (1995, 98) noted in her study that, "further attention must be devoted to the aspects of the built environment that facilitate wayfinding". Despite this call in 1995, the current literature review has found very few studies comparing actual wayfinding performance by adults with intellectual disability and typically developing adults undertaking exactly the same task (i.e., measuring use and success of building features in wayfinding).

Having developed a comprehensive survey of research about aspects of wayfinding in this chapter, the next chapter will discuss the research philosophy that underpins the current study.

Chapter 3:

Research Philosophy and Implications for Research Design

3.1 Introduction

This chapter provides a description of the various philosophical approaches to research to give context to the researcher's own philosophical stance, provides a description of research paradigms and then declares the current researcher's worldview underpinning the approach to this study. The chapter ends with a description of the three components of that world view; the ontology, epistemology and research methodology.

Johnson (2005, 5) suggests that research is "a procedure used to view and re-view the world in order to understand it". It involves a combination of both experience and reasoning to discover the truth (Cohen, Manion and Morrison 2007). However, research differs from simple personal experience in three ways: research is systematic and controlled, it is empirical relying on experience for validation and is self-correcting with mechanisms to protect from error (Cohen, Manion and Morrison 2007). Whilst research may provide knowledge, the interpretation of that knowledge is affected by the researcher's own beliefs and influences about the nature of knowledge itself (i.e., their research philosophy). As Egbert and Sanden (2013, 31) suggest, "research is not an objective endeavour, as much as we often try to have it look like one".

Individuals possess unique conceptual frameworks, or combinations of beliefs and understandings based on the accumulation of experiences in which they have been immersed across their lifetimes (Egbert and Sanden 2013). These experiences form a person's existence and are responsible for creating, for each individual, a slightly different ability to perceive the world, including a unique understanding of knowledge (Egbert and Sanden 2013). When constructing and carrying out research, a researcher cannot "turn off their selves and ignore their beliefs and perceptions" (Egbert and Sanden 2013, 25). Their beliefs, perceptions and experiences influence how the research is approached and conducted (Egbert and Sanden 2013; Killam 2013).

It is important, therefore, for the researcher in this current study to declare a philosophical stance in order to provide context for the approach used for the enquiry.

3.2 Philosophical approaches to undertaking research

Historically, the various approaches to research philosophy have been grouped into broad categories, based on the shared beliefs of the researchers within those groups. However, there is inconsistency in literature in the grouping, naming and characterising of the research represented by each category (Killam 2013). Some commentators ascribe to an ‘either-or’ scenario, where worldviews are condensed into two ‘opposing’ concepts of research. The overarching difference appears to be between a scientific, pure approach on one side and a more applied research approach on the other side. Fellows and Liu (2008) describe pure research as developing knowledge, contributing to the body of theory and aiding a search for truth, whilst applied research seeks to solve practical problems where adding to knowledge is more incidental. Bailey (1997), on the other hand, suggests that research can be divided between ‘quantitative’ and ‘qualitative’ approaches, although this may be viewed more as describing the research method than research philosophy. The two approaches are described in detail in chapter 4, Sections 4.7 and 4.8.

Cohen, Manion, and Morrison (2007) suggest two different groupings, one based on the reasoning behind the process (deductive/inductive) and one based on a perceived worldview (traditional/interpretive). Deductive reasoning “consists of a major premise based on an a priori or self-evident proposition, a minor premise providing a particular instance, and a conclusion” (Cohen, Manion and Morrison 2007, 6). Cohen, Manion, and Morrison (2007, 6) suggest the example: “All planets orbit the sun. The earth is a planet. Therefore, the earth orbits the sun”, which “assumes, through a sequence of logical steps that a valid conclusion can be deduced from a valid premise”(6). Inductive reasoning, on the other hand, involves studying a number of individual cases to develop a better understanding (Cohen, Manion and Morrison 2007; Saunders 2009). The second of Cohen’s groupings is the traditional/interpretive comparison. A traditional view holds that social and natural sciences are the same and are concerned with “discovering natural and universal laws regulating and determining individual and social behaviour” (Cohen, Manion and Morrison 2007, 7), whereas the interpretive view considers the social and natural sciences but also “emphasizes how people differ from inanimate natural phenomena and, indeed, from each other” (Cohen, Manion and Morrison 2007, 7). The traditional view could be linked to the quantitative approach mentioned earlier, and the interpretative view linked to a qualitative approach.

The categorisation of research philosophy does not fit easily within an “either/or” framework, because, as Fellows and Liu (2008, 7) suggest, the classification of research philosophy “is difficult, not only due to the use of 'fuzzy' definitions but, more importantly, because the work occurs within a continuum“. In other words, the various philosophies

(referred to as paradigms) are not discrete, but change linearly along a continuum. The positioning in general and the juxtaposition of various conceptual approaches along the continuum provides guidance on the relative groupings of similar conceptual ideas as well as the nature of each approach and what it entails. There is, however, some confusion over the number of and terms used by authors in describing paradigms (Mackenzie and Knipe 2006). A review of research by Mackenzie and Knipe (2006), Killam (2013), Fellows and Liu (2008) and Guba and Lincoln (1982) indicated the following major paradigms: positivism, post-positivism, critical theory and constructivism. A brief explanation of each paradigm has been provided in order to give context to the researcher's declared philosophical stance in conducting this research.

3.3 Research paradigms

A research paradigm provides a set of beliefs and a way of thinking (a worldview) and provides a framework to guide research and enquiry (Guba and Lincoln 1994; Killam 2013; Lincoln and Guba 2000; Mackenzie and Knipe 2006; Saunders 2009). They influence the shape of the research undertaken and the methods chosen (Creswell 2007; Fellows and Liu 2008). No paradigm should be considered better than any other (Guba and Lincoln 1994). As Guba and Lincoln (1994, 108) suggest, "they are all inventions of the human mind and hence subject to human error. No construction can be incontrovertibly right". A paradigm simply represents "the most informed and sophisticated view that its proponents have been able to devise" (Guba and Lincoln 1994, 108). However, given that a paradigm can affect choice of methodology, it is important for a researcher to clarify his or her research paradigm (research philosophy) at the outset of a research study so the reader can consider the approach and methodology for the study in the context of this paradigm (Mackenzie and Knipe 2006).

3.3.1 Positivism

Positivism is considered "the oldest and most historically accepted way of approaching scientific enquiry" (Killam 2013, 22). It is a rationalistic paradigm (Guba and Lincoln 1982) that is sometimes called the "received view" (Guba and Lincoln 1994; Killam 2013) or scientific method (Mackenzie and Knipe 2006). The paradigm is an objective inquiry, considered to be 'value free' because values are specifically excluded on the basis that they are confounding variables that would be detrimental to discovering the truth (Guba and Lincoln 1994). According to Egbert and Sanden (2013, 42), "meaning exists independent of the consciousness of any individual" and therefore, the inquirer's voice becomes that of a disinterested scientist (Guba and Lincoln 1994).

Positivism "searches for the truth or facts about reality" (Killam 2013, 21). Essentially, it is implementing a reductionist view, assuming the existence of a common rational structure to help resolve any questions of difference (Guba and Lincoln 1994). It attempts to relate solutions towards the empirical world (Lincoln and Guba 2000), where "causes probably determine effects or outcomes" (Creswell 2003, 7). The research, therefore, focuses on asking about issues that prompt definitive answers (Egbert and Sanden 2013) and seeks to verify hypotheses often using mathematical (quantitative) means (Guba and Lincoln 1994). There is a view that only quantitative data is valid and of high quality (Sechrest 1992). Saunders (2009) suggests it is a lower-risk research strategy.

As proponents of the potentially opposing philosophy of constructivism, (Guba and Lincoln 1994) provide criticism of the positivist approach to research by suggesting that it:

- diminishes the role of the context in which the observer and participants exist
- lacks insight and creativity to see how research results can be applied
- disregards the meanings behind behaviours
- fails to use evaluation information
- develops theories that have little or no meaning for the participant
- lacks applicability to individual cases.

3.3.2 Post-positivism

The belief system underlying post-positivism is essentially the same as positivism (Guba and Lincoln 1982). It still takes a scientific approach (Creswell 2007) but suggests that "objectivity is a useful but not necessarily attainable ideal in natural settings" (Egbert and Sanden 2013, 59). It is not possible to be so "positive about claims of knowledge when studying the behavior and actions of humans" (Creswell 2003, 7). As Egbert and Sanden (2013, 7) suggest, "reality is multi-layered and complex and a single event can have multiple interpretations".

Post-positivism arose from criticism and reaction to the positivist viewpoint (Guba and Lincoln 1994) and was one of the early departures from positivism (Killam 2013) occurring just after World War II (Mackenzie and Knipe 2006). Furthermore, post-positivism takes a broader view of theory underpinning research by acknowledging that there may be a number, not just the one being tested, that relate to any specific research (Cook and Campbell 1979) and that all theory is provisional and capable of being challenged (Mackenzie and Knipe 2006).

Even though post-positivism has made a shift away from the strict scientific approach of positivism, it is, nonetheless, still considered to be "value free" (Guba and Lincoln 1994) and the research process still has “elements of being reductionist, logical, an emphasis on empirical in data collection, cause-and-effect oriented and deterministic based on a priori theories “ (Creswell 2007, 20).

3.3.3 Critical theory

Critical theory is an even further shift away from positivism than post-positivism (Guba and Lincoln 1994). It is sometimes also referred to as the transformative, neomarxist, feminist, or participatory paradigm (Mertens 2010). Whilst positivist ideology favours deduction, critical theory looks to a combination of both deduction and induction (Saunders 2009). Critical theory is primarily used to guide research that focuses on social justice (Egbert and Sanden 2013; Killam 2013) and the daily experiences of people within their own environment (Egbert and Sanden 2013). It therefore also differs from the previous positivist and post-positivist paradigms in that values are actually given greatest importance (Guba and Lincoln 1994). The process of identifying truth involves looking at the political environment and hidden agendas of the social environment rather than through experimentation (as in the positivist paradigm) (Egbert and Sanden 2013). There is no longer a single truth to be discovered but many, and this can be achieved through a series of insights that transform over time (Guba and Lincoln 1994). Guba and Lincoln (1994) suggests that advocacy and activism are central to this paradigm approach and that processes of confrontation and conflict are used to critique and transform the social environment. This paradigm approach now receives much greater acceptance and recognition from the research community with research being accepted by journals and funding agencies (Guba and Lincoln 1994).

There are a number of variants to the critical theory paradigm, two of which (transformative and pragmatic) may be pertinent to the approach to the current research study.

a) The transformative paradigm

This arose during the 1980s and 1990s (Mertens 2010) because of dissatisfaction with the existing paradigms that “did not adequately address social and marginalised peoples” (Creswell 2003, 9). Creswell (2003, 9-10) also notes that transformative researchers wanted greater political involvement with a view to reform that could “change the lives of the participants, the institutions in which individuals work or live, and the researcher's life".

b) The pragmatic paradigm

This paradigm "is not committed to any one system of philosophy or reality" (Mackenzie and Knipe 2006, 4), but as the name implies, takes a more pragmatic view of advocacy and social justice by accepting that a combination of outcomes are possible. There may be some identifiable truths but also a number of realities dependent on the participants involved. For example, research might suggest that a person who is non-ambulant and wheelchair-bound is unable to walk (a truth) and therefore describe the person as disabled. Yet, the impact to the person of being wheelchair-bound may be minimal and therefore, in their view they are not "disabled', thus opening a debate on what is 'reality' for a person in a wheelchair. As Creswell (2003) suggests, the researcher needs not only to focus on the 'what' (in the example: the fact that the person is in a wheelchair) but also on the 'how' (in the example: how will this affect their daily activities). Creswell (2007) notes there are many forms of pragmatism, but as a general theme, the research problem is central.

This paradigm more than any other, therefore, provides the "philosophical framework for mixed methods research" (Tashakkori and Teddlie 2010, 95), where researchers can use both quantitative and qualitative methods to obtain the "best understanding of a research problem" (Creswell 2003, 12). Creswell (2003) suggests that pragmatism is not based on any one philosophical approach and therefore researchers have a freedom of choice of methods to use. Truth is what works at the time. Creswell (2007, 23) summarises the paradigmatic approach well by suggesting that "the individual using this worldview will use multiple methods of data collection to best answer the research question, will employ both quantitative and qualitative sources of data collection, will focus on the practical implications of the research, and will emphasize the importance of conducting research that best addresses the research problem".

3.3.4 Constructivism

In constructivism, knowledge is subjective, rather than objective, and therefore not measurable through experiment (Egbert and Sanden 2013). Emphasis is placed on the context of the research (Fellows and Liu 2008) and the participants' experiences (Creswell 2003; Killam 2013). The researcher's role is that of passionate participant (Guba and Lincoln 1994). Knowledge is individual and personal to the participant rather than imposed from external events; this knowledge affects the participants' perceptions of their worlds and the events that occur within it (Egbert and Sanden 2013). Each person's worldview is likely to be different from others (Fellows and Liu 2008; Johnson 2005).

Constructivists do not generally begin with a theory, but rather collect data and develop a theory to explain that data (Crotty 1998; Mackenzie and Knipe 2006). This approach uses predominantly qualitative methods (Crotty 1998; Guba and Lincoln 1982; Mackenzie and Knipe 2006) to help find sense from the collected data (Crotty 1998), although a mixture of qualitative and quantitative methods may be used where quantitative approaches reinforce the qualitative data (Mackenzie and Knipe 2006). According to Saunders (2009), collection and analysis takes longer using inductive methods and, as a result, can potentially extend the duration of a research project. There is also concern, according to Saunders (2009, 127) that "no useful data patterns and theory will emerge" in the constructivist approach.

There are a number of subsets of constructivism. Three are discussed below: social constructivism, interpretivism and participatory/advocacy/participative.

a) Social constructivism

A social constructivist worldview acknowledges that others impact on our interactions and therefore how we discover truth (Egbert and Sanden 2013). Research within social constructivism can be guided by a number of theoretical perspectives including feminist theories, critical theory and critical race theory (CRT), queer theory, and disability theories (Creswell 2007). Research using disability theory within a social constructivist worldview extends the depth of enquiry to incorporate knowledge and understanding about the meanings of inclusion and the life experiences not only of those with disability, but also to those who are either related to or assist people with disability (Creswell 2007). This very clearly shows the move in disability research from the positivist "experiment" to the constructivist "participant experience". Creswell (2007) suggests that the social constructivist approach now encourages research that more clearly identifies people with disability as individuals who have differing experiences. Whilst disability theory may provide the theoretical underpinning to the research and an understanding of disability itself, the research process in social constructivism is not guided by a theory, but rather relies on the result of inquiries to "develop a theory or pattern of meaning" (Creswell 2007, 21). Whilst the positivist view is that researchers should be separated from participants, in social constructivism the researcher finds him or herself closely interacting with participants. Researchers have to recognise, therefore, that their own background can shape their interpretation and the position they take with regard to participant responses (Creswell 2007). Research processes must be rigorously tested to ensure observation and recording of participant interactions are made without bias. Researchers can then use this qualitative data to "make sense [of] (or interpret) the meanings others have about the world" (Creswell 2007, 21).

b) Interpretive

Social constructivism can also be aligned with interpretivism to create another perspective for researchers. Creswell (2007) suggests there are various communities of qualitative researchers each having a “distinct body of literature and unique issues of discussion” (Creswell 2007, 23). The positions these communities hold provide a specific lens through which the research and data are viewed.

c) Participatory/Advocacy/Participative

Another subset of constructivism is the participatory/advocacy/participative approach (Creswell 2003). In this approach the research contains a political action agenda for reform that “may change the lives of participants, the institutions in which they live and work, or even the researchers' lives” (Creswell 2007, 21). Issues addressed focus on “empowerment, inequality, oppression, domination, suppression, and alienation” (Creswell 2003, 70). Similar to social constructivism, the research is intended to address marginalised or disenfranchised groups or individuals (Creswell 2003) relating to feminism, racial discourse, queer theory and disability

3.3.5 Which is better?

The above discussion implies that paradigms are discrete and exclusive indicating perhaps some sort of competition between approaches (Saunders 2009). As discussed earlier in this chapter, this competitive stance tends to imply that a researcher can only ascribe to one or other of these paradigms and that historically the only appropriate and valid approach to research is within the positivist paradigm. Realistically, however, there is no way to prove that any paradigm is better than any other (Johnson 2005; Killam 2013) and ‘choosing between one position or the other is unrealistic in practice” (Saunders 2009, 109).

3.4 Research philosophy underpinning the current study

The research philosophy that underpins the approach to the current research is influenced by the researcher’s own worldview developed through personal experience and beliefs. The next section describes that worldview and how the research philosophy developed.

3.4.1 Researcher's worldview

It is important for a researcher to define their position or worldview as it directs everything they see and do as a researcher (Killam 2013; Saunders 2009). Guba and Lincoln (1994) go so far as to suggest that it could even be more important to define the paradigm applicable to the research than to declare the research method/s used. By stating a worldview, researchers are acknowledging that they are starting a project "with certain assumptions about how they will learn and what they will learn during their inquiry" (Creswell 2003, 6). The researcher's beliefs provide a rationale for the researcher's approach in developing the research study (Killam 2013) and will affect research design, data collection, analysis and presentation of results (Egbert and Sanden 2013).

The worldview for the researcher in this present study has been informed and altered by life experiences. In earlier years, the current author was a novice painter and musician. In these fields, meaning was in the eye of the beholder and emotion depended on a setting or personal set of circumstances. There was no hard fact, no single reality. It was particularly subjective, qualitative and constructivist. Later, the author became a quantity surveyor (measuring quantities of building material from drawings and administering building projects based on defined contract conditions). This world had a hard reality, where truth was evident from the written word or the lines on a drawing. It was scientific, quantitative and positivist. This sharply contrasted with the subjective world of art and music. Yet there was a fine balance and an acknowledgement that each approach suited the circumstances. This researcher's worldview was of pragmatism. Later in life, however, the author married and had children, one of whom has an intellectual disability. In trying to understand the life experiences of a child with intellectual disability, the researcher's previous pragmatist view was challenged by a more social constructivist worldview. There is no single characteristic that can describe all people with disability. Truth is found in the multitude of realities they experience. In the researcher's view, therefore, research about disability should not be based on assumptions that there will be a single common truth, but in understanding the richness in the diversity of truths.

With respect to research for this study, the current researcher's worldview is, therefore, predominantly one of social constructivism, but at the same time accepting a more pragmatic paradigm in some aspects of disability. This worldview, therefore, guides the researcher's approach to research with people with ID. As discussed later, it also allows for a range of methodologies, often described as mixed methods, to address the research aim and objectives.

3.4.2 Components of the researcher's worldview

Research paradigms are supported by a specific conceptual framework of components that helps explain the research rationale and methodology. The framework, according to Creswell (2007), comprises ontology (what is knowledge), epistemology (how we know it) and methodology (the processes for studying it). Hitchcock and Hughes (1995, 21) suggest that "ontological assumptions give rise to epistemological assumptions, which in turn give rise to methodological considerations" and then to data collection. The following section describes how the declared social constructivist worldview informs the content of the paradigm framework.

a) Ontology

The research process expects discovery of truth or truths. Ontology can be used as a process by which a researcher explains his or her understanding of truth. However, determining what is real or true depends on a person's beliefs about the nature of reality (Killam 2013). To this end, Cohen, Manion, and Morrison (2007, 7) ask the fundamental questions about truth in a social context; "is social reality external to individuals — imposing itself on their consciousness from without", "of an objective nature" and "a given 'out there' in the world", or the "product of individual consciousness", "individual cognition" and "created by one's own mind"? The researcher's worldview is more in line with the latter, which is the realist position contending that "objects have an independent existence and are not dependent for it on the knower" (Cohen, Manion and Morrison 2007, 7).

Killam (2013, 8) provides another way to assess the researcher's ontological belief by asking the question: "Is there one reality that is context-free and can be discovered, or multiple mental constructions of reality that are bound by context?". In the context of this study, the researcher's answer would be the latter, as reality is the result of individual cognition (providing opportunity for several truths dependent on situation and participants).

b) Epistemology

Epistemology asks, "what is the nature of the relationship between the knower (or would-be knower) and what can be known" (Guba and Lincoln 1994, 108). It has also been described as "the individual lens, created through our worldview, that we use to understand knowledge in the world" (Egbert and Sanden 2013, 38), or as (Killam 2013, 8) succinctly explains it, "how we come to know what we know". The relationship between knower and what can be known, however, is not random, but is constrained by the researcher's ontological belief (Guba and Lincoln 1994). Therefore, in declaring an ontological belief, the researcher defines his or her epistemological approach to discovering knowledge and the associated

research methods that would be used in the process (Cohen, Manion and Morrison 2007; Crotty 1998; Guba and Lincoln 1994; Saunders 2009). For example, a researcher whose ontological belief is one where truth exists irrespective of an individual's actions or beliefs (i.e., an objective viewpoint), will ascribe to a more objectivist epistemological stance (i.e., positivism, post-positivism, etc.), whereas a researcher who believes that multiple truths can exist based on an individual's experiences and environment, will ascribe to a more subjectivist epistemological stance (i.e., constructivism). Killam (2013, 8) suggests that a researcher's epistemological approach could be assessed by asking; "Does the researcher believe that the relationship with participants should be objective or subjective?". Cohen, Manion, and Morrison (2007, 7) suggest "how one aligns oneself in this particular debate profoundly affects how one will go about uncovering knowledge of social behaviour" and, particularly, will impact on the questions a researcher will ask, the methods he or she will use to collect data and the meaning ascribed to the results (Egbert and Sanden 2013).

The current researcher's previously declared ontological approach that multiple truths could exist, therefore, determines that the epistemological approach for this current study is one of social constructivist. Declaring this approach, in turn determines and helps justify the types of methodologies and methods that the researcher has used.

c) Research methodology

The research methodology is the manner in which knowledge is discovered in a systematic manner (Killam 2013) and methods used can vary, influenced by both the researcher's ontological and epistemological beliefs (Egbert and Sanden 2013; Killam 2013; Mackenzie and Knipe 2006) as well as the nature of the research being undertaken (Egbert and Sanden 2013). Once chosen, the research methodology guides the researcher's activities for the remainder of the research study (Denzin and Lincoln 1994; Egbert and Sanden 2013).

3.4.3 Quantitative, Qualitative or Mixed Methods

Historically, two methodological approaches, quantitative and qualitative, have been used. A quantitative methodological approach aligns with the philosophical stance of positivists and post-positivist because it involves identifying variables and hypotheses and uses measurement and observation (Creswell 2003; Egbert and Sanden 2013). Qualitative approaches on the other hand, align more closely with the constructivist viewpoint, looking at individual experiences in order to develop theory or enhance advocacy/participatory approaches (Creswell 2003). More recently, however, researchers have sought to expand their research design by implementing different methods to enrich their findings (Creswell

2003), choosing to use ‘mixed methods’, a combination of both quantitative and qualitative methodologies.

Quantitative

The quantitative method provides answers to specific questions based on numerical data that is analysed statistically (Creswell 2003). It is linked to the scientific method approach, using precise aims and objectives to test hypotheses and asks “what, how much, how many?” (Fellows and Liu 2008, 9). Data produced are immediate or cross-sectional (e.g., testing concrete strength, consumer use of products) (Fellows and Liu 2008). Data is collected using instruments that provide statistical data (Creswell 2003), requiring controlled environments in order to identify a particular aspect of reality (Johnson 2005). The researcher isolates a variable in order to predict or demonstrate a causal relationship (Johnson 2005). Positivist researchers may choose to use this empirical approach (Egbert and Sanden 2013).

Qualitative

In the qualitative method, researchers “take the world as they find it instead of trying to manipulate conditions to isolate variables” (Johnson 2005, 7). The method seeks to find the meaning people attribute to events and processes (Fellows and Liu 2008) and can provide a deeper understanding of the research topic (Egbert and Sanden 2013; Johnson 2005). Data collected can be in the form of verbal or written text or recorded observation (Creswell 2008), using a number of approaches including “narrative, phenomenology, grounded theory, ethnography or case study” (Creswell 2007, 101). There is a view however, that only quantitative research provides valid and high quality data (Sechrest 1992). Morrow (2005) undertook an investigation of how research results obtained through qualitative approaches have been judged and offered strategies for conducting and writing qualitative research reports. Morrow (2005) suggests that, for trustworthiness, qualitative methodologies require “sufficiency of and immersion in the data, attention to subjectivity and reflexivity, adequacy of data, and issues related to interpretation and presentation”.

Mixed methods

Qualitative and quantitative methods are often considered as opposing approaches because they emanate from potentially opposing paradigmatic positions (quantitative from a positivist paradigm and qualitative from a constructivist paradigm) (Egbert and Sanden 2013). However, the polarisation of methods is not that rigid. Egbert and Sanden (2013) suggest that there is a place for combining both methodologies because it provides “the best of both quantitative and qualitative approaches” (Creswell 2003, 22). Mixed methods tend to be used by researchers who believe in a more pragmatic approach to research, in particular

for the social and human sciences, where combining methods helps to address differing requirements within the research study and cancel or neutralise potential biases from either method (Creswell 2003). Results can be generalised, whilst the methods still provide opportunity for in-depth investigation of issues (Creswell 2003).

According to Creswell (2003), mixed methods can be undertaken as a sequential or concurrent process. In the sequential process, the researcher starts with one methodology and then uses the other (for instance, starting with quantitative to identify the scope and issues and then develop a better understanding of those issues using in-depth qualitative analyses). In a concurrent process, both quantitative and qualitative data are collected simultaneously allowing integration of both forms of information in the analysis of results.

3.4.4 Chosen approach

In this current study, the researcher has chosen to use mixed methods for the following reasons:

- It aligns with the researcher's declared social constructivist epistemological stance, which "acknowledges the impact of others around us and our social interactions with them, on our ways of discovering truths"(Crotty 1998, 22).
- It helps "capture the best of both quantitative and qualitative approaches" (Creswell 2003, 24) in the process of data collection and method of analysis
- It can provide rigour to the results (Killam 2013)
- It suits research in areas where a topic has rarely been investigated based on a certain participant type (Morse 1991); in this study, participants with ID.

3.5 Summary

This chapter has explained the various philosophical stances that influence approaches to research and has identified the researcher's own philosophical stance. The researcher's philosophical stance is a social-constructivist research paradigm, with an ontological underpinning that supports the view of multiple truths to be discovered. The declared epistemological stance favours constructivism and, in alignment with this view, uses a mixed-methods research methodology.

Having established and justified the research philosophy underpinning this research study, the following chapter explains the research methods, including approaches to data collection and analysis.

Chapter 4:

Research Methods and Approach to Analysis

4.1 Introduction

The preceding chapter provided information about the researcher's worldview and culminated in the researcher declaring a social constructivist viewpoint. Given that this viewpoint indicates a belief that there is more than one perceivable truth in research, it follows that the research method used for this current study is a mixed methods approach (using both quantitative and qualitative methods). This chapter describes the methods used to collect and analyse both quantitative and qualitative data and concludes with statements about the validity and reliability of the research methodology and the ethical standards for this study.

4.2 Review of previous research methods

In order to achieve the aim of the research study, information needed to be collected about the use of wayfinding features by people with ID and by people who are typically developing. A review of data collection methods used in previous research about wayfinding by people with ID was undertaken to assess whether methods used might suit the current study. Three data collection methods were identified and are discussed in the following sections.

i) Methods assessing variation in wayfinding capability

Methods used in this category were generally experimental in nature, involving testing in laboratory-like settings to identify levels of capability in areas such as spatial ability, spatial processing and memory. Many researchers used a quantitative approach; Pani, Mervis, and Robinson (1999) manipulated figures and shapes in their experiment to assess spatial processing; Caron et al. (2004) observed wayfinding through a life-sized labyrinth to assess the spatial abilities of people with high functioning autism; Reck, Hund, and Landau (2010) tested memory for object locations by moving objects within a box; and Mammarella et al. (2009) tested the ability of children to process spatial information by using verbal descriptions to see if they could recall and correctly locate landmarks in a box. Whilst offering excellent insight into the difficulties that may be encountered in wayfinding, the methods sought information about the participants' abilities, rather than the wayfinding

environment. As such, they were not pertinent to the aim of this research study and therefore not included as part of the current study.

ii) Methods testing assistive technology

These methods focussed on manually and/or electronically collecting data about the efficacy of technology to help in wayfinding. Generally, they involved observing a journey using electronic data collection. During a period from 2006 to 2011, a number of research publications were produced about the use of technology and assistive devices for wayfinding by people with ID. These included wizard-of-Oz techniques (Liu, Hile, Kautz, et al. 2006; Liu et al. 2008; Liu et al. 2009; Liu, Hile, Borriello, et al. 2006), using RFID tags attached to parts of a building (Chang, Chen, et al. 2008; Chang et al. 2010; Chang, Wang, et al. 2007), using QR-Codes attached to parts of a building to send the signals to a handheld PDA (Chang, Tsai, et al. 2007; Chang, Tsai and Wang 2008; Tsai 2007) and Bluetooth sensors (Chang et al. 2009; Chang, Chu, et al. 2008; Chang and Wang 2010a). Much of the data is based on similar experimental conditions, with variations in the device being tested and the reporting of the studies follows a similar format. Participants had to find their way around a building using an assistive device (such as a PDA) that would give them guiding instructions. Experimenters followed the participants for safety, to collect additional data and to assist other experimenters in sending navigation advice. Whilst utilising observation for data collection, the studies focussed entirely on assessing the benefit of using a device to help in wayfinding and were not, therefore suited to the current research study.

iii) Methods that identified aspects of the built environment affecting wayfinding by people with ID

Data for these studies were collected using the following methods:

Self-reporting of past experiences: using techniques such as group discussion (Disability Rights Commission 2004a; Sohlberg et al. 2005), consultation with stakeholders to obtain opinions from targeted groups or individuals (Mencap 2004) and interviews (sometimes in association with other collection methods such as observation) to obtain in-depth personal information about experiences (Antonakos 2004; Beveridge and Wiegand 2000).

Analysis of case studies: using case studies to assess the efficacy of existing wayfinding systems within a built environment (Disability Rights Commission 2004a; ODPM 2006).

Recording output of a current wayfinding systems: using self-reported or automated collection of data to gather ongoing information about the ease of wayfinding in a particular facility Brown, Wright, and Brown (1997).

Observation of actual wayfinding: using either participant observation (where the observer participated in some way with the people being studied) or non-participatory observation (where the observer remained completely detached from the participant) (Caldwell and Atwal 2005; Creswell 2008; Dudley 2005). The environment in which observation occurred was either computer generated (a virtual environment) or real and the choice of environment depended on the purpose of the research and what aspects of the environment were being considered. Data from observation was recorded either manually or through electronic means using different techniques.

Using manual recording of data

Abu-Ghazzeh (1996) used two observers in a study about wayfinding in a university building. During the observation, one observer documented all actions, gestures, directions, etc., whilst the other encouraged each participant to verbalise their actions and thinking. Smith and Adkins (2006) used manual recording to observe four participants during a visit to a shopping mall, choosing to use note-taking in preference to tape recording as the tape recorder would be too intrusive and might affect the experience for the participants. Notes were taken at salient points in the conversation about the environment travelled and the route taken. Farran et al. (2010) manually recorded participant wayfinding choices during observation to test route learning and the effect of landmarks. Participants were first guided through the route and then undertook the route themselves during which the number of correct decisions made at choice points were recorded. Courbois et al. (2012) used manual recording to count the number of incorrect turns, pauses at junctions and use of participant-identified objects (the landmarks) during a wayfinding exercise.

Using taped recording

Passini et al. (1998) used tape-recording to collect data about wayfinding decisions by people with dementia. The research occurred within a hospital environment, utilised recorded observation of decisions and analysed the outcomes based on those decisions. The approach to data collection and analysis used in that study helped to inform the current researcher's own methodology. Research by Rainville, Passini, and Marchand (2001) builds on that of Passini and discusses the benefit of interrogating participants whilst recording their wayfinding exercise. Salmi, Ginthner, and Guerin (2004) and Salmi (2007a) also based their research on studies by Passini, utilising tape recording to study environmental factors in wayfinding and decision making.

Using video recording

Sohlberg et al. (2007) and Fickas, Sohlberg, and Hung (2008) used video observation to study the effects on route finding as a result of prompts (aerial map, point of view map, text based instructions, audio direction) delivered via a handheld device strapped to each participant's wrist. Researchers accompanied the participant while observing and manually recording data on the participants' responses and behaviours. At the same time a videographer video-taped the subject. Tape from the trials was scored by a third researcher to assess inter-rater reliability. Lemoncello, Sohlberg, and Fickas (2010) used video observation again in their investigation of getting lost behaviour and wayfinding strategies by people with acquired brain injury.

4.3 Chosen methods for data collection in the current study

Having reviewed the previous approaches, a mixed methods approach, aligning with the researcher's social constructivist philosophical viewpoint, was chosen that provided the means to capture relevant data in order to address the research aim.

The methods used comprised:

- *Quantitative*
    - Video observation and statistical analysis of participant trips through a hospital building (i.e., evidence-based) and
    - Statistical analysis of Likert scale questions administered during post-visit interviews (see Appendix B).
- *Qualitative*
    - Analysis of responses to open-ended questions discussed in post-visit interviews.

A mixed methods approach allowed not only collection of statistical data about levels of success in actual wayfinding, but also the opportunity to further investigate the personal feelings and experiences of participants with respect to their wayfinding activity that might add meaning to the statistical analyses.

4.4 Choice of location

The location chosen for the practical wayfinding exercise needed to present participants with a reasonably complex wayfinding task (i.e., complexity of layout, intensity of wayfinding

information, choice of route and other environmental factors) in order to generate a depth and breadth of data about factors affecting wayfinding. However, if the complexity was such that few participants were able to reach the required destinations then the exercise would have limited research value and be wasteful of the participant's time and effort. It also needed to be a location where participants would likely visit at some point in their lives. The literature review findings (chapter 2, Section 2.4.3.d) described how hospitals and health care facilities presented particular wayfinding difficulties and were visited reasonably regularly by people with ID. Consequently, a major hospital in Perth was chosen as the location for the observation. Permission was requested from the hospital to undertake the research in their facility and ethics approval was obtained from the hospital authority (See Appendix C).

4.5 Sample size

As the research study used both quantitative and qualitative methods, the researcher needed to ensure that the sample size would be sufficient to reduce sampling error (Creswell 2008). Qualitative approaches are typically based on smaller sample sizes (Mason 2010) for their in-depth analyses, whilst quantitative approaches tend towards using larger sample sizes for statistical analysis (Onwuegbuzie and Collins 2007). As the same participants for this study would provide data for both quantitative and qualitative analysis, a sample size needed to be found that would satisfy the rigour expected for both approaches (Onwuegbuzie and Collins 2007). Deciding on a sample size in qualitative studies is contentious as there are no clearly defined principles for assessing appropriate size. Ethical considerations may constrain the number of participants given the extent of invasiveness or discomfort a qualitative research approach may cause (Green and Thorogood 2009). This was a concern for the current research participants for whom the impact needed to be minimised to the extent required only for the research itself. Mason (2010) undertook a survey of 560 studies from PhD theses that used a qualitative approach and found that the mean sample size was 31. Ritchie, Lewis, and Elam (2003) suggest that sample sizes in qualitative studies may be dictated by the point at which sufficient meaning has been obtained from the data collected. This was called the principle of saturation by Glaser and Strauss (1967). The initial intention was to hold 30 interviews with a view that this could be expanded to achieve data saturation. In this research study, however, it was found that the first 30 participants had yielded data saturation.

For quantitative research, Cohen, Manion, and Morrison (2007, 101) suggest 30 is "held by many to be the minimum number of cases if researchers plan to use some form of statistical analysis on their data" and therefore the sample of 30 also met minimum expectations for the

quantitative component. A review of literature about past research on wayfinding by people with ID found that studies relied on much smaller sample sizes, possibly due to difficulties in accessing participants from the disability community. It is a strength of the current study, therefore, by comparison to these previous studies, that there were 30 participants with ID in the main group and 30 TD participants in the control group.

4.5.1 Obtaining the samples

The current study objectives required comparison between the use of building features by people with ID and typically developing people. Consequently, two samples needed to be identified: one comprising adults with intellectual disability (the 'Main group"), the other comprising typically developing adults (the Control group'). The sampling frames (populations) from which samples need to be chosen were: adults with ID (the 'Main' group) and typically developing adults (the 'Control' group). As the chosen research methodology is mixed methods, both quantitative and qualitative data were to be collected from the same participants, indicating a concurrent, identical sampling design (Onwuegbuzie and Collins 2007). A non-random convenience sampling method (Creswell 2008, 155; Onwuegbuzie and Collins 2007, 286) was used to obtain a sample that met the required selection criteria for each group (discussed later in this chapter). Given that sampling for both quantitative and qualitative methods was based on non-random sampling it would be classified as Type 4 (frequent combination) on the 'Matrix crossing type of sampling scheme by research approach' used by Onwuegbuzie and Collins (2007) (see Appendix D).

Potential participants from both groups were provided with an information sheet and consent form that used simple and clear terms (see Appendix E) to explain the purpose of the research and the actions required of them in participating. Once confirmed as a participant in the study, each participant was given a code name to maintain the confidentiality of their involvement in the study (see Appendix F for details of the coding regime).

4.5.2 Sampling for the main group

The "main group" comprised adults with mild ID who have the capacity to independently attempt the wayfinding exercise and who might have reasonable success in reaching the required destinations. This precluded those with moderate and severe intellectual disability who would most likely require assistance from a parent, guardian or carer, rather than being able to independently find their way. No distinction was made between the varying types of ID as there is still uncertainty of the cause of ID in over 50% of cases (Castell 2014); using only those where the cause was known would therefore exclude over 50% of the population.

To be able to identify participants suitable for this research it was necessary to identify criteria that would meet the needs of this research study. The criteria are not and should not be considered as a definition of disability. The criteria for the main group (see Table 4.1) are similar to those established by Salmi (2007a) in her study about wayfinding by people with ID, primarily because they are equally pertinent to the current research study, but also because they have been successfully used in a research study to identify difficulties for people with ID in wayfinding (albeit, a different aspect of wayfinding).

Table 4.1. Sampling Criteria for the Main Group (Participants with ID)

Criteria	Explanation
Between 18 and 65 years old	
Have an IQ between 50 and 70	Eligibility for registration with the Disability Services Commission in Western Australia required a person to have an IQ of 70 or below and, on that basis, were also eligible for a Disability Support Pension (DSP). Meeting this selection criteria could be demonstrated by a participant receiving a DSP as a result of ID. The criteria were verified in discussion with a participant and/or carer/guardian, with the participant's consent.
Be able to walk without difficulty (or easily move around with a wheelchair)	In order to undertake the wayfinding exercise at the research location, the participant was required to be able to walk (or move freely using a wheelchair)
Be able to see clearly (including use of glasses and/or contact lenses)	In order to independently undertake the wayfinding exercise, the participant would need to be able to have reasonable vision for distant objects, signs and directions
Be able to hear clearly (including use of hearing aid)	It would be necessary for participants to hear conversation or sounds that might affect wayfinding
Be able to talk to people and let them know what is wanted	It was considered appropriate for participants to have some ability to talk with people during the wayfinding exercise
Speak English all the time	The participants were required to communicate with the researcher during the wayfinding exercise in order to describe the reason for actions, their thoughts etc. and also, subsequently, to take part in an interview about their wayfinding experience. An ability to speak English was therefore essential
Be able to understand signs that mean "stop", "exit" and "toilets"	This criterion was used to identify a minimum level of cognition for wayfinding aids. Although required, it did not imply that the person needed to know how to process the information to support wayfinding. Potential participants were asked to explain each term.

Organisations that provided support and social activities for people with ID were identified and approval was granted to ask whether members were interested in participating in the research study. Information sheets about the research study (see Appendix E) were circulated to members and then individual members made it known if they were keen to participate. Given that gender may impact on wayfinding ability the study sought to provide a similar

number of male and female participants. The method of sampling was non-random convenience sampling (Creswell 2008, 155; Onwuegbuzie and Collins 2007, 286), to obtain a balance of participants based on gender and the above criteria. The resulting participant group composition is shown in Table 4.2.

Table 4.2. Profile of Participants for Main Group

	Age range						Gender	
	18-25	26-30	31-35	36-40	41-45	Over 45	Male	Female
No. of participants	21	4	2	0	0	3	14	16

4.5.3 Sampling for the control group

Eligibility criteria for people within the control group to participate in the research is shown in Table 4.3.

Table 4.3. Sampling Criteria for the Control Group (TD participants)

Criteria
Between 18 and 65 years old
Be able to walk without difficulty (or easily move around with a wheelchair)
Be able to see clearly (including use of glasses and/or contact lenses)
Be able to hear clearly (including use of hearing aid)
Be able to talk to people and let them know what is wanted
Speak English all the time

Given the nature of the research topic, it was considered appropriate for control group participants to have some understanding of ID, either through contact with people with ID or through some form of training or academic instruction. This could allow control group participants to not only reflect on their own wayfinding experience but also on the possible implications for people with ID. Participants were therefore initially sought through university education degree programs at Curtin University and subsequently, due to lack of volunteers, through convenience sampling from people working for care organisations involved in caring for people with ID. Information and consent forms were provided to participants about the research study (see Appendix E).

The method of sampling was non-random convenience sampling (Creswell 2008, 155; Onwuegbuzie and Collins 2007, 286) in order to obtain participants based on gender, awareness of intellectual disability and the above criteria. The resulting participant group composition is shown in Table 4.4.

Table 4.4. Profile of Participants for Control Group

	Age range						Gender	
	18-25	26-30	31-35	36-40	41-45	Over 45	Male	Female
No. of participants	22	1	2	1	3	1	14	16

Once both sample groups had been identified, each participant was allocated a code number to maintain confidentiality of individual involvement in the research (see Appendix F for details of the coding regime).

4.6 The pilot study

An initial pilot study for both the observation and interview processes was undertaken involving two people with intellectual disability and two typically developing people. These participants were not included in the subsequent research data collection. The purpose of the pilot study was to trial the observation and interview processes. A number of issues arose that needed resolving. Table 4.5 indicates the issues and how they were resolved.

Table 4.5. Issues Arising from Pilot Studies and Resolution

Issues	Resolution
Assess the feasibility of video-taping participants in a hospital environment	Video-taping was feasible but care is needed to avoid videoing of non-participants
Practice video-taping so that future visits are not affected by technical issues	The researcher and assistant were fully conversant with the video-taping process
Assess the viability of asking participants to take three separate journeys	The time commitment for three trips (a, b and c) and attending the interview was acceptable
Ensure the routes to reach each destination were sufficiently complex and provided sufficient wayfinding decisions to generate the necessary volume of data for analysis	Starting points for Trip a and Trip b had to be altered to provide sufficient wayfinding complexity
Identify any issues that participants may experience in interacting with the dynamic, noisy hospital environment that might be a risk to participants	Participants managed interaction with the hospital environment with minimal risk (However, this risk would be continually monitored during the observation visits)
Establish a reasonable time limit within which participants could comfortably reach each destination	Individual trips were completed in times ranging from two to seven minutes. A maximum observation time of 15 minutes was therefore established for each trip. This would allow participants adequate time to find the destination, but not prolong the trip and cause anxiety in circumstances where a participant was having difficulty finding the destination
Ensure interview questions were clear to participants and would provide data pertinent to the research aim	Interview questions were clear and appropriate for collection of data

4.7 Quantitative data - collection and analysis

There were two quantitative data collection processes undertaken for this current study: observation and Likert scale interview questions.

4.7.1 Observation

a) Data collection

Participant video observation was used to record participant actions and conversations during a series of real-world wayfinding exercises, informed by the processes used by Abu-Ghazzeh (1996), Passini et al. (1998), Courbois et al. (2012), Rainville, Passini, and Marchand (2001), Sheehan, Burton, and Mitchell (2006) and Lemoncello, Moore Sohlberg, and Fickas (2010) . Observation provided "a better understanding of the wayfinding task" (O'Neill 1991b, 282). The observation was considered participant observation[13] because activity was recorded while accompanying participants in their wayfinding trips. However, the observers did not participate in any decision-making for wayfinding.

A real-world, rather than virtual or experimental wayfinding environment was chosen to elicit reactions based on a dynamic nature of a real-world location. Whilst both real and virtual environments can create feelings of being lost, in the real world this may constrain exploration. Research by Diemer et al. (2015) assessed creation of perception and presence using virtual reality and found limitations in the ability to generate some emotions. In relation to using a virtual environment for this current research, therefore, a participant knows that he or she never leaves the current testing location but is simply experiencing representations of other locations. As such, this may limit development of feelings of anxiety and nervousness experienced in the real world and may encourage participants to make unrealistic decisions and/or take risks they would not otherwise have made. A real-world experience, therefore, was considered more appropriate.

Video recording had the benefit of capturing actions and decisions in the environmental context within which they occurred, and record activities leading up to and as a consequence of those actions and decisions. It allowed repeated in-depth review of the recorded journey in order to identify the salient points for this research and allowed second-by-second coding of actions and events that would not have been feasible with manual data collection methods.

[13] Participant observation occurs where the observer actually takes part in the activity being observed and at the same time records the observation (Creswell 2008). Non-participant observation is where the observer watches and records the activity from a suitable location but does not experience the activity that the participant undertakes (Creswell 2008). In the current study the observer and assistant accompanied the participant in the wayfinding exercise (although not assisting the participant), hence it has been termed participant observation.

Participants made their own way to the hospital or, if required, were collected from a venue and driven to the hospital by the researcher. Whilst some participants were brought to the hospital by family members, friends or support workers, they did not accompany the participant during the observation or interview process. The observation component required each participant to undertake three separate wayfinding trips: Trip a) to find the eye clinic reception counter, located on the ground floor in the Outpatients department, Trip b) to find the nurses enquiries counter in Ward G64, located on the 6th floor and finally, Trip c) to exit the building from Ward G64 by any means (e.g., lift, stairs).

The participant's trip to each location was video-recorded using two separate cameras; one held by the researcher walking beside the participant in order to capture verbalised thoughts and actions as well as where the participant looked and another camera held by an assistant walking approximately three metres behind the participant to capture where the participant went, what was happening along the way (environmental factors such as light, noise and crowds) and the participant's interaction with other people and use of wayfinding features (e.g., maps, signs, directories). These videos were synchronised and combined into a single side-by side video for coding, resulting in 179 separate videos of wayfinding journeys (one participant did not undertake the third trip). The videos provided a record of participant activity and information used during wayfinding and provided the means to compare activities and performance between adults with and without intellectual disability. The videos showed where participants made decisions along the route in order to reach the destination. Previous studies have identified these locations as 'decision points' (Janzen 2006; Malkin 1989; Mondschein, Blumenberg and Taylor 2005; O'Neill 1991b; Passini 1984a) and have suggested that they are good points at which to situate wayfinding information so that it is seen, used and remembered (Golledge 1999a; Golledge and Stimson 1997; Janzen 2006). Given their impact on wayfinding, therefore, decision points were chosen as the basis for analysing the video data.

Participants were taken to the start point (the Art Gallery in Block A) and asked if they were still comfortable in undertaking the task. Two participants with ID decided at this point that they did not want to proceed with the exercise and were accompanied back to their respective places of residence. As a result, two further participants were identified, using non-random convenience sampling, to replace those participants and maintain comparable sample sizes for the main and control groups.

At the start of each trip participants were given a card showing the name of the destination.

- Trip a: Eye Clinic Reception Counter in the Outpatients Department.
- Trip b: Enquiry counter in Ward G64.

- Trip c: Out of the building (using any exit).

The number of times a participant referred to the card was recorded. Once a destination was reached participants were given a short break and then given the next card. Participants were advised that they could ask members of the public or hospital staff for directions.

During each journey the following information was obtained:

- A video-taped recording of locations visited and features used for wayfinding.
- A video-taped recording of participants explaining their actions.
- Time taken (recorded via the video-taping).
- Distance travelled (recorded by the assistant wearing a pedometer).

During the journeys, participants were encouraged to think aloud to indicate what they were looking at, why they chose to go in certain directions and how they were feeling. Care was taken in these conversations to avoid influencing participant wayfinding decisions.

As a result of the pilot study, a maximum period of 15 minutes for each trip was deemed sufficient time for participants to find the respective destination (see Table 4.6). If participants had not reached the destination by this time, observation was stopped and participants were accompanied to the destination they were attempting to find. The 15-minute time-period was considerably beyond any of the times recorded in the pilot studies and therefore participants in the main study were not informed of the time limit, in order to avoid observation becoming a race and/or creating unnecessary anxiety.

Observation continued until the participant reached each destination or the maximum observation period of 15 minutes had been reached. Durations for each trip were recorded. If the participant was not close to the destination after 15 minutes, the wayfinding exercise was stopped and the participant was guided to the pertinent destination for that journey. This occurred in 21 separate trips, all by participants with ID. Care was taken to debrief these participants to avoid feelings of failure.

Coding the observations

A coding structure was created, based on the decision point process identified by Arthur and Passini (1992), to capture and record data from the video observations. Information needed to be recorded about the type of decision point, wayfinding information available at that point, the relevance of that information and ultimately the wayfinding outcome from the

decision point. Analysis of this data would then help identify which aspects of the environment affected wayfinding by adults with and without intellectual disability and provide the ability to compare the two groups to isolate any specific issues for people with ID.

For the purposes of coding, layout diagrams were drawn for each building and at all levels, dividing areas into coding zones (e.g., L1 meaning lift lobby 1, C14 meaning corridor 14). Each layout diagram showed information about the features within the zone (e.g., S1a meaning sign "1", side "a"; D1 meaning directory "1", M1 meaning map "1"). See Figure 4.1 for an example of one of the layout diagrams. Information about each feature was recorded including its relevance for each trip (based on whether the feature provided specific information to aid the participant in reaching the required destination).

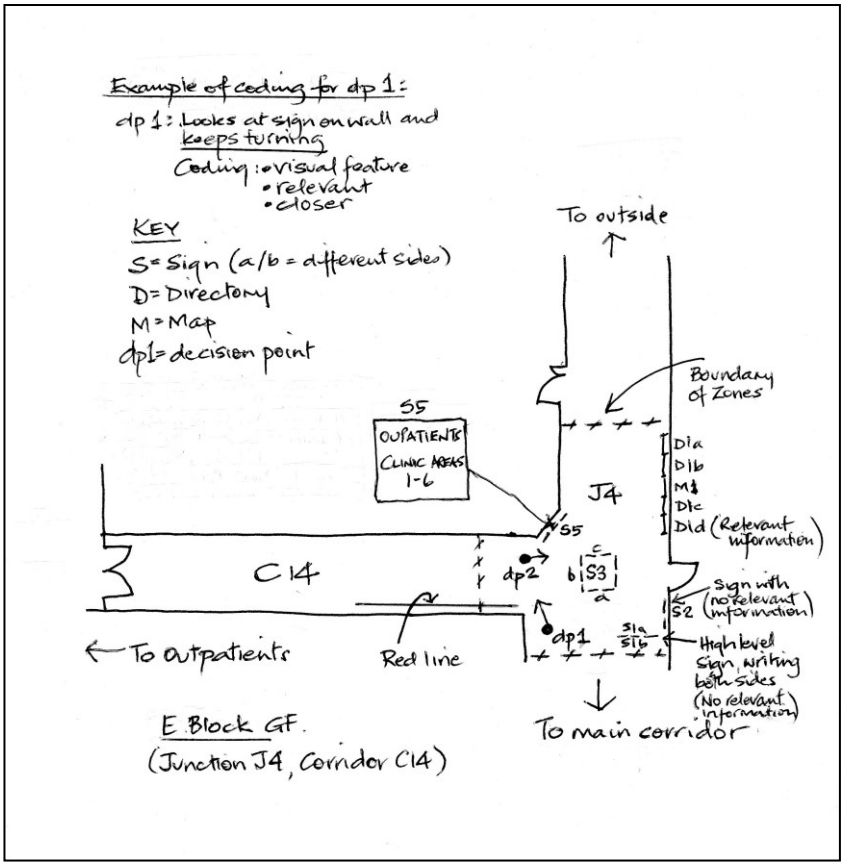


Figure 4.1. Hand-drawn zone layout showing coded features and decision points (dp). (Note: Some features and 'dp' coding have been removed to make explanation of the process clearer.)

There were four levels of coding for each decision point (see Figure 4.2). These levels were:

- *Level 1*: identifying the existence of each decision point.

- *Level 2*: identifying the type of decision point based on the feature being used. Initially coded as ‘cue’, ‘layout’ or ‘other’ (this was later recoded based on feature type: spatial, visual, sensory or supportive to better reflect the type of features identified).
- *Level 3*: identifying whether the information was relevant for the trip being taken. On this basis, a sign may be relevant for one trip, but not relevant for others.
- *Level 4*: identifying the outcome of the decision. Getting closer to or no further away from the destination was considered *success*. Getting further away from the destination was considered *failure* (see Figure 4.3 for more information).

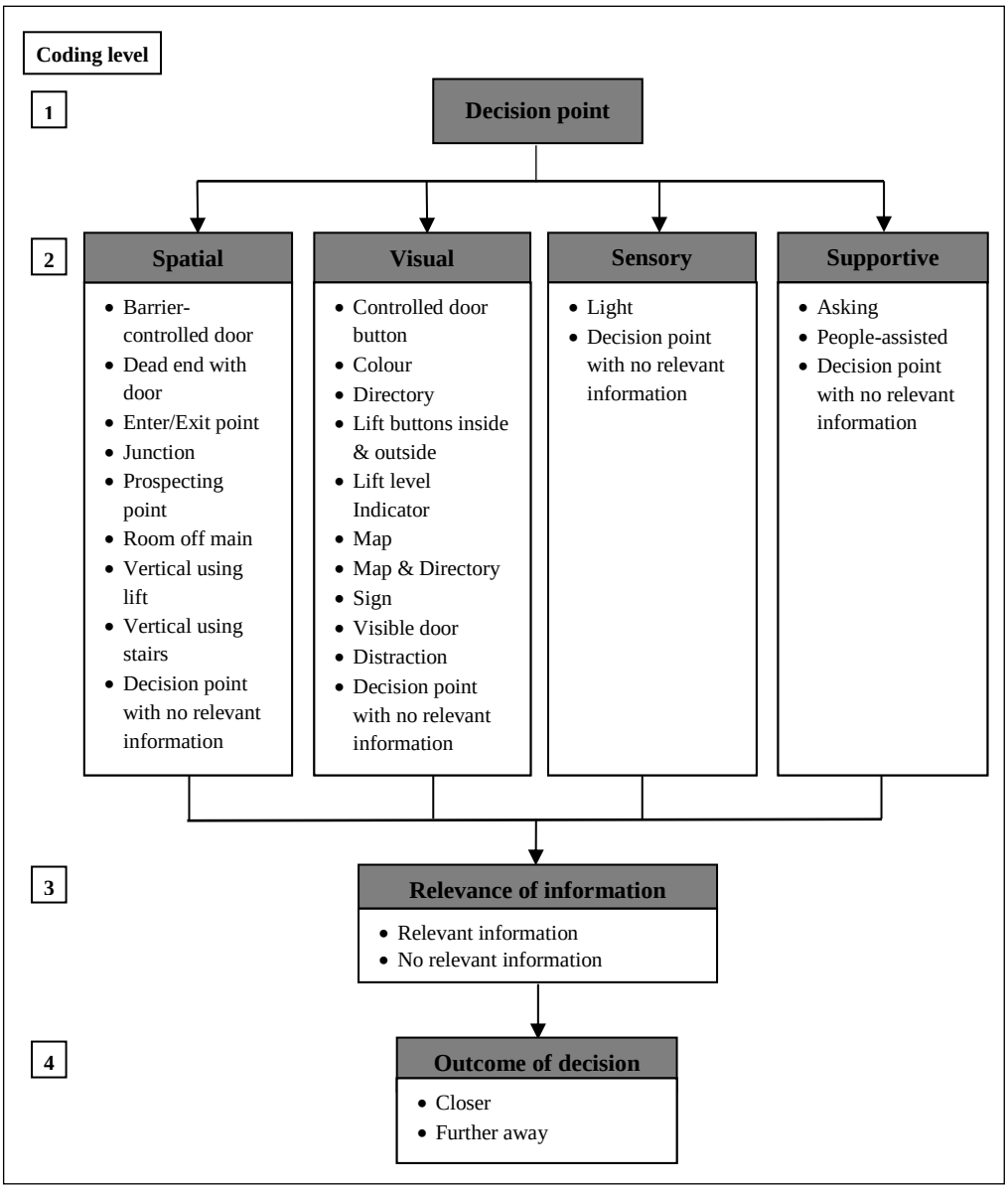


Figure 4.2. Coding structure for video observation

As a result of initial coding there were 109 differing variables. This was a significant number and deemed unnecessary for the purposes of the analysis. To assist in reducing the number of variables, all features within a component that had no relevant information for a specific trip were grouped into one feature (e.g., spatial features with no relevant information). This was considered appropriate as the type of feature is irrelevant if it contained no relevant information. Some sub-types of feature (e.g., sign high on wall, sign at eye level on wall, sign on ceiling) were also reviewed and combined. After this review, the number of features was reduced to 26. These features became the variables for use in the analysis of success between participant groups and in assessing the influence of features on wayfinding success.

Figure 4.3 provides an explanation of three scenarios that explain how the coded outcome was decided. With so many pathways to get to a destination, it would be extremely complex to identify the shortest route at every decision point. The decision of ‘closer’ or ‘further away’, therefore, has been assessed on the same basis used by O'Neill (1991b, 273), that further away “is scored when the participant makes a turn in a direction that is incongruent with a more efficient completion of the wayfinding task”.

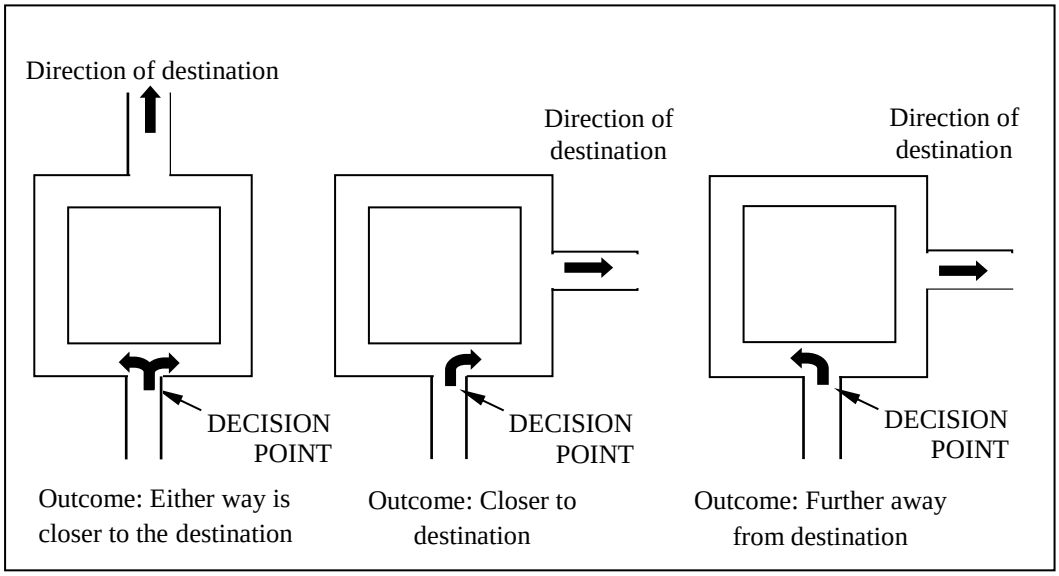


Figure 4.3. Assessing the outcome of a decision point

Creating a code book

After a decision point had been identified from the video, it was drawn on the relevant layout diagrams along with a coding sequence (showing levels 2, 3 and 4 coding) (see Fig 4.1, dp1 and dp2). In this way, the layout diagrams collectively became a code book, providing consistency in the coding of similar decisions at similar points in the building.

Coding the videos

ProcoderDV coding software, created by Prof Jon Tapp from the Vanderbilt Kennedy Center in the USA (Tapp 2003), was chosen for time-based coding of the videos. The program was specifically designed for observation analysis and therefore allowed coding of actions against a running timeline. It provided a video player screen to play back the observation video and a linked coding section in which the observed events could be recorded and coded (see Figures 4.4 and 4.5). The previously described coding structure was entered into the program prior to coding. Coding was carried out by playing the video until a codable event was identified. The event was entered into the inbuilt time-based spreadsheet that contained the previously designed coding structure and then the video was restarted. Once a trip had been coded, the program exported the spreadsheet as a *.csv file for use in MSExcel.

Figure 4.4. Side-by-side video recording

Time	Point type	Read	Dec pt	Pr/ref	Reason	Layout	Other	Cue	Nat of info	Outcome
0:00:00.00										
0:00:06.59							start			
0:00:28.05	dec pt		dec pt	prosp	other		just prospecting		no relevant	closer to destination
0:00:39.42	dec pt		dec pt	pr/ref	layout	room off main			no relevant	closer to destination
0:00:43.33	dec pt		dec pt	prosp	cue			sign	no relevant	closer to destination
0:00:46.49	dec pt		dec pt	prosp	layout	left or right turn			no relevant	no closer
0:00:49.43	dec pt		dec pt	prosp	layout	left or right turn			relevant	further away
0:01:12.56	dec pt		dec pt	prosp	cue			asking	relevant	closer to destination
0:01:52.08	dec pt		dec pt	prosp	cue			col code	relevant	closer to destination
0:01:53.06	read card	read card								
0:01:55.52	dec pt		dec pt	prosp	other		just prospecting		no relevant	closer to destination
0:01:57.74	read card	read card								
0:02:10.17	read card	read card								
0:02:42.38	dec pt		dec pt	prosp	cue			sign-wall eye level	relevant	closer to destination
0:02:51.61	read card	read card								
0:02:56.61	dec pt		dec pt	prosp	cue			col code	relevant	closer to destination
0:03:07.17	read card	read card								
0:03:11.43	read card	read card								
0:03:14.69	dec pt		dec pt	prosp	cue			sign	no relevant	further away
0:03:29.45	dec pt		dec pt	prosp	cue			sign	no relevant	no closer
0:03:34.93	dec pt		dec pt	prosp	cue			asking	relevant	closer to destination
0:04:20.89	dec pt		dec pt	prosp	cue			sign-wall eye level	relevant	closer to destination
0:04:31.62							reached destination			

Figure 4.5. Extract of coded information from MSExcel

The exported MSExcel file was identified as the master 'Journey Coding" document. Using Excel formulae, data from the document was used to create a spreadsheet suitable for comparing success between groups in using each wayfinding feature. Information was collected for 26 variables and was used in the comparison exercise described in chapter 5, Section 5.4.2.c.

b) Data analysis

Coded data were analysed for two purposes:

- To compare the success between participant groups in using each feature from the observation
- To assess the influence of features on overall wayfinding success

The process undertaken for each of these analyses is described in the following sections.

i) Comparing the success between participant groups in using each feature from the observation

Data about the frequency and success by each participant group in using each feature were extracted from the coded observation spreadsheet and entered into SPPS. An independent samples t-test, using Levene's test for equality of variances and a confidence interval of 95% (Horn 2017), was undertaken to assess the significance of the difference between groups for each feature. Results are discussed under relevant headings within chapter 5.

ii) Assessing the influence of features on overall wayfinding success (based on time taken to reach destinations)

Data preparation

This analysis is based only on trips where participants reached the destination. By necessity, therefore, data from trips where the participant did not reach the destination before the 15-minute deadline were excluded. Consequently, the analysis was based on 89 trips by TD participants (29 for trip a, 30 for trip b and 30 for trip c) and 67 trips by participants with ID (25 for trip a, 18 for trip b and 24 for trip c).

For the analysis, successful wayfinding was defined as reaching the trip destination on or before the statistical mean time taken for that trip by the respective participant group. This was defined as the dependent variable and was defined as either success (1) or fail (0). See Table 4.6 for mean trip times.

Table 4.6. Mean Time For Trips

Trip	Main Group (ID) Mean time (seconds)	Control Group (TD) Mean time (seconds)
A	396.00	233.79
B	663.33	500.00
C	310.00	264.00

The independent variables were the 26 different types of decision points identified from coding the observation data as noted above. The value of the variable for each participant's trip/s was based on the probability of success of that participant when using the feature, calculated as follows:

$$\text{Probability} = \frac{\text{No. of Successes}}{\text{(No. of successes + No. of failures)}} \times 100\%$$

The following attributes were given to the probability of success:

Attribute 1: probability between 0-20%.
Attribute 2: probability between 21-40%.
Attribute 3: probability between 41-60%.
Attribute 4: probability between 61-80%.
Attribute 5: probability between 81-100%.
Attribute 6: variable was not used.

For example, if a participant used a variable four times, but on only one occasion got closer, then the attribute would be calculated thus:

$$\text{Probability} = \frac{1 \times 100\%}{4} = 25\%$$

This would be shown as attribute 2 (being between 21-40%)

In this way, scoring of variables was based on a probability of success.

Data analysis

Initially, a logistic regression was undertaken (Sperandei 2014) to predict the effect of features on time taken. Analysis of results, however, could not identify which feature was more important than any other for the two participant groups in overall wayfinding success. Subsequently, a random forest classification (Breiman 2001) was undertaken to see if this process would provide clarity about the impact of features on wayfinding success. Random forest is a classification method based on the principle of decision tree analysis and combines many trees to create a "forest". A more detailed explanation of this process is provided in Appendix G. Using the same dependent and independent variables and attributes, as discussed above, the random forest classification process was able to provide

data about the varying influence of different features on predicting success in wayfinding and was therefore used to analyse data in this study.

Random forest classification was used to create a model that could predict, within a given percentage accuracy (72% for the TD participant group and 79% for the ID participant group), whether a wayfinding trip would be successful or not (based on time taken). Data from the observed trips (described above in the section on data analysis*)* were used to train and test the model. The model was then used to provide a score, called the Mean Decrease Accuracy (MDA), which ranked features according to their ability to affect prediction of an outcome (either success or fail), therefore identifying the most influential in predicting either wayfinding success or failure.

Wayfinding success or failure, however, is not dependent on one feature alone but on a combination of features. Assessment of whether a feature's influence (based on MDA) would increase success or failure, therefore, needed to be considered in combination with all other features used in a trip. To assess whether the identified MDA ranking would improve success or increase failure, further investigation was undertaken of the observation data from the study. Contingency tables were created (see examples in Figure 4.6), to compare the extent of successful use of a feature in relation to the most common outcome of trips in which it was used. This information, combined with the ranking of features by their mean decrease accuracy (MDA), provided the means for assessing the influence of features on wayfinding success.

CONTROL GROUP – Example Contingency Tables

Only categories 4 and 5 have been included (6 means the variable was not used in a trip and 1, 2 and 3 are negligible success rates)

Feature X01 **Probability attributes**

	0	**1**	**2**	**3**	**4**	**5**	**6**
No. of times used in:							
Failed trip:					1	2	30
Successful trip:					0	0	56

RESULT: 3 Fail, 0 Success

Most common outcome of trips in which feature was used: FAIL

Feature X08 **Probability attributes**

	0	**1**	**2**	**3**	**4**	**5**	**6**
No. of times used in:							
Failed trip:		0			1	14	18
Successful trip:		1			0	12	43

RESULT: 15 Fail, 12 Success

Most common outcome of trips in which feature was used: FAIL

Feature X16 **Probability attributes**

	0	**1**	**2**	**3**	**4**	**5**	**6**
No. of times used in:							
Failed trip:			1	6	8	18	0
Successful trip:			0	1	6	48	1

RESULT: 26 Fail, 54 Success

Most common outcome of trips in which feature was used: SUCCESS

Figure 4.6. Contingency tables indicating the most common outcome of trips

Features with the greatest benefit for wayfinding success would be those, therefore, that had the greatest ability to influence the wayfinding outcome (based on MDA ranking) and that on evidence from the current study were used in trips that were predominantly successful (based on time taken). Features with the least benefit for wayfinding (unless redesigned or their use reconsidered by designers) would be those that had the greatest ability to influence a wayfinding outcome but had been used in predominantly unsuccessful trips (based on time taken) in the current study.

Table 5.29 in chapter 5 shows the results of this ranking of features.

4.7.2 Likert scale questions from the interview document

a) Data collection

Following the observation, semi-structured interviews ranging between 20 and 45 minutes in duration were conducted with each participant. A number of Likert scale questions were included in the semi-structured interviews in order to obtain participant perceptions about various aspects of their wayfinding experience and personal preferences. Likert scale questions were specifically chosen as they provided ordinal data to assess and compare participant attitudes towards various aspects of wayfinding within the study site. As such, they provided knowledge to support the aims and objective of the research study. The content of questions (e.g., asking which features they preferred and how much they liked each feature) were based on features identified through the review of published literature about wayfinding. Likert scale questions were grouped into two sections:

- *General wayfinding*: asking about finding destinations, aspects of the building, recalling journeys, knowing where to go and using wayfinding cues (signs, landmarks and the like).
- *Environmental considerations*: asking how the participant felt during the journeys (i.e., nervous, unsafe, helpless); aspects of the environment, asking about noise, light, surface textures, smell and other issues.

Providing Likert scale questions in the interviews immediately following each participant's trip also gave participants the opportunity to rate their experience and the various features within the study site, whilst still fresh in their mind. The scale terms used in the Likert scale questions were carefully crafted to provide understanding for both TD participants and

participants with ID. A copy of the semi-structured interview questionnaire document is included in Appendix B, which shows the Likert scale questions.

At the end of the interview each participant was offered a gift voucher of $25 as a token of appreciation for undertaking the activity.

b) Data analysis

Response data from the Likert scale questions were entered into SPSS. Comparison between participant groups was undertaken using cross-tabulation. A Chi-square test was used to compare results between participant groups for each of the Likert scale questions (McDonald 2014). Whilst cross-tabulation identifies the extent of difference between the sample mean distributions of two groups, the results may also be influenced by a trend (i.e., that participants with ID generally may or may not have greater difficulty than TD participants) and therefore it is better to not only review the significance of the difference in means (using the Chi-Square test) but also to review the significance of the difference in the trend means between groups. This can be achieved by using linear-by-linear association (Howell 2017) described in the SPSS results.

4.8 Qualitative data - collection and analysis

4.8.1 Thematic analysis of interviews

a) Data collection

Following the observation, as previously noted, semi-structured interviews were conducted with each participant ranging from 20 to 45 minutes in duration. Interviews were audio recorded and recordings transcribed for each of the 60 participants. Some conversations with people with ID were more difficult to transcribe as they contained sounds and/or partial words. Nonetheless, transcription meticulously recorded all interaction.

Interview questions were of two types;

i) *Questions as a follow up to the participant's score in a Likert question*: these questions sought explanation for the score given in the Likert scale and were often specific to a single feature or aspect of the environment. As a result, opportunity for broad and deep discussion was limited. For some questions, participants gave no more than a single sentence answer, others may be two or three sentences.

ii) *Separate questions seeking participant opinion*: these questions elicited more conversation, but still provided limited options for analysis.

b) Analysis

The NVivo 11 Pro software (Version 11.3.2.779) was used as both the means for storing the participant answers to open-ended interview questions and for thematic analysis. Thematic analysis is a "method for identifying, analysing, and interpreting patterns of meaning ('themes') within qualitative data" (Clarke and Braun 2017, 297) and is acknowledged as being flexible in the sample sizes, the questions it can analyse and the way the data can be themed (Clarke and Braun 2017). It is eminently suited to analysis of interview data (Braun 2013). Theming for this study was inductive as the various themes were not defined before analysis but identified as they emerged from analysis of the interview transcripts

The content of each interview was initially allocated to a single participant node and then analysed to find themes. Figure 4.7 below gives an example of a coding process. Coding levels varied according to the nature of the initial question (e.g., "How much do you like using colour?", "What specific problems do you think someone with intellectual disability would have?").

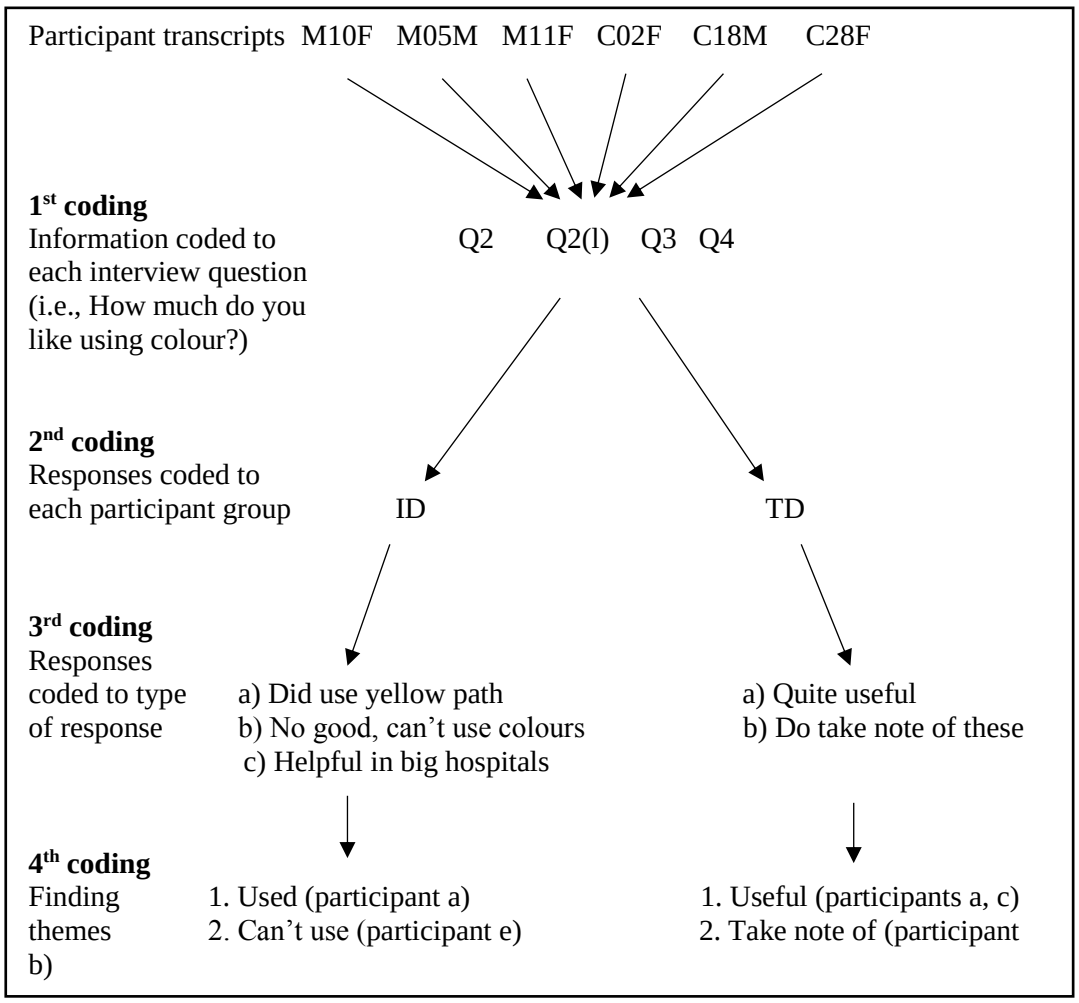


Figure 4.7. Coding sequence for interview responses using NVivo software

With often limited comments from participants, options for analysis were minimal, apart from looking for consistency in the responses. Responses to the general open-ended questions about how to improve wayfinding did provide opportunity for greater thematic analysis. Repeating comments were collated into nodes and finally condensed into tables identifying the common themes (see Appendices I to M). Where possible, tables showed the number of times a particular theme was mentioned during the interviews with all participants from each group. Tables showing consolidated data from coding are included in chapter 5.

4.9 Validity and reliability

The credibility of any research is of vital importance because others will look to that research to guide or support further research or to inform decisions. The construction and findings of the research, therefore, must be both reliable and valid. As Creswell (2008, 169) states, "if scores are not reliable, they are not valid".

4.9.1 Validity in general

Validity means that any instrument used in the research study will measure what it is supposed to measure and report scores that are valid (Cohen, Manion and Morrison 2007). It requires that "individual scores from an instrument make sense, are meaningful and enable the researcher to draw good conclusions from the sample to the population" (Creswell 2008, 169). Creswell (2008, 171) suggests that validity can be affected by a "poorly designed study", "participant fatigue" and/or an "inability to make useful predictions from scores" derived from the study. With respect to qualitative research, however, Cohen, Manion, and Morrison (2007) suggest it will inevitably have a degree of bias due to the nature of the method.

There are four common types of validity sought in research;

- Internal: that "a particular event, issue or set of data which a piece of research provides can actually be sustained by the data" (Cohen 2007, 135).
- External: the degree to which results can be generalised to a wider population (Cohen, Manion and Morrison 2007).
- Content: that questions included in the questionnaire represent all "possible questions that a researcher could ask" about the topic (Creswell, 2008,172).

- Construct: that it uses a good measure, determined by whether "scores from an instrument are significant, meaningful, useful, and have a purpose" (Creswell, 2008, 173).

Validity can be achieved in quantitative research through "careful sampling, appropriate instrumentation, appropriate statistical treatments of data, acknowledging in-built standard error in methods, and seeking controllability, replicability, predictability" (Cohen, Manion and Morrison 2007, 133). Validity in qualitative research can be achieved through trustworthiness (Guba and Lincoln 1982) and through "honesty, depth, richness and scope of the data achieved, the participant approached and the extent of triangulation" (Cohen, Manion and Morrison 2007, 133).

4.9.2 Validity in the current research study

a) Internal validity

Findings must reflect the phenomena being researched (Cohen, Manion and Morrison 2007). All observations and interview information from this study have been recorded and are therefore in a form that is auditable. Authenticity of findings for this study is achieved through the use of observation and interviews that provided participants the opportunity to show and report issues "through their own eyes" (Cohen, Manion and Morrison 2007, 136).

Internal validity in this study is achieved through triangulation using previous research, the observation study and the recorded interviews. Triangulation is useful in a social constructivist philosophy as it provides the opportunity to combine quantitative data (with defined outcomes) with qualitative data that reflects the changing nature of the social environment. Using triangulation of multiple data collection methods and analyses provides greater confidence and trustworthiness in the eventual findings (Cohen, Manion and Morrison 2007; Killam 2013).

This study used a methodological triangulation (Cohen, Manion and Morrison 2007), comprising three processes; literature review, observation and interviews. The combination of these independent approaches helped "gain insights and results, to assist in making inferences and in drawing conclusions" (Fellows and Liu 2008, 9), and as such provided a check on validity (Cohen, Manion and Morrison 2007). In chapter 5, results from the three methods are specifically compared and contrasted to see where results concurred or if there was divergence of opinion. By calling on data from three sources, the discussions were better informed and suggestions about improvements in the design of building features for wayfinding could be made with greater confidence.

b) External validity

External validity refers to the extent to which the research outcomes can be generalisable. In a positivist philosophy, this would be expected. However, in a social constructivist approach, where the environment may affect perceptions of truth, there may be less expectation, as there may be more than one truth. In social research, according to Cohen, Manion, and Morrison (2007), it is sufficient to have confidence about comparability with other environments and transferability to other similar locations, similar people, but not to every situation. The extent to which it is generalisable therefore needs to be stated.

Guba and Lincoln 1985, suggest the following risks to external validity, which are discussed in relation to this study:

- *Selection and construct effects*: The general demographics for both participant groups in this study (18 to 60 years, abilities in reading, conversing, walking and understanding) were set to be representative of the wider population. The defining difference between the two groups was whether participants had or did not have an intellectual disability. Within the confines of the sample demographics, results can be considered comparable and therefore fairly represent the wider population. The type of disability was not dictated in the selection criteria, only IQ levels. The results should therefore be generalisable to a similar section of the wider population with ID. Sample sizes of 30 are considered sufficient for observation and have therefore been determined as appropriate for generalising to a wider population.
- *Setting effect*: The observation occurred in a hospital and therefore results are based on that environment. They would most likely be comparable and transferable to other similar locations, which, according to Cohen, Manion, and Morrison (2007), is sufficient external validity for social research. In any event, many of the features experienced are common to most buildings and therefore experiences may be generalisable to a wider range of buildings.

4.9.3 Reliability

a) Reliability in general

Reliability in research “means that scores from an instrument are stable and consistent” and repeatable if an instrument were to be administered several times and at different times (Creswell 2008, 169). Reliability can be affected, for example, by ambiguous and unclear survey questions or non-standardised test procedures (Cohen, Manion and Morrison 2007).

Although difficult to achieve, it is important to strive for maximum reliability (Cohen, Manion and Morrison 2007).

Creswell (2008) suggests that reliability can be achieved in a number of ways; test-retest (the same people at two different times), alternate forms of reliability, a combination of alternative forms and test-retest, inter-rater reliability (more than one person observes behaviour of the participants) and internal consistency reliability (administering an instrument once for each person in the study).

b) Reliability in the current study

All results have been crossed-checked against the original data (from audio recording, field notes, coding, analysis and results of analysis).

For the observation study

A pilot study was undertaken prior to the main study to trial the location and data collection methods. Two participants with ID and two TD participants undertook both the wayfinding exercise at the hospital and the semi-structured interview. None of the participants from this pilot study were used in the subsequent main study. Details of the pilot study are described earlier in this chapter. The pilot study specifically investigated routes chosen to see if they were feasible and would provide sufficient and appropriate data for the study. As a result of the pilot, routes were amended to ensure sufficient complexity in wayfinding. Times were checked to establish appropriate maximum trip durations for the main study and video recording procedures. In addition, starting and finishing and general trip administration were trialled to avoid interruptions during the main study.

Participant (rather than non-participant) observationwas used in order to observe participants within the wayfinding environment. To mitigate the impact of observers being present during the trips, participants were informed about the purpose and process for video-taping their journeys and advised that observers could not participate in or advise on the participant's wayfinding decisions. In prompting participants to verbalise actions and thinking during the wayfinding process, the observers avoided any interaction that might influence the participants' wayfinding choices. Rules for each observation (e.g., fixed procedures for starting points, end points and rules about asking) provided consistency in recording and collecting data.

For the coding

The process of collecting data for this observation study (using two separate video recorders and asking participants to verbalise their wayfinding decisions) was specifically designed to

help identify participant activities during wayfinding. As the observations were recorded and combined into a single video for each trip comprising side-by-side synchronised videos, they provide a permanent record that could be reviewed at any time. Other studies of wayfinding have relied on manual recording of observation data as the event occurs, which risks the loss of observed data because events may happen too fast and provides no opportunity to review coding at a later stage. Using video avoided the pressure of having to code wayfinding activity as it happened during the visits and allowed the trips to be reviewed as many times as required in order to code actions and outcomes. As mentioned earlier in this chapter, a code book was created to help consistency in the way decision points were coded. The codebook became a coding guide for each participant trip. Reliability in coding was tested by asking another person to code a sample of videos. The new coder was given the codebook, an explanation of the observation process and training in coding the wayfinding activities. They were told that the codebook was only a guide and could be changed if they felt the sequence was not correctly recorded. The coder randomly selected data from trips by three participants with ID and three TD participants. Each trip was then coded by the new coder, using the ProcoderDV software. A comparison for similarity was made between the original coding for the 18 trips and the reviewer's coding. The total number of identified occurrences for each of the 26 variables was collated from the two coding events.

Presentation of these results follows a template suggested by Hallgren (2012). Inter-rater reliability was assessed using a two-way mixed, absolute, average-measures Intraclass Coefficient (ICC) (McGraw and Wong 1996) to assess the degree that coders provided consistency in their observation of the use of features by participants. The resulting ICC was in the excellent range, ICC = 0.97 (Cicchetti 1994), indicating that coders had a high degree of agreement and suggesting that frequency of use of features was rated similarly across coders. The high ICC suggests that a minimal amount of measurement error was introduced by the independent coders. See Appendix H for results from the inter-rater reliability test.

For the semi-structured interviews

Interviewees were fully informed about what was expected within the interview. Reliability of information obtained from the interview document was achieved by appropriately structuring the interview and interview document. The range and content of questions in the interview document were informed by previous research about wayfinding and also previous wayfinding studies. The pilot study for this research included trialling the interview document and found no changes were needed.

The interview document also provided opportunity to cross check issues by asking questions about similar topics, but from different perspectives. For instance, they were asked which

features they liked the most, why they like them, what features they found difficult to use, what helped them, and then open-ended questions to follow up on any issued raised by the participant in answering the questions, or where the observer had witnessed issues for the participant during the preceding observation exercise.

Qualitative interviews

The interviews were held immediately after the observation trips, so participants' recollection of issues was easier. They were held in the same location (Level 8 of the hospital) and recorded for future transcription. The interview questions were carefully explained to participants who may have had difficulty in understanding their meaning, ensuring no bias or influence in how the participant was to answer the question. Each interview was audio recorded for future transcription and the transcription was careful to record all words (and sounds from participants with ID) to faithfully represent the content of the discussions.

The reliability of the scope of interview questions within the interview document is supported by its similarity to a successful use of similar types of questions used by Salmi (2007a) in a study about wayfinding features. The scope of questions has also been established through extensive analysis of past literature about wayfinding using NVivo qualitative data analysis software. The reliability was further tested in the pilot surveys. Responses from participants of the pilot study indicated that questions were clear and designed to encourage conversation about wayfinding generally and individual features.

4.10 Ethical considerations

Ethical standards in research are essential and compliance is managed jointly by the National Health and Medical Research Council, Australian Research Council and Australian Vice-Chancellors' Committee. The NHMRC publish a National Statement on Ethical Conduct that addresses ethical considerations for conducting research with participants having intellectual disabilities in chapter 4.5 of the document (NHMRC 2007). The text emphasises that "people with a cognitive impairment, an intellectual disability, or a mental illness are entitled to participate in research" (NHMRC 2007, 65) and sets out principles to ensure that ethical standards are established and upheld throughout the research process. The principles and how they are upheld are discussed below using headings from the National Statement (NHMRC 2007):

4.10.1 There must be merit to people with ID in the research being undertaken

The outcome of this current research is intended to improve opportunities for people with ID to access and navigate their way through the built environment. Findings identify suggested adaptations that could be made to existing buildings and for new building design to improve accessibility for people with ID. As such the merit of the research to people with ID is inherent in the findings of the research itself.

4.10.2 Participants with ID must have the capacity to consent and participate

All participants were given information about the research and consent forms that were structured in a simple format, using language that would provide the greatest understanding by all prospective participants. The ethics committee at Curtin University gave commendation for the simplicity and clarity of the forms. With consent from prospective participants with ID, the forms were also provided to a parent, guardian or carer of the person with ID to help in ensuring maximum understanding. Copies of the Information and Consent forms are provided in Appendix E.

As a person 18 years or over, participants with ID had the legal capacity to consent to the research (unless guardianship was in place) and respect for this right was uppermost in the researcher's actions. The forms and required activity were discussed with all participants to ensure understanding about the requirements and activity involved if agreeing to take part. Care and consideration was given to discussions with people with ID to make sure they understood the forms and activity and, with their approval, were also discussed with a sibling, parent or carer who may have accompanied the person. These discussions were conducted in the presence of the prospective participant. Some participants with ID declined the request to participate and their decision was fully respected.

Research by Dye, Hardy, Hare, & Burton (2004) has suggested that incorrectly assessing the capacity for consent in this group may result in them being precluded from important research work. Hence, they suggest it would be better to base involvement in the research on the level of risk and/or benefit obtained by participating. There was no obvious likelihood of risk in their participation in this study as they were under observation from the researcher at all times.

Criteria for participating in the study were chosen, in part, because those criteria had been successfully used in a previous research study by Salmi (2007a) to obtain a sample

population for research about wayfinding through a shopping centre and office building. The criteria were sufficient to ensure that, if met, the participant would have the capacity to participate. In the event that a participant found the wayfinding too difficult, there were procedures in place in the research protocol that would mean the study was stopped and the participant counselled to ensure no feelings of disappointment.

Ethics approval for the study was obtained from Curtin University Human Research and Ethics Committee as well as from the Ethics committee of the Hospital at which the observation took place (see Appendix C for ethics consent).

4.11 Summary

This chapter has described the choice of methods to be used for the data collection and then described how those methods were enacted for this specific study. The chapter has also discussed about the validity and reliability of the research undertaken and of the findings of the research and has concluded with a discussion about the ethical principles and standard underpinning the research study. The next chapter collates and presents the results of the research methods.

Chapter 5:
Results

5.1 Introduction

This chapter collates and reports results obtained using video observation and semi-structured interview processes described in chapter 4. For clarity, the structure used to report results in this chapter broadly follows the sequence used to describe features in the literature review, with additional sections added where extra features were identified during the observation process at the hospital site. Information is initially presented about the categories of trips used for the various analyses and then results presented about wayfinding strategies, the interrelationship of physical elements, the attributes of the environment and the effect of individual components and features of the built environment on wayfinding success. The chapter concludes with results pertaining to emotional factors affecting wayfinding.

5.2 Presentation of results

Two types of data have been collected in this research study: quantitative (from coded observations and responses to Likert scale interview questions) and qualitative (from transcribed responses to open-ended interview questions). In the following presentation of results for each of the various aspects and features of wayfinding, results from quantitative and qualitative data are linked and compared to provide greater insight. The full statistical data from coded observations and Likert scale questions along with detailed thematic analysis of interview responses are provided in Appendices I to N. This chapter presents a combined summary of the detailed quantitative and qualitative data for each of the wayfinding aspects and features.

5.3 Categories of trips used in the analysis

Three categories of participant trips were identified from analysis of the observation data:

- Category 1: “Completed” trips, where the participant reached the destination within 15 minutes (156 No.)
- Category 2: “Incomplete” trips, where a participant did not want to start a trip, did not reach the destination before 15 minutes, or the trip was stopped to avoid undue stress (22 No.)

- Category 3: “Extended” trips where a participant was allowed to finish a trip that extended beyond the 15 minutes because they were very close to the destination and to avoid feelings of inadequacy (2 No.)

Table 5.1 shows which categories were used for each of the analyses described below.

Table 5.1. Types of Data Used in Analyses

Analysis	Categories	Reason for using this category of trip
Statistics for overall trip	1	Only completed trips were used in this analysis as the table compared data about completed trips
Random forest classification	1	Only completed trips were used in this analysis as it sought to identify the influence of features on wayfinding success based on time to complete
Comparison of success in using each feature	1, 2 and 3	Data from all trips could be used for this analysis as it focussed on comparing the successful use of types of features, rather than the overall success in reaching destinations

5.4 Wayfinding strategies

The hospital site used for the observation comprised a complex layout of corridors and rooms and provided no opportunity for an overview of the layout. Consequently, for participants, this favoured a linear/route based wayfinding strategy (See Chapter 2, Section 2.2.3.b.i) requiring route or procedural knowledge obtained from information gathered as they travelled along the route to each destination.

From observation and subsequent interviews with participants it was evident that participants were using a linear/route strategy to find at least two of the destinations (the Outpatients eye clinic reception counter and the Ward G64 enquiries counter) and therefore placed greatest emphasis on finding route information rather than using configurational information. However, by the time they had reached Ward G64, some of the participants (from both ID and TD groups) had developed sufficient understanding of the layout and juxtaposition of points that they could employ a basic spatial/orientation strategy. Nonetheless, there was an overwhelming reliance on route based information.

5.4.1 Overall trip results

As part of the observation and subsequent coding, data about the number of trips completed, time taken, distance travelled and number of decision points used were collated to assess

overall differences in wayfinding performance between participants with ID and TD participants. Table 5.2 below provides a summary of the results. Detailed results supporting each of the identified aspects are included in Appendix I.

Table 5.2. Observed Differences in Wayfinding Performance Between Participant Groups

Aspect	Trip categories		ID	TD	ID Compared to TD	Between-group statistical significance
No. of participants completing the trips	1	Trip a	25	29	4 fewer	
		Trip b	18	30	12 fewer	
		Trip c	24	30	6 fewer	
Average time taken (minutes)	1	Trip a	6.6	3.9	69.2% slower	Yes
		Trip b	11.1	8.3	33.7% slower	Yes
		Trip c	5.2	4.4	18.2% slower	No
Average distance travelled (No. of steps)	1	Trip a	332	226	46.9% further	Yes
		Trip b	596	454	31.3% further	Yes
		Trip c	326	222	46.9% further	Yes
Complexity (Average No. of decision points used to arrive at destination)	1	Trip a	25.6	18.4	39.1% more	Yes
		Trip b	49.6	39.4	25.9% more	Yes
		Trip c	19.7	17.3	13.9% more	No
No. of times referring to destination card (average per trip)	1	Trip a	10.6	6.8	55.9% more	Marginal
		Trip b	14.4	9.9	45.5% more	No
		Trip c	2.8	1.3	115.4% more	Marginal

Table 5.2 provides a comprehensive comparison of the two participant groups in their wayfinding activity and shows that in all aspects listed, participants with ID were less successful in their wayfinding than the TD participants.

Four participants with ID did not manage to find the Outpatients eye clinic reception (Trip a). Only 60% of participants with ID managed to find Ward G64 (Trip b) within the allotted maximum time, which is a concern for independent living, particularly if the trips had been to visit friends or family in the hospital. One participant with ID did not want to undertake Trip c and five people with ID did not manage to get out of the building (Trip c) within the allotted time.

Participants were asked in the interviews to rate the ease of finding destinations ‘a’ and ‘b’. Table 5.3 shows participant responses compared to actual success in reaching each destination.

Table 5.3. Percentage of Participants Completing Trip a and Trip b

Trip	Group	Reached destination within max 15 minutes		How easy was it to find the destination (refer to Appendix I – Tables I.9 and 10) for detailed results)			
				Rated impossible, very hard or hard		Rated reasonably easy, easy or very easy	
		No.	%	No.	%	No.	%
Trip a to Outpatients	ID	25	83.3	6	20	24	80
	TD	29	96.7	9	30	21	70
Trip b to Ward G64	ID	18	60	19	63.3	11	36.7
	TD	30	100	12	40	18	60

a) For Trip a

In response to the interview question "How easy was it to find the Outpatients clinic?", both participant groups reported relative ease, with only a marginally statistical difference between the two. However, data from the video observation clearly indicated Trip a was much harder for participants with ID because they took 85.7% longer time, travelled 46.9% further distance and encountered 55.8% more decision points along the way than the TD participants. No reason has been identified for this variation between perception and reality.

In the semi-structured interviews, both groups were asked to give reasons why they found this trip either easy or hard. The most common feature mentioned by both groups for making the journey easy was signs. Participants with ID also mentioned "asking for help" and "receiving directions from someone else" as important. Both groups were asked to describe what they looked for to help them reach the Outpatients clinic reception counter. The categories with most comments from both groups were signs, asking for help, directories and maps.

b) For Trip b

Most participants in both groups rated ease for Trip b (to Ward G64) around the centre of the scale, either 'hard' or 'relatively easy' so there was only a marginally significant statistical difference between participant groups in their opinion of how easy it was to find the location. Overall trip data from the observation clearly indicates, however, that Trip b was much harder for the participants with ID with only 18 out of 30 participants actually completing the trip within the time. On average, compared to the TD participants, the participants with ID took 33.7% longer time, travelled 31.3% further distance, and encountered 25.9% more decision points along the way. In the semi-structured interview, both groups were asked to give reasons why they found this trip either easy or hard. The category with most comments

from both participant groups was “signs” (either making it easy or hard), followed by “asking” or “being given instructions”. Findings about specific features are discussed in more detail in chapter 6 under each wayfinding component.

Most participants felt getting to Ward G64 enquiries counter was harder than getting to the Outpatients eye clinic reception counter. This perception may be related to the fact that, in finding the Ward G64 enquiries counter, participants encountered twice the number of decision points and travelled, on average, twice as far as they did finding the Outpatients eye clinic reception counter. Of those participants indicating Ward G64 was easier to find, 10 mentioned that signs had helped the most (3 ID, 7 TD). Of those participants indicating Outpatients was harder to find, 2 mentioned a lack of signage referring to the “Eye Clinic” (2 TD) and 2 mentioned a lack of signage saying “Outpatients” (2 TD).

c) For Trip c

The third trip (Trip c) required participants to get out of the building using any means (e.g., stairs, lift, etc.). Although not simulating the urgency of an emergency scenario, the results would nonetheless provide information about the degree of difficulty for participants in egressing the building.

Table 5.4 shows the number who managed to get out of the building (Trip c) and also shows responses to the question whether participants thought they could get out in a hurry.

Table 5.4. Percentage of Participants Completing Trip c

Trip	Group	Reached destination within max 15 minutes		Do you think you could get outside of the building in a hurry? (Refer to Appendix I, Table I.17 for detailed results)					
				“No”		“Maybe”		“Yes”	
		No.	%	No.	%	No.	%	No.	%
Trip c exit the building	ID	24	80	9	30	1	3.3	20	66.7
	TD	30	100	8	26.7	6	20	16	53.3

Only 67% of participants with ID and 53% of the TD participants believed they could get out in a hurry. However, success in getting out was higher than this perception for both groups.

5.4.2 The wayfinding environment

These results relate to the specific components and features that create the wayfinding environment. Due to the extent of statistical information relating to each feature, results are

either contained in tables within this chapter or are summarised in the chapter, with references to the detailed data contained in appendices.

The following sections also include information from participant responses to interview questions. Themed analyses of these responses have been provided in tables in the appendices. Where information from those analyses is included in the following sections, reference is made to the relevant table.

a) Inter-relationship of physical elements

The inter-relationship of wayfinding elements within a building is important for determining the coherence of the wayfinding environment. In his discussion of wayfinding, Lynch (1960) used five elements relating to a cityscape to determine the wayfinding environment: paths, landmarks, nodes, edges and districts. Passini (1984b, 1996) suggested these could also be related to the built environment and in particular to building interiors. These elements are identifiable within the hospital used for the observation study. The “paths” relate to the corridors, “landmarks” relate to the café, ATM, etc., “nodes” are the main junctions, “edges” relate to the enclosing walls of the various hospital blocks and “districts” could be related to the various functional spaces (e.g., operating theatres, wards, outpatients, etc.). The extent to which the environment provided information for accessibility, particularly for participants with ID, will be described in the remainder of this chapter.

b) Attributes of the wayfinding environment

Chapter 2, section 2.2.3.a.ii included discussion about the accessibility of a wayfinding environment in terms of its legibility, imageability and relatedness, because these attributes can affect a person’s desire to use that environment. In comments made during the interviews, participants identified issues relating to legibility (how easy it was to learn and remember an environment) and imageability (comprehending the environment).

Legibility: Participants were asked to recall in words how they got to two of the destinations (Outpatients and Ward G64). The results in Table 5.5 show the number of participants who could recall their full journey to each destination.

Table 5.5. Participants’ Recall of Trips

Could remember the complete journey	ID Participants	TD Participants
Outpatients (Trip a)	4	14
Ward G64 (Trip b)	1	14

The scores from TD participants indicate that the trips through the building were reasonably easy to remember. However, the scores by the participants with ID indicate they had a much harder time remembering the routes, suggesting their perception of legibility might be much lower. As one participant with ID said, “I can’t learn so much”.

Imageability: When providing responses to interview questions, participants indicated issues relating to imageability, such as not knowing where everything is (ID 4, TD 6), finding bearings (1 ID, 2 TD), too many ways to go (2 ID, 1 TD), so many corridors (2 ID, 5 TD) not knowing what to look for (2 ID, 1 TD) and no logical order (0 ID, 2 TD). As there was no specific question about imageability, frequencies shown are merely indicating the number that chose to mention some aspect of imageability. Had they been specifically asked to comment on imageability, there would most likely have been more and varied responses.

These observations from participants, however, help to build a picture of participant wayfinding experience, particularly within the hospital environment used for this study.

c) Specific components and features affecting wayfinding

This next section describes findings about 26 specific features identified during coding of participant trips at the hospital. Conversations during the interviews includes further feature types relating to the sensory component (e.g., noise, touch, smell, heat, crowdedness and people moving in a specific direction), not specifically observed in the hospital study.

Some of the features included in Table 5.6 below are described as having “no relevant information” (e.g., spatial decision point with no relevant information). This label refers to any feature viewed by the person whilst wayfinding, that contained no relevant information for the trip being taken. As these features provided no relevant information, there was no need to differentiate the type of feature (e.g., map, sign, junction, etc.), but simply record whether it was used successfully or not. Consequently, they have been grouped under a single feature in each of the four components (e.g., spatial decision point with no relevant information, visual decision point with no relevant information). There were two reasons for including these statistics. First, it identifies the extent of decision points where no relevant information was available for participants to use and, second, it shows how successful participant groups were in making decisions without relevant information.

Features with no relevant information were encountered by all 60 participants, 2,400 times in total (1,463 ID, 937 TD). Not surprisingly (because it combines several types of feature), it was the most commonly occurring feature in the spatial component. Participants with ID only had 70% success at these points whilst the TD participants had 81% success. This

difference provides an important insight into the capacity of participants with ID to undertake wayfinding in the absence of guiding information.

All 26 observed features are listed in Table 5.6 along with data about the number of participants who used each feature, the number of decision points at which the feature was used and the measure of success (closer to or further away from the destination) based on the decision made at those points. It should be noted that the frequency with which features were used does not imply preference for those features, but is a combination of both probable preference and availability within the venue. Table 5.7 provides a summary of this data.

Table 5.6. Comparison of Success by Participants at Decision Points

		ID Participants				TD Participants				Independent samples t-test		
Component	Feature	No. using feature	Dp's*	Successful Dp's	% success	No. using feature	Dp's	Successful Dp's	% success	Difference in success (based on each participant)		
										t	*df*	*P=*
Spatial	Barrier-controlled door	3	3	3	100.0	1	1	1	100.0	no difference		
Spatial	Dead end with door	2	2	0	0.0	0	0	0	0.0	not used by one group		
Spatial	Enter/Exit point	2	2	2	100.0	7	8	8	100.0	no difference		
Spatial	Junction	30	276	221	80.1	30	225	191	84.9	1.792	58	0.08
Spatial	Prospecting point	29	135	107	79.3	28	80	65	81.3	.369	55	.71
Spatial	Room off main	18	27	25	92.6	18	20	20	100.0	1.37	17	.19
Spatial	Vertical using lift	28	69	60	87.0	30	65	63	96.9	2.12	31.26	0.04
Spatial	Vertical using stairs	2	3	3	100.0	1	1	1	100.0	no difference		
Spatial	Decision point with no relevant info	30	675	454	67.3	30	421	319	75.8	3.35	58	0.001
Visual	Controlled door button	1	1	1	0.0	1	1	1	0.0	no difference		
Visual	Colour	4	6	6	100.0	3	4	4	100.0	no difference		
Visual	Directory	22	97	91	93.8	26	102	100	98.0	1.24	33.54	.22
Visual	Landmark	3	5	5	100.0	1	1	1	100.0	no difference		
Visual	Lift buttons inside & outside	26	74	62	83.8	30	74	74	100.0	2.65	25	.14
Visual	Lift level Indicator	26	111	107	96.4	30	130	130	100.0	1.71	25	.10
Visual	Map	8	33	33	100.0	22	90	87	96.7	-.86	28	.40
Visual	Map & Directory	16	33	28	84.8	17	31	31	100.0	2.27	15	.04
Visual	Sign	30	410	379	92.4	30	447	435	97.3	1.99	37.28	.05
Visual	Visible door	22	29	25	86.2	22	29	29	100.0	1.81	20	.09
Visual	Distraction	10	38	28	73.7	2	2	0	0.0	-4.13	9	.01
Visual	Decision point with no relevant info	30	762	550	72.2	30	504	433	85.9	3.87	58	.001
Sensory	Light	6	6	6	100.0	7	10	10	100.0	no difference		
Sensory	Decision point with no relevant info	0	0	0	0.0	1	1	1	100.0	not used by one group		
Supportive	Asking	19	79	77	97.5	15	38	37	97.4	.41	31.71	0.68
Supportive	Person-assisted	6	9	9	100.0	1	1	1	100.0	no difference		
Supportive	Decision point with no relevant info	14	26	23	88.5	7	11	8	72.7	-.91	7.31	0.39
	Totals	**387**	**2,911**	**2,305**	**79.1**	**390**	**2,297**	**2,050**	**89.2**			

*Decision points

Table 5.7. Summary of Data Relating to the Four Components of Wayfinding

		ID Participants				TD Participants			
Component	Number of separate types of feature*	No. using feature	No. of dp's**	No. of successful dp's	% success	No. using feature	No. of dp's	No. of successful dp's	% success
Spatial	9	144	1192	875	73.4	145	821	668	81.4
Visual	12	198	1599	1315	82.2	214	1415	1325	93.6
Sensory	2	6	6	6	100.0	8	11	11	100.0
Supportive	3	39	114	109	95.6	23	50	46	92.0
Totals	**26**	**387**	**2,911**	**2,305**	**79.2**	**390**	**2,297**	**2,050**	**89.2**

*This total represents the number of features under this category that were available and actually used by participants
**decision points

Participants were also asked to choose from a list of features, which they liked using the most (see Table 5.8).

Table 5.8. Features Participants Like Using the Most

Group	Signs	Landmarks	Maps	Directories	Colour coding	Asking people	Total	Pearson Chi-Square
ID	14 (46.7%)	1 (3.3%)	4 (13.3%)	2 (6.7%)	3 (10.0%)	6 (20.0%)	30 (100.0%)	X^2 (5, N = 60) = 8.91, p = .07
TD	14 (46.7%)	3 (10.0%)	10 (33.3%)	1 (3.3%)	0 (0.0%)	2 (6.7%)	30 (100.0%)	

There is only a marginally significant statistical difference between the two groups. There is a very strong and similar preference for signs by both groups, with maps coming a much-reduced second. Participants were not asked to consider this in relation to the site just visited, but this may have influenced their preference, given that signs were the predominant feature used in the study.

d) Spatial features

Spatial features are generally fundamental to the layout of the buildings and the internal spaces. Passini (1984b) suggested that spatial movement could be defined as either vertical or horizontal. As a result, decision points relating to horizontal (e.g., corridors) and vertical movement (lifts and stairs), have all been included under the one heading of spatial features.

Table 5.9 compares the success of TD and ID groups in using spatial decision points, aggregated for the three trips (a, b and c), and includes where spatial decisions points had no relevant information. A review of the results indicates that participants with ID were less successful than TD participants overall in this component and specifically in five of the nine

spatial features used, with two of these ("vertical using a lift" and "spatial decision points with no relevant information") having a statistically significant difference. The following sections describe results for each of the spatial features identified in Table 5.9 and any other spatial features identified during the interviews or through researcher observations. The discussion is based on quantitative data from the observation and interviews (Likert scale responses), qualititative data from the semi-structured interviews and observation notes made by the researcher during coding of each trip.

Table 5.9. Comparison of Success by Participants Using Spatial Decision Points

	ID Participants				TD Participants			
Spatial feature	No. using feature	Dp's*	No. of successful Dp's	% success	No. using feature	No. of Dp's	No. of successful Dp's	% success
Barrier-controlled door	3	3	3	100.0	1	1	1	100.0
Dead end with door	2	2	0	0.0	0	0	0	0.0
Enter/Exit point	2	2	2	100.0	7	8	8	100.0
Junction	30	276	221	80.1	30	225	191	84.9
Prospecting point	29	135	107	79.3	28	80	65	81.3
Room off main	18	27	25	92.6	18	20	20	100.0
Vertical using lift	28	69	60	87.0	30	65	63	96.9
Vertical using stairs	2	3	3	100.0	1	1	1	100.0
Decision point with no relevant info	30	675	454	67.3	30	421	319	75.8
Totals	**144**	**1192**	**875**	**73.4**	**145**	**821**	**668**	**81.4**

*decision points

i) Building layout generally

The building layout refers to the configuration and interconnection of spaces within the building, particularly corridors and visual access. Table 5.10 provides participant responses to Likert scale interview questions related to the building layout.

Table 5.10. Consolidated Statistics for Building Layout *

	Combined ratings	ID	TD
How easy was it to see what was coming up ? (%, No of people)	Impossible, very hard and hard,	23.3% (7)	10.0% (3)
	Reasonably easy, easy, very easy	76.7% (23)	90.0% (27)
Do you think there was more than one way to go? (%, No of people)	Yes	53.3% (16)	93.3% (28)
	No	46.7% (14)	6.7% (2)
How easy were the corridors to use? (%, No of people)	Impossible, very hard and hard,	3.3% (1)	10.0% (3)
	Reasonably easy, easy, very easy	96.7% (29)	90.0% (27)

* (See Appendix J, Tables J.2, J.3, J.5, J.7 and J.8 for full statistics)

Participants with ID thought it was relatively hard to see what was coming up (ID 23.3%, TD 10.0%). When asked whether there was more than one way to get to the destinations, only 53.3% of the participants with ID, as opposed to 93.3% of the TD participants, thought there was more than one way. Participant verbal responses in the interviews have been included in Appendix J: Table J.1, J4 and J.6 but did not show any specific repeating issues.

Comments by participants with ID to open-ended interview questions relating to the building layout suggested that "*it was just hard to get to*"(M16M), "*it was very big*"(M05M), "*a lot of walking to do*"(M06F), and "*it would be frustrating… figure out how to go…I have to, you know, this way, or that way*"(M11F).

Participants were also asked to rate the ease of using the corridors. Responses showed very similar results for both groups with 29 participants with ID and 27 TD participants rating it "Reasonably Easy" to Very Easy" (see Appendix J, Tables J.7 and J.8). In responses to open-ended interview questions, most participants with ID, who rated using corridors as "Reasonably Easy", commented that there were no specific issues, whilst three said there were not a lot of signs and two indicated it was alright, once you knew where you were going (see Appendix J, Table J.9)

In the process of coding video observations, a number of points were identified by the researcher (see Appendix J, Table J.10). Interestingly, one of the TD participants (C07F) observed the building layout; "*would be terrible for someone who is late for an appointment*". Three participants with TD (C01F, C02F and C03F) also mentioned during their visits just how big the hospital is. Comments by two participants with ID demonstrated a level of spatial knowledge, saying, "*I have to go back down again*" (M23F) or "*I've gone too far*" (M24M), but could not utilise that information before reaching an incorrect location.

ii) Controlled doors

Controlled doors have been included in the spatial component as they form a barrier/constraint to spatial movement. Although accessing the doors also involves understanding signage, the signage has been considered an integral part of the spatial feature and hence described here. Controlled doors were encountered in only one location, which was used by four participants 4 times (3 ID and 1 TD) (see Table 5.9). All four participants were successful in using this feature, so there was no difference in the level of success between the two groups. Although infrequently used, the feature presented some interesting issues for wayfinding. The controlled doors were across a main corridor and were designed to control access to a specific area that the hospital wanted people to be aware of before entering. The push button for the door was not beside the door but on the wall preceding the

doors by about two metres. Whilst there was a sign on the door indicating that a button needed to be pushed to gain access, it did not clearly indicate where the push button was located and therefore caused some concern for participants who could not initially find it. As one TD participant (C28F) responded, when asked about issues affecting people with ID, "*if it says there'll be a button on the right, you sort of expect it to be there on your right, not take, you know, ten steps back and there it will be*". Whilst this issue could be confronting to both ID and TD groups, observation of the reaction indicated it caused particular concern for participants with ID, delaying overall wayfinding.

iii) Dead end with door

This feature was used by two participants, in total 2 times (2 ID and 0 TD) (see Table 5.9). The outcome from both decision points was unsuccessful (i.e., further away) as the participants chose to turn back and find another way rather than going through the door that would have taken them closer to exiting the building.

iv) Enter/Exit point (entry to building)

There was some "clutter" due to a proliferation of signs around the entry to Block E and the entry doors had highly reflective glass, both of which are to be avoided according to the CRC for Construction Innovation (2007). However, none of the participants seemed to be affected by, nor mentioned, either of these issues in their trips around the hospital. The feature occurred at the decision point where participants had to enter another building, after they had started their trips and was used by nine participants 10 times (2 ID and 8 TD) (see Table 5.9). Of the 10 occurrences, all were used successfully, therefore there was no statistically significant difference in the level of success with this feature between the two groups. There were no specific comments in the interviews about entry/exit doors except one by a TD participant (C19M), who was frustrated (and concerned) that an exit door at the bottom of the fire stairs appeared to be locked or jammed.

v) Junction (corridor off main corridor, crossroads, left or right turn)

There was a marginally significant statistical difference in success between groups using this feature. The ID group had 80.1% success with this feature whilst the TD group had 84.9% success (see Table 5.9). There were a number of junctions on the ground floor of the hospital, along the main thoroughfares, that presented numerous signs and/or maps and directories. From video observation (see Appendix J, Tables J.10 and J.13), these presented some difficulty for participants with ID who had to filter out relevant and irrelevant information and may account for some of the difference in success at junctions.

vi) Prospecting point (just prospecting)

This decision point relates to locations where a participant stopped and looked around for available wayfinding information. The decision point was not linked to any specific feature (e.g., a map or junction), but was linked to a specific action by participants who were looking to see where they were and what to do next. It is included under the list of spatial features because it is related to understanding where they are in the internal space of the building. Although described for convenience as a "feature", it is more realistically a "prospecting" point.

This feature was used by 57 participants, in total 215 times (135 ID and 80 TD) and was the third most used feature in the spatial component. The ID group had 79.3% success with this feature whilst the TD group had 81.3% success (Table 5.9). There was no statistically significant difference in the level of success with this feature between the two groups. These decision points represented 4.6% of all points used by participants with ID and 3.5% of all points by TD participants.

vii) Room off main (lobby, shop or bank, stairs, etc.)

This feature refers to locations where a participant saw an open space just off the main thoroughfare and stopped to investigate whether they wanted or needed to go into that space. The spaces had no door or had a door (e.g., to the bank) that was kept open. The areas off the main thoroughfare had a specific purpose that was indicated in some cases.

This feature was used by 36 participants, 47 times in total (27 ID and 20 TD). The ID group had 92.6% success with this feature whilst the TD group had 100.0% success. There was only a marginally significant statistical difference in the level of success with this feature between the two groups.

viii)Vertical using lift

This feature has been included in the spatial component because it relates to movement vertically through the building. Features used as part of the lift operation such as lift indicators, lift buttons, etc., have been included in the visual component. Table 5.11 provides consolidated statistics about this feature.

Table 5.11. Consolidated Statistics for Using Vertical Lift *

	Rating	ID	TD
Success in using feature overall (%, No. of decision points)		87.0% (69)	96.9% (65)
How easy was it to use the lifts? (%, No of people)	Impossible, very hard and hard,	0.0% (0)	3.3% (1)
	Reasonably easy, easy, very easy	100.0% (30)	96.7% (29)

* (see Table 5.6 and Appendix J, Tables J.14 and J.15 for full statistics)

Lifts were used more successfully by TD participants and the difference in the level of success between groups was stastically significant. The following observations by the researcher during coding of trips (see Appendix J, Table J.19) may help explain this significant difference:

1. A participant with ID (M06F) entered a lift on the first floor to go down to the ground floor but the lift did not move. After leaving the lift, walking down some stairs and looking at the lift doors on the ground floor, it was apparent from a sign that the lifts were under maintenance and out of action. There was no sign on the first floor. The participant was visibly stressed by this situation.

2. Other incidents involving participants with ID:
    a. getting into a lift but not pressing any buttons
    b. getting lost in the gold lift lobby and deciding to press the down button but no idea why
    c. not knowing how to get out of the lift
    d. entering a lift going in the wrong direction to that wanted
    e. having no idea why they chose a floor to travel to
    f. not understanding what B and G meant alongside lift buttons inside the lift
    g. pressing G on the lift buttons thinking it meant the “G” in ward G64
    h. pressing a screw head above the panel inside the lift, thinking it would direct the lift
    i. getting out at wrong floors
    j. ordering the lift to go in the wrong direction
    k. not knowing which floor the participant was on or which floor the lift had stopped at
    l. not knowing how to call the lift so just waiting until one arrived
    m. not knowing which floor a lift was on because lift level indicators were not working.

However, despite these considerable difficulties, which impacted on wayfinding by participants with ID, they still all rated the use of lifts between “Reasonably Easy” to “Very Easy”, as did TD participants (see Appendix J, Table J14).

Consolidated responses to open-ended questions by participants with ID identified the following (see Appendix J, Tables J.16, 17 and 18 for details).

Table 5.12. Consolidated Comments From Participants About Using Lifts (No. of times mentioned)

ID		TD	
Problems			
Inadequate signage	2	Inadequate signage	2
Slow	1	Slow	4
Crowded	1	Cramped	1
Not sure which button to press to open it	2	Confusing colour	2
Could be scared	1	Uncertainty about direction	5
		Long walk and difficult to find	5
		Not sure if for everyone	2
		Need audible warning inside	1
		Not sure if use in emergency	2
		Poor level indicators outside and inside	5
		Faded numbers inside	1
		Too many	1
		Misread instructions	1
		Thought all the same	1
Helpful aspects			
Easy to get where you want to go	18	Easy to get where you want to go	13
Good signage and indicators	27	Good signage and indicators	12
Just looked outside	1	Lift already called	1
When outside asked	1	Lots of them	4
No comment + unclear	8	Not busy	1
		Good instructions from lady	3
Suggested improvements			
Need to know which lift to use	1		
Uncertain about which level to go to	1		
More lifts	1		
Put G signs and others when you go up lifts	1		

ix) Vertical using stairs (enter/leave stairwell, up/down stairs)

Stairs have similarly been included in the spatial component as they relate to vertical movement through the space. Stairs were predominantly used for Trip c whilst getting out of the buildng. Most participants preferred using the lift and therefore the stair feature has only been used by three participants, 4 times in total (3 ID and 1 TD) (see Table 5.9). Both groups had 100% success with this feature so there was no difference between the two groups. Observations from the video (see Appendix J, Table J.20) identified some issues within the stairs that are covered under other sections in this chapter.

x) At spatial decision points with no relevant information

As previously noted, this item represents any spatial feature where there was no relevant information to assist the person in reaching the required destination. There was no reason to separate different types of feature within the group, but simply note that participants used features that provided no relevant information for the journey being undertaken.

These decision points were used by all 60 participants. Of the 1,096 spatial decision points with no relevant information, 675 were used by participants with ID (with 67.3% success) and 421 by TD participants (with 75.8% success). The difference in percentage success was statistically significant.

e) Visual features

The visual component comprises features of a building environment (e.g., signs, maps, directories, colour on a wall, pictures and the like) that are generally installed or constructed/created later in the process of constructing a building.

Table 5.13 compares the success of participants with ID and TD participants in using visual decision points, aggregated for the three trips (a, b and c), and also shows the effect on success where visual decision points had no relevant information.

Table 5.13. Comparison of Success by Participants Using Visual Decision Points

Feature	ID Participants				TD Participants			
	No. using feature	Dp's*	No. of successful Dp's	% success	No. using feature	No. of Dp's	No. of successful Dp's	% success
Controlled door button	1	1	1	0.0	1	1	1	0.0
Colour	4	6	6	100.0	3	4	4	100.0
Directory	22	97	91	93.8	26	102	100	98.0
Landmark	3	5	5	100.0	1	1	1	100.0
Lift buttons inside & outside	26	74	62	83.8	30	74	74	100.0
Lift level Indicator	26	111	107	96.4	30	130	130	100.0
Map	8	33	33	100.0	22	90	87	96.7
Map & Directory	16	33	28	84.8	17	31	31	100.0
Sign	30	410	379	92.4	30	447	435	97.3
Visible door	22	29	25	86.2	22	29	29	100.0
Distraction	10	38	28	73.7	2	2	0	0.0
Decision point with no relevant information	30	762	550	72.2	30	504	433	85.9
Totals	**198**	**1,599**	**1,315**	**82.2**	**214**	**1,415**	**1,325**	**93.6**

* Decision points

A review of the overall results indicates that participants with ID were less successful than TD participants in this component and specifically in seven of the 12 visual features used; three of these had statistically significant difference: “map and directory”, “signs” and “visual decision points with no relevant information”.

The following sections describe results for each of the visual features identified in Table 5.13 and any visual features raised in the interviews or through researcher observations.

i) Controlled door button

The button was used by two participants, in total 2 times (1 ID and 1 TD) (see Table 5.13). Both groups had 0.0% success with this feature. There was no statistical significant difference in the level of success with this feature between the two groups. There were two buttons, one either side of a set of security doors across the corridor. Users approaching the door from one side were instructed by a message on the doors to press a silver button that was not close to the doors, but some way back up the preceding corridor. The button on the other side of the door had a message saying “Please press silver button” but did not say why. It happened to be located right beside a fire escape door and so the participant with ID pressed it believing it was for those doors. One of the TD participants approached the doors from the other side and took some time to realise that the door button was some way back from the doors themselves.

ii) Colour coding

Colour-coding at the hospital site was mainly provided to identify different lifts (e.g., blue lift, green lift, etc.), although there was a set of yellow floor tiles inserted into a brown floor area intended to guide people at a junction towards the Outpatients department. Table 5.14 provides consolidated results about the use of colour in the observation study.

As both groups had 100% success, there is no statistical significant difference in success with this feature between the groups. Participants with ID considered colour-coding easier to use and more helpful than did the TD participants, which may explain why they liked using colour-coding more than the TD participants.

Responses to open-ended interview questions by both groups (see Appendix K, Table K.9) were, however, a little more ambivalent about the value of colour coding for wayfinding, with some saying it was useful and others saying not. Responses from at least half the participants with ID mentioned the colour of lifts in their responses, so there was certainly an

Table 5.14. Consolidated Statistics About Colour Coding *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	100% (6)	100% (4)
How difficult to use at the research site (%, No. of people)	Impossible, Very hard and Hard,	33.3% (10)	50.0% (15)
	Reasonably easy, easy, very easy	66.7% (20)	50.0% (15)
How much did colour-coding help to find the way (%, No. of people)	Not at all, A tint bit, A little	56.7% (17)	66.7% (20)
	Quite a lot, A great deal	43.3% (13)	33.3% (10)
How much do participants like using this feature (%, No. of people)	Not at all, A tiny bit, A little	36.7% (11)	56.7% (17)
	Quite a lot, A great deal	63.3% (19)	43.3% (13)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)		Rated 4th most popular	Rated least popular

* (See Table 5.13 and Appendices I; tables I.19 and I.20, and K; tables K.3 to K.8 for full statistics)

awareness of the link between colour and lifts. A couple of participants with ID (M01F and M15M) mentioned the green colour on exit signs as helping to identify where the exits were. The yellow coloured flooring tiles indicating the way to the Outpatients was mentioned by eight participants with ID, but only actually observed being used by two participants. The low score of 43% from ID participants for colour helping to find the way may be explained by comments from participants with ID such as; "*Did you see any colour coding? No*" (M25F), "*Can't really use only colours, it's really hard to find… might be another, place with the same colour, so its confusing*" (M27F). TD participants ranked colour coding least popular, which may be a reflection of their responses in the interview that indicated limited interest in using colour coding.

Suggestions by participants with ID to make it easier to find the way around the hospital included putting more coloured squares in the ground (M11F), using colour strips along the floor (M19F) and putting colours on the board and map at the main entrance (M28M).

iii) Directories

Directories refers to the boards listing a number of locations. They can occur on their own, as happened in the lift lobbies, or in conjunction with a map. Where they have been used in association with a map they have been considered a composite feature called "Map and Directory" and described separately in these findings. The reason for treating them differently is due to limitations in video observation. With two types of feature very close to each other, it was not possible to differentiate which feature was being used. On the other hand, some maps were separate or sufficiently spaced apart to identify whether the

participant was viewing the map or the directory. Table 5.15 gives the consolidated statistics from the observation and interviews.

Table 5.15. Consolidated Statistics About Directories *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	93.8% (97)	98% (102)
How difficult to use at the research site (%, No. of people)	Impossible, Very hard and Hard,	36.7% (11)	40.0% (12)
	Reasonably easy, easy, very easy	63.3% (19)	60.0% (18)
How much do participants like using this feature (%, No. of people)	Not at all, A tiny bit, A little	30.0% (9)	46.7% (14)
	Quite a lot, A great deal	70.0% (21)	53.3% (16)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)		Rated 5th most popular	Rated 5th most popular

* (see Table 5.13 and Appendices I; tables I.19 and I.20, and K: tables K.11 to K14 for full statistics)

Although there was no statistical significant difference in success with directories between the two groups, TD participants were more successful overall. By way of contradiction, results from the Likert scale questions indicated that participants with ID found directories easier to use and liked using them much more than the TD participants did. One participant with ID suggested that they were useful because they provided names and the floor they were on.

Both groups ranked popularity in using this feature very low, which is a more realistic representation of the interaction of participants with ID with directory boards. One participant with ID (M10M) stood and pointed at random labels on the directory, not finding the necessary destination. Another (M22F) misread the directory and thought that G64 would be on the ground floor, not Building G, level 6. This confusion about the naming convention for wards also affected some of the TD participants (e.g., C04F, C10M and C16M). Another participant with ID (M27F) saw G64 on the directory board but was looking for the enquiries counter in G64, which was not shown. Video observation also showed that on several occasions participants with ID (e.g., M06F, M12M, M18F) would use a directory, walk away in the right direction but then return to the board, have another look and then use the board successfully again. Whilst increasing the number of successful uses, this action indicated a lack of certainty about decision making at that point.

Participants from both groups provided responses to open-ended interview questions about the problems, usefulness and improvements that could be made to directories (see Appendix K, table K.15). Responses were quite contradictory. With respect to problems, some participants with ID (e.g., M27F, M09M) indicated directories were hopeless or difficult to

use and TD participants (C20M, C17F and C25M) suggested directories were confusing, vague or complicated, requiring a participant to have to guess, whereas others in both groups thought they were very helpful. TD participants offered suggestions to make them easier to use (C01F and C20M) including making them bigger (C17F), providing more specific information (C17F), and relating better to the adjoining map (C22M and C24M).

iv) Landmarks

Table 5.16 describes the consolidated statistics relating to the use of landmarks at the hospital.

Table 5.16. Consolidated Statistics About Landmarks *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	100.0% (5)	100% (1)
How difficult to use at the research site (%, No. of people)	Impossible, Very hard and Hard,	63.3% (19)	60.0% (18)
	Reasonably easy, easy, very easy	36.7% (11)	40.0% (12)
How much do participants like using this feature (%, No. of people)	Not at all, A tiny bit, A little	50.0% (15)	36.7% (11)
	Quite a lot, A great deal	50.0% (15)	63.3% (19)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)	-	Least popular	Rated 3rd most popular

* (see Table 5.13, Appendices: I: tables I.19 and I.20, and K, tables K.17 to K20 for full statistics)

This feature was used by four participants, in total 6 times (5 ID and 1 TD). Both groups had 100% success with this feature and therefore there was no statistically significant difference in the level of success with this feature between the two groups.

Participants from both groups provided responses to open-ended interview questions about the problems, usefulness and improvements that could be made to directories (see Appendix K, table K.21). TD participants provided more responses than participants with ID. Eight TD participants suggested there were problems because they could not recognise what might constitute a landmark. Two TD participants (C03F and C23M) also suggested that landmarks may have different meanings for different people. Both groups were able to identify some key landmarks such as the café, paintings on walls, the ATM and people eating in the restaurant. Interestingly, however, as the above statistics show, neither group made much use of landmarks in their wayfinding. Appendix K.22 provides further observation notes that generally reiterate points raised elsewhere in this section.

v) Lift buttons (inside and outside)

The choosing, calling and accessing of lifts, and directing lift movement, involves many complex decisions. This feature was used by 56 participants, in total 148 times (74 ID and 74 TD). The participants with ID had 83.8% success with this feature whilst the TD participants had 100% success (see Table 5.13). There was a statistical significant difference in the level of success with this feature between the two groups.

vi) Lift level indicator

This feature has been given separate attention from the other lift features because it presented some specific difficulties for participants. It relates to the participant decisions made as a result of viewing the lift level indicator displayed in the lift lobbies and the lift level indicator displayed above the door inside the lift. This feature was used by 56 participants, in total 241 times (111 ID and 130 TD). Participants with ID had 96.4% success with this feature whilst the TD participants had 100% success (see Table 5.13). There was a marginal statistically significant difference in the level of success with this feature between the two groups.

vii) Maps

As previously mentioned, maps could be placed on their own (e.g., a fire escape plan) or be placed in conjunction with a directory. Where closely linked with a directory, they are included and described under the Visual component section headed “Combined map and directory”, otherwise they are included here. Table 5.17 provides the consolidated statistics for maps, obtained from observation and interviews.

This feature was used by 30 participants, in total 123 times (33 ID and 90 TD). Participants with ID had 100% success with this feature whilst the TD participants had 96.7% success. There was no statistical significant difference in the level of success with this feature between the two groups.

Whilst the level of success was almost identical between groups, the statistics show that only 8 (26.7%) participants with ID used maps compared with 22 (73.3%) TD participants. Given that 53.3% of participants with ID said they liked using maps and it was rated third most popular feature amongst participants with ID, it is interesting that only 26.7% actually used them.

Table 5.17. Consolidated Statistics About Maps *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)		100.0% (33)	96.7% (90)
How difficult to use at the research site (%, No. of people)	Impossible, Very hard and Hard,	73.3% (22)	53.3% (16)
	Reasonably easy, easy, very easy	26.7% (8)	46.7% (14)
How much do participants like using this feature (%, No. of people)	Not at all, A tiny bit, A little	46.7% (14)	30.0% (9)
	Quite a lot, A great deal	53.3% (16)	70.0% (21)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)		Rated 3rd most popular	Rated 2nd most popular

* (See Table 5.13 and Appendices: I; tables I.19 and I.20 and K; tables K.23 to K26 for full statistics)

Responses by participants with ID to open-ended interview questions may give some indication why they were rarely used. Frequency of similar comments and participant codes are shown for each comment:

- Some can't read maps (4) (M09M, M11F, M26F, M27F).
- Difficulty understanding /getting confused (4) (M20M, M30M, M12M).
- Not enough and not clear (10) (M06F, M15M, M16M, M22F, M23F, M24F, M25F, M26F, M31M, M32F).
- Can't picture the location in my head (1) (M12M).
- Not enough appropriate information (2) (M13M, M20M).
- Not sure which map to look at (1) (M20M).
- Easier to use signs (2) (M09M, M18F).

viii) Combined map and directory

This feature was used by 33 participants, in total 64 times (33 ID and 31 TD). The ID group had 84.8% success with this feature whilst the TD group had 100% success (see Table 5.13). There was a statistically significant difference in the level of success with this feature between the two groups.

As previously mentioned, this feature is simply a combination of a directory board and map very close together. Much of the commentary reported in preceding sections of these findings about maps and about directories, therefore, would equally apply to this feature. It is interesting to note that there was a statistically significant difference in the success scores. Appendix K.29 provides further observation notes that generally reiterate points raised elsewhere in this chapter.

ix) Signs

The hospital contains a wide range of signs fulfilling several different functions (e.g., informational, directional, warning) and attached in different locations (e.g., to a wall, ceiling, door, window, etc.). For the purposes of this research study, all signs that contained information relevant to the trips that participants had to make have been grouped together under this feature. Table 5.18 shows consolidated statistics for this feature.

Table 5.18. Consolidated Statistics About Signs *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	92.4% (410)	97.3% (447)
How difficult to use at the research site (%, No. of people)	Impossible, Very hard and Hard,	73.3% (11)	53.3% (16)
	Reasonably easy, easy, very easy	26.7% (198)	46.7% (14)
How much do participants like using this feature (%, No. of people)	Not at all, A tiny bit, A little	36.7% (11)	6.7% (2)
	Quite a lot, A great deal	63.3% (19)	93.3% (28)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)	-	Rated most popular	Rated most popular

* (see Table 5.13 and Appendices I; tables 1.19 and I.20, and K; tables K.30 to K33 for full statistics)

This feature was used by all 60 participants, in total 857 times (410 ID and 447 TD). Participants with ID had 92.4% success with this feature whilst the TD participants had 97.3% success. There was a statistical significant difference between the two groups in the level of success with this feature.

Of all the features that contained relevant information for the trips, this was by far the most commonly used. This is not surprising as signs were the most prevalent feature available in the hospital for wayfinding. From initial observation of the above statistics, it is clear that the participants with ID found great difficulty in using signs. The difference in perceived difficulty and in the extent to which the two groups like using signs is also statistically significant.

It seems surprising that despite achieving 92.4% success, 43.3 % of participants with ID thought using signs between “impossible” and “hard”. An analysis of interview responses from participants with ID is shown in Appendix K, table K.34) and table 5.19 lists the interview responses from participants with ID relating to problems encountered with signs.

Table 5.19. ID Participant Responses About Problems With Signs

Reason for difficult	No. of responses (not mutually exclusive)	Participants
Hard to find directions	1	M01F
Not be able to read them	7	M01F, M11F, M12M, M14F, M16M, M25F, M30M
More helpful than maps	1	M12M
Need more	5	M01F, M13M, M20M, M23F, M32F
Hard to understand	7	M01F, M13M, M15M, M18F, M20M, M27F, M30M
Too high	1	M32F
Writing too small	1	M01F
Too vague	2	M06F, M27F
Too big	1	M07M
Didn't know words	2	M14F, M32F
Too many	1	M30M

General observation notes about participant use of signs are shown in Appendix K, Table K.35 and further reinforce comments made elsewhere in this section about difficulties for participants using signs.

x) Visible door

This feature occurred where a participant, in the course of travelling to a destination, saw a door, stopped to investigate whether it could be used to get to the required destination and, if not, moved on. The feature was included in the statistics for features with relevant information because, until checking the door, there was no indication whether it was relevant to the journey or not. Examples of locations for these doors include a fire door, stairwell doors, doors to the outside and doors to an adjoining area.

This feature was used by 44 participants, in total 58 times (29 ID and 29 TD). The ID group had 86.2% success with this feature whilst the TD group had 100% success (see Table 5.13). There was a marginal statistically significant difference in the level of success with this feature between the two groups.

xi) Visual distraction

This feature occurred where a participant was distracted by an object or information that had no capacity to assist in wayfinding (e.g., a piece of movable equipment, temporary picture/posters, etc.). They are not included in the category "Visual - Decision points with no relevant information" because they are different from a feature that may have potential to assist but provided no relevant information.

This type of feature was used by 12 participants, in total 40 times (38 ID and 2 TD). The ID group had 73.7% success with this feature whilst the TD group who only encountered this

feature twice had no success (see Table 5.13). There was a marginal statistically significant difference in the level of success with this feature between the two groups. Visual distractions provide no value to the wayfinding process, but simply delay reaching the destination. Research has found, however, some distractions can contribute to overstimulation for people with autism and therefore need to be avoided or managed appropriately (UK Department for Children Schools and Families 2008, 198). General observation notes about the effect of distractions are shown in Appendix K, Table K.36. They highlight the case of one participant with ID (M05M) who was distracted by a poster of a policeman and other minor distractions for people with ID (M02F, M05M, M07M and M17F).

xii) At visual decision points with no relevant information

This feature type comprised visual features (e.g., signs, maps, etc.) that were used by participants, but contained no information that would help find their destination. These features were used by all 60 participants, in total 1,266 times (762 ID and 504 TD). The ID group had 72.2% success with this feature whilst the TD group had 85.9% success (see Table 5.13). There was a statistically significant difference in the level of success with this feature between the two groups. The comparatively lower level of success by participants with ID in making decisions at these points mirrors results from the “Spatial” component and further emphasises the importance of providing adequate, timely and consistent wayfinding information.

f) Sensory features

Apart from spatial and visual components within the wayfinding environment, a person’s wayfinding may also be affected by features that impact on their senses whilst travelling through the environment (Lynch 1960). Features in this component, therefore, relate to points where a person makes a decision as a result of sensory information from the environment, such as sight (e.g., amount of light), hearing (e.g., sounds), touch (e.g., variations in the texture of materials), smell (e.g., food smells, hospital smells), heat (related to touch), crowdedness and people moving through an environment (related to all senses). Table 5.20 shows results for wayfinding success using sensory features. As evident from the Table, “light” was the only feature affecting wayfinding that was identified specifically during the coding of videos. The other sensory features are included in this section as they were discussed in the interviews with participants.

Table 5.20. Comparison of Success by Participants Using Sensory Decision Points

Feature	ID Participants				TD Participants			
	No. using feature	Dp's *	No. of successful Dp's	% success	No. using feature	No. of Dp's	No. of successful Dp's	% success
Light	6	6	6	100.0%	7	10	10	100.0%
Decision point with no relevant info	0	0	0	0.0%	1	1	1	100.0%
Totals	**6**	**6**	**6**	**100.0%**	**8**	**11**	**11**	**100.0%**

(* Decision points)

i) Light

Light conditions were not static across all participant trips, given that trips were made at different times of the day, with different weather conditions outside and with different lighting settings under hospital staff control. This feature was experienced by 13 participants, in total 16 times (6 ID and 10 TD). Both groups had 100% success in using the feature so there was no difference in level of success for this feature between the two participant groups. Table 5.21 shows consolidated statistics for this feature.

Table 5.21. Consolidated Statistics for Light *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	100.0% (6)	100.0% (10)
How much did the feature help you find your way (%, No. of people)	Not at all, A tiny bit, A little	50.0% (15)	36.7% (11)
	Quite a lot, A great deal	50.0% (15)	63.3% (19)
How much did this feature make your wayfinding more difficult? (%, No. of people)	Not at all, A tiny bit, A little	100.0% (30)	96.7% (29)
	Quite a lot, A great deal	0.0% (0)	3.3% (1)

* (see Table 5.20 and Appendix L, Tables L.1 to L.4 for full statistics)

This feature occurred during Trip c (getting out of the hospital) and relates to the light provided by glazed exit doors giving guidance to those participants seeking to get out. However, the value of light for this purpose would obviously depend on the time of day.

Although lighting levels are briefly discussed in chapter 2, Section 2.4.3.c.iii – Lighting, they were not specifically measured as part of this study. Consequently, observation of lighting levels by researchers and participants was based on general comparison between surrounding areas. The ward area was darker because lights had been turned off.

Both participant groups considered light had given a reasonable amount of help in their wayfinding, but some areas they visited were quite dark (in the wards at times when lights

were turned off and in some of the longer corridors away from the main circulation areas), which may have affected their view of the help lighting provided. Similarly, the general level of light throughout the hospital was quite high and therefore perceptions that lighting made their wayfinding difficult were expected to be low

In response to open-ended interview questions (see Appendix L, Table L.5), participants indicated that they preferred well-lit locations because it helped find the information needed to get to a destination. Participants with ID suggested it was a little dark sometimes coming out of the Outpatients, going down one of the hallways and coming out of the lifts. Reviewing the observations in those locations showed that lights had been turned off as mentioned.

ii) Noise

There was no observed indication at any decision point that noise had affected a wayfinding decision. Table 5.22 indicates that only two participants from each group (M07M, M14F, C01F and C06F) felt that it had made their wayfinding more difficult.

Table 5.22. Consolidated Statistics for Noise *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	None observed	None observed
How much did the feature make wayfinding more difficult (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	93.3% (28)
	Quite a lot, A great deal	6.7% (2)	6.7% (2)

* (see Appendix L, tables L.6 and L.7 for full statistics)

In conversation about noise, the majority of both groups (ID 24, TD 23) (see Appendix L, Table L.8) indicated that noise had not made their trips difficult at all.

iii) Touch (Texture)

Touch has been considered in this study to refer to texture on surfaces. However, it may also be considered a visual feature, because it can be used to highlight different surfaces. For the purposes of this study, it is considered sensory because the most likely effect for participants would be on the sensation of touch when using different floor surfaces.

There were no decision points observed during the trips where participants appeared to or indicated that their decision had been affected by the touch or texture of a part of the building. This supports Darken’s (1996) opinion that touch is of less value in finding a distant destination. Table 5.23 shows consolidated statistics for this feature.

Table 5.23. Consolidated Statistics for Touch (Texture) *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	None observed	None observed
How much did the feature help you find the way (%, No. of people)	Not at all, A tiny bit, A little	83.3% (25)	100.0% (30)
	Quite a lot, A great deal	16.7% (5)	0.0% (0)
How much did the feature make wayfinding more difficult (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	96.7% (29)
	Quite a lot, A great deal	6.7% (2)	3.3% (1)
How difficult was it to use the feature (%, No. of people)	Impossible, Very hard and Hard,	70.0% (21)	86.7% (26)
	Reasonably easy, Easy, Very easy	30.0% (9)	13.3% (4)
How much did you like using the feature (%, No. of people)	Not at all, A tiny bit, A little	63.3% (19)	76.7% (23)
	Quite a lot, A great deal	36.7% (11)	23.3% (7)

* (see Appendix L, tables L.9 to L.16 for full statistics)

The results in Table 5.23 were drawn from responses to Likert scale questions in the interview. Although not specifically identified in the observation of trips, texture appears to have helped participants with ID find their way. More participants with ID than TD participants thought texture was easy to use, although several participants from both groups explained in open-ended questions that they really hadn't considered or experienced it. More participants with ID than TD participants liked the idea of using texture.

In responses to open-ended interview questions (see Appendix L, Table 17), both groups had similar comments and indicated that texture had no significant impact on their wayfinding.

iv) Smell

Culinary aromas emanating from food shops, cafes or restaurants can help in navigation by linking memorable smells with specific locations within an environment (CRC for Construction Innovation 2007; Darken 1996). Depending on the time of the visit, there were places (e.g., on the ground floor near the café) where smells were evident, but there was no evidence from the observation of trips that smell had helped participants to know where to go.

Statistics from scale questions in the interview (see Table 5.24) indicate that this feature had little impact on wayfinding for either participant group. Responses to open-ended interview questions (see Appendix l, Table L.22) provided little extra insight other than to highlight the lack of effect it had and also the types of smells that were experienced, both good (food) and not so good (hospital ward smells). There were only two responses from participants with ID (M07M and M31M) and two from TD participants (C06F and C23M) that identified smell as linking with specific areas (e.g., a café or a ward).

Table 5.24. Consolidated Statistics for Smell *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	None observed	None observed
How much did the feature help you find the way (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	100.0 (30)
	Quite a lot, A great deal	6.7% (2)	0.0% (0)
How much did the feature make wayfinding more difficult (%, No. of people)	Not at all, A tiny bit, A little	96.7 (29)	100.0 (30)
	Quite a lot, A great deal	3.3% (2)	0.0% (0)

* (see Appendix L, tables L.18 to L.21 for full statistics)

v) Heat

The effect of heat causing discomfort and reducing cognitive processing capacity was mentioned by Salmi (2007a) in relation to research about wayfinding by people with ID. However, in the current research study there was no indication that heat impacted on any decision about wayfinding by participants, most probably because the research occurred within an air-conditioned building.

vi) Crowdedness

Attempting to use crowded spaces can affect a person's ability to recall information about a building (Dogu and Erkip 2000) and also increase the desire to seek refuge away from the crowds (Ramanujam 2006). Both reactions may be detrimental for wayfinding. In the current research study, there were times of day when the building's public areas became reasonably crowded (and noisy). However, there were no excessively crowded areas. Consequently, video observations found no decision points affected by crowdedness.

To fully investigate whether there were unseen implications for participants due to crowds, scaled questions and associated open-ended questions were given to participants to describe how they felt. Statistics from the scale questions are shown in Table 5.25.

Table 5.25. Consolidated Statistics for Crowdedness *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	None observed	None observed
How much did the feature making wayfinding more difficult (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	100.0% (30)
	Quite a lot, A great deal	6.7% (2)	0.0% (0)

* (see Appendix L, tables L.23 and L.24 for full statistics)

From the above results, it is clear that crowdedness was not perceived to affect wayfinding. This was confirmed by the lack of any observed wayfinding decisions based on

crowdedness. In responses to open-ended questions (see Appendix L. Table L.25) only a few specific points were mentioned where this might have influenced participants. Two participants with ID (participants M16M and M22F) suggested that there were too many people walking around (referring to the long spine thoroughfare and in the lift lobby, which became busy at times of the day). Another two participants (M01F and M24F) mentioned lifts being crowded. A couple of the TD participants (C13F and C26M) had similar concerns but were also nervous getting into lifts that were being used for patient transfer. Nonetheless, there were no obvious decisions made that were based on crowdedness.

vii) People moving in a specific direction

When trying to find a destination, it is possible that people all moving in a specific direction may give unintended guidance on which way to go (Silva et al. 2015). For instance, if travelling to a Chicago Cubs game, it would be very easy to see which way to travel from the station to Wrigley Field Stadium as the crowds, dressed in Cubs attire, were all moving towards the same destination. This might also be very helpful in the event of an emergency when trying to get out of a building. Following the "flow" may help lead someone out, although there are other concerns about too many people using one exit, etc. At the research site, this might equate to a person getting into a lift when everyone else wanted to go in the opposite direction, or walking down a corridor where everyone was going the other way. These interview questions were asked to see if this phenomenon had in any way affected decisions about where to go. See table 5.26 for consolidated statistics about this feature.

Table 5.26. Consolidated Statistics for People Moving in a Specific Direction *

	Rating	ID Participants	TD Participants
Success in using feature overall (%, No. of decision points)	-	None observed	None observed
How much did the feature help you find the way (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	96.7% (29)
	Quite a lot, A great deal	6.7% (2)	3.3% (1)
How much did the feature making wayfinding more difficult (%, No. of people)	Not at all, A tiny bit, A little	93.3% (28)	100.0% (30)
	Quite a lot, A great deal	6.7% (2)	0.0% (0)

* (see Appendix L, tables L.26 to L.29 for full statistics)

Responses to these scaled questions give little indication of any decision being affected by people moving in a specific direction. Responses to open-ended interview questions (see Appendix L, Table L.30) gave a little more information. One participant with ID (M27F) thought this feature would help because it would signal where to go, whilst another (M17F) was concerned they may follow but end up not going where they wanted to go. A couple of

TD participants (C06F and C09F) thought it was difficult where everyone was getting out of a lift that they wanted to get into. Another TD participant (C22M) thought people moving in a specific direction would be useful because other people may know where to go, even if they didn't (e.g. to the wards or reception).

viii)At sensory decision points with no relevant information

This feature was used once by one TD participant (C22M). The ID group had 100.0% success (see Table 5.20). Comparison between groups, therefore, is not possible.

g) Supportive features

This component refers to features where a participant is provided with wayfinding advice either by asking or by being helped by someone who volunteers to assist with information (person-assisted). The two features, asking and person-assisted are considered in detail in this section. See table 5.27 for a comparison of success between participant groups in using these features. Salmi (2006) suggests that obtaining information in this way can be problematic for people with ID because the response may provide more information than can be memorised. This was evident from the video observations, but has not translated into any significant difference in success between groups.

Table 5.27. Comparison of Success by Participants Using Supportive Decision Points

	ID Participants				TD Participants			
Feature	No. using feature	Dp's *	No. of successful dp's	% success	No. using feature	No. of dp's	No. of successful dp's	% success
Asking	19	79	77	97.5%	15	38	37	97.4%
Person-assisted	6	9	9	100.0%	1	1	1	100.0%
Decision point with no relevant info	14	26	23	88.5%	7	11	8	72.7%
Totals	**39**	**114**	**109**	**95.6%**	**23**	**50**	**46**	**92.0%**

* (decision points)

The overall data from video observation shows that both groups had similar success when asking for information and being person-assisted but, interestingly, participants with ID had more success at points where the supportive information was not relevant to their specific journey.

i) Asking

Table 5.28 gives consolidated data for participants using this feature.

Table 5.28. Consolidated Statistics for Asking People*

	Rating	ID Participants	TD Participants
Success in asking people overall (%, No. of decision points)		97.5% (79)	97.4% (38)
Success with person-assisted overall (%, No. of uses)		100% (9)	100% (1)
How difficult to ask people at the research site (%, No of uses)	(Reasonably easy, easy, very easy)	63.3% (19)	70.0% (21)
How much do participants like using people for help (%, No. of participants)	(Quite a lot, A great deal)	56.7% (17)	43.3% (13)
Most popular feature (from six features: signs, landmarks, maps, directories, colour coding and asking people)		Rated 2nd most popular	Rated 4th most popular

* (see Table 5.27 and Appendices I.19 and I.20, and M; tables M.1 to M.4 for full statistics)

Participants with ID were reluctant to approach someone to ask because they were not sure whether it was appropriate to ask that person. Research by the Disability Rights Commission (2004a) indicated that people with ID preferred asking someone wearing a recognisable uniform or at least someone in authority. People who wore uniforms at the hospital, however, were predominantly nurses or support staff such as linen support staff, orderlies in wards, etc. who were primarily based in the wards and not in the general circulation areas. Doctors were identifiable by having a stethoscope or identity card, but generally did not wear a uniform. Specialists (e.g., psychologists, audiologist, etc.) wore everyday clothing, but would have an identity tag somewhere. Many of the other clerical support staff, working in various medical support roles, wore everyday clothing. Overall, it was less likely to find someone wearing a uniform around the main areas. Through observation, participants seemed reluctant to ask doctors. As one participant with ID suggested (M13M), “they couldn’t help me cos’ they were too busy” (see Appendix M, Table M.5). This was apparent in interview responses where 11 (36.7%) participants with ID rated asking people between “Impossible” and “Very hard”. From observation, there appeared to be a reluctance to bring themselves to the attention of others, preferring anonymity. This has been investigated under the heading of prospect-refuge theory, discussed briefly in the literature review (Section 2.2.3b.iii).

Whilst the level of success was similar, the above results also show that participants with ID asked almost twice as many times for information as TD participants. This difference either means it was a preferred approach by people with ID (which is unlikely given the interview responses) or, more likely they had difficulty in using wayfinding features (as evidenced by results in other components) and therefore had to ask.

Responses by participants with ID to the interview open-ended questions (see Appendix M, Table M.5) about asking, indicated the following:

- Comments about the experiences of participants with ID who thought asking was relatively easy:
  - Asked a doctor because "doctors will like know a lot more" (M06F)
  - I just got help (2 similar responses)
  - "I'm always …quite… a brave young man" (M15M)
  - "I tried to ask some people but they, didn't respond…it didn't bother me because I knew someone would be busy" (M11F)
  - Knows who to ask "cos' of their badge" (M15M))
  - "Cos' people are friendly at the hospital" (M19F)
  - But some instructions were "…just a bit too much" (M19F)
  - The person "just looked like a nice man that might have known his way around (M25F)

- Comments from those participants with ID who thought asking was relative hard:
  - "If I ask people and they don't understand (M01F)
  - "I do it myself" (M14F)
  - They didn't see anyone to ask (M17F, M18F, M20M and M31M)
  - "It would be easy if the person looked friendly" (M23F)
  - "Cos there were people around me" (M24F)

ii) Person-assisted (person volunteers to help participant)

These decision points occurred where another person offered to assist the participant. This activity occurred for seven participants, in total 10 times (9 ID and 1 TD). Both groups had 100% success with this feature so there was no significant difference in the level of success between the two groups (see Table 5.27). This would be expected, given that the feature comprises giving assistance to a participant to direct them how to get to the destination. Responses to open-ended questions (see Appendix M, Table M.6) showed no specific recurring themes.

iii) At supportive decision points with no relevant information

This refers to a point where a person asked or was helped, but the information or assistance provided was not relevant for the trip in question. This occurred for 21 participants, in total 37 times (26 ID and 11 TD). The ID group had 88.5% success with this feature whilst the

TD group had 72.7% success (see Table 5.27). There was no significant difference in the level of success with this feature between the two groups.

5.4.3 Influence of features on wayfinding success (based on time taken)

The random forest classification process (described in Chapter 4, Section 4.7.1.b.ii and Appendix G) create a model that predicted wayfinding outcomes (success or failure based on time taken). The model produced a ranking of the influence of features on model prediction and, when combined with analysis of the most common outcomes of trips in which the features were used in the current study, provided an ability to assess the influence of all features based on success and/or failure.

The features ranked the highest were those that could have most influence in predicting the outcome of a trip and were used in trips in the current study where the most common outcome was success. The features ranked the lowest were those that had the most influence in predicting the outcome of trip but were used in trips in the current study where the most common outcome was failure. See figure 5.1 for a visual representation of the ranking process.

Feature variable	Influence of variable on model outcome (based on MDA)	Most common outcome of trips in which feature was used in the current study	Ranking based on benefit for wayfinding (1 is highest)
X12	Highest influence		1
X16			2
etc.	↓	Success	3
			4
	Least influence		5
	Highest influence		6
			7
	↓	Equal Success/Failure	8
			9
	Least influence		10
	Least influence		11
			12
	↓	Failure	13
			14
	Highest		15

Figure 5.1. Visual representation of the ranking process

The rankings (see Table 5.29 and 5.30) provide an indication of the features that would be most useful in wayfinding and those that need further improvement or discarding.

Table 5.29. Comparison of the Influence of Features on Wayfinding Success (based on time taken) – Grouped into components

Component	Variable	Participants with ID (across all journeys)			TD participants (across all journeys)		
		Influence	Rank o/all	Ranking (in component)	Influence	Rank o/all	Ranking (in component)
Spatial	Barrier - Controlled door	-0.057	18	6	0.000	14	7
Spatial	Dead end	0.000	19	7	0.000	14	6
Spatial	Enter/Exit point	0.000	19	7	5.733	20	9
Spatial	Junction	2.082	2	1	-1.517	11	4
Spatial	Prospecting point	1.892	3	2	3.776	17	8
Spatial	Room off main	0.762	5	4	-2.480	12	5
Spatial	Vertical-using lift	1.532	4	3	1.112	6	2
Spatial	Vertical-using stairs	-1.005	17	5	0.000	10	3
Spatial	Spatial decision point with no relevant information	4.964	24	8	3.897	1	1
Visual	Colour	-0.318	10	6	3.323	16	10
Visual	Controlled door button	0.000	15	10	0.000	14	8
Visual	Directory	0.024	7	3	2.155	4	3
Visual	Landmark	1.005	14	9	0.000	14	8
Visual	Lift buttons inside & outside	-0.294	9	5	2.258	3	2
Visual	Lift Indicator	-1.702	13	8	0.911	7	5
Visual	Map	-0.044	8	4	0.503	15	9
Visual	Map & Directory	1.063	20	12	0.258	9	7
Visual	Sign	0.138	6	2	2.573	2	1
Visual	Visible door	-0.376	11	7	1.522	5	4
Visual	Visual distraction	-0.423	16	11	0.000	14	8
Visual	Visual decision point with no relevant information	4.657	1	1	0.667	8	6
Sensory	Light	-1.093	12	1	-3.635	13	2
Sensory	Sensory decision point with no relevant information	0.000	15	2	0.000	10	1
Supportive	Asking	2.062	22	2	4.722	19	3
Supportive	Person-assisted	1.931	21	1	0.000	10	1
Supportive	Supportive decision point with no relevant information	2.420	23	3	4.529	18	2

The highest ranked features in influencing wayfinding success for each participant group from Table 5.29 are displayed in Table 5.30 for comparison between participant groups.

Table 5.30. Comparison of Features with Highest Influence on Wayfinding Success

Component	Rank	Participants with ID	TD participants
Overall	1	Visual decision point with no relevant information	Spatial decision point with no relevant information
	2	Junction	Sign
	3	Prospecting point	Lift buttons inside & outside
Spatial	1	Junction	Spatial decision point with no relevant information
	2	Prospecting point	Vertical using lift
Visual	1	Visual decision point with no relevant information	Sign
	2	Sign	Lift buttons inside & outside
Sensory	1	Light	Sensory decision point with no relevant information
	2	Sensory Decision point with no relevant information	Light
Supportive	1	Person-assisted	Person-assisted
	2	Asking	Supportive decision point with no relevant information

5.4.4 Emotional reactions affecting wayfinding

Participants were asked a number of questions in the interviews about emotional reactions experienced during wayfinding and whether these emotions had affected their wayfinding in the hospital.

How much of the time did participants feel nervous?

Table 5.31 shows aggregated participant responses to the Likert scale question about feeling nervous.

Table 5.31. Aggregated data for how much participant felt nervous

Group	Not of the time, Very little of the time	Some of the time, Most of the time, All of the time
ID	14(46.7%)	16 (53.3%)
TD	16 (53.3%)	14 (46.7%)

Around half the participants in each group (16 ID, 14 TD) felt nervous between ‘some’ and ‘all’ of the time and 37% of ID participants and 53% of TD participants stated that it had affected where they went (see Appendix N, Tables N1 and N.2). Most comments from participants with ID focussed on personal issues such as lack of familiarity with the location

and having unknown people around whilst wayfinding (see Appendix N, Table N.3). One participant with ID (M27F) had an interesting description of wayfinding in the hospital, likening it to a maze; another observed that hospitals are normally safe for people, therefore they knew it was a safe environment. Observation notes made during coding of the videos indicated that some participants with ID (M05M, M06F, M17F and M25F) became nervous at certain points, including at a poster that showed a policeman warning about bullying staff, also at exit doors that didn't look like they ought to be opened, at a door at the end of a short corridor, at lifts that were not properly signed as out of order, when getting closer to the emergency department, at the dead-end of a corridor when there was loud banging and when seeing a sick patient (see Appendix N, Table N.4).

How much of the time did participants feel unsafe?

Table 5.32 shows aggregated participant responses to the Likert scale question about feeling unsafe.

Table 5.32. Aggregated data for how much participant felt unsafe

Group	Not of the time, Very little of the time	Some of the time, Most of the time, All of the time
ID	27(90.0%)	3 (10.0%)
TD	29 (96.7%)	1 (3.3%)

Participant responses to this question are shown in Appendix N, Tables N.5 and N.6 and indicate that most participants (90% ID, 96.7% TD) experienced little or no feeling of being unsafe. The number of participants whose feeling of being unsafe affected where they went was, therefore, very low (5 ID, 6 TD). There was limited discussion from both groups in response to open-ended questions about what made them feel unsafe (see Appendix N, Table N.7). One participant with ID (M18F) said she; *"….didn't want to get into something I wasn't meant to"*. Comments from TD participants focussed mainly on spatial issues (e.g., lifts, a small corridor and locked doors). Observations made during coding (see Appendix N, Table N.8), were also limited with one TD participant not keen to enter a ward area.

How much of the time did participants feel they knew where to go and/or feel helpless/lost?

Table 5.33 shows aggregated participant responses to the Likert scale question about feeling they knew where to go/feeling helpless.

Table 5.33. Aggregated data for how much participants felt they knew where to go/lost

Group	Not of the time,	Very little of the time, Some of the time,	Most of the time, All of the time
ID	5 (16.7%)	23 (76.6%)	2 (6.7%)
TD	2 (6.7%)	26 (86.6%)	2 (6.7%)

Participant responses are shown in Table 5.33 and Appendix N, Tables N.9 to N.15. Responses by both participant groups to the questions were predominantly in the range "Very little of the time" and "Some of the time". However, marginally more participants with ID indicated that feeling helpless/lost had affected where they went (see Appendix N, Table N.12). Respondents were asked to describe what made them feel helpless or lost and how it affected where they went. Generally, participant responses indicated having feelings of not knowing where they were, having to use signs that only people at the hospital would understand, being unfamiliar with the environment and general unease with using signs (see Appendix N, Tables N.13 to N.14 for participant responses and Table N.15 for observations made during coding).

Would participants be happy to find the locations on their own

Whether a person would be prepared to undertake trips on their own is likely to be influenced by all the above-mentioned issues. When asked, 25 participants out of 30 in each group said they would be happy to find the locations on their own (see Appendix N, Table N.16).

5.5 Summary

This chapter has collated and reported results about wayfinding by participants with ID and TD participants in a major hospital in Perth. The information has been obtained through video observation and recorded semi-structured interviews and the two sources of information have been triangulated. Where appropriate, the results from the two separate participant groups have been compared statistically for significance to identify if issues are relevant for one or both groups.

The following chapter provides discussion about each wayfinding feature, based on the results from this chapter and then offers suggestions, based on the data obtained, about how wayfinding features may be made more inclusive to improve wayfinding for people with ID.

Chapter 6:

Discussion

6.1 Introduction

This chapter discusses the implications of the results reported in chapter 5. The structure broadly mirrors that used in chapter 5 to assist cross-checking. Initially, results regarding the wayfinding strategies used and overall wayfinding performance are discussed, followed by a detailed discussion of the results pertaining to each of the specific components and features. Suggestions are provided at the end of each discussion, informed by previous research described in chapter 2, by results recorded in chapter 5 and findings discussed in this chapter.

The research data is based on observation of wayfinding trips in a hospital in Perth by 60 participants, 30 adults with intellectual disability and 30 typically developing adults. Having reviewed published literature extensively for similar research, it appears, based on participant numbers that this may be one of the larger studies undertaken to date about this topic. Also, data for this study was obtained using a real and dynamic environment (a hospital), rather than a simulated environment and was meticulously recorded using video observation and audio-recorded interviews. Other studies, such as Riley (1995), have involved fewer participants with ID or have used virtual environments and laboratory testing.

6.1.1 Wayfinding strategy: Route learning

As discussed in the literature review (chapter 2, section 2.2.3.b.i), initial wayfinding strategies can be divided into either linear/route or spatial/orientation strategies and the choice of strategy is context-specific (Lawton, Charleston and Zieles 1996). As the design of the hospital did not provide opportunity to overview the building layout, most participants initially used a linear/route learning strategy to wayfinding, which concurs with research by Salmi (2007a) who suggests route learning suits environments (such as the site for the current study) where it is difficult to oversee the entire environment from vantage points. Successful route learning also requires information to be available as a person moves from point to point (Darken 1996). This was evident, particularly for participants with ID, who had difficulty making decisions at points with no relevant information. Configurational strategies for wayfinding (see Chapter 2, Section 2.2.3.b.i) were slow to develop, perhaps being used only for the last trip, by which time some participants were showing an ability to use relational and configurational knowledge.

The following recommended design considerations are based on observation from this study and may help visitors, specifically with ID, develop successful wayfinding strategies:

- Ensure the built environment provides timely and adequate wayfinding information wherever a building user needs to make a wayfinding decision. This suggestion not only involves providing the information, but understanding when and how the information needs to be provided (e.g., in proximity to and accessible at all decision points and in a usable format, particularly for people with ID). See Chapter 2, Section 2.2.3.b.ii (Decision making – decision execution – information processing), for related observations by Passini (1984b) and section 6.1.4 in this chapter for commentary about the effect on wayfinding in this current study where decision points had no relevant information.

- Provide opportunity for greater visual access so people can better see what is coming up and establish better configurational understanding. See Chapter 2, Section 2.2.3.a.iii (Spatial features), for explanation of visual access. Visual access may be affected by the building layout and results from this study (Chapter 5, Section 5.4.2.d.i,) showed that 23.3% of participants with ID people found it relatively hard to see what was coming up while only 10% of TD participants found it relatively difficult.

- When considering the information needed for wayfinding, be aware that people may have differing or limited personal schemata (i.e., mental images of what an object or location may look like) (see Chapter2, Section 2.2.3.b.i - Using schemata to assist in wayfinding). Designers may inadvertently assume their schemata are universally understood and therefore not provide information they perceive to be obvious.

6.1.2 Wayfinding environment: Level of success

The observation study found that participants with ID completed only 67 out of 90 trips within the allotted time compared to 89 out of 90 by TD participants. In doing so, participants with ID took longer, travelled further and made more wayfinding decisions on average than TD participants (see Chapter 5, Section 5.4.1 – Table 5.2). This result is supported by Salmi (2007a), who noted that people with ID, attempting to find restrooms in a shopping mall, took 190% longer on average than TD participants.

With these findings, it is apparent that trips were more onerous for people with ID and in the case of Trip c, where four participants with ID could not get out of the building, could be life

threatening in the event of an emergency. The clear and substantiated finding in this study that participants with ID had more difficulty than TD participants in wayfinding serves to support the need for better informed building design that aids wayfinding by people with ID.

The number of decision points used by participants in the current study varied according to the route taken, the information available and whether that information was acknowledged and used. Results show that in all three trips, participants with ID used more decision points than TD participants. Research suggests that the number of decision points encountered in a wayfinding journey makes wayfinding more complex (Weisman 1981), with too many having a negative effect on wayfinding performance (Arthur and Passini 1992; O'Neill 1991a; Raubal and Egenhofer 1998b). Salmi (2007a) suggests such complexity would not be helpful for people with ID when wayfinding. Consequently, overall wayfinding success for people with ID may be improved by looking at ways to reduce the number of decision points and/or increase their effectiveness.

The following suggested solutions to help people with ID are informed by the findings discussed in subsequent sections (6.1.3 and 6.1.4) below:

- Reduce the complexity of decision making at decision points by embracing some of the suggestions provided in the following detailed discussion about features.
- Introduce “best route” instructions (available before the visit) that could be handed/sent to visitors, not just this-is-where-it-is maps, which may not be easy for people with ID to process (Sohlberg et al. 2007).
- Identify common destinations (e.g., outpatients and wards) and provide specific information at entry points to show how to get to those destinations, not just listing wards on a directory board. This information could then be colour-coded to link corridors to lifts and level indicators to floors. This would overcome a number of issues; the lack of visual accessibility to see into the distance mentioned by Salmi (2007a), the complexity of corridors mentioned by (Sawyer and Bright 2007) and the choice of lifts and different levels to negotiate to be able to reach the destination.
- Alternatively, provide specific signage for a predetermined route. A good example for this is the distinctive signage system used in San Francisco to guide tourists around a 49-mile scenic drive through the city. The signs comprise a bird symbol and the words “49 Mile Scenic Drive” and an arrow pointing the direction to go. It is distinctive and therefore very simple to recognise (not only by words but also by symbol) and gives directions at every turn. This could be used for Wards (perhaps using a bed symbol) or Outpatients (using a suitable symbol). In the interviews, TD

participants noted a lack of symbols for the trips they took. Research suggests that using symbols is beneficial for people with ID (Disability Rights Commission 2004a; Yalon-Chamovitz 2009) and Lee et al. (2014) suggest they could be beneficial for anyone who could not read signs.

- Make routes more predictable to help people with ID reduce the number of decision points required, by providing more logical layouts (ODPM 2006), reducing distractions and improving signage that meets the needs of people with ID (UK Department for Children Schools and Families 2008).
- Make placement and design of decision points both logical and rational (CRC for Construction Innovation 2007) as they are likely to become salient places in a person's memory (O'Neill 1991b). As such, they are the most logical places to situate wayfinding information so that it is seen, used and remembered (Golledge 1999a; Golledge and Stimson 1997; Janzen 2006).
- Whilst not an adaptation to the built environment, travel training may be a further option to consider in assisting with wayfinding.

Implementing the above recommendations, should increase participant confidence in wayfinding. This may reduce the number of times participants feel the need to reconfirm the destination (this was evident in the current study, by the number of times participant felt the need to refer to the destination card).

6.1.3 Difficulty in finding locations

It is concerning that statistics (see Appendix I, Table I.16) show one participant could not get out within fifteen minutes (M25F) and four never managed to get out of the building at all (M05M, M07M, M17F and M23F). As Dogu and Erkip (2000) note, escaping a building is an essential ability for anyone, particularly given that such situations can be highly stressful and disorienting. Whilst acknowledging there may be support mechanisms to help with escape (e.g., fire wardens, specific plans for known persons with ID in the building), not being able to get out of a building may affect a person's perception of their own abilities and impact on their self-confidence to undertake other daily living activities.

In response to the interview question about getting out of the building, 30% of participants with ID and 26.7% of TD participants said they could not do it. ID participants suggested the following reasons: lifts were slow (M11F and M27F), difficulty finding where exits are (M27F), it was very confusing (M23F), it was not in the back of their head (M08F), would be hard as it is not a familiar place (M12M) and because "I'm a slow person" (M17F). As

part of a conversation, one participant with ID (M23F) was asked: “Supposing there was a fire, and there was nobody else around, do you think you’d have been able to get out”, to which they replied, “No”. These responses, along with observed data that four participants (M05M, M07M, M17F and M23F) did not actually get out of the building, raises concern for their safety. Furthermore, given egress may be necessitated by an emergency, even having these perceptions could increase anxiety and possibly impair the cognitive processing needed to work out how to get out.

6.1.4 Specific components and features affecting wayfinding

There is a body of research about design of wayfinding features, such as signs, for the general population and for people with physical and sensory impairments (Commonwealth Government of Australia 2010b; CRC for Construction Innovation 2007; Disability Rights Commission 2004a; HREOC 2006; Hunter 2010a; Malkin 1989; NHS-Estates 1999; ODPM 2006; Salmi 2007a). However, much less has been written about accommodating the wayfinding needs of people with ID (ODPM 2006; Salmi 2007a; Salmi, Ginthner and Guerin 2004). It was not the intent of this study to challenge existing guides, but to identify the influence of wayfinding features and suggest solutions to enhance inclusive design of those features to improve wayfinding success for people with ID.

In the process of observing participants during wayfinding in a hospital building, 26 categories of features were identified that were used for wayfinding. These have been grouped into four main components; spatial (e.g., layout, junctions), visual (e.g., signs, maps, directories), sensory (e.g., light, sound) and supportive (e.g., asking, person-assisted) (see Chapter 5, Table 5.6). In each component, a separate category of feature was included to represent features used that contained no relevant information for the trip being taken. Overall, these features occurred at a significant number of decision points (50% of all decisions points for participants with ID and 41% for TD participants). This is important because the lack of relevant wayfinding information at those decision points meant participants needed to make a decision based on one or more of the following: a) familiarity with the current building, b) memory of previous similar situations, c) a developed configurational knowledge or d) an educated guess, all of which require cognitive processing ability (Algase et al. 2004; Passini 1984b). The results show that participants with ID achieved a successful outcome of 70% at these points whereas TD participants achieved 81% success. Given that people with ID have difficulty with cognitive processing (Harris 2006), this difference in success between the two groups is not surprising and emphasises the importance of providing adequate, timely and consistent wayfinding information.

Ranking of features according to frequency of use, was the same for both participant groups (most to least): visual, spatial, supportive, sensory (see chapter 5, table 5.7). Visual and spatial features represented the significant proportion of all features used by each group (96% ID, 97%TD). However, ID participants had significantly lower success than TD participants in using visual and spatial features to get closer to the destination (78% ID, 89%TD). Signs, followed by junctions were the most often and successfully used features by both participant groups (excluding features with no relevant information) (see chapter 5, table 5.6).

Research prior to the observation identified signs, landmarks, maps, directories and colour coding as features commonly discussed in literature about wayfinding. An interview question was created to find out which of these features participants liked using the most (not necessarily at the study site). The researcher added "asking" to the list to see how this would fare in comparison to the other features. Signs were the feature overwhelmingly preferred by both groups, but interestingly, 'asking' was ranked second by participants with ID, but only fourth by TD participants.

Suggested solutions to improve wayfinding success for people with ID:

- Focus design attention on increasing inclusivity in the design of visual features as they were found in this study to be the most used type of feature by people with ID, but less successfully in comparison to TD people (see chapter 5, table 5.7).
- Optimise inclusivity in the design of features for people with ID in the other three components so they can supplement use of visual features.
- Ensure suitable opportunities for people with ID to ask for help (see chapter, table 5.4.2.g.i).
- Reduce the need to make decisions at points where there is no relevant information. This may require a review of the information at specific decision points or, more broadly, a review of the wayfinding system to provide more confidence to a person undertaking wayfinding. Possible actions may include introducing new wayfinding information (e.g., a revised sign or map, etc.), providing greater use of colour coding, providing general travel advice for visiting the hospital and travel training to build experiences of what to do in similar situations.

a) Spatial features

Spatial features are probably the most difficult to retrospectively alter in an existing building as they would require remodelling of a building interior that, in many instances, may not be

possible or, at the very least, extremely costly. Consequently, these features need to be given priority by the designer when first considering the building and the interrelation of usable spaces. In terms of the observation study, the most common spatial features used by both groups were “decision points with no relevant information” and “junctions” (see chapter 5, table 5.6). Participants with ID were less successful compared to TD participants in using the following spatial features: managing junctions, prospecting points, rooms off main corridors, using lifts and decision points where there was no relevant supporting information. Each feature is discussed below.

i) Building layout generally

A well designed building layout will help building users to find where they need to go (Sawyer and Bright 2007). On the other hand, complex floor plans reduce wayfinding performance (Baskaya, Wilson and Özcan 2004; Dogu and Erkip 2000; Ng 2003; O'Neill 1991a, 1992; Peponis, Zimring and Choi 1990; Werner and Schindler 2004). According to Kaplan, Kaplan, and Ryan (1998), providing visual access can also give confidence to the person undertaking wayfinding, which is of particular importance to people with ID. Participants with ID in Salmi’s (2007a) study of use of a shopping mall were able to develop spatial organisation as a result of being able to look around whilst on escalators. However, in this current study, development of spatial perception for both participant groups was hindered because they found it difficult to see what was coming next. This was due to the building layout of the hospital, which provided little opportunity for visual access. The nature of operations undertaken in a hospital requires provision of quiet and secluded areas, not only for patients, but for operations, consultations and the like. This limits visual access across areas and reduces the opportunity to oversee the building layout and develop configurational knowledge for future wayfinding. According to research by Carpman, Grant, and Simmons (1985), lack of visual access can have greater influence on wayfinding than signage, when entering a hospital. The effect in the current study was also different across groups, with significantly fewer participants with ID than TD participants believing there was more than one way to go to each destination (see chapter 5, table 5.10). Distances from entry points to destinations were quite considerable, which increased the need for participants with ID to receive regular reinforcing information that they were travelling in the right direction.

Suggested solutions to help people with ID:

- Enhance visual accessibility (e.g., windows, open foyers).

- Minimise the need for so many decisions points by clear and consistent directions to the key locations.

ii) Controlled doors

Both groups were ultimately successful in using this feature (see chapter 5, section 5.4.2.d.ii) but there were some signage problems. The doors were located in the ward area and were controlled by a button, some distance from the doors themselves. On first viewing, it was difficult to link the doors with the isolated button. The signage appeared to be a post-construction addition and not part of the overall wayfinding system. Using these doors led to confusion and unnecessary delay in wayfinding.

Suggested solutions to help people with ID:

- Any post-design adjustments to a wayfinding system need to be considered in relation to the whole system so that they are fully integrated.
- Ensure the intended meaning is properly represented on any sign.

iii) Dead end with door

This feature was only experienced by participants with ID and was not successfully used as participants turned back and looked elsewhere (see chapter 5, section 5.4.2.d.iii). There was some confusion and frustration for the participants with ID who encountered these doors. One participant with ID (M29M) walked a long distance to exit the building through some doors, only to find they could not get out that way. This situation would be similar whether experienced by a person with ID or who is TD. However, the person with TD may possess a greater ability to contemplate this probability, therefore looking along the way for alternative exit options.

Suggested solutions to help people with ID:

- Ensure doors are clearly marked if not intended to be accessible, not only at the doors, but from some distance away.
- If designed to be accessible, then destinations that can be reached by going through the door should be clearly noted on or beside the door.

iv) Entry/Exit point

This feature was used successfully by both groups in the observation study. Entry and exit points need to be easy to use and logically place (ODPM 2006). Entrances should also be free of clutter (CRC for Construction Innovation 2004), which was not the case in the current

study where some entrances had significant amounts of distracting posters nearby the doors. This did not seem, however, to distract participants in using the doors. One participant (C13F) encountered an exit door at the bottom of a stairwell that was temporarily jammed and could not be opened.

Suggested solutions to help people with ID:

- Ensure doors are fully operational.
- Provide clear and uncluttered access.

v) Junction

Participants with ID had less success than TD participants in using this feature in the observation study (see chapter 5, table 5.9). There is no specific mention of junctions in literature about wayfinding by people with ID, and therefore no previous specific recommendations for their design. In literature about general wayfinding, on the other hand, they are discussed as part of the configuration of the building and it is suggested that they are accompanied by suitable signage and direction (UK Department for Children Schools and Families 2008). NHS-Estates (1999) suggests that, whilst signs may help with wayfinding, the real problem is illogical or complicated layouts with many junctions. The best option would be to simplify building layouts (i.e., reduce the number of junctions). In fact Baskaya, Wilson, and Özcan (2004) suggest that there is a relationship between the number of decision points (such as junctions) and difficulty with wayfinding. Given the significant number of decision points required at junctions in the current study, this may help to explain why participants with ID were less successful overall with their wayfinding.

Suggested solutions to help people with ID:

- If possible, combine a junction with some memorable feature (i.e., landmark) to make the layout more legible.
- Provide clear and adequate signage.
- In existing buildings, review the usefulness of the wayfinding information provided at junctions.

vi) Prospecting points

Participants with ID were less successful than TD participants in using this feature in the observation study (see chapter 5, table 5.9). A prospecting decision point refers to a location where participants stop to look around. There may be relevant information nearby but they

may not have seen it and will therefore make a decision without the use of any other feature (e.g., they stop midway along a corridor to rethink which direction to go, and there is a sign at the end of the corridor, but they have not necessarily seen it). Whilst the number of these points is small in relation to the total decision points used, they nonetheless represent a point of uncertainty, which may be difficult to manage for someone with ID. A good wayfinding design should seek to minimise a person's uncertainty about where they are and where they need to go by providing supportive wayfinding information at short and regular intervals (Passini 1988; Rousek and Hallbeck 2011b).

Suggested solution to help people with ID:

- Ensure information is repeated at regular intervals along corridors and not just at key nodes and intersections.

vii) Room off main corridor

Participants with ID were less successful than TD participants in managing decision points where there was a room leading off a main corridor (see chapter 5, table 5.9). Although these points represented a very small number of the overall decision points in the study, they did cause confusion during wayfinding and delayed participants in their trips.

Suggested solution to help people with ID:

- Check signage at points where areas or rooms open onto a major corridor to ensure the use of the area or room is clearly indicated and the person undertaking wayfinding knows it is not relevant in finding a specific destination.

viii) Vertical - Using lift

Participants with ID had significantly less success than TD participants using this feature in the observation study (see chapter 5, table 5.9). Nicholas (2000) noted that building design needed to pay attention to making the transition from horizontal circulation to vertical circulation easier. However, other than Nicholas (2000), no published studies referred directly to lift use by people with ID.

Chapter 5, table 5.12 collates participant responses to open-ended questions about the lifts, and identifies problems, helpful aspects and suggested improvements for lifts. Although there are a number of positive responses from participants with ID about using the lifts, this self-reporting does not reflect the quite considerable difficulties several participants with ID experienced in coping with vertical movement through the building. The shared use of lifts for both public use and hospital service use (patients, food, etc.) caused some difficulties for

participants with ID who became quite anxious on occasions. The lifts did not provide a particularly quick service and were often quite full, which made their use even more difficult. Notes made during the coding of observation videos, however, identified a number of issues. Such issues created complexity that may contribute to severe memory overload (Hölscher et al. 2007) and disorientation during vertical travel (Soeda, Kushiyama and Ohno, 1997 cited in Hölscher et al. 2007). As a result of the observation, four main areas of difficulty have been identified for people with ID when using lifts; a) understanding how to use a lift, b) understanding how to know which direction to go and which floor the lift was on when the doors opened, c) not understanding lift call button use and d) a lack of indication about the floor levels from inside the lift car.

Suggested solutions to help people with ID:

- Provide training to use lifts (either by the occupants of the building facility or by a disability support worker undertaking the training directly with the person with ID).
- Ensure lift indicators are checked and working both inside and outside the lift cars.
- Ensure signage relating to maintenance activity is attached to doors at every level, if and when lifts are not working.
- Ensure buttons in the lift car are adequately labelled.

ix) Vertical - using stairs

Both participant groups were successful in using this feature in the observation study (see chapter 5, table 5.9). Given the limited use of stairs, however, they did not feature in any of the participant comments during the interviews. During the observation exercise one TD participant (C13F) commented on a lack of signage to indicate how to get out of the building.

Participants were given the option to exit the building by any means and therefore often chose the lift. Had it been intended to simulate an emergency, then a lot more participants would have experienced using the stairs and there may have been more comments made.

Suggested solution to help people with ID:

- Stairs and stairwells need to have clear and frequent signage about exits and floor levels.

x) At spatial decision points with no relevant information

Participants with ID had significantly less success than TD participants using this feature in the observation study (see chapter 5, table 5.6). Such points required participants to intially realise that there was no relevant information and then decide what action to take. This action would depend on having the ability to create, filter and retrieve information from memory, create and use cognitive maps or simply to guess, all of which required cognitive processing, which may be difficult for people wth ID.

Suggested solution to help people with ID:

- Ensure relevant information is provided at or within site of all decision points.

b) Visual features

Visual features are provided to give assistance to a person navigating the spatial layout. Not all visual features provide specific directional information. Some may result from the design of objects or areas within the space, such as a closed door, a window or a café, that helps create a visual feature (e.g., a landmark) and position a person within the space. Visual features are generally easier to add to a building after the initial construction and can therefore also be relatively easy to add or modify without requiring significant retrospective remodelling of a building interior.

Unfortunately, it is for this reason that design of the visual component of wayfinding may be left until late in the design/construction process, whereas it should be considered integral to the design of the overall wayfinding system and be incorporated early in the building design process. Passini (Arthur and Passini 1992) provides an anecdote about a commercial building in Montreal that was built without consideration of wayfinding and, despite a subsequent massive signage project to improve the situation, was eventually torn down. A subsequent press release cited impossible wayfinding as the primary reason for its demolition.

In terms of the observation study, the most common visual features used by both participant groups were “signs” and “decision points with no relevant information”. Participants with ID, however, were less successful than TD participants in several features including directories, lift buttons inside and out, lift level indicators and visible doors and were significantly less successful using combined map and directories, signs, distractions (significant) and decision points with no relevant information. There was a clear overall difference in wayfinding success for features in this component. These differences are discussed in the following sections.

i) Using visual schemata

Raubal and Worboys (1999) suggest that people use mental images, called “schemata”, developed through experience, to help understand and identify what they are looking for when wayfinding. These schemata are not just about locations but also about generic objects or situations (Golledge 2003). For instance, a person may use the word “ward” to describe a destination, and someone else, on hearing this, would be able to retrieve a schema from memory that gives them a mental image of what a ward looks like and therefore an indication of what they need to look for. A person with ID, however, may not have the cognitive processing capability to create or retrieve such schemata and therefore the word ward may have no association with an image that could guide them. In the observation exercise, one participant (M16M) was looking for the outpatients eye clinic reception counter, but seemed to be looking in unusual locations (e.g., at the ceiling). When asked, they had no idea what a reception counter would look like and therefore no idea where it might be located (e.g., floor, wall or ceiling). The only way to find it, based on being given the destination card to follow, would have been to ask someone or to match the word on the card with the same word in a sign, map or directory.

Suggested solutions to help people with ID:

- Building designers need to review wayfinding designs to ensure reliance is not placed on having specific schemata if there is any possibility that other users would not have developed a similar schemata.
- Provide visual support on features (e.g., symbols) to help a person retrieve schemata or to replace the need for them.

ii) Controlled door button

Having overcome a difficulty understanding the link between the door and a separate button, both participant groups were successful using this feature in the observation study (see chapter 5, section 5.4.2.d.ii).

Suggested solutions to help people with ID:

- Ensure any additional signs added post-construction, comply with an overall wayfinding system to maintain consistency needed for successful wayfinding (Passini 1984b, 1996; Salmi 2007a).
- Implement a control system to monitor additions to a wayfinding system. An example of a signage control system can be viewed on the website of Queensland University of Technology (2017).

iii) Colour

Both participant groups were equally successful at decision points using this feature in the observation study (see Table 5.6). Observations and comments made by participants during wayfinding suggested that colour was most useful in conjunction with the lifts (blue, green and gold). This colour-coding related more to the wording rather than the actual colour of lifts, which could not be seen until entering the lift lobbies. This intense colour-coding at the lifts could only confirm a participant had arrived at the right place, but not give a long distance visual cue.

Other than the colour-coding of lifts, the opportunity for participants to use colour-coding was somewhat limited. Research has suggested that colour-coding could also be useful for delineating paths (Darken 1996; Kaplan, Kaplan and Ryan 1998; Malkin 1989), which some participants had identified when discussing the use of yellow tiles in the floor to direct them towards Outpatients. However, few actually benefitted from using these yellow tiles as they were not particularly distinct. Dalke et al. (2006) warns that choices of colour, particularly in hospitals, is often misguided and inconsistent and colour coding poorly maintained. In interview responses, TD participants indicated limited preference for colour-coding (see chapter 5, table 5.14).

Suggested solutions to help people with ID:

- Provide more colour strips on the floor, which concurs with literature (Dalke et al. 2006).
- Use more colour in directories and maps.
- Use colours to separate functional areas (ODPM 2006).
- Use ‘focal’ colours (i.e., easy to describe, such as red) that can be remembered and described in instructions (Farran, Courbois, VanHerwegen, Cruickshank, et al. 2012).
- Use soothing colours that will not over-stimulate some people with ID (UK Department for Children Schools and Families 2008).

iv) Directories

Participants with ID were less successful than TD participants at using directories in the observation study, yet in comparison to TD participant rankings, rated them easier to use and more liked. However, both groups ranked directories as one of the least popular features to use (see chapter 5, table 5.15). From the observations, participants with ID seemed very

confused with all the information presented and therefore spent some time in front of the boards looking for words. Participants with TD (C11F, C18M) actually noted, interestingly, that there were no symbols or distinctive colours to help differentiate and identify locations listed on the boards. Also, some places were described slightly differently (e.g., x-ray or radiology) and some places were only listed as their main feature (e.g., Outpatients) but did not list any of the functional areas within that department (e.g., Eye Clinic). In a wayfinding study, Salmi (2007a) found that directories may provide information, but not necessarily increase legibility of the wayfinding environment. One TD participant also observed that the directories did not show directions for getting out of the building. Findings by Salmi (2005, 2007a) noted a similar difficulty for participants using directories to get out of a shopping mall, resulting in directories not being used.

Although it may seem logical that a directory would be linked to a map, this was not the case at the hospital site. The adjoining maps were often simply a configurational plan of the site with outlines of buildings. They did not necessarily show the locations listed in adjoining directory boards. This situation was noted by some TD participants (C22M and C24M) who had hoped they would be linked. These issues repeat the problems cited by Dogu and Erkip (2000) where participants found directories to be confusing and lacking in organisation.

Suggested solutions to help people with ID

- Add more detail for locations, not just a general location (e.g., Eye Clinic in Outpatients rather than just Outpatients).
- Link points in the directory to locations on an adjoining map.
- Use design guidelines suggested by Salmi (2007a) for the presentation of information.
- Rationalise layout and functional areas chosen to be listed in the directory.
- Provide separate boards for distinct functional areas or use colour on the one board to differentiate functional areas.
- Supplement written information with the use of symbols (e.g., symbol of a bed beside a ward location).

v) Landmarks

Few participants from either group used this feature, but both groups were successful whenever it was used (see chapter 5, table 5.6). Participants with ID rated this feature the least popular out of signs, landmarks, maps, directories, colour coding and asking people.

Reviewing the video observations showed that workers at the hospital relied on landmarks in their directions to participants with ID (e.g., the ATM, café, newsagent and aboriginal paintings). However, directions including these landmarks were lengthy and complex; when asking participants, after moving away from the person helping, they could remember very few of the directions or the landmarks indicated, so the value in referring to landmarks was lost.

The observation study identified some distinctive points that could easily be termed landmarks, such as a particularly visible ATM at a major intersection, a hairdresser's shop or the main café. These were situated in general and regularly used areas. Yet, once at the wards on level 6, each ward had a similar look. The wards were repeating designs along long corridors, giving limited opportunity to create memorable landmarks.

Very few participants developed their own knowledge of landmarks, and of those who did, it was generally only by the time they were taking Trip c. Using landmarks to help participants with ID to find their way was of little value, which concurs with research by Roskos-Ewolsen et al. (2006). There were very few highly visible landmarks to use in the wards, which repeated floor layouts and had very similar colours.

Suggested solutions to help people with ID:

- Ensure suitably identifiable landmarks are included in the wayfinding design.
- If designed specifically to be part of a wayfinding system, then ensure that landmarks are distinctive, easily recognisable and memorable for people with ID.
- Training participants with ID to use landmarks (e.g., by the occupants of the building facility or by a disability support worker undertaking the training directly with the person with ID).
- Provide maps that show the locations of landmarks and include a picture of the landmark alongside.

vi) Lift buttons inside and outside the lift car

Participants with ID were significantly less successful than TD participants at using this feature in the observation study (see chapter 5, table 5.6). Using lifts is a complex activity, particularly as vertical movement when in the lift gives no opportunity to reconcile location in relation to floors. Using the buttons, both inside and out, requires trust that they will work as expected (including lighting up). There were no identifiable publications in the literature review specifically discussing research about use of lifts by people with ID and therefore little with which to compare the observed data.

Apart from one TD participant (C05F) who had difficulty, all other TD participants were able to negotiate using the lift buttons to call and use the lifts. However, despite eventual success in using this feature, some participants with ID (M08M, M10M, M14F and M16F) had difficulty in understanding how to use the buttons to call a lift and which button to use once inside. One participant with ID (M23F) was so worried about calling a lift that the participant decided just to wait for one to come without calling it. Once inside the lift, some participants with ID were not always clear which button to press, sometimes pressing the same floor that the lift was currently on, sometimes not pressing any button. When pressed, the indicator light beside the expected destination floor did not always light up, which caused concern for some participants, particularly those with ID, who were not sure if the lift would stop at the required destination. One participant with ID (M19M) entered a lift going in the wrong direction because they called it to go in the wrong direction. Some got into the lift and sent it to the wrong floor, in one case to the basement, where they walked around before realising they needed to go back up to the ground floor.

Suggested solutions to help people with ID:

- Make sure maintenance of the lift car and buttons is up to date.
- Give training in lift use (either by the occupants of the building facility or by a disability support worker undertaking the training directly with the person with ID).
- Add words to give meaning to buttons inside the lifts (e.g., up/down).
- Don’t use graphic design on buttons that may have no meaning.
- Include the words “way out” alongside the button for a floor that provides a way out of the building.

vii) Lift level indicators

Participants with ID were less successful than TD participants at using this feature in the observation study (see chapter 5, table 5.6). The lift indicator on the outside of some lifts stopped working on occasions. This simple breakdown caused concern, particularly to participants with ID, who had no idea whether lifts were working or not and whether they should find another lift. Of much greater concern for participants with ID, however, were situations where the lift level indicator inside the lift was not working. Once inside the lift, with doors closed, the lift level indicator was the only way to know what the lift was doing. If the indicator was faulty, as some were at the hospital, participants had no idea whether they were arriving at their requested destination. Consequently, there was greater pressure on participants to assess which level the lift had arrived at by reference to what could be seen

when the lift car doors opened. If unfamiliar with using the particular set of lifts, it is not immediately clear where to look outside a lift car for information about the current level. Furthermore, on some occasions the lift was full and visual access to the lift lobby severely restricted. Levels of anxiety were clearly raised, particularly for some participants with ID, who were unexpectedly required to quickly identify a floor before the doors closed again. If the doors closed and the lift moved off, then the anxiety increased significantly because they were travelling in a direction and to a location that was unknown. Whilst participants with ID generally coped, the additional anxiety caused by the failed indicator was clearly visible and mentioned by participants (M13M, M25F). Anxiety can then cause irrational decisions and affect immediate wayfinding.

Suggested solution to help people with ID:

- Regular maintenance of all lift indicators.

viii) Maps

Participants with ID were slightly more successful than TD participants at using this feature in the observation study. However, only eight participants with ID (M12M, M14F, M20M, M25F, M26F, M27F, M29M and M31M) actually used the feature despite ranking it their third most popular feature (out of signs, landmarks, maps, directories, colour coding and asking people). The most common criticism from participants with ID in open-ended interview questions about using maps was that they had not seen one. Literature suggests that maps should be placed at entry points and key decision points (CRC for Construction Innovation 2007; Huelat 2007; Pollet and Haskell 2003; Salmi 2006). A couple of participants with ID (M20M, M30M), also indicated getting confused using them and having difficulty working out how the map related to their location, supporting similar findings from Salmi (2005) and Beneicke, Biesek, and Brandon (2003). Further criticisms by participants with ID (M26F, M09M) indicated a desire for simplicity, which concurs with findings by the ODPM (2006) in which people with ID could only use maps if they were very simple.

Suggested solutions to help people with ID:

- Provide more maps at convenient locations.
- Orient maps to match the immediate location (this was rarely done, and was complex for a person with ID to manipulate).
- Follow advice provided by Salmi (2007a) with respect to map design for people with ID (see chapter 2, section 2.4.3.c.ii)

ix) Combined maps and directories

Participants with ID were significantly less successful than TD participants in using this feature in the observation study. A combination of map and directory presented a complex display of words and information that needed to be sifted for required information. One of these combined features was situated in the main intersection between the spine walkway that ran the full length of the hospital and a corridor that went to the Outpatients. It was an extensive display and contained a significant amount of information. Participants with ID either avoided it (one saw it but simply walked straight past the feature) or, as several did, stood for a long time in front of the board, walking from one section to another, seemingly trying to comprehend the information and where to look. This is supported by research from the ODPM (2006), which also identified problems for people with ID in being presented with complex information.

Suggested solution to help people with ID:

- Identify information pertaining to common functional areas within a building and present that information in separate map/directories, rather than all in one feature.

x) Signs

Participants with ID were significantly less successful than TD participants in using this feature (see chapter 5, table 5.6) despite ranking it the most popular feature (out of signs, landmarks, maps, directories, colour coding and asking people). Interview responses to open-ended questions identified a number of problems with signage for participants with ID, the most frequent being the inability to read and understand the information, not understanding the words, and insufficient signage.

Review of the video observation (see Appendix K, Table K.35) also identified four important issues regarding the use and clarity of signs by participants with ID:

- Unclear labelling of locations and, perhaps, a presumption that people would automatically understand area coding. Participants from both groups had trouble understanding the naming/numbering of wards, thinking the “G” in “Ward G64”, meant either “ground floor” or “green”.

- Direction signs having inconsistent terminology for the same area (e.g., Radiology/X-ray), an issue noted in previous research (Pollet and Haskell 2003).

- Making assumptions about how people interpret information from signs. Four participants with ID were unable to find their way out of the building in Trip c. Having found an EXIT sign, they looked for a way to exit, but only found a door

labelled “Fire Stairs”, so continued to the next EXIT sign. This continued around level 6 until they arrived back at the same sign. Eventually these journeys had to be stopped because the participants could not get out.

- A lack of supplemental visual support (pictograms, pictures, etc) on signs as suggested by Mencap (2004) and The UK Disability Rights Commission (2004a).

On one occasion, a participant with ID (M10M) actually held the destination card up to the feature to see if the wording matched. This would seem to indicate that they were using the name on the destination card purely as a visual pattern that needed to be matched to similar visual patterns on a wayfinding feature, and not seeing the word as representing a functional location in a hospital This perception has ramifications for wayfinding. If a person cannot attribute any meaning to the visual pattern, then they have no means of finding the location other than matching identical visual patterns that may appear along the way and hopefully at the final destination. However, if a person can attribute meaning to a word then they may be able to mentally visualise an image or schema of the destination and look for places that would match that image or schema (i.e., if looking for a ward they might look for a location capable of holding beds away from the noisy public spaces).

There were surprisingly few locations where signs provided supplemental visual support (pictograms, pictures, etc.), contrary to the recommendations of Mencap (2004) and the UK Disability Rights Commission (2004a) to aid understanding by people with ID.

Where there were insufficient signs, several participants chose to ask for assistance from people working at the hospital, similar to participants in Salmi’s research (Salmi 2007a), although participants in that study appeared to benefit more from asking than participants in the current study.

Other issues raised in responses by participants with ID to open-ended interview questions, suggested the need for more signs, and improvements relating to size, clarity, applicability and readability, which concurs with advice suggested by Salmi (2007a).

Suggested solutions to help people with ID, based on findings from this study:

- Ensure clarity of meaning for all users (e.g., EXIT and fire stairs) This concurs with prevous research (Disability Rights Commission 2004a; ODPM 2006). When designing signs, seek advice from people both with and without ID to ensure the meaning of a sign is clearly understood. This may not always happen because, incorrectly, the designer may believe the meaning is obvious. Michael Small, from the Human Rights and Equal Opportunity Commission (now Australian Human Rights Commission) produced a CD in 2007 entitled “The good, the bad and the

ugly", which showcased examples of how perception of accessibility did not match reality (including sign design).

- Provide consistency and continuity in the naming of locations (e.g., describing locations as either Radiology or X-ray).
- Monitor the use of temporary signs to ensure they meet overall wayfinding conventions for the building in question.
- Provide symbols and pictograms wherever possible to assist people with ID in identfying locations, also suggested from findings by the ODPM (2006).
- Ensure signage meets the minimum standards recommended by authorities advocating for people with ID, such as the Disability Rights Commission (Disability Rights Commission 2004a).

xi) Visible door

Participants with ID were significantly less successful than TD participants in using this feature (see chapter 5, table 5.6). These doors had no significance for finding the required destinations, but occurred along corridors travelled by participants to get to a destination. Participants halted and looked at a door to see if it was the direction to take. Where there was no visual line of sight through the door or any signage, all participants showed a degree of reluctance to open the door, not knowing what was behind. These doors, therefore, presented mystery which, depending on a participant's preference, might create interest or concern.

Suggested solution to help people with ID:

- Provide clear and understandable signs to say that the door should not be used except by certain people or in certain circumstances.

xii) Visual distraction

This feature has been separately categorised because it affected participants but had no purpose for wayfinding, whereas features grouped under the "Visual features with no relevant information" were intended to give wayfinding support. This feature represents points where a participant may have been distracted by a view out of the window or, as happened in the observation study, affected by a public poster. This poster, placed in locations around the hospital, was intended to target and stop bullying of staff by visitors/patients. It comprised a uniformed WA policeman pointing straight at anyone viewing the poster with the words at the bottom saying, "NO STAFF ABUSE, NO

EXCUSE". For some participants with ID, however, it caused considerable distraction and anxiety.

Suggested solutions to help people with ID:

- Consider the potential impact of a poster on people with ID, who may not understand the message in a poster but be affected by seeing it. As advice from the UK Department for Children Schools and Families (2008) suggests, some distractions can cause overstimulation for people with autism.
- Make sure building maintenance has policy and procedures in place to control the extent and type of posters used, particularly on major circulation routes and in lifts.

xiii)At visual decision points with no relevant information

Participants with ID were significantly less successful than TD participants in using this feature (see chapter 5, table 5.6). At the point where these features are located, they may provide information relevant for one trip that may not be relevant for the current trip. The large number of occasions where this occurred in relation to visual features, highlighted the many decision points that did not have the necessary information for the current trip. Without having wayfinding information pertinent to the current trip, many participants with ID were unsuccessful at these points.

Suggested solution to help people with ID:

- Review design of all features to see whether they can include wayfinding information that would suit other journeys and not just the one for which they were originally intended.

c) Sensory features

In comparison with other components, there were only a few decision points in this component, all relating to light, that were observed during the visits to the hospital site. Nonetheless, participants provided responses to a series of scale and open-ended questions in the interviews about other sensory information that they may have experienced within the hospital environment. Answers to these questions are discussed in the following sections.

i) Light

The amount and use of light is important within an environment because it can either help or hinder finding and using features and, poorly designed, can create a lack of coherence (Salmi

2007a). Both groups were successful at decision points using light (chapter 5, table 5.6). Some areas were particularly dark for operational reasons (wards, etc.), which did make a few participants in both groups feel nervous. Generally, lighting was good and interview responses and ratings indicated this was helpful for wayfinding. As Sawyer and Bright (2007) noted, providing adequate light provides greater visibility throughout the building in which the wayfinding occurs.

Suggested solutions to help people with ID:

- Ensure adequate light for wayfinding, particularly at intersections of major routes.
- Advise visitors that parts of the building may have subdued lighting at certain times.

ii) Noise

Noise can affect the ability to focus and memorise information (UK Department for Children Schools and Families 2008) and cause overstimulation in some people with ID (Smith and Adkins 2006, 72). However, no decision points were observed that were based on noise. No observed areas had excessive noise although, on occasions, down the main spine thoroughfare, groups of workers may have been noisy when talking together quite loudly, but this was only in passing and did not appear to affect participants (reflected in their interview responses). Interview responses indicated very little difficulty caused by noise and therefore no solutions were identified as necessary resulting from this study.

iii) Touch/Texture

There were no decision points observed that were based on touch/texture. In response to interview questions, more participants with ID than TD participants indicated they had been aware of texture, but had found it difficult to use.

Suggested solution to help people with ID:

- If texture is to be designed as a wayfinding aid, this purpose needs to be made clear.

iv) Smell

Smells were experienced intermittently and not by all participants. They did not appear to affect any wayfinding decisions in any of the trips in this research.

Suggested solution to help people with ID:

- If smell is to be purposely used as a wayfinding aid, it needs to be consistent and well planned (CRC for Construction Innovation 2007; Darken 1996).

v) Heat

There were no decision points observed nor interview responses relating to heat.

vi) Crowdedness

There were no decision points observed relating to crowdedness. The lift lobbies did cause some concern because the lifts were slow and people would congregate in the lobbies. Also, the lifts were often being used for other purposes such as food delivery, patient transfer, maintenance, linen services and the like. Consequently, when a lift arrived it was not always possible to use, which added another layer of complexity and frustration.

Suggested solution to help people with ID:

- Better signage on lifts advising that they may have dual purpose and be closed to the public.

vii) People moving in a specific direction

There were no decision points observed relating to people moving in a specific direction. Participants suggested that it might help but this might only be where a participant did not otherwise know where to go.

viii)At sensory decision points with no relevant information

There were no decision points observed nor interview responses relating to this feature that indicated a need for further design consideration.

d) Supportive features

In terms of the observation study, the most common supportive feature used by both groups was “asking”.

i) Asking

Both groups achieved a similarly high level of success at these decision points (see chapter 5, table 5.6). Responses by participants with ID to the open-ended interview questions indicated that they seemed confident in asking, but some could not find a person to ask. Many of the people being asked were very helpful and wanted to give as much information as possible. However, when the observer asked participants with ID after only seconds of receiving instructions, most could not remember much more than the first two steps. There were several instances where people who were asked either ignored or were rude to a participant with ID.

Suggested solutions to help people with ID:

- Provide more readily available enquiry counters than just the front reception counter.
- Instigate a helper system where staff can wear a visible sign showing they can offer wayfinding assistance.
- Train staff to provide directions in manageable chunks that could easily be remembered.
- Provide clearly identifiable consistent landmarks at all major intersections so that directions can be given that use these points.

ii) Person-assisted

Both groups were successful at decision points where information was being given to a participant to direct them how to get to the destination (see chapter 5, table 5.6). It is hospital procedure to expect staff to assist visitors/patients who may appear to be lost and this occurred successfully on several occasions.

iii) At supportive decision points with no relevant information

Both participant groups were successful at decision points where they asked or were assisted, but information provided was not useful or pertinent to finding the destination (see chapter 5, table 5.6).

6.1.5 Influence of features on overall wayfinding success

The following comments are based on the outcome of random forest modelling in predicting the impact of various building features on overall wayfinding success and also on analysis of observed trip data. The random forest method is discussed in chapter 4, section 4.7.1.b.ii and the results listed in chapter 5, Section 5.4.3.

i) For participants with ID

The top three ranked features influencing wayfinding success by participants with ID were:

Visual decision points with no relevant information. This feature ranked first in overall influence on wayfinding success and ranked first in influence on wayfinding success in the visual component. These decision points provided either no wayfinding information at all or wayfinding information that was only useful for travelling to other destinations, not to the destination the participant was seeking. These decision points required the participant to

process whatever wayfinding information was available at that point, then assess whether it was relevant or not and, if not, make a decision based on either previous experience or guesswork. The decision points caused confusion and uncertainty for people with ID. Video observation showed them standing for periods of time looking at the surrounding area trying to make a decision on which way to go. Given its impact on time taken, this feature needs greater attention in overall wayfinding design.

Junctions. This feature ranked second in overall influence on wayfinding success and first in influence on wayfinding success in the spatial component. This level of influence is understandable given the complexity of the building layout and the consequent number of junctions. Participants with ID encountered 276 such decision points and had 80% success in using them (compared to 85% by TD participants). The frequency with which they occurred provided greater opportunity to influence the wayfinding outcome. Wayfinding information presented at these decision points, therefore, needed to be clear and understandable. Several major junctions on the ground floor, despite providing substantial information to help in wayfinding, were nonetheless very confusing for participants with ID. Whilst scoring 80% success in using junctions, participants actually spent a long time looking at the presented information in order to filter out irrelevant information and act on the relevant information, thereby delaying their trips. Making a decision also relied on significant cognitive processing ability, which is difficult for people with ID (see chapter 2, section 2.3.2).

Prospecting point. This feature was ranked third in overall influence on wayfinding success and second in influence on wayfinding success in the spatial component. There were 135 decision points where prospecting occurred, of which 79% produced a successful outcome. Prospecting meant that a participant stopped at a point (e.g. mid-way along a long corridor) to look around and see where they were and where they ought to go. Relevant information might have been available, but not at the prospecting point. The participant, therefore, had to look into the distance to try and find information that would confirm they were travelling in the right direction. These decision points created uncertainty for participants. Wayfinding information needed to be more accessible at these points, regularly spaced along long thoroughfares, otherwise participants can become uncertain or may forget previously provided instructions.

ii) For TD participants

Features that had the greatest influence on overall wayfinding success for TD participants were, first: spatial decision points with no relevant information; second: signs; and third: lift buttons inside and outside. Wayfinding design at these decision points needs consideration by designers as it has a high impact on wayfinding outcomes.

iii) Overall influence of features on success

Figures in tables 5.29 and 5.30 (see chapter 5), give a sense of which features have the greatest impact on wayfinding success for both groups. Different types of 'decision points with no relevant information' featured in the rankings as having a high level of influence on wayfinding success for both groups. This result is not unexpected, given they provide no support to the person who is undertaking wayfinding. Signs also featured in the lists for both groups (2nd most influential for participants with ID and most influential for TD participants in the visual component), which emphasises the need for these features to be given careful attention in an overall wayfinding design.

6.1.6 Emotional reactions affecting wayfinding

A wayfinding environment can create emotional reactions during wayfinding such as feelings of anxiety and insecurity (Passini 1999), which may impact on the willingness to continue wayfinding. When asked in the current study, 25 out of 30 participants from each group said they would be keen to find the locations on their own. The concern, therefore, is for the five from each group who may not want to visit the hospital unless accompanied, and the consequence of this for independent living. Furthermore, review of the video observation indicates that participants with ID were lost significantly more often than their responses intimated and certainly much more than TD participants (see Appendix N, Table N.15). If, in some way, the design of the building and its wayfinding features could reduce these negative emotional reactions, then it could help increase the independence of all participants.

Suggested solution to help people with ID:

- Implement the solutions discussed throughout this chapter.

6.1.7 Concluding observation

The results of this study represent a substantial and clear indication of the extent of the difference in wayfinding success for people with ID and people who are typically developing. In so doing, it highlights a specific need beyond that of the general population, to address issues relating to wayfinding by people with ID.

6.2 Summary

This chapter has presented a detailed discussion of the findings of the observation and interviews undertaken as part of this study and has provided suggested solutions for improved design of each feature, based on those findings. Implementation of suggested solutions can be considered the subsequent progression of the current study, hence beyond its scope. The next chapter uses information collated from previous research and this current study to develop a wayfinding feature framework that incorporates features used in wayfinding and also indicates their influence on wayfinding success.

Chapter 7:
Development of a Framework

7.1 Introduction

In previous chapters, information has been presented about the literature relating to wayfinding (chapter 2), the results of the current research study (chapter 5) and a discussion about those findings (chapter 6). In this chapter, the information is used to develop a framework that represents wayfinding based on the study.

This chapter provides a description of each of the four wayfinding components and presents a wayfinding feature matrix for each component. A decision-making process diagram was produced to indicate where these matrices are incorporated into a wayfinding process. Following this, a wayfinding feature framework was developed based on the data from the study. The chapter concludes with a proposed checklist for future design in the built environment to help improve accessibility and wayfinding, primarily for people with ID.

7.2 Components of the wayfinding environment

In the preceding chapters, discussion about wayfinding features has been divided into four major components; spatial, visual, sensory and supportive. This grouping is based on the way features contribute to a person's understanding of the wayfinding environment. Spatial features help to improve configurational and relational understanding of the space; visual features help to create a visual image that can be stored in memory and retrieved when required; sensory features use the senses of smell, touch and hearing to help define memorable locations; supportive features, through communication with other building users, help to enhance a person's own understanding of the wayfinding environment.

In the following sections of this chapter, wayfinding feature matrices are presented for each of the four wayfinding components. There are two matrices for each component; one representing wayfinding by participants with ID and the other representing wayfinding by TD participants. This allows comparison of wayfinding between the two groups. Each matrix triangulates the findings from the three research activities undertaken in this research study; literature review, observation and interviews.

The matrices are in Tables 7.1, 7.2, 7.3, 7.4, 7.7, 7.8, 7.9 and 7.10. This section explains the source and meaning of the columns in each matrix.

i) Feature

The list of features included in each component was derived from previous research about wayfinding (the literature review), features identified during the observation and any additional features identified from participant responses during the interviews.

ii) Sample of literature sources

This column indicates where previous research has been undertaken about specific features, as identified in the literature review. For those matrices representing wayfinding by participants with ID (Tables 7.1, 7.3, 7.7 and 7.9), this column lists key references relating specifically to research/publications about wayfinding by people with ID. For those matrices representing wayfinding by TD participants (Tables 7.2, 7.4, 7.8, 7.10), this column lists key research/publications that address use of features by the general population and by people with disability in general.

iii) Occurring in observation

This data is derived from observation of wayfinding by the respective participant groups based on activity at decision points. The data in the matrices shows the number of decision points and level of success when a feature was used. This provides a profile of success/failure using each of the features within a component and allows comparison of success between the two participant groups.

iv) Emerging from responses to interview questions

The column headed "*Discussed in relation to questions about:*" lists questions to which participant responses included reference to the listed feature. The extent of questions in which participants discussed each feature provides a general indication of the diverse implications of using that feature and validates inclusion of the feature in the list. The next three columns indicate the percentage of participants responding to each Likert scale interview question as noted in the column heading (see Chapter 6). As some of the listed features emerged once observation was undertaken, they were not included in Likert scale questions that had been prepared prior to observation. A combination of Likert scale and open-ended questions helped provide triangulation of data and validation of observations.

v) Influence on wayfinding success (based on time taken)

The final column provides a ranking of the feature's assessed influence on wayfinding success (based on time taken), with 1 being the greatest beneficial influence. An explanation

of the process of ranking features is provided in chapters 4 (section 4.7.1.b.ii) and 5 (section 5.4.3).

7.3 Spatial component

Spatial features are fundamental to the layout of a building and affect movement through the internal spaces. They need early consideration in building design as they are generally the most difficult to retrospectively alter in an existing building. Tables 7.1 and 7.2 list the features identified as being pertinent to the spatial component. A detailed discussion of each of these features is provided in Chapter 6; Section 6.1.4.a.

Comparison of the extent of previous research between the two groups indicates a lack of published research about wayfinding by people with ID in relation to the general population. Except for ‘dead end with door, all features in Tables 7.1 and 7.2 were identified being used by both groups during the video observation, with generally a higher number of uses by the participants with ID but with less success. As discussed in Chapter 6 this extra frequency of use adds to the complexity of journeys by people with ID and may explain the extra time they took and greater distance they travelled to reach each destination. There were several questions where participants from both groups provided no discussion or comment. However, there was considerable discussion about the lifts, which was expected, because participants with ID were significantly less successful using this feature, and both groups were critical of the lifts as being crowded and slow. Both groups rated ease of use of corridors very high.

Spatial features that had the greatest influence on wayfinding success by participants with ID (based on time taken) were junctions, prospecting points and vertical - using lifts, and on wayfinding success by TD participants were spatial decision points with no relevant information, vertical – using lifts and vertical – using stairs. Given that lifts were influential on wayfinding success and were observed giving difficulty for both groups, building design needs to pay special attention to this wayfinding feature.

Table 7.1. Spatial Features Wayfinding Matrix (Participants with ID)

Feature	Key literature sources (referring to people with ID)	Occurring in observation		Emerging from responses to interview questions				Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	
Building layout (incl. corridors, what was coming up)	(Yalon-Chamovitz 2009) (Salmi 2007a)	Not a separate feature	No stats	What was coming up? Was there more than one way? How easy were corridors? Complexity?	Corridors 96.7	-	-	No stats
Barrier controlled door	None specific to this feature	3	100.0	No specific comments?	-	-	-	6
Dead end with door	None specific to this feature	2	0.0	What was most annoying?	-	-	-	7
Entry/Exit point	(ODPM 2006)	2	100.0	How easy to find Ward G64?	-	-	-	7
Junction	None specific to this feature	276	80.1	No specific comments	-	-	-	1
Prospecting point	(Salmi 2007a)	135	79.3	No specific comments	-	-	-	2
Room off main	None specific to this feature	27	92.6	No specific comments	-	-	-	4
Vertical using lift	None specific to this feature	69	887.0	How easy to find Ward G64? Could you get out in a hurry? What problems for person with ID? What was most annoying? How to make it easier? How easy to use the lifts? How much did lifts help you? How difficult to use?	-	-	-	3
Vertical using stairs	None specific to this feature	3	100.0	Could you get out in a hurry?	-	-	-	5
Decision point with no relevant information	Combination of the above sources	675	67.3	What problems for person with ID? What was most annoying?	-	-	-	8
TOTAL		1192	73.4		-	-	-	

* Decision points ** Percentage of respondents

Table 7.2. Spatial Features Wayfinding Matrix (TD Participants)

Feature	Key literature sources (Generally)	Occurring in observation		Emerging from responses to interview questions				Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	
Building layout (incl. corridors, what was coming up)	(O'Neill 1991a) (Baskaya, Wilson and Özcan 2004) (Passini 1984b) Weisman (1981)	Not a separate feature	No stats	What was coming up? Was there more than one way? Corridors?	Corridors 90.0	-	-	Not recorded as separate feature
Barrier controlled door	(Sawyer and Bright 2007)	1	100.0	No specific comments	-	-	-	7
Dead end with door	None specific to this feature	0	0.0	No specific comments	-	-	-	6
Entry/Exit point	(Huelat 2007) (CRC for Construction Innovation 2004)	8	100.0	How easy to find Ward G64?	-	-	-	9
Junction	(Passini 1984b)(intersection)	225	84.9	How easy were the corridor to use? What was the most helpful feature? How difficult was it to use signs?	-	-	-	4
Prospecting	(Appleton 1996)	80	81.3	No specific comments	-	-	-	8
Room off main	None specific to this feature	20	100.0	No specific comments	-	-	-	5
Vertical using lift	(Pollet and Haskell 2003)	65	96.9	How easy to find Ward G64? Could you get out in a hurry? What problems for person with ID? What was the most annoying thing? How easy to use the lifts? How much did lifts help you? How much do you like using lifts? How difficult to use? What was most helpful?	-	-	-	2
Vertical using stairs	(Sawyer and Bright 2007) (Pollet and Haskell 2003)	1	100	Could you get out in a hurry?	-	-	-	3
Decision point with no relevant information	Combination of the above sources	421	75.8	What specific problems would a person with ID have? Is there any other information that could help?	-	-	-	1
TOTAL		821	81.4					

* Decision points ** Percentage of respondents

7.4 Visual component

Visual features assist wayfinding by presenting images in various forms to increase a person's awareness of where they are (e.g., maps, landmarks, colour), where to go (e.g., signs, indicators, etc.) and what to do (e.g., instructional signs). They are easier to install post-construction of a building in comparison to changing a building layout, but are best designed as part of the overall wayfinding system at the time of designing the building itself so they integrate and support the spatial features. Tables 7.3 and 7.4 list the features identified as being pertinent to the visual component. A detailed discussion of each of these features is provided in Chapter 6.

Again, comparison of the extent of previous research between the two groups, indicates a lack of published research about wayfinding by people with ID using these features.

Features listed in Tables 7.3 and 7.4 were observed being used by both groups, more frequently by participants with ID, but with less success.

Colour, maps and signs were the most commonly discussed visual features in interview discussions by both groups. Colour featured in discussions quite significantly, but mainly because it was not widely available to use.

Table 7.3. Visual Features Wayfinding Matrix (Participants with ID)

Feature	Key literature sources (referring to people with ID)	Occurring in observation		Emerging from responses to interview questions				Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	
Colour	(ODPM 2006) (Farran, Courbois, VanHerwegen, Cruickshank, et al. 2012)	6	100.0	How easy to find Outpatients/Ward G64? What problems for person with ID? What was most helpful? How much did colour help? How to make it easier? How much do you like using colour? How difficult was it to use?	66.7	43.3	63.3	6
Controlled door button	None specific to ID	1	0.0	No specific comments	-	-	-	10
Directory	(Nind and Seale 2009) (Salmi 2006)	97	93.8	What was most helpful? Did it affect where you went?	63.3	-	70.0	3
Landmark	(Courbois et al. 2012)	5	100.0	How much do you like using landmarks? How difficult was it to use?	36.7	-	50.5	9
Lift buttons inside & outside	None specific to this feature	74	83.8	No specific comments	-	-	-	5
Lift level indicator	None specific to ID	111	96.4	No specific comments	-	-	-	8
Map	(Disability Rights Commission 2004a) (Sohlberg et al. 2007)	33	100.0	How easy to find Outpatients/Ward G64? How to make it easier? How difficult to use maps? What problems for person with ID? What was most helpful/annoying? Would anything else help? How much do you like using maps? Which do you like using most?	26.7		53.3	4
Map & Directory	As maps, above	33	100.0	No specific comments	-	-	-	12
Sign	(ODPM 2006)	410	92.4	How easy to find Outpatients/Ward G64? Could you get out in a hurry? How to make it easier? What problems for person with ID have? What was most helpful/annoying? Anything else that could help? How much do you like using signs? Which do you like using most? How difficult to use signs?	56.7	-	63.3	2
Visible door	None specific to this feature	29	86.2	No specific comments	-	-	-	7
Visual distraction	(Olsen 2005) (UK Department for Children Schools and Families 2008)	38	73.7	No specific comments	-	-	-	11
Decision point with no relevant information	Combination of the above sources	762	72.2	No specific comments	-	-	-	1
TOTALS		1599	82.2					

* Decision points ** Percentage of respondents

Table 7.4. Visual Features Wayfinding Matrix (TD Participants)

Feature	Key literature sources (General)	Occurring in observation		Emerging from responses to interview questions				Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	
Colour	(Hidayetoglu, Yildirim and Akalin 2012) (Sawyer & Bright, 2007	4	100.0	How easy to find outpatients/Ward G64? What problems for person with ID? What was most helpful thing? How easy was it to use the lifts? How easy to use the corridors? How much did colour help? How to make it easier? How much do you like using colour? How difficult to use?	50.0	33.3	43.3	10
Controlled door button	(Sawyer and Bright 2007)	1	0.0	What specific problems for people with ID?	-	-	-	8
Directory	(Dogu and Erkip 2000)	102	98.0	What problems for people with ID? What was most annoying? How to make it easier? How much do you like using directories? Which do you like using the most? How difficult were directories to use? How could it be made easier? What was the most helpful?	60.0	-	53.3	3
Landmark	(Caduf and Timpf 2006) (Baskaya, Wilson and Özcan 2004)	1	100.0	What problems for people with ID? What was the most helpful thing? Anything else that could help? How much do you like using landmarks? Which do you like the most? How difficult was it to use?	40	-	63.3	8
Lift buttons inside/outside	(Prideaux 2006) (Passini 1981)	74	100.0	No specific comments	-	-	-	2
Lift level indicator	(Sawyer and Bright 2007)	130	100.0	How easy was it to use the lift?	-	-	-	5
Map	(Passini 1984b)	90	96.7	How easy to find Outpatients/Ward G64? How easy were corridors to use? What problems for person with ID? How difficult to use maps? What was most annoying? How much do you like using maps? What was most helpful? Which do you like using most?	46.7		70.0	9
Map & Directory	(Passini 1984b)	31	100.0	What was most helpful?	-	-	-	7
Sign	(The Information Design Unit of Enterprise IG 2005)	447	97.3	How easy to find Outpatients/Ward G64? Could you get out in a hurry? How easy to see what's coming up? What was most annoying? What problems for a person with ID? What was the most helpful? How to make it easier? Anything else to help? How much do you like using signs? Which do you like using most? How difficult were signs to use?	76.7	-	93.3	1
Visible door	None specific to this feature	29	100.0	No specific comments	-	-	-	4
Visual distraction	(Passini 1984b)	2	0.0	How easy to find Outpatients?	-	-	-	8
Decision point with no relevant information	Combination of the above sources	504	85.9	No specific comments	-	-	-	6
TOTALS		1415	93.6					

* Decision points ** Percentage of respondents

Results comparing features favoured by participants compared against their degree of wayfinding success for both participant groups are shown in Tables 7.5 and 7.6.

Table 7.5. Rating of Visual Features by Participants with ID

Feature	Directory	Sign	Colour	Map	Landmark
Most liked (%)	70	63.3	63.3	53.3	50.5
Success (%)	93.8	92.4	100.0	100.0	100.0

Table 7.6. Rating of Visual Features by TD Participants

Feature	Sign	Map	Landmark	Directory	Colour
Most liked (%)	93.3	70.0	63.3	53.3	43.3
Success (%)	97.3	96.7	100.0	98.0	100.0

There is little similarity between rating and success for either group and little comparability overall between groups. This presents another reason to treat wayfinding design differently for each group.

Features that had the greatest influence on wayfinding success (based on time taken) by participants with ID were visual decision points with no relevant information, signs and directories. Features that had the greatest influence on wayfinding success (based on time taken) by TD participants were signs, lift buttons inside and outside and directories. Signs and directories featured in the top three influential features for both groups, indicating that these features should be targeted by designers to help improve wayfinding success. Decision points with no relevant information had greatest influence for participants with ID, indicating that building designers need to ensure all decision points have appropriate wayfinding information available on which to make decisions.

7.5 Sensory component

Sensory features provide a personal experience to the users that helps them memorise and later identify locations. They may be permanent, but are often only temporary being dependent on the changing use of spaces or environmental conditions in an operational building. If creating an eating area, such as the café and take-away food area in the study site for this research study, then it can create sensory features of smell and sound. However, once closed the feature no longer provides any sensory experience and therefore no longer exists. A planter with fragrant flowers will only provide a sensory experience if constantly maintained. Similarly, using light can be either permanent or temporary. As occurred in the

observation study, some areas may dim the lights (e.g., the wards) at certain times of the day, or turn them off to save energy (see Chapter 6, Section 6.1.4.c.i). Natural light from outside will also change dependent on time of day and year and on the prevailing weather. The ability to use the sense of touch, however, may be permanent through use of surface textures in the fabric of the building. Tables 7.7 and 7.8 list the features identified as being pertinent to the sensory component. A detailed discussion of each of these features is provided in Chapter 6; Section 6.1.4.c.

The literature review identified previous research for a number of features and hence their inclusion in the matrix. However, only two of the features (light and decision points with no relevant information) were specifically observed being used by either group. Generally, interview comments related to not being able to identify features and therefore their lack of use.

As Tables 7.7 and 7.8 indicate, more features are in this group than were observed, suggesting that ranking of influence of only two features on wayfinding success has limited value. Nonetheless, the results show that trips by participants with ID indicated that light had greater influence on wayfinding success; trips by TD participants showed that sensory decision points with no relevant information had greater influence.

Table 7.7. Sensory Features Wayfinding Matrix (Participants with ID)

Feature	Key literature sources (referring to people with ID)	Occurring in observation		Emerging from responses to interview questions					Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	Rating of how much feature made it more difficult (quite a lot/a great deal) % **	
Light	(Bogdashina 2016)	6	100.0	How much did light make it more difficult? How much did light help?	-	50.5	-	0.0	1
Noise	(UK Department for Children Schools and Families 2008)	None	-	How much did noise make it more difficult?	-	-	-	6.7	-
Touch/Texture	(Royal National Institute of Blind People 2016)	None	-	How much did texture make it more difficult? How much did texture help? How much do you like using texture? How difficult was texture to use?	30.0	16.7	36.7	6.7	-
Smell	Royal National Institute of Blind People, 2007)	None	-	How much did smell make it more difficult? How much did smell help?	-	6.7	-	3.3	-
Heat	(Salmi 2007a)	None	-	No specific comments	-	-	-	-	-
Crowdedness	(Salmi 2007a)	None	-	How much did crowds make it more difficult?	-	-	-	6.7	-
People moving in the same direction	None specifically for this feature	None	-	How difficult with people moving in the same direction? How much did people moving in same direction help you?	-	6.7	-	6.7	-
Decision points with no relevant information	Combination of the above sources	0	-	No specific comments	-	-	-	-	2
TOTAL		6	100.0						

* Decision points ** Percentage of respondents

Table 7.8. Sensory Features Wayfinding Matrix (TD Participants)

Feature	Key literature sources (General)	Occurring in observation		Emerging from responses to interview questions					Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	Rating of how much feature made it more difficult (quite a lot/a great deal) % **	
Light	(Sawyer and Bright 2007)	10	100.0	What was most helpful? How much did light make it more difficult? How much did light help?	-	3.3	-	3.3	2
Noise	(Hygge & Knez, 2001)	None	-	How much did noise make it more difficult? What was the most annoying?	-	-	-	6.7	-
Touch/Texture	(Arthur and Passini 1992)	None	-	What specific problems would a person with ID have? How much did texture make it more difficult? How much did texture help? How much do you like using texture? How difficult was texture to use?	13.3	0.0	23.3	3.3	-
Smell	(CRC for Construction Innovation 2007) (Darken 1996)	None	-	How much did smell make it more difficult? How much did smell help?	-	0.0	-	0.0	-
Heat	(Hygge & Knez, 2001)	None	-	No specific comments	-	-	-	-	-
Crowdedness	(Ramanujam 2006) (Carpman, Grant and Simmons 1985)	None	-	much did crowds make it more difficult? What specific problems for a person with ID?	-	-	-	0.0	-
People moving in the same direction	(Passini 1981)	None	-	How difficult with people moving in the same direction How much did people moving in the same direction help you	-	3.3	-	0.0	-
Decision points with no relevant information	Combination of the above sources	1	100.0	No specific comments	-	-	-	-	1
TOTAL		11	100.0						

* Decision points ** Percentage of respondents

7.6 Supportive component

Supportive features relate to different ways in which guidance is provided to the person undertaking wayfinding by other persons within the wayfinding space. The features are temporary given they depend either on people being within the same space as the person who is wayfinding or being in attendance at given points of enquiry such as a reception counter. It also depends on whether the person who is present is willing and capable of assisting. Supportive features such as reception or enquiry counters are best considered at the time of building design to complement other aspects of a comprehensive wayfinding design. Nonetheless, temporary or portable points of enquiry could be established post-construction. Tables 7.9 and 7.10 list the features identified as being pertinent to the supportive component. A detailed discussion of each of these features is provided in Chapter 6.; Section 6.1.4.d.

All three listed features in Tables 7.9 and 7.10 were identified being used by both groups during the video observation, with a significantly higher number of uses by the participants with ID and with marginally more success. Whilst some participants may have a preference to ask for help, the greater frequency by people with ID suggests that they are having difficulty in finding and/or using other “built-in” features. Asking can contribute to time and, as some video observations show, add stress. The ease of asking was rated quite low by people with ID, which concurs with video observations where several participants with ID were either ignored or given highly complex instructions that were forgotten quickly afterwards. There was considerably more conversation in interviews about asking than about person-supported features.

As only three features were identified, the ranking of influence of features on wayfinding success (based on time taken) has limited value. Nonetheless, the results show for both participant groups, person-assisted decision points had the most influence on wayfinding success.

Table 7.9. Supportive Features Wayfinding Matrix (Participants with ID)

Feature	Key literature sources (referring to people with ID)	Occurring in observation		Emerging from responses to interview questions				
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	Influence on successful wayfinding (1 being most influential)
Asking	(ODPM 2006) (Sohlberg et al. 2005)	79	97.5	How easy to find Outpatients? How easy to find ward G64? How to make it easier? What problems for person will ID have? What was most helpful? What was most annoying? Anything else that could help? How much do you like using asking? Which do you like using most? How difficult to use asking? Happy to find location on own?	63.3	–	56.7	2
Person-assisted	(Mencap 2007)	9	100.0	How to make it easier? How much like using people to assist?	–	–	–	1
At supportive decision points with no relevant information	Combination of the above sources	26	88.5	No specific comments	–	–	–	3
TOTAL		114	95.6					

* Decision points ** Percentage of respondents

Table 7.10. Supportive Features Wayfinding Matrix (TD Participants)

Feature	Key literature sources (General)	Occurring in observation		Emerging from responses to interview questions				Influence on successful wayfinding (1 being most influential)
		No. of dp's *	% success	Discussed in the following questions:	Rating of relative ease (reasonably easy/ easy/ very easy) % **	Rating of extent of help (quite a lot/a great deal) % **	Rating of how much is feature liked (quite a lot/a great deal) % **	
Asking	(Sawyer and Bright 2007)	38	97.4	How easy to find Outpatients? How easy to find ward G64? How to make it easier? What problems will person with ID have? What was most helpful? What was most annoying? Anything else that could help? How much do you like using? Which do you like using most? How difficult to use asking?	70.0	-	43.3	3
Person-assisted	(Hygge and Knez 2001)	1	100.0	What problems will person with ID have? How much like using people to assist?	-	-	-	1
At supportive decision points with no relevant information	Combination of the above sources	11	72.7	No specific comments	-	-	-	2
TOTAL		11	92.0					

* Decision points ** Percentage of respondents

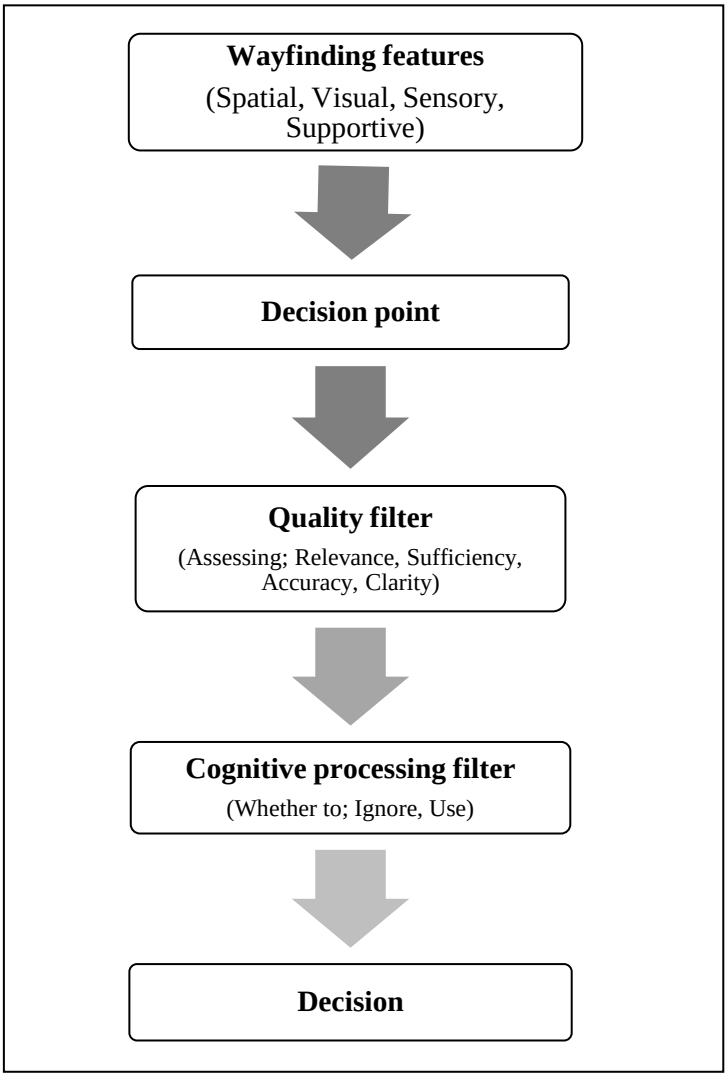
7.7 Developing the framework

Information from the matrices in Section 7.3, 7.4, 7.5 and 7.6 has been used to develop a wayfinding feature framework. Given that the wayfinding observation for this study was based on decision points and decision-making, the framework is similarly based on a decision-making process.

7.7.1 The decision-making process

The wayfinding decision-making process identified by the current study is a five-stage process (see Figure 7.1 for a graphic representation of this process)

Figure 7.1. Wayfinding Decision Making Process



Collection of wayfinding information from the environment

The process starts when the person who is seeking to find a destination, encounters one of the features provided in the wayfinding environment (discussed in the preceding sections and shown in the four matrices). The person now has to make a decision based on that information. This is the area of focus for this research study because it is at this point that the building designer needs to know what accommodations or adjustments need to be made to the feature in order to make it more useful for a person with ID.

Creating a decision point

A decision point is created because the person has to decide how to process the information. These decision points are the basis for the analysis of observations in this study.

The quality filter

Before making a decision the person needs to assess the quality of the information being provided by the feature. This is the quality filter. The person undertaking wayfinding has to determine whether the information is a) relevant to the trip being taken, b) sufficient to be able to know what to do, c) accurately reflecting the current situation and finally d) clear in what it is suggesting. This filtering requires considerable cognitive processing ability and the outcome is important as it will dictate whether the person gets closer to the destination or not. The current study identified a significant percentage of features at decision points where the feature provided no relevant information for the trip being taken causing considerable difficulties for all building users in deciding which way to go. This suggests that building designers not only need to understand the wayfinding needs of people with ID, but also need procedures to undertake a quality audit of the proposed wayfinding design (involving wayfinding specialists including people with ID) to fully check the functionality of the designed features and system once installed.

The cognitive processing filter

The final filter relates to the capability of the person themselves to make the decision, based on available information which may or may not be complete, useful and accurate. This filter is significant in wayfinding by people with ID because again it relies on cognitive processing capability.

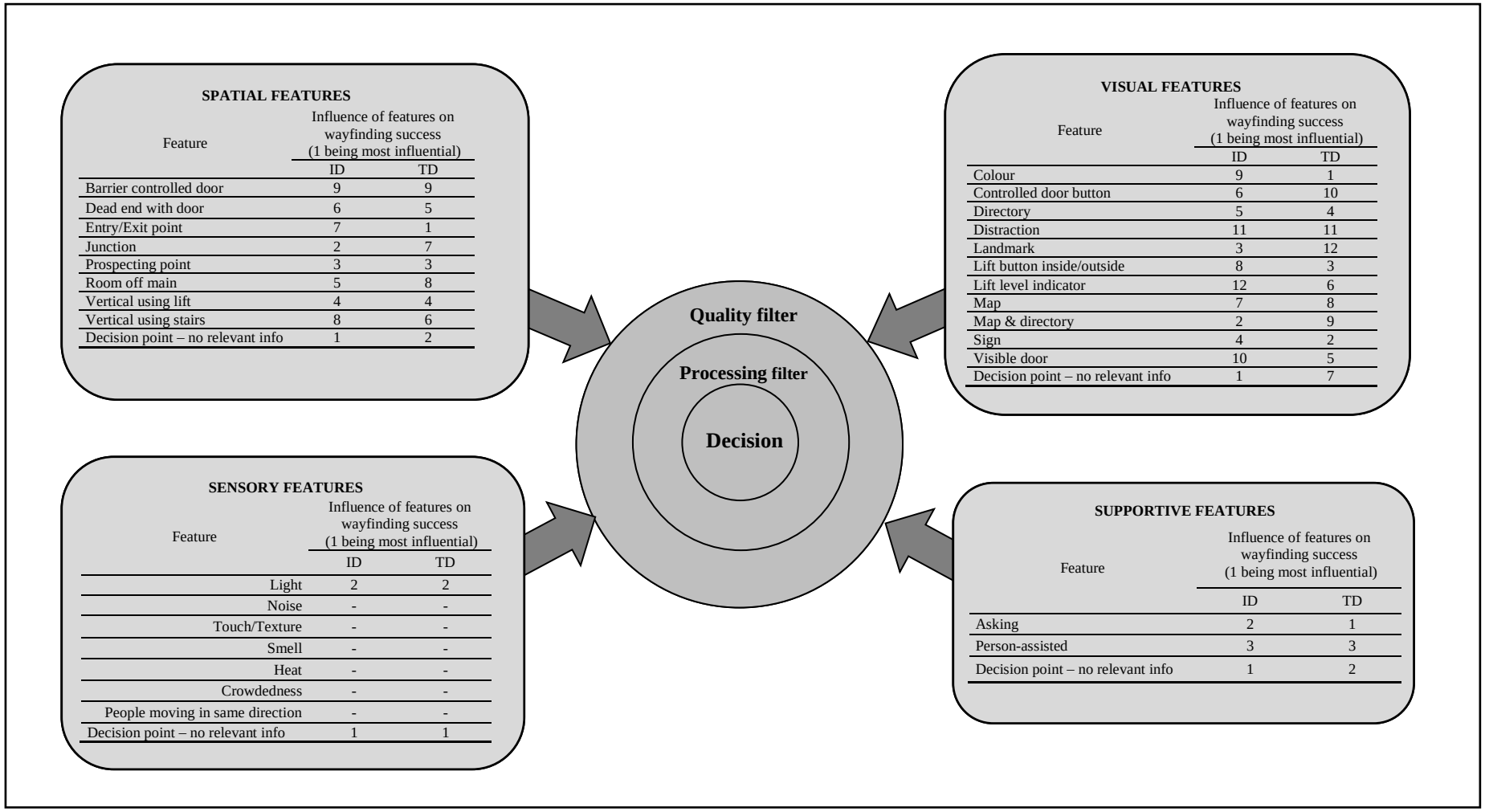
The decision

The end of the process is the decision itself, the outcome of which will either result in getting closer to, neither closer nor further away from, or further away from the destination. These outcomes were recorded as part of the observation process and used to measure success in wayfinding.

7.7.2 Creating the wayfinding feature framework

The wayfinding feature framework (see Figure 7.2) is created by incorporating the information about the influence of features on wayfinding success from the separate feature matrices (Tables 7.1 to 7.4 and 7.7 to 7.10) into a decision-making process.

The wayfinding feature framework provides a means for building designers to assess which features from each of the four components (spatial, visual, sensory and supportive) have greater influence on wayfinding success. In effect, the framework provides a palette of features from which the building designer can choose, based on their effectiveness for wayfinding. It also provides a checklist to indicate if features that are being incorporated by necessity into a building (e. g., lifts) may have beneficial or detrimental effect on wayfinding for people with ID and therefore warrant particular attention to ensure appropriate inclusivity for people with ID.



SPATIAL FEATURES

Feature	Influence of features on wayfinding success (1 being most influential)	
	ID	TD
Barrier controlled door	9	9
Dead end with door	6	5
Entry/Exit point	7	1
Junction	2	7
Prospecting point	3	3
Room off main	5	8
Vertical using lift	4	4
Vertical using stairs	8	6
Decision point – no relevant info	1	2

VISUAL FEATURES

Feature	Influence of features on wayfinding success (1 being most influential)	
	ID	TD
Colour	9	1
Controlled door button	6	10
Directory	5	4
Distraction	11	11
Landmark	3	12
Lift button inside/outside	8	3
Lift level indicator	12	6
Map	7	8
Map & directory	2	9
Sign	4	2
Visible door	10	5
Decision point – no relevant info	1	7

SENSORY FEATURES

Feature	Influence of features on wayfinding success (1 being most influential)	
	ID	TD
Light	2	2
Noise	-	-
Touch/Texture	-	-
Smell	-	-
Heat	-	-
Crowdedness	-	-
People moving in same direction	-	-
Decision point – no relevant info	1	1

SUPPORTIVE FEATURES

Feature	Influence of features on wayfinding success (1 being most influential)	
	ID	TD
Asking	2	1
Person-assisted	3	3
Decision point – no relevant info	1	2

Figure 7.2. Wayfinding feature framework (the influence of building features on wayfinding success by adults with and without intellectual disability)

7.8 Summary

This chapter has presented information collected from previous research, observation and interviews and culminates with presentation of a wayfinding framework.

There are several ways a building designer might use this information (and preceding discussion) when looking at designing a new facility, or adapting an existing facility, that will improve wayfinding success for people with ID as well as the general population. It is important to note, however, that the results obtained from this study are based on a hospital setting in Perth, Australia and may not be directly generalisable to other types of buildings and other locations.

With the above provision, information from this study could be used to:

a) Identify the features most used (see Table 5.6) and focus on making sure they are appropriately designed for the building and for people with ID.

b) Identify features seldom used and either exclude them from future wayfinding design or look at explanations why they were not used (Chapter 5, Section 5.4.2.c) and ensure future design improves their useability.

c) Identify features not used successfully by people with ID and look at explanations (see Chapter 6, Section 6.1.4) to ensure future design does not replicate design errors.

d) Gain a better understanding of what was most influential to each group in minimising time taken to reach a destination and place more reliance on those features (if appropriate) in new building design. (see Chapter 7, Sections 7.2 to 7.6)

e) Understand the effect of certain features on a person's feelings (e.g., nervousness, feeling unsafe or lost) and also their preferences for prospect and refuge during a wayfinding journey to improve building design. (see Chapter 5, Section 5.4.4), and

f) Identify features not used at all and investigate whether this is because they were not relevant in the current study building or were poorly designed (see Chapter 5, Table 5.6) and use this to inform better building design.

Chapter 8:
Conclusion and Further Research

8.1 Introduction

This concluding chapter summarises work described in the preceding chapters and demonstrates how the research study has addressed the aim and objectives introduced in chapter 1. It concludes by describing limitations on the research outcome and providing suggestions for future research.

Chapter 1 provided the context and reason for undertaking this research. It described the historical background to wayfinding and how humans have depended on this activity for survival. It also introduced the factors that affect successful wayfinding: adequate information, a person's physical and sensory ability, and a person's cognitive processing ability. It demonstrated, through acknowledged definitions, how having an intellectual disability may affect a person's cognitive processing capability and as a result affect wayfinding ability. It proposed that this limited capability needed to be considered by building designers when designing buildings so that the eventual design would be fully inclusive. Furthermore, it identified that the Australian Government, in introducing recent Access to Premises legislation, had been unable to include specifications about wayfinding as there was insufficient research-based evidence to support such requirements.

The literature review in chapter 2 identified a broad range of published research about issues relating to wayfinding by the general population. However, limited research was found about building design for people with ID, and even less that had undertaken actual observation of wayfinding by people with ID in a real-world context to verify that problems existed and the extent to which they affected wayfinding.

The most relevant studies to the current study are those undertaken by Salmi, Ginthner, and Guerin (2004) about critical factors affecting wayfinding where 13 participants with ID and 10 TD participants looked for restrooms in a shopping mall and Salmi (2007b) about environmental preference for environmental features in which 42 students self-reported on wayfinding in a shopping mall and office building and 10 participants with ID were tape recorded visiting the same locations.

The current research is differentiated from and therefore adds to this previous knowledge by:

- using a much larger sample of people with ID and TD actually undertaking the wayfinding

- using video recording to capture a visual record of participant activity for the purposes of observation and review, and to capture a recording that showed the surrounding environmental information
- the extent and depth in the data recorded and coded for each feature
- using in-depth interviews with all participants to gain personal views on the wayfinding experience
- including analysis of the influence of individual features on time taken for wayfinding and creating a wayfinding feature framework

The earlier research was important for helping to develop an understanding of the subject. This current research study has expanded on the earlier work, providing evidence-based findings that contribute greater depth and understanding in this important but under-developed area of study.

8.2 Overall findings

Given the lack of real-world evidence-based data about problems for people with ID in wayfinding, this study used video observation to record 60 adults (30 with ID, 30 typically developing) whilst undertaking wayfinding to three destinations in a major hospital in Perth. The results (chapter 5) and discussion (chapter 6) have shown that, in comparison to TD participants, participants with ID took longer, travelled further and had to make more decisions to get to the same destinations and, in some cases, were unable to even reach a destination. Analysis of data from the current study has identified the varying influence of features on wayfinding success (based on time taken to reach the destination) for both participant groups. The three most influential features on wayfinding success by participants with ID were visual decision points with no relevant information, junctions and prospecting points. The three most influential features on wayfinding success by TD participants were spatial decision points with no relevant information, signs and lift buttons inside and outside. The wayfinding feature framework developed in chapter 7, has been based on triangulation of findings from the literature review, observation, interviews and their subsequent analysis. The information provided gives guidance to inform future building design, which can address areas of specific need in providing a more accessible built environment for adults with ID and the wider community.

8.3 Meeting the aim and objectives of the study

It is an expectation of any research study that the results meet the aim/s and objectives set at the outset of undertaking the research. For this current research study, there is one aim and four objectives in support of that aim. The following section discusses how each objective has been managed and achieved and concludes with how this has met the overall aim.

8.3.1 Objectives

Objective 1. To identify and establish the fundamentals of wayfinding and current understanding of the extent of impact of the wayfinding environment on wayfinding by people with intellectual disability

This objective has been achieved through an extensive detailed survey, review and synthesis of existing research and publications about wayfinding generally and about wayfinding by people with ID. Chapter 2 provides details of the fundamentals of wayfinding in relation to the general population including discussion of the components that create a wayfinding environment within a building (e.g., spatial, visual, sensory and supportive). Works such as Arthur and Passini's *Wayfinding: People, Signs and Architecture* (Arthur and Passini 1992), Golledge's series of papers during the 1990s about human wayfinding and cognitive mapping and, more recently, the CRC for Construction Innovation (2007) about wayfinding design guidelines, have been incorporated into the synthesis of previous research about wayfinding fundamentals.

Chapter 2 reviewed and analysed literature relating to wayfinding by people with general disabilities (which may also be pertinent to people with ID) and, specifically wayfinding by people with ID. This section required significant investigation, yet is limited in content, because there is a lack of previous research about wayfinding by people with ID. Articles and guides about wayfinding by people with ID are often published on advocacy group websites (e.g., the NSW Council for Intellectual Disability (NCID)) rather than scientific journals and relevant information has been included from those sources. Detailed searches also identified a number of relevant articles about the use of assistive devices to help people with ID navigate within buildings. These have been briefly described and acknowledged as contributing to wayfinding by people with ID within the built environment, but are not directly relevant to the current study as they do not address the design of the building itself, but rather look at devices to help navigation in the building.

Objective 2. To investigate the extent and success in the use of different wayfinding features by adults with intellectual disability, including comparison with typically developing adults, and to assess the influence of features on overall wayfinding success (based on time taken to reach destinations)

This objective has been achieved through analysis of data obtained from observation of 60 adults (30 with and 30 without intellectual disability) undertaking three trips to three different locations within a major hospital in Perth and conducting semi-structured interviews afterwards with participants to discuss their wayfinding experience. Data has been analysed based on information and action taken at wayfinding decision points along each trip. Video recordings were coded to identify use of different types of wayfinding information and the level of success at each decision point. The results were then statistically analysed for frequency and difference in success between participant groups. The method of data collection has been discussed in chapter 4, the results described in chapter 5 and the findings discussed in chapter 6. This achieves the specific objective to investigate the extent and success in the use of different wayfinding features by people with ID and by comparison with TD participants.

Time taken to reach each destination was also recorded for each participant during observations and, in conjunction with decision point information, has been analysed using a random forest classification to assess the influence on wayfinding success (based on time taken) when using wayfinding features. The process of random forest classification has been discussed in chapter 4 and Appendix G and the results presented and discussed in chapters 5, 6, and 7 as part of the development of the wayfinding feature framework. This achieves the objective to investigate the extent to which different wayfinding features influence time taken to reach the destinations.

Objective 3. To investigate ways of enhancing inclusive design of wayfinding features to improve wayfinding success by adults with intellectual disability

The investigation of ways to enhance inclusive design of wayfinding features has been based on reviewing the outcome of statistical analysis of wayfinding decisions from the observation, along with participant responses to Likert scale questions and individual participant comments in semi-structured interviews. Questions asked in the semi-structured interviews were specifically designed to yield meaningful findings about participant views (see chapter 5) and have added further depth to this assessment. Observations recorded by the researcher during coding of videos have also been included.

This information has then been synthesised and presented in the discussion of each feature in chapter 6. Each section then culminates in a set of recommended solutions to improve wayfinding and the inclusivity of building design for people with ID. Suggested solutions have been cross-checked to identify if other authors or studies have identified similar problems or made similar suggestions. The solutions have potential to enhance inclusive design practice, but will require further development through future research on aspects that are beyond the scope of this research study.

Objective 4. To develop a framework that incorporates wayfinding features and their influence on overall wayfinding success (based on time taken to reach destinations)

This objective is achieved by the development of the wayfinding feature framework described in chapter 7. The list of features in the framework is triangulated from past research synthesised in the literature review, features used by participants in the three trips at the hospital and identified in the video observation (see chapter 5) and features described by participants in response to interview questions (see chapter 5). The 26 features listed are grouped into four components and represent a range of building features/components that form a building wayfinding system. Analysis of data from the current research study has indicated levels of success by both participant groups in using features and the influence of those features on wayfinding success (based on time taken) in the observation setting. These results have been included in the wayfinding feature framework (see chapter 7) to show the overall relationship in contributing to wayfinding success.

8.3.2 Aim

The aim of the study was to support more inclusive building design for people with ID through development of evidence-based guidance about the influence of building features on wayfinding success. The three components in this aim have been achieved.

i) Evidence-based

A review of past research about wayfinding by people with ID found a number of studies in which participants were asked to undertake either an exercise in a laboratory setting or use a computer-based virtual reality environment to simulate a wayfinding exercise. These are not real settings and may not represent activity that would occur in a real-world setting. The current study recorded wayfinding by participants in a real environment, held interviews with participants based on their real-world wayfinding experience and provided observer notes based on the actual coded wayfinding. Chapter 5 provided the results and chapter 6 the

discussion of this data and therefore the aim to provide evidence-based information has been met.

ii) Guidance about the influence of building features on wayfinding success

Analysis of video observations in this study has provided evidence of the level of participant success in using various building features, highlighted problems that affect use of these features and identified their influence on wayfinding success (based on time taken). Furthermore, participant responses to interview questions have provided specific information about individual features and ways to improve wayfinding success at the hospital. Data about the successful use of wayfinding features have been tabulated in chapter 5, table 5.6 and their influence on overall wayfinding success, tabulated in chapter 5, table 5.29. This has therefore met the aim to provide guidance about the influence of wayfinding features on wayfinding success.

iii) To support inclusive building design

Inclusive design is intended to provide accessibility for all people, irrespective of ability, age, race or cultural background (Inclusive Design Research Centre 2017). However, the current research study has focussed specifically on wayfinding by people with ID, as they have an acknowledged deficit in cognitive processing that may affect wayfinding ability, unless the built environment is adapted for their use. In researching this topic, however, it is also noted that suggested adaptions may have benefit for a wider group as well as for those people with ID who navigate buildings. For example, some building users may be experiencing deficits in cognitive processing due to age, illness (e.g., dementia, Alzheimer's disease) or through acquired brain injury from infection or accident. The extent and nature of information about wayfinding by people with ID obtained from this research study is a useful resource to help inform and support inclusive building design for a wide range of building users and therefore meets the final component of the aim.

8.4 Importance and implications for the discipline

The research undertaken in the study has significant importance and implications for a number of disciplines.

8.4.1 Importance

Providing equitable access in the built environment is a basic human right and legal action can be taken for any discrimination on the grounds of disability under the Disability

Discrimination Act 1992. Neither the Building Code of Australia nor the Disability Standard - Access to Premises (introduced in 2010), provide specific guidelines for designing buildings to be accessible for people with ID. Furthermore, the Disability Standard purposely did not mention wayfinding at the time of its introduction (2010) because there was insufficient research evidence to support any guidelines. This acknowledged omission has implications for all building users, but particularly for people with ID who would greatly benefit from having formalised specifications to enforce the appropriate building adaptions. However, in 2017, there are still no legally formalised guidelines on wayfinding and building accessibility that specifically mention people with ID, hence the importance of this research in helping to inform and provide the requested evidence for action to address accessibility guidelines for people with ID in Australia.

This current study is also important because it contributes to scholarly knowledge in the domain of building design for people with ID where there is limited previous research (as indicated by the literature review). In comparison, there is extensive research about accessibility for people with physical and sensory impairments and they are well-represented in the building guidelines. This current research will help redress that imbalance.

Observation and evidence-based approaches to the data collection for this study also provide traceable information for validation rather than relying on anecdotal or third-party reported information about problems experienced by people with ID. This robustness of the methodology is necessary, in order to convince others to embrace the adaptations required for accessibility and wayfinding by people with ID. The methodology developed in this study for observing and analysing data about wayfinding, sets a standard for further research in this field of study, and the knowledge gained will serve as a point of reference and a firm foundation for further study about wayfinding by people with ID.

8.4.2 Implications for the building design profession

Given that there is limited published guidance about building accessibility for people with ID, the findings in this research add significantly to the opportunity for building design professionals to provide accessible buildings for people with ID.

Issues of disability access can be contentious and can provide the basis for legal action. This can affect building owners, designers, project managers, operators and contractors. There are examples in the USA where legal action has been brought against parties involved in the ownership and design of buildings, based on the Americans with Disability Act (the American equivalent of the Australian Disability Discrimination Act)(Grasberger 2012; Loulakis and Santiago 2002). Whilst disability access is essential for equity, it may bring

financial implications to implement, especially in situations that involve retrofitting of an existing building and implementation may be met with some reluctance. Nonetheless, providing accessible buildings in Australia is an obligation under the Disability (Access to Premises – Buildings) Standard and ultimately also under the Disability Discrimination Act 1992. The information provided by this research study will help building professionals to better understand building accessibility for people with ID and help them meet their obligations under relevant legislation.

8.5 Limitations

A number of limitations in this research need to be explained.

An extensive literature search collated a significant body of research about wayfinding in general and about building access for people with disabilities. However, there is a lack of publications about wayfinding by people with ID and an even smaller body of published research dealing with this topic. Nonetheless, extensive searching, using numerous search terms informed and supported the findings of this current research study. Furthermore, reviewing individual publication references has confirmed literature saturation with recurring referenced publications forming part of the literature used to support and inform this study. Despite this effort, however, it is not possible to say all publications about wayfinding by people with ID have been identified, particularly because some are privately published to an exclusive member group.

The sample population of people who participated in this study presents some limitations. The number of participants (30 ID, 30 TD) was considered sufficient for the purposes of the research (particularly the statistical analysis) but it is acknowledged that expanding the sample to cover more participants would always carry the possibility to expand the scope of this research and therefore enrich the findings. A minimum age limit of 18 was established, initially for the participant group with ID, because the intent was to involve independent building users. To ensure comparability, therefore, a minimum age of 18 was applied in sampling for both groups. Apart from this minimum age limit, however, sampling did not attempt to define the age profiles of the two participant groups. Whilst there is a range of differing types of intellectual disability (e.g., Williams syndrome, Down syndrome), the sampling process did not differentiate between these types in obtaining the sample participant group with ID. The two participant groups were closely matched in terms of gender, both having 16 female and 14 male participants, with a view to investigating wayfinding differences due to gender as part of the study. However, the magnitude and complexity of the study without this additional investigation about gender has meant the

comparison was not included in the eventual scope of research. Having acknowledged these as sampling limitations, they also provide opportunity for further research to expand or differentiate between ages, gender and types of ID.

There are limitations in relation to the observation process. In recording data about the trip, the researcher and assistant needed to accompany participants in their wayfinding and to interact with them to record what they were thinking and why they took certain actions. Participants were advised at the commencement of observation that they could not ask the researchers for directions. Whilst the researchers attempted to minimise interference, it is inevitable that being recorded and answering questions had some impact on their wayfinding process and the researchers' presence may have impacted on feelings of nervousness and safety. Part of the rationale for using the observation location for the research was its realistic and dynamic wayfinding environment. However, the changing environment (e.g., light, sound, smell, crowdedness, lifts) presented a potential limitation to the research study because participants may not have experienced exactly the same conditions for each wayfinding activity. In reality, only minimal changes were experienced during wayfinding and were considered insignificant.

Participants were not told about the fifteen-minute time limit to reach each destination because the pilot studies determined it was possible to achieve each trip in that time and this procedure would allow participants to focus on wayfinding rather than beating a time. However, not knowing there was a time limit, some participants may have taken longer than necessary to reach a destination (although this was not obvious from the recorded video observation). There were also no specific conditions agreed for stopping a trip prior to the fifteen minutes other than to avoid unacceptable participant stress. These situations were generally obvious, however, as there were both visual and audible indications of increasing stress.

There are a number of limitations in relation to the collection and analysis of data. The ability for participants to articulate feelings and experiences in the interview process varied between the two participant groups. Great emphasis was placed on explaining interview questions and Likert scales to both groups. However, it is not possible to know, particularly for some participants with ID, whether responses were arbitrary or reflected personal experiences. Information provided by some participants in the interviews was difficult to understand and transcribe and may have resulted in loss of valuable insight. The interview was intended to help add meaning to observations and also to gain insight on specific issues (e.g., how much a person liked signs and why). However, in many cases responses were minimal, particularly by participants with ID, giving limited opportunity for in-depth analysis.

Random forest analysis was used to assess the influence of features on wayfinding success for each participant group and therefore only used data from journeys that were successfully completed within the mean timeframe established from actual group trips. Consequently, data was used from only 89 trips by TD participants and 67 from participants with ID. Results are reported separately for the two groups and therefore the imbalance between groups is irrelevant, but it is always possible that adding data from more participants to each group may affect the overall results, depending on the wayfinding activity of those extra participants.

There is a limitation on the reported outcomes of the research. The intent of the research was to develop evidence-based guidance about the influence of building features on wayfinding success and to provide, as far as possible, generic guidance. However, this study has been based in a hospital in order to provide participants with a dynamic, real-world environment in which to undertake their wayfinding. The list of features identified in the wayfinding feature framework, therefore, is based on observation and interview discussion about wayfinding in a hospital environment. As such, it is not intended to represent an exhaustive list of building features for all building types, given that some will have specialised features for specific use (e.g., escalators in a shopping centre, rotating doors in the entrance of an office building). The results shown in the framework for level of success and influence on time taken are based on wayfinding in a hospital located in Perth and may not be directly generalisable to other hospitals or other buildings in other locations. Further research should be carried out using other building types and in other locations to help create a database of wayfinding information

8.6 Recommendations for further research

The limited scope of existing research about wayfinding by people with ID also provides considerable opportunity for further research. The following recommendations emanate from issues arising during this current research study.

- Similar observation studies could be carried out to create wayfinding feature frameworks for a range of building types and locations. Creating more frameworks would add to the body of knowledge and provide a valuable resource to guide new building design.
- There is published research about the effect of gender and age on wayfinding by the general population, but much less about their effects on wayfinding by people with ID. Similar research to the current study, but with more detailed demographic

stratification, could help add knowledge about the effect of gender and age on wayfinding by people with ID.

- Conditions such as Alzheimer's disease, dementia and acquired brain injury share similar deficits in cognitive processing to those experienced by people with ID. Further research could be undertaken, based on the methodology and findings of this study, to better understand their specific wayfinding needs and, in so doing, expand understanding and the body of knowledge about wayfinding and inclusive design.
- Further research could be undertaken to identify whether specific features within a building environment have varying impact on wayfinding by people with differing types of intellectual disability (e.g., Down syndrome, Williams syndrome). The outcome of this research would help refine wayfinding understanding and subsequently inform building design that accommodates wayfinding by people with all types of intellectual disability.
- This current study reports varying levels of success for people with ID in using 26 wayfinding features and then suggests design changes to improve success for people with ID in using those features. Further research can be conducted to implement those suggestions and, in so doing, provide further evidence for building owners and occupiers to justify investment in making the necessary alterations.

8.7 Summary

The first section of this chapter reviewed the context for the study and showed how it had differentiated from and added to the previous studies in the field of research. The subsequent section presented findings about the wayfinding features and the development of the wayfinding feature framework which represents the culmination of the research process and a means for providing wayfinding design guidance for building use by people with ID.

This final chapter concludes the thesis by describing the importance of the research study to the building professions, identifying limitations in the methodology and finally by providing recommendations for further research.

In achieving the aims and objectives set out at the beginning of the thesis, this study provides the evidence and opportunity to achieve greater inclusivity for people with ID by addressing their specific wayfinding requirements within the built environment.

References

Aboim Borges, Miguel de, and Fernando Moreira Da Silva. 2015. "User-Sensing as Part of a Wayfinding Design Process." *Procedia Manufacturing* 3: 5912-5919. doi: 10.1016/j.promfg.2015.07.902.

Abu-Ghazzeh, Tawfiq. 1996. "Movement and Wayfinding in the King Saud University Built Environment: A Look at Freshman Orientation and Environmental Information." *Journal of Environmental Psychology* 16: 303-318.

Adaptive Environments. 1995. *ADA Title III Compliance Materials: Checklist for Existing Facilities Version 2.1*. Edited by National Institute on Disability and Rehabilitation Research.

Algase, Donna, Gw-Ryung Son, Elizabeth Beattie, Jun-Ah Song, Sara Leitsch, and Lan Yao. 2004. "The Interrelatedness of Wandering and Wayfinding in a Community Sample of Persons with Dementia." *Dementia and Geriatric Cognitive Disorders* 17: 231-239. doi: DOI: 10.1159/000076361

Allen, Gary. 1999a. "Cognitive Abilities in the Service of Wayfinding: A Functional Approach." *Professional Geographer* 51: 554-561. doi: DOI: 10.1111/0033-0124.00192

———. 1999b. "Spatial Abilities, Cognitive Maps, and Wayfinding: Bases for Individual Differences in Spatial Cognition and Behavior." In *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes*, ed. R. Golledge, 46-80. Baltimore, MD: Johns Hopkins University Press.

American Psychiatric Association. 2013a. *The Diagnostic and Statistical Manual of Mental Disorders*. 5th ed.

———. 2013b. DSM-5 Intellectual Disability Fact Sheet. Accessed 16 December 2016, https://www.psychiatry.org/File%20Library/Psychiatrists/Practice/DSM/APA_DSM-5-Intellectual-Disability.pdf.

Antonakos, Cathy L. 2004. "Compensatory Wayfinding Behavior in Topographic Disorientation from Brain Injury." *Journal of Environmental Psychology* 24 (4): 495-502. doi: http://dx.doi.org/10.1016/j.jenvp.2004.09.002.

Antonakos, Cathy L., Bruno J. Giordani, and James A. Ashton-Miller. 2004. "Wayfinding with Visuo-Spatial Impairment from Stroke and Traumatic Brain Injury." *Disability Studies Quarterly* 24 (3). doi: 10.18061/dsq.v24i3.508.

Appleton, Jay. 1975. *The Experience of Landscape*. London: John Wiley.

———. 1996. *The Experience of Landscape*. Chichester, UK: John Wiley & Sons Ltd.

Appleyard, Donald. 1969. "Why Buildings Are Known: A Predictive Tool for Architects and Planners." *Environment and Behavior* 1: 131-156. doi: 10.1177/001391656900100202

Arthur, Paul, and Romedi Passini. 1992. *Wayfinding: People, Signs and Architecture*. Ontario: McGraw-Hill Ryerson Ltd.

Aspinall, P. 2001. "Building Behaviour." *Building Service Engineering* 22: 34-46. doi: 10.1191/014362401701524109

Australian Institute of Health and Welfare. 2012. *Dementia in Australia. Cat. No. Age 70*. Canberra. http://www.aihw.gov.au/publication-detail/?id=10737422958&tab=2.

Baddeley, Alan. 2003. "Working Memory: Looking Back and Looking Forward." *Nature reviews. Neuroscience* 4: 829. doi: 10.1038/nrn1201.

Bailey, Patricia Hill. 1997. "Finding Your Way around Qualitative Methods in Nursing Research." *Journal of Advanced Nursing* 25 (1): 18-22. doi: 10.1046/j.1365-2648.1997.1997025018.x.

Baskaya, Aysu, Christopher Wilson, and Yusuf Özcan. 2004. "Wayfinding in an Unfamiliar Environment: Different Spatial Settings of Two Polyclinics." *Environment and Behavior* 36 (6): 839-867. doi: 10.1177/0013916504265445.

Bell, Paul, Thomas Greene, Jeffrey Fisher, and Andrew Baum. 2001. *Environmental Psychology*. 5th ed. Belmont, CA: Wadsworth Group/ Thomson Learning.

Beneicke, Alice, Jack Biesek, and Kelley Brandon. 2003. *Libris Design Project: Wayfinding and Signage in Library Design*.

Bennett, Jean. 2009. "Gene Therapy for Color Blindness." *New England Journal of Medicine* 361 (25): 2483-2484. doi: doi:10.1056/NEJMcibr0908643.

Benson, Megan. 2010. "The Effects of Landmark Instruction on Wayfinding in Persons with Down Syndrome." edited by Edward C. Merrill, Frances Conners and Joe Weber: ProQuest Dissertations Publishing.

Best, Gordon. 1969. "Direction-Finding in Large Buildings." In *Architectural Psychology*, ed. David Canter, 72-75. London: RIBA Publications.

Better Health Channel. 2017. Dyslexia. Accessed 20 May 2017, https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/dyslexia?viewAsPdf=true.

Beveridge, Sally, and Patrick Wiegand. 2000. "Developing Spatial Independence among Children with Learning Difficulties." In *The Child's World: Triggers for Learning*, eds Margaret Robertson and Rod Gerber, 276-293. Camberwell, Vic.: ACER Press.

Bogdashina, Olga. 2016. *Sensory Perceptual Issues in Autism and Asperger Syndrome*. 2 ed: Jessica Kingsley

Böök, Anders, and Tommy Garling. 1981. "Maintenance of Orientation During Locomotion in Unfamiliar Environments." *Journal of Experimental Psychology: Human Perception and Performance* 7: 995-1006. doi: 10.1037/0096-1523.7.5.995.

Boot, F. H., J. J. M. Pel, H. M. Evenhuis, and J. van der Steen. 2012. "Factors Related to Impaired Visual Orienting Behavior in Children with Intellectual Disabilities." *Research in Developmental Disabilities* 33 (5): 1670-1676. doi: http://dx.doi.org/10.1016/j.ridd.2012.04.007.

Boriello, Gaetano, Dieter Fox, Henry Kautz, Lin Liao, Don Patterson, Pat Brown, Mark Harniss, and Johnson Kurt. 2006. Project Access: Wayfinding for Persons with

Cognitive Disabilities. Accessed 13 May 2009, http://www.cs.washington.edu/mssi/2006/talks/12-Kautz.pdf.

Bradley, Nicholas, and Mark Dunlop. 2005. "An Experimental Investigation into Wayfinding Directions for Visually Impaired People." *Personal and Ubiquitus Computing* 9: 395-403. doi: 10.1007/s00779-005-0350-y

Braun, Virginia. 2013. *Successful Qualitative Research : A Practical Guide for Beginners / Virginia Braun & Victoria Clarke*. Edited by Victoria Clarke. London: London : SAGE.

Breiman, Leo. 2001. "Random Forests." *Machine Learning* 45 (1): 5-32. doi: 10.1023/a:1010933404324.

Brieman, Leo, and Adele Cutler. No date. Random Forests. Accessed 11 March 2017, https://www.stat.berkeley.edu/~breiman/RandomForests/cc_manual.htm.

Broadbent, D. 1958. *Perception and Communication*. London: Pergammon.

———. 1965. "Information Processing in the Nervous System." *Science* 150: 457-62. doi: 10.1126/science.150.3695.457.

Brown, Barbara, Holly Wright, and Craig Brown. 1997. "Post-Occupancy Evaluation of Wayfinding in a Pediatric Hospital: Research Findings and Implications for Instruction." *Journal of Architectural and Planning Research* 14 (1): 35-51. http://cdmbuntu.lib.utah.edu/cdm/ref/collection/uspace/id/3014.

Brown, David J., David McHugh, Penny Standen, Lindsay Evett, Nick Shopland, and Steven Battersby. 2011. "Designing Location-Based Learning Experiences for People with Intellectual Disabilities and Additional Sensory Impairments." *Computers & Education* 56 (1): 11-20. doi: http://dx.doi.org/10.1016/j.compedu.2010.04.014.

Brown, Laura. 1997. Observational Field Research. Accessed 24 June 2017, http://www.socialresearchmethods.net/tutorial/Brown/lauratp.htm [Permalink to this cache]

Caduf, David, and Sabine Timpf. 2006. "A Framework for Assessing the Salience of Landmarks for Wayfinding Tasks " *Cognitive Processing* 7 (Supplement 1): 23. doi: 10.1007/s10339-006-0049-7.

Caldwell, Kay, and Anita Atwal. 2005. "Non-Participant Observation: Using Video Tapes to Collect Data in Nursing Research." *Nurse Researcher* 13 (2): 42-54.

Cappelletti, Manuela, Noel Gazzano, Emanuele Gipponi, Francesco Ranzani, and Celestina Tripodi. 2005. "Wayfinding - Find Your Way in Healthcare Systems: Accessibility and Welcoming." In *Healthcare Systems, Ergonomics and Patient Safety*, eds R. Tartaglia, S. Bagnara, T. Bellandi and S. Albolini, 228-232. Taylor and Francis, UK.

Caron, M. J., L. Mottron, C. Rainville, and S. Chouinard. 2004. "Do High Functioning Persons with Autism Present Superior Spatial Abilities?" *Neuropsychologia* 42 (4): 467-481. doi: http://dx.doi.org/10.1016/j.neuropsychologia.2003.08.015.

Carpman, Janet, and Myron Grant. 2002. "Wayfinding: A Broad View." In *Handbook of Environmental Psychology*, eds R. Betchel and A. Churchman, 427-442. New York, NY: John Wiley and Sons.

Carpman, Janet, Myron Grant, and Deborah Simmons. 1985. "Hospital Design and Wayfinding: "A Video Simulation Study"." *Environment and Behavior* 17 (3): 296-314. doi: 10.1177/0013916585173002

Casakin, Hernan, Thomas Barkowsky, Alexander Klippel, and Christian Freksa. 2000. "Schematic Maps as Wayfinding Aids." *Lecture Notes In Computer Science* 1849: 54-71. doi: 10.1007/3-540-45460-8_5.

Casserley, Catherine, and Marcus Ormerod. 2003. "The Legal Argument for Inclusive Design " In *Inclusive Design : Design for the Whole Population*, 142-154. London : Springer London.

Castell, Lindsay. 2006. "Building Access for the Intellectually Disabled: A Preliminary Study" *Conference Proceedings AUBEA, July, 2006*, Australia: University of Technology Sydney.

———. 2008a. "Adapting Building Design to Access by Individuals with Intellectual Disability " *Australasian Journal of Construction Economics and Building* 8 (1): 11-22. doi: http://dx.doi.org/10.5130/AJCEB.v8i1.2994

———. 2008b. "Building Access for the Intellectually Disabled." *Facilities* 26 (3/4): 117-130. doi: 10.1108/02632770810849463.

———. 2014. "Building Access for People with Intellectual Disability, Dubious Past, Uncertain Future." *Facilities* 32: 675-684. doi: 10.1108/F-03-2012-0017.

Center for Inclusive Design and Environmental Access. 2001. *Universal Design New York*. New York: A City of New York Office of the Mayor, School of Architecture and Planning, University at Buffalo,. http://www.ap.buffalo.edu/idea/Publications/pdfs/udny1.pdf.

Chang, Yao-Jen. 2010. "Anomaly Detection for Travelling Individuals with Cognitive Impairments." *SIGACCESS Access. Comput.* (97): 25-32. doi: 10.1145/1873532.1873535.

Chang, Yao-Jen , Wan Chih Chang, and Tsen-Yung Wang. 2009. "Context-Aware Prompting to Transition Autonomously through Vocational Tasks for Individuals with Cognitive Impairments." In *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility, Pittsburgh, Pennsylvania, USA*, 19-26. 1639648: ACM. doi: 10.1145/1639642.1639648.

Chang, Yao-Jen , Yen-Yin Chu, Chen-Nien Chen, and Tsen-Yung Wang. 2008. "Mobile Computing for Indoor Wayfinding Based on Bluetooth Sensors for Individuals with Cognitive Impairments" *Wireless Pervasive Computing, 2008. ISWPC 2008. 3rd International Symposium on*, doi: 10.1109/iswpc.2008.4556284.

Chang, Yao-Jen, Chen-Nien Chen, Li-Der Chou, and Tsen-Yung Wang. 2008. "A Novel Indoor Wayfinding System Based on Passive RFID for Individuals with Cognitive Impairments" *Pervasive Computing Technologies for Healthcare, 2008. PervasiveHealth 2008. Second International Conference on*, doi: 10.1109/pcthealth.2008.4571043.

Chang, Yao-Jen, Yan-Ru Chen, Chia Yu Chang, and Tsen-Yung Wang. 2009. "Video Prompting and Indoor Wayfinding Based on Bluetooth Beacons: A Case Study in Supported Employment for People with Severe Mental Illness" *Communications and*

Mobile Computing, 2009. CMC '09. WRI International Conference on, doi: 10.1109/cmc.2009.134.

Chang, Yao-Jen, Shu-Ming Peng, Tsen-Yung Wang, Shu-Fang Chen, Yan-Ru Chen, and Hung-Chi Chen. 2010. "Autonomous Indoor Wayfinding for Individuals with Cognitive Impairments." *Journal of NeuroEngineering and Rehabilitation* 7 (1): 45. doi: 10.1186/1743-0003-7-45

Chang, Yao-Jen, Shih-Kai Tsai, Yao-Sheng Chang, and Tsen-Yung Wang. 2007. "A Novel Wayfinding System Based on Geo-Coded QR Codes for Individuals with Cognitive Impairments" *Proceedings of the 9th international ACM SIGACCESS conference on Computers and accessibility, Tempe, Arizona, USA*, 1296843: ACM. doi: 10.1145/1296843.1296887.

Chang, Yao-Jen, Shih-Kai Tsai, and Tsen-Yung Wang. 2008. "A Context Aware Handheld Wayfinding System for Individuals with Cognitive Impairments." In *Proceedings of the 10th international ACM SIGACCESS conference on Computers and accessibility, Halifax, Nova Scotia, Canada*, 27-34. 1414479: ACM. doi: 10.1145/1414471.1414479.

Chang, Yao-Jen, and Tsen-Yung Wang. 2010a. "Comparing Picture and Video Prompting in Autonomous Indoor Wayfinding for Individuals with Cognitive Impairments." *Personal and Ubiquitous Computing* 14 (8): 737-747. doi: 10.1007/s00779-010-0285-9.

———. 2010b. "Indoor Wayfinding Based on Wireless Sensor Networks for Individuals with Multiple Special Needs." *Cybernetics and Systems* 41 (4): 317-333. doi: 10.1080/01969721003778584.

Chang, Yao-Jen, Tsen-Yung Wang, and Yan-Ru Chen. 2011. "A Location-Based Prompting System to Transition Autonomously through Vocational Tasks for Individuals with Cognitive Impairments." *Research in Developmental Disabilities* 32 (6): 2669-2673. doi: http://dx.doi.org/10.1016/j.ridd.2011.06.006.

Chang, Yao-Jen, Tsen-Yung Wang, Yu-Chia Chuang, and Shih-Kai Tsai. 2007. "Ontology-Based Personalized Wayfinding System Using Deviation Detecting for Individuals with Cognitive Impairments" *Convergence Information Technology, 2007. International Conference on*, doi: 10.1109/iccit.2007.131.

Cheng, Karen, and Sarah Pérez-Kriz. 2014. "Map Design for Complex Architecture: A User Study of Maps & Wayfinding." *Visible Language* 48 (2): 6-33.

Cicchetti, Domenic V. 1994. "Guidelines, Criteria, and Rules of Thumb for Evaluating Normed and Standardized Assessment Instruments in Psychology." *Psychological Assessment* 6 (4): 284-290. doi: 10.1037/1040-3590.6.4.284.

CIRIA. 2004. Buildings for All to Use 2 – Improving the Accessibility of Public Buildings and Environments. CIRIA.

Clarke, V., and V. Braun. 2017. "Thematic Analysis." *Journal of Positive Psychology* 12 (3): 297-298. doi: 10.1080/17439760.2016.1262613.

Clarkson, P. John, and R. Coleman. 2015. "History of Inclusive Design in the UK." *Applied Ergonomics* 46: 235-247. doi: 10.1016/j.apergo.2013.03.002.

Cocks, Errol. 1998. *An Introduction to Intellectual Disability in Australia*. 3rd ed: Australian Institute on Intellectual Disability, ACT, Australia

Cohen, L, L Manion, and K Morrison. 2007. *Research Methods in Education*. Oxon, UK.: Routledge.

Commonwealth Government of Australia. 2009. "Access All Areas: Report of the Inquiry into Draft Disability (Access to Premises - Buildings) Standards." edited by House of Representatives Standing Committee on Legal and Constitutional Affairs.

———. 2010a. "Access All Areas: Government Response." edited by House of Representatives Standing Committee on Legal and Constitutional Affairs.

———. 2010b. *Disability (Access to Premises - Buildings) Standards 2010* Australian Government

Cook, Thomas D., and Donald T. Campbell. 1979. *Quasi-Experimentation : Design & Analysis Issues for Field Settings*. Edited by Donald T. Campbell. Boston: Boston : Houghton Mifflin.

Corlett, E. N., I. Manenica, and R. P. Bishop. 1972. "The Design of Direction Finding Systems in Buildings." *Applied Ergonomics* 3 (2): 66-69. doi: 10.1016/0003-6870(72)90054-3.

Courbois, Yannick., Mark Blades, Emily Farran, and Pascal Sockeel. 2012. "Do Individuals with Intellectual Disability Select Appropriate Objects as Landmarks When Learning a New Route?" *Journal of Intellectual Disability Research* 57 (1): 80-89. doi: 10.1111/j.1365-2788.2011.01518.x.

CRC for Construction Innovation. 2004. Way-Finding in the Built Environment. Accessed 22 January 2008, http://www.construction-innovation.info/images/pdfs/Way_finding.pdf.

———. 2007. Wayfinding Design Guidelines. Accessed 22 January 2008, http://www.construction-innovation.info/images/pdfs/Publications/Industry_publications/CRC0002_CRC_Wayfinding_Guidelines.pdf.

———. 2008. "Wayfinding in the Built Environment - Presentation to the FMA of Australia." Powerpoint, http://www.hpw.qld.gov.au/SiteCollectionDocuments/WayfindingPowerPointPres.pdf.

Creswell, John W. 2003. *Research Design : Qualitative, Quantitative, and Mixed Methods Approaches / John W. Creswell*. 2nd ed. ed. Thousand Oaks, Calif.: Thousand Oaks, Calif. : Sage Publications.

———. 2007. *Qualitative Inquiry and Research Design : Choosing among Five Approaches*. 2nd ed, *Qualitative Inquiry and Research Design*. Thousand Oaks: Sage Publications.

———. 2008. *Educational Research : Planning, Conducting, and Evaluating Quantitative and Qualitative Research / John W. Creswell*. 3rd ed. ed. Upper Saddle River, N.J.: Upper Saddle River, N.J. : Pearson/Merrill Prentice Hall.

Cromby, J., P. Standen, and D. Brown. 1996. "The Potentials of Virtual Environments in the Education and Training of People with Learning Disabilities." *Journal of Intellectual Disability Research* 40 (6): 489-501. doi: 10.1046/j.1365-2788.1996.805805.x

Crotty, Michael. 1998. *The Foundations of Social Research : Meaning and Perspective in the Research Process / Michael Crotty*. St Leonards, NSW: St Leonards, NSW : Allen & Unwin.

Dalke, Hilary, Jenny Little, Elga Niemann, Nilgun Camgoz, Guillaume Steadman, Sarah Hill, and Laura Stott. 2006. "Colour and Lighting in Hospital Design." *Optics & Laser Technology* 38: 343-365. doi: 10.1016/j.optlastec.2005.06.040.

Darken, Rudolph. 1996. "Wayfinding in Large-Scale Virtual Worlds." Dissertation, The George Washington University, Washington, DC. http://search.proquest.com.dbgw.lis.curtin.edu.au/docview/304293679?accountid=10382

Davis, Rebecca, and Catherine Weisbeck. 2016. "Creating a Supportive Environment Using Cues for Wayfinding in Dementia." *Journal of Gerontological Nursing* 42 (3): 36-44. doi: 10.3928/00989134-20160212-07.

Denzin, N, and Y Lincoln, eds. 1994. *Handbook of Qualitative Research*. Thousand Oaks, California, USA: Sage Publications.

Devlin, Ann Sloan. 2014. "Wayfinding in Healthcare Facilities: Contributions from Environmental Psychology." *Behavioral Sciences* 4 (4): 423-436. doi: 10.3390/bs4040423.

Diemer, Julia, Georg W. Alpers, Henrik M. Peperkorn, Youssef Shiban, and Andreas Mühlberger. 2015. "The Impact of Perception and Presence on Emotional Reactions: A Review of Research in Virtual Reality." *Frontiers in Psychology* 6 (26). doi: 10.3389/fpsyg.2015.00026.

Disability Rights Commission. 2004a. Good Signs: Improving Signs for People with a Learning Disability: A Report to the Disability Rights Commission. Accessed 24 June 2017, https://www.jiscmail.ac.uk/cgi-bin/webadmin?A3=ind0709&L=GEM&E=base64&P=6201305&B=--yXv)-M2nxBtvvrBTWfHz771UM9iLSNLnmKPA%27V0xQMLJ1P%27iVTAQoRzRXe.WeiHdzn3o%3Fc&T=APPLICATION%2FPDF;%20name=%22DRC%20Signs%20for%20People%20with%20Learning%20Disabilities.pdf%22&N=DRC%20Signs%20for%20People%20with%20Learning%20Disabilities.pdf.

———. 2004b. Nop Survey on Disabled Peoples Experiences of Access to Services in Britain Full Report January 2003. Accessed 30 November 2007, http://83.137.212.42/sitearchive/DRC/library/research/services_and_transport/nop_survey_on_disabled_people%20.html.

Disability Services Commission. 2004. State Government Access Guidelines for Information, Services and Facilities. Accessed 24 June 2017, http://www.disability.wa.gov.au/Global/Publications/Understanding%20disability/Built%20environment/State%20Government%20Access%20Guidelines.pdf.

Dogu, Ufuk, and Feyzan Erkip. 2000. "Spatial Factors Affecting Wayfinding and Orientation: A Case Study in a Shopping Mall." *Environment and Behavior* 32: 731-755. doi: 10.1177/00139160021972775

Dudley, James R. 2005. *Research Methods for Social Work : Becoming Consumers and Producers of Research / James R. Dudley*. Boston: Boston : Pearson/Allyn & Bacon.

Duker, Pieter, and Eef Rasing. 1989. "Effects of Redesigning: The Physical Environment on Self, Stimulation and on-Task Behavior in Three Autistic-Type Developmentally Disabled Individuals." *Journal of Autism and Developmental Disorders* 19 (3).

Dye, Linda, Steve Hardy, Dougal Hare, and Mark Burton. 2004. "Capacity to Consent to Participate in Research - a Recontextualization." *British Journal of Learning Disabilities* (32): 144-150. doi: 10.1111/j.1468-3156.2004.00262.x

Egbert, Joy, and Sherry Sanden. 2013. *Foundations of Education Research: Understanding Theoretical Components*. Florence, Italy: Taylor and Francis.

Equality Commission for Northern Ireland. 2014. *Accessible Goods and Services: A Good Practice Guide to Making Reasonable Adjustments* Belfast, Northern Ireland. http://www.equalityni.org/ECNI/media/ECNI/Publications/Employers%20and%20Service%20Providers/Every%20customer%20counts/Accessible_Goods_Services.pdf .

Evans, Gary W., Catherine Smith, and Kathy Pezdek. 1982. "Cognitive Maps and Urban Form." *Journal of the American Planning Association* 48 (2): 232-244. doi: 10.1080/01944368208976543.

Farran, E, Y Courbois, J Vanherwegen, and M Blades. 2012. "How Useful Are Landmarks When Learning a Route in a Virtual Environment? Evidence from Typical Development and Williams Syndrome." *Journal of Experimental Child Psychology* 111 (4): 571-586. doi: 10.1016/j.jecp.2011.10.009.

Farran, Emily, Mark Blades, Jill Boucher, and Lesley Tranter. 2010. "How Do Individuals with Williams Syndrome Learn a Route in a Real-World Environment?" *Developmental Science* 13: 454-468. doi: 10.1111/j.1467-7687.2009.00894.x

Farran, Emily, Y Courbois, J VanHerwegen, A Cruickshank, and M Blades. 2012. "Colour as an Environmental Cue When Learning a Route in a Virtual Environment: Typical and Atypical Development." *Research in Developmental Disabilities* 33 (3): 900-908. doi: 10.1016/j.ridd.2011.11.017.

Farran, Emily, Harry Purser, Yannick Courbois, Marine Balle, Pascal Sockeel, Daniel Mellier, and Mark Blades. 2015. "Route Knowledge and Configural Knowledge in Typical and Atypical Development: A Comparison of Sparse and Rich Environments." *Journal of Neurodevelopmental Disorders* 7. doi: 10.1186/s11689-015-9133-6.

Fellows, R, and A Liu. 2008. *Research Methods for Construction* Chichester, UK: Blackwell Publishing.

Fickas, Stephen, McKay Sohlberg, and Pei-Fang Hung. 2008. "Route-Following Assistance for Travelers with Cognitive Impairments: A Comparison of Four Prompt Modes." *International Journal of Human-Computer Studies* 66 (12): 876-888. doi: http://dx.doi.org/10.1016/j.ijhcs.2008.07.006.

Fletcher, Howard. 2006. "The Principles of Inclusive Design. (They Include You.)." London, UK.: Commission for Architecture and the Built Environment.

Foti, F, L Petrosini, D Cutuli, D Menghini, F Chiarotti, S Vicari, and L Mandolesi. 2011. "Explorative Function in Williams Syndrome Analyzed through a Large-Scale Task with Multiple Rewards." *Research in Developmental Disabilities* 32 (3): 972-985. doi: 10.1016/j.ridd.2011.02.001.

Frankenstein, J., S. Brüssow, F. Ruzzoli, and C. Hölscher. 2012. "The Language of Landmarks: The Role of Background Knowledge in Indoor Wayfinding." *Cognitive Processing* 13 (S1): 1-6. doi: 10.1007/s10339-012-0482-8.

Freksa, Christian. 1999. "Spatial Aspects of Task-Specific Wayfinding Maps." In *Visual and Spatial Reasoning in Design*, eds J. Gero and B. Tversky, 15-32. Sydney: Key Centre of Design Computing and Cognition, University of Sydney.

Gärling, Tommy, Erik Lindberg, Manuel Carreiras, and Böök Anders. 1986. "Reference Systems in Cognitive Maps." *Journal of Environmental Psychology* 6: 1-18. doi: Doi: 10.1016/s0272-4944(86)80031-7.

Gärling, Tommy, Erik Lindberg, and Timo Mantyla. 1983. "Orientation in Buildings: Effects of Familiarity, Visual Access, and Orientation Aids." *Journal of applied psychology* 68: 177-186. doi: 10.1037/0021-9010.68.1.177.

Giannopoulos, Ioannis, Peter Kiefer, Martin Raubal, Kai-Florian Richter, and Tyler Thrash. 2014. "Wayfinding Decision Situations: A Conceptual Model and Evaluation." In *Geographic Information Science*, 221-234. Berlin: Springer.

Giles, Caroline. 2012. "Diagnostic Dilemmas: DSM-5 Review and Development." In *In-Psych 2012*: Australian Psychological Society.

Glaser, Barney G., and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Chicago, Aldine Pub. Co.

Goldstein, Bruce. 2008. *Cognitive Psychology: Connecting, Mind, Research, and Everyday Experience*. 2nd ed. Belmont, CA: Thomson-Wadsworth.

Golledge, R, J. Rayner, and J. Parnicky. 1983. "Spatial Competence of the Borderline Retarded" *14th Environmental Design Research Association Conference Lincoln, NB,*

Golledge, Reginald. 1992. "Place Recognition and Wayfinding: Making Sense of Space." *Geoforum* 23: 199-214. doi: 10.1016/0016-7185(92)90017-X

———. 1993. "Time and Space in Route Preference." In *13th Meeting of the Pacific Regional Science Conference Organization and Seventeenth Annual Meeting of the Canadian Regional Science Association, Vancouver, British Columbia, Canada,* July 11-14

———. 1999a. *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes*. Baltimore, MD: The John Hopkins University Press.

———. 2003. "Human Wayfinding and Cognitive Maps." In *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*, eds M. Rockman and J. Steele, 25-43. London: Routledge.

Golledge, Reginald, Valerie Dougherty, and Scott Bell. 1993. "Acquiring Spatial Knowledge: Survey Versus Route- Based Knowledge in Unfamiliar Environment."

In *Association of American Geographers Conference, Atlanta, Georgia, USA*. doi: 10.1111/j.1467-8306.1995.tb01798.x

Golledge, Reginald G. 1999b. "Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes." *Psycoloquy* 10.

Golledge, Reginald, and Tommy Gärling. 2004. "Cognitive Maps and Urban Travel." In *Handbook of Transport Geography and Spatial Systems*, eds D Hensher, K Button, K Haynes and P Stopher, 501-512. Amsterdam: Elsevier Science.

Golledge, Reginald, Jack Loomis, and Roberta Klatzky. 1997. "A New Direction for Applied Geography." *Applied Geographical Studies* 1 (3): 151-168. doi: 10.1002/(SICI)1520-6319(199723)1:3<151::AID-AGS1>3.0.CO;2-0.

Golledge, Reginald, and Robert Stimson. 1997. *Spatial Behavior: A Geographic Perspective*. New York, NY: Guilford Press.

Gordon, Gary. 2003. *Interior Lighting for Designers*. 4th ed. Hoboken, NJ: John Wiley & Sons.

Grasberger, Eric. 2012. "Commentary: ADA Claims: The Buck Stops with Developers." *Daily Journal of Commerce Oregon*, 24 June 2017. http://djcoregon.com/news/2012/11/15/ada-claims-the-buck-stops-with-developers/.

Greater London Authority. 2004. *Working with Disabled People for Inclusive Access - Case Studies*. http://www.london.gov.uk/gla/publications/equalities/Case_studies.pdf.

Green, Judith, and Nicki Thorogood. 2009. *Qualitative Methods for Health Research / Judith Green and Nicki Thorogood*. Edited by Nicki Thorogood. 2nd ed. Los Angeles, London: SAGE.

Guba, E, and Y Lincoln. 1982. "Epistemological and Methodological Bases of Naturalistic Inquiry." *Educational Communication and Technology* 30 (4): 233-252. doi: 10.1007/BF02765185

———. 1994. "Competing Paradigms in Qualitative Research." In *Handbook of Qualitative Research*, 105-117. Thousand Oaks, California, USA: Sage Publications.

Hallgren, Kevin. 2012. "Computing Inter-Rater Reliability for Observational Data: An Overview and Tutorial." *Tutorials in Quantitative Methods for Psychology* 8 (1): 23-34.

Haq, Saif, Glenn Hill, and Adetania Pramanik. 2005. "Comparison of Configurational, Wayfinding and Cognitive Correlates in Real and Virtual Settings, June 2005." In *Proceedings of the 5th International Space Syntax Symposium, Delft University of Technology, Delft,*, edited by Akkelies van Nes. Techne Press. http://www.arch.ttu.edu/Architecture/Faculty/Haq_S/resume/Haq-Abstracts.htm.

Haq, Saif, and Craig Zimring. 2003. "Just Down the Road a Piece: The Development of Topological Knowledge of Building Layouts." *Environment and Behavior* 35: 132-160.

Harker, Maurice, and Nigel King. 2002. *Designing for Special Needs: An Architect's Guide to Briefing and Designing Options for Living for People with Learning Disabilities*. Edited by for the Shirley Foundation. London: RIBA Enterprises.

Harris, James. 2006. *Intellectual Disability: Understanding Its Development, Causes, Classification, Evaluation, and Treatment*: Oxford University Press, New York, USA.

Herzog, Thomas. 1992. "A Cognitive Analysis of Preference for Urban Spaces." *Journal of Environmental Psychology* 12: 237-248. doi: 10.1016/S0272-4944(05)80138-0

Herzog, Thomas, and A Bryce. 2007. "Mystery and Preference in within-Forest Settings." *Environment and Behavior* 39: 779-796. doi: 10.1177/0013916506298796

Herzog, Thomas, and J Flynn-Smith. 2001. "Preference and Perceived Danger as a Function of the Perceived Curvature, Length and Width of Urban Alleys." *Environment and Behavior* 33: 653-666. doi: 10.1016/S0272-4944(05)80138-0.

Herzog, Thomas, and Laura Kropscott. 2004. "Legibility, Mystery, and Visual Access as Predictors of Preference and Perceived Danger in Forest Settings without Pathways." *Environment and Behavior* 36 (5): 659-677. doi: 10.1177/0013916504264138

Herzog, Thomas, and Olivia Leverich. 2003. "Searching for Legibility." *Environment and Behavior* 35 (4): 459-477. doi: Identifier: ISSN: 0013-9165 ; E-ISSN: 1552-390X ; DOI: 10.1177/0013916503035004001

Hidayetoglu, M. Lutfi, Kemal Yildirim, and Aysu Akalin. 2012. "The Effects of Color and Light on Indoor Wayfinding and the Evaluation of the Perceived Environment." *Journal of Environmental Psychology* 32 (1): 50-58. doi: http://dx.doi.org/10.1016/j.jenvp.2011.09.001.

Hitchcock, Graham, and David August Hughes. 1995. *Research and the Teacher : A Qualitative Introduction to School-Based Research*. Edited by David August Hughes. 2nd ed. ed. London: London : Routledge.

HM Government. 2010. Building Regulations: Approved Document M - Access to and Use of Buildings (2015). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441786/BR_PDF_AD_M2_2015.pdf.

Hölscher, Christoph, Simon Büchner, Tobias Meilinger, and Gerhard Strube. 2007. "Map Use and Wayfinding Strategies in a Multi-Building Ensemble " In *Lecture Notes in Computer Science: Spatial Cognition V Reasoning, Action, Interaction*, 365-380. Springer Berlin.

Holscher, Christoph, Thora Tenbrink, and Jan M. Wiener. 2011. "Would You Follow Your Own Route Description? Cognitive Strategies in Urban Route Planning." *Cognition* 121 (2): 228-247. doi: 10.1016/j.cognition.2011.06.005.

Horn, Robert. 2017. Understanding the Independent-Samples T Test Northern Arizona University. Accessed 23 March 2017, http://oak.ucc.nau.edu/rh232/courses/EPS525/Handouts/Understanding%20the%20Independent%20t%20Test.pdf

Howell, D. 2017. Treatment of Ordered Variables in a Contingency Table. University of Vermont. Accessed 23 March 2017, https://www.uvm.edu/~dhowell/methods7/Supplements/OrdinalChiSq.html.

HREOC, (Human Rights and Equal Opportunity Commission) 2006. Building Regulation and Equitable Access - an Australian View. Accessed 19 November 2007, http://www.hreoc.gov.au/disability_rights/buildings/standev.htm.

Huelat, Barbara. 2007. Wayfinding: Design for Understanding: A Position Paper for the Environmental Standards Council. The Center for Health Design. Accessed 17 August 2011, http://www.healthdesign.org/chd/research/wayfinding-design-understanding.

Hund, Alycia M., and Devin M. Gill. 2014. "What Constitutes Effective Wayfinding Directions: The Interactive Role of Descriptive Cues and Memory Demands." *Journal of Environmental Psychology* 38: 217-224. doi: 10.1016/j.jenvp.2014.02.006.

Hunt, Earl, and David Waller. 1999. *Orientation and Wayfinding: A Review - Onr Technical Report N00014-96-0380*. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.46.5608&rep=rep1&type=pdf

Hunt, Michael. 1984. "Environmental Learning without Being There." *Environment and Behavior* 16 (3): 307-334. doi: 10.1177/0013916584163002.

Hunter, Susan. 2010a. Design Resources: Dr-01 - Architectural Wayfinding. Center for Inclusive Design and Environmental Access. Accessed 17 June, http://udeworld.com/documents/designresources/pdfs/ArchitecturalWayfinding.pdf.

———. 2010b. Design Resources: Dr-14 Spatial Orientation, Environmental Perception and Wayfinding Center for Inclusive Design and Environmental Access. Accessed 17 June, http://udeworld.com/documents/designresources/pdfs/SpatialOrientation.pdf.

Hygge, Staffan, and Igor Knez. 2001. "Effects of Noise, Heat and Indoor Lighting on Cognitive Performance and Self-Reported Affect." *Journal of Environmental Psychology* 21 (3): 291-299. doi: 10.1006/jevp.2001.0222.

Iacono, Teresa, Christine Bigby, Carolyn Unsworth, Jacinta Douglas, and Petya Fitzpatrick. 2014. "A Systematic Review of Hospital Experiences of People with Intellectual Disability." *BMC Health Services Research* 14 (1): 505. doi: 10.1186/s12913-014-0505-5.

Inclusive Design Research Centre. 2017. What Is Inclusive Design. Accessed 24 May 2017, http://idrc.ocadu.ca/about-the-idrc/49-resources/online-resources/articles-and-papers/443-whatisinclusivedesign.

Ishikawa, Toru, and Daniel Montello. 2005. "Spatial Knowledge Acquisition from Direct Experience in the Environment: Individual Differences in the Development of Metric Knowledge and the Integration of Separately Learned Places." *Cognitive Psychology* 52: 93-129. doi: 10.1016/j.cogpsych.2005.08.003

Janicki, M. P., Pw Davidson, C. M. Henderson, P. McCallion, J. D. Taets, Lt Force, S. B. Sulkes, E. Frangenberg, and Pm Ladrigan. 2002. "Health Characteristics and Health Services Utilization in Older Adults with Intellectual Disability Living in Community Residences." *J. Intell. Disabil. Res.* 46: 287-298. doi: 10.1046/j.1365-2788.2002.00385.x

Janzen, Gabriele. 2006. "Memory for Object Location and Route Direction in Virtual Large-Scale Space." *The Quarterly Journal of Experimental Psychology* 59: 493-508. doi: 10.1080/02724980443000746

JMU Access Partnership. 2007. *Design for Disabled People in Home Zones*. http://democracy.leeds.gov.uk/documents/s17488/Designing_for_DisabledPeople_in_Home_Zones.pdf.

Johnson, Andrew. 2005. *A Short Guide to Action Research*. Boston, USA: Pearson Education.

Johnson, Mark. 2007. *The Meaning of the Body: Aesthetics of Human Understanding*. Chicago, IL: The University of Chicago Press

Kaplan, Rachel. 1973. "5.3 Predictors of Environmental Preference." In *Fourth International Edra Conference*, ed. W. Preiser, 265-274. Blacksburg, VA: Dowden, Hutchinson and Ross, Inc, Stroudsburg, PA.

———. 1977. "Patterns of Environmental Preference." *Environment and Behavior* 9 (2): 195-216. doi: 10.1177/001391657792003

Kaplan, Rachel, and Stephen Kaplan. 1989. *The Experience of Nature: A Psychological Perspective*. New York: Cambridge University Press.

Kaplan, Rachel, Stephen Kaplan, and Terry Brown. 1989. "Environmental Preference: A Comparison of Four Domains of Predictors." *Environment and Behavior* 21 (5): 509.

Kaplan, Rachel, Stephen Kaplan, and Robert Ryan. 1998. *With People in Mind: Design and Management of Everyday Nature*. Washington, DC: Island Press.

Kaplan, Stephen, and Rachel Kaplan. 1982. *Cognition and Environment: Functioning in an Uncertain World*. New York, NY: Praeger.

———. 2003. "Health, Supportive Environments, and the Reasonable Person Model." *American Journal of Public Health* 93 (9): 1484-1489.

———, eds. 1978. *Humanscape: Environments for People*. North Scituate, Massachusetts: Duxbury Press.

Kaplan, Stephen, Rachel Kaplan, and John Wendt. 1972. "Rated Preference and Complexity for Natural and Urban Visual Material " *Perception and Psychophysics* 12 (4): 354-356. http://www.springerlink.com/content/d113gl6326gk5617/fulltext.pdf.

Killam, L. 2013. *Research Terminology Simplified: Paradigms, Axiology, Ontology, Epistemology and Methodology*. Sudbury, Ontario: Author.

Kinsley, Kirsten M., Dan Schoonover, and Jasmine Spitler. 2016. "Gopro as an Ethnographic Tool: A Wayfinding Study in an Academic Library." *Journal of Access Services* 13 (1): 7-23. doi: 10.1080/15367967.2016.1154465.

Kirasic, Kathleen. 1984. "Expression of Configurational Knowledge of Large-Scale Environments: Students' Performance of Cognitive Tasks." *Environment and Behavior* 16: 687-712. doi: 10.1177/0013916584166002

Knez, Igor. 2001. "Effects of Colour of Light on Nonvisual Psychological Processes." *Journal of Environmental Psychology* 21 (2): 201-208. doi: 10.1006/jevp.2000.0198.

Knez, Igor, and Staffan Hygge. 2002. "Irrelevant Speech and Indoor Lighting: Effects on Cognitive Performance and Self-Reported Affect." *Applied cognitive psychology* 16 (6): 709-718. doi: 10.1002/acp.829.

Kowalska-Styczen, Agnieszka, Joanna Bartnicka, Christophe Bevilacqua, and Geoffrey Lepoutre. 2014. "Chapter 10, Wayfinding by Colors in Public Buildings." In *Human Factors of a Global Society: A System of Systems Perspectives*, 115-122. Boca Raton, Florida, USA: CRC Press/Taylor & FRancis.

Kueh, Christopher. 2006. "A User-Centred Approach to Effective Wayfinding Map Design: Integrating Theory, Practice and User Participation." Unpublished doctoral dissertation. Curtin University of Technology. Perth.

LaGrow, Steven, William Wiener, and Robert LaDuke. 1990. "Independent Travel for Developmentally Disabled Persons: A Comprehensive Model of Instruction." *Research in Developmental Disabilities* 11 (3): 289-301. doi: http://dx.doi.org/10.1016/0891-4222(90)90014-Y.

Lancioni, G. E., M. F. O'Reilly, N. N. Singh, J. Sigafoos, F. Campodonico, and D. Oliva. 2009. "A Wheelchair User with Visual and Intellectual Disabilities Managing Simple Orientation Technology for Indoor Travel." *Journal of Visual Impairment & Blindness* 103 (5): 308-313.

Lancioni, Giulio E., Nirbhay N. Singh, Mark F. O'Reilly, Jeff Sigafoos, Gloria Alberti, Francesca Scigliuzzo, Mario Signorino, Doretta Oliva, Angela Smaldone, and Maria L. La Martire. 2010. "Persons with Multiple Disabilities Use Orientation Technology to Find Room Entrances During Indoor Traveling." *Research in Developmental Disabilities* 31 (6): 1577-1584. doi: http://dx.doi.org/10.1016/j.ridd.2010.05.004.

Lancioni, Giulio E., Nirbhay N. Singh, Mark F. O'Reilly, Jeff Sigafoos, Francesca Campodonico, and Doretta Oliva. 2010. "Two Persons with Multiple Disabilities Use Orientation Technology with Auditory Cues to Manage Simple Indoor Traveling." *Research in Developmental Disabilities* 31 (2): 397-402. doi: http://dx.doi.org/10.1016/j.ridd.2009.10.002.

Lawton, Carol. 1996. "Strategies for Indoor Wayfinding: The Role of Orientation." *Journal of Environmental Psychology* 16: 137-145. doi: 10.1006/jevp.1996.0011.

Lawton, Carol, Stephanie Charleston, and Amy Zieles. 1996. "Individual- and Gender-Related Differences in Indoor Wayfinding." *Environment and Behavior* 28: 204-219. doi: 10.1177/0013916596282003

Lawton, Carol, and Janos Kallai. 2002. "Gender Differences in Wayfinding Strategies and Anxiety About Wayfinding: A Cross-Cultural Comparison." *Sex Roles* 47: 389-401. doi: 10.1023/A:1021668724970.

Lee, Seunghae, Sibel Seda Dazkir, Hae Sun Paik, and Aykut Coskun. 2014. "Comprehensibility of Universal Healthcare Symbols for Wayfinding In healthcare Facilities." *Applied Ergonomics* 45 (4): 878-885. doi: 10.1016/j.apergo.2013.11.003.

Lemoncello, Rik, McKay Moore Sohlberg, and Stephen Fickas. 2010. "How Best to Orient Travellers with Acquired Brain Injury: A Comparison of Three Directional Prompts." *Brain Injury* 24 (3): 541-549. doi: doi:10.3109/02699051003610425.

Lemoncello, Rik, McKay Moore Sohlberg, and Stephen Fickas. 2010. "When Directions Fail: Investigation of Getting Lost Behaviour in Adults with Acquired Brain Injury." *Brain Injury* 24 (3): 550-559. doi: doi:10.3109/02699050903446807.

Levine, Marvin, Iris Marchon, and Gerard Hanley. 1984. "The Placement and Misplacement of You-Are-Here Maps." *Environment and Behavior* 16 (2): 139-157. doi: 10.1177/0013916584162001.

Li, Rui, and Alexander Klippel. 2016. "Wayfinding Behaviors in Complex Buildings." *Environment and Behavior* 48 (3): 482-510. doi: 10.1177/0013916514550243.

Lin, J, J Wu, and P Lee. 2003. "Healthcare Needs of People with Intellectual Disability in Institutions in Taiwan: Outpatient Care Utilization and Implications." *Journal of Intellectual Disability Research* 47 (3): 169-180. doi: 10.1046/j.1365-2788.2003.00454.x.

Lincoln, Yvonna S., and E Guba. 2000. "Paradigmatic Controversies, Contradictions, and Emerging Confluences." In *Handbook of Qualitative Research*, eds N Denzin and Y Lincoln. Thousand Oaks: Sage Publications.

Liu, A. L., H. Hile, G. Borriello, H. Kautz, B. Ferris, P. A. Brown, M. Harniss, and K. Johnson. 2006. "Implications for Location Systems in Indoor Wayfinding for Individuals with Cognitive Impairments" *Pervasive Health Conference and Workshops, 2006*, doi: 10.1109/pcthealth.2006.361699.

Liu, Alan, Harlan Hile, Henry Kautz, Gaetano Borriello, Pat Brown, Mark Harniss, and Kurt Johnson. 2006. "Indoor Wayfinding: Developing a Functional Interface for Individuals with Cognitive Impairments." In *Proceedings of the 8th international ACM SIGACCESS conference on Computers and accessibility, Portland, Oregon, USA*, 95-102. 1169005: ACM. doi: 10.1145/1168987.1169005.

Liu, Alan, Hartan Hile, Henry Kautz, Gaetano Borriello, Pat Brown, Mark Harniss, and Kurt Johnson. 2008. "Indoor Wayfinding: Developing a Functional Interface for Individuals with Cognitive Impairments " *Disability and Rehabilitation: Assistive Technology* 3 (1 and 2): 69-81.

Liu, Alan L. , Harlan Hile, Gaetano Borriello, Pat A. Brown, Mark Harniss, Henry Kautz, and Kurt Johnson. 2009. "Customizing Directions in an Automated Wayfinding System for Individuals with Cognitive Impairment." In *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility, Pittsburgh, Pennsylvania, USA*, 27-34. 1639649: ACM. doi: 10.1145/1639642.1639649.

Livingstone-Lee, Sharon A., Ronald W. Skelton, and Nigel Livingston. 2014. "Transit Apps for People with Brain Injury and Other Cognitive Disabilities: The State of the Art." *Assistive Technology*. doi: 10.1080/10400435.2014.930076.

London Borough of Croydon. 2000. *Designing for Accessibility: Supplementary Planning Guidance No. 10*.

Loomis, Jack, Roberta Klatzky, Reginald Golledge, and John Philbeck. 1999. "Human Navigation by Path Integration " In *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes* ed. R. Golledge, 125-151. Baltimore, MD: The John Hopkins University Press

Loulakis, Michael, and Simon Santiago. 2002. "ADA Liability: Does It Extend to Designers?" *Civil Engineering* 72 (2): 96.

Lovelace, Kristin, Mary Hegarty, and Daniel Montello. 1999. "Elements of Good Route Directions in Familiar and Unfamiliar Environments." In *Spatial Information Theory. Cognitive and Computational Foundations of Geographic Information Science Lecture Notes in Computer Science*

eds Christian Freksa and David Mark, 751-751. Springer Berlin / Heidelberg.

Lunsky, Yona, Rob Balogh, Alin Khodaverdian, Deborah Elliott, Christine Jaskulski, and Susan Morris. 2012. "A Comparison of Medical and Psychobehavioral Emergency Department Visits Made by Adults with Intellectual Disabilities." *Emergency Medicine International* 2012. doi: 10.1155/2012/427407.

Lynch, Kevin. 1960. *The Image of the City*. Cambridge, MA: MIT Press.

Mackay, Donald. 1973. "Aspects of the Theory of Comprehension, Memory and Attention." *The Quarterly Journal of Experimental Psychology* 25 (1): 22-40. doi: 10.1080/14640747308400320.

Mackenzie, Noella, and Sally Knipe. 2006. "Research Dilemmas: Paradigms, Methods and Methodology." *Issues in Educational Research* 16.

Makela, Kaj, and Perttu Prusi. 2001. "Project Paper: Providing Route Instructions with Speech." Speech Interface Design course, Department of Computer Science, The University of Tampere. www.cs.uta.fi/~kjr/SID/projects/SID_project.doc.

Malinowski, Jon, and William Gillespie. 2001. "Individual Differences in Performance on a Large-Scale Real-World Wayfinding Task." *Journal of Environmental Psychology* 21: 73-82. doi: 10.1006/jevp.2000.0183

Malkin, Jain. 1989. "Wayfinding: An Orientation System for Hospitals." *Progressive Architecture* 70 (12): 107-108

Mammarella, Irene C., Chiara Meneghetti, Francesca Pazzaglia, Filippo Gitti, Claudia Gomez, and Cesare Cornoldi. 2009. "Representation of Survey and Route Spatial Descriptions in Children with Nonverbal (Visuospatial) Learning Disabilities." *Brain and Cognition* 71 (2): 173-179. doi: http://dx.doi.org/10.1016/j.bandc.2009.05.003.

Marquez, David X., Rebecca H. Hunter, Michelle H. Griffith, Lucinda L. Bryant, Sarah J. Janicek, and Adam J. Atherly. 2017. "Older Adult Strategies for Community Wayfinding." *Journal of Applied Gerontology* 36 (2): 213-233. doi: 10.1177/0733464815581481.

Mason, Mark. 2010. *Sample Size and Saturation in Phd Studies Using Qualitative Interviews* [saturation; sample size; interviews size, personal interviews.]. Vol. 11, *2010*.

McDonald, J. 2014. *Handbook of Biological Statistics*. In 3rd ed. Baltimore, Maryland, USA: Sparky House Publishing.

McGraw, Kenneth O., and S. P. Wong. 1996. "Forming Inferences About Some Intraclass Correlation Coefficients." *Psychological Methods* 1 (1): 30-46. doi: 10.1037/1082-989X.1.1.30.

McMullen, Wanda. 2001. "User Preferences in an Interior Multiuse Space as Related to Community Enhancement in a Collede of Law." Graduate School University of Florida. http://ufdc.ufl.edu/UFE0000334/00001.

Meilinger, Tobias, Markus Knauff, and Heinrich Bulthoff. 2008. "Working Memory in Wayfinding—a Dual Task Experiment in a Virtual City." *Cognitive Science* 32: 755-770. doi: 10.1080/03640210802067004.

Mencap. 2004. Welcoming People with a Learning Disability to Your Venue. Accessed 25 June 2017, http://rflmedia.therfl.co.uk/docs/venues%20accessible%20to%20people%20with%20learning%20disabilities.pdf.

———. 2007. Communicating with a Person with a Learning Disability. Accessed 25 June 2017, http://socialwelfare.bl.uk/subject-areas/services-client-groups/adults-disabilities/mencap/175121Communicatingwithpeople_updated.pdf.

Mengue-Topio, Hursula, Yannick Courbois, Emily K. Farran, and Pascal Sockeel. 2011. "Route Learning and Shortcut Performance in Adults with Intellectual Disability: A Study with Virtual Environments." *Research in Developmental Disabilities* 32: 345-352. doi: 10.1016/j.ridd.2010.10.014.

Merriam-Webster Online Dictionary. 2012. Merriam-Webster. Accessed 12 March 2012, http://www.merriam-webster.com/dictionary/mystery.

Mertens, Donna. 2010. *Research and Evaluation in Education and Psychology*. 3 edition ed: SAGE Publications,Thousand Oaks, CA

Miller, George. 1956. "The Magical Number Seven Plus or Minus Two: Some Limits on Our Capacity for Processing Information." *Psychological Review* 63: 81-97. doi: 10.1037/0033-295X.101.2.343.

Mitchell, Peter, and Danielle Ropar. 2004. "Visuo-Spatial Abilities in Autism: A Review." *Infant and Child Development* Vol.13: 185-198. doi: 10.1002/icd.348.

Mokhov, Alexey. 2014. "Guidelines for Design of Learning Environments for Children on the Autistic Spectrum." edited by Edward H. Steinfeld, Korydon Smith and Sue Weidemann: ProQuest Dissertations Publishing.

Mondschein, Andrew, Evelyn Blumenberg, and Brian Taylor. 2005. "Cognitive Mapping, Travel Behavior and Access to Opportunity." In *85th Annual Meeting of the Transportation Research Board, Washington, DC*. http://trrjournalonline.trb.org/doi/abs/10.3141/1985-29.

Montello, Daniel. 2005. "Navigation." In *The Cambridge Handbook of Visuospatial Thinking*, eds Priti Shah and Akira Miyake. New York, NY: Cambridge University Press.

Moore, David, John Burton, and Robert Myers. 2001. "Chapter 29.2: Information-Processing Approach to Human Cognition." In *Handbook of Research for Educational Communications and Technology : A Project of the Association for Educational Communications and Technology*, ed. D. Jonassen. New York, NY: MacMillan Retrieved from http://www.aect.org/edtech/ed1/29/index.html#291

Morag, Ido, Ann Heylighen, and Liliane Pintelon. 2016. "Evaluating the Inclusivity of Hospital Wayfinding Systems for People with Diverse Needs and Abilities." *Journal*

of Health Services Research & Policy 21 (4): 243-248. doi: 10.1177/1355819616642257.

Morris, Colleen A. 2010. "Williams Syndrome." In *Management of Genetic Syndromes*, eds Suzanne B. Cassidy and Judith E. Allanson, 909-924. Hoboken, N.J.: Hoboken, N.J. : Wiley-Blackwell.

Morrow, Susan. 2005. "Quality and Trustworthiness in Qualitative Research in Counseling Psychology." *Journal of Counseling Psychology* 52 (2): 250-260. doi: 10.1037/0022-0167.52.2.250.

Morse, M. Janice. 1991. "Approaches to Qualitative-Quantitative Methodological Triangulation." *Nursing Research* 40 (2): 120-123.

Murakoshi, Shin, and Miho Kawai. 2000. "Use of Knowledge and Heuristics for Wayfinding in an Artificial Environment." *Environment and Behavior* 32: 756 - 774. doi: 10.1177/00139160021972784

Nardini, Marko, Janette Atkinson, Oliver Braddick, and Neil Burgess. 2008. "Developmental Trajectories for Spatial Frames of Reference in Williams Syndrome." *Developmental Science* 11 (4): 583-595. doi: 10.1111/j.1467-7687.2007.00662.x.

National Disability Authority. 2008. Promoting Safe Egress and Evacuation for People with Disabilities. Accessed 8 April 2009, http://www.accessibletourism.org/resources/accessible-egress-report.pdf.

National Library of Medicine. 2017. Genetics Home Reference: Turner Syndrome. Accessed 20 May 2017, https://ghr.nlm.nih.gov/condition/turner-syndrome.

Ng, Cheuk. 2003. "Satisfying Shoppers'psychological Needs: From Public Market to Cyber-Mall." *Journal of Environmental Psychology* 23: 439-455. doi: 10.1016/S0272-4944(02)00102-0

NHMRC. 2007. National Statement on Ethical Conduct in Human Research. NHMRC. Accessed 20 February 2007, http://www.nhmrc.gov.au/publications/synopses/e72syn.htm.

NHS-Estates. 1999. *Wayfinding: Guidance for Healthcare Facilities* London. UK: Harrogate NHS Estates, UK. https://www.researchgate.net/publication/285334248_Wayfinding_Guidance_for_Healthcare_Facilities_Published_by_NHS_Estates_in_1999_research_and_co-written_by_Colette_Jeffrey_whilst_at_Information_Design_Unit_UK.

Nicholas, Helen. 2000. The Art and Science of Wayfinding. *Access by Design*, 5 - 7.

Nijs, Greg, and Ann Heylighen. 2015. "Turning Disability Experience into Expertise in Assessing Building Accessibility: A Contribution to Articulating Disability Epistemology." *Alter - European Journal of Disability research, Revue européen de recherche sur le handicap* 9 (2): 144-156. doi: 10.1016/j.alter.2014.12.001.

Nind, Melanie, and Jane Seale. 2009. "Concepts of Access for People with Learning Difficulties: Towards a Shared Understanding." *Disability & Society* 24 (3): 273-287. doi: 10.1080/09687590902789446.

Norman, Donald. 1968. "Toward a Theory of Memory and Attention." *Psychological review* 75: 522-536. doi: 10.1037/h0026699.

NSW Health. 2009. "Technical Series 2 - Wayfinding for Health Facilities." edited by Strategic Procurement & Business Development, NSW: NSW Government.

O'Neill, Michael. 1991a. "Effects of Signage and Floor Plan Configuration on Wayfinding Accuracy." *Environment and Behavior* 23: 553-574. doi: 10.1177/001391659123500.

———. 1991b. "Evaluation of a Conceptual Model of Architectural Legibility." *Environment and Behavior* 23: 259-284. doi: 10.1177/0013916591233001

———. 1992. "Effects of Familiarity and Plan Complexity on Wayfinding in Simulated Buildings." *Journal of Environmental Psychology* 12: 319-327. doi: 10.1016/S0272-4944(05)80080-5

ODPM, (Office of the Deputy Prime Minister). 2003. *Planning and Access for Disabled People: A Good Practice Guide*. http://www.communities.gov.uk/documents/planningandbuilding/pdf/156681.pdf.

———. 2006. *Final Report for Signage and Wayfinding for People with Learning Difficulties: Building Research Technical Report 6/2005*. http://www.communities.gov.uk/publications/planningandbuilding/finalreport.

Olsen, Richard. 2005. *Summary Guidelines for School Design to Include Children with Disabilities*. http://www.edlawcenter.org/assets/files/pdfs/publications/LRFP_Disabilities.pdf.

Onwuegbuzie, Anthony J., and Kathleen M. T. Collins. 2007. "A Typology of Mixed Methods Sampling Designs in Social Science Research." *Qualitative Report* 12 (2): 281-316.

Ormerod, Marcus, and Rita Newton. 2005. "Briefing for Accessibility in Design." 23: 285-294. doi: 10.1108/02632770510600254.

Pani, John, Carolyn Mervis, and Byron Robinson. 1999. "Global Spatial Organisation by Individuals with Williams Syndrome." *Psychological Science* 10 (5): 453-458. doi: 10.1111/1467-9280.00186

Passini, Romedi. 1981. "Wayfinding: A Conceptual Framework." *Urban Ecology* 5: 17-31. doi: 10.1016/0304-4009(81)90018-8

———. 1984a. "Spatial Representations, a Wayfinding Perspective." *Journal of Environmental Pyschology* 4: 153-164. doi: 10.1016/S0272-4944(84)80031-6

———. 1984b. *Wayfinding in Architecture*. New York, NY: Van Nostrand Reinhold Co. Ltd.

———. 1988. "Wayfinding without Vision: An Experiment with Cogenitally Totally Blind People." *Environment and Behavior* 20: 227-252. doi: 10.1177/0013916588202006

———. 1990. "The Spatio-Cognitive Abilities of the Visually Impaired Population." *Environment and Behavior* 22: 91-118. doi: 10.1177/0013916590221005

———. 1996. "Wayfinding Design: Logic, Application and Some Thoughts on Universality." *Design Studies* 17: 319-331. doi: 10.1016/0142-694X(96)00001-4

———. 1999. "Wayfinding: Backbone of Graphic Support Systems." In *Visual Information for Everyday Use : Design and Research Perspectives*, eds H. J. G. Zwaga, Theo Boersema and Henriëtte C. M. Hoonhout, 241-256. London: London : Taylor & Francis.

Passini, Romedi, Helene Pigot, Constant Rainville, and Marie-Helene Tetreault. 2000. "Wayfinding in a Nursing Home for Advanced Dementia of the Alzheimers' Type." *Environment and Behavior* 32: 684-710.

Passini, Romedi, Constant Rainville, Nicolas Marchand, and Yves Joanette. 1998. "Wayfinding and Dementia: Some Research Findings and a New Look at Design." *Journal of Architectural and Planning Research* Vol 15: 133-151.

Passini, Romedi, Constant Rainville, and M Habib. 2000. "Spato-Cognitive Deficits in Right Parietal Lesion and Its Impact on Wayfinding: A Case Study." *Neurocase: The Neural Basis of Cognition* 6: 245 - 257. http://www.informaworld.com/10.1080/13554790008402774.

Pati, Debajyoti, Thomas E. Harvey, Douglas A. Willis, and Sipra Pati. 2015. "Identifying Elements of the Health Care Environment That Contribute to Wayfinding." *HERD: Health Environments Research & Design Journal* 8 (3): 44-67. doi: 10.1177/1937586714568864.

Pazzaglia, F., and A. Moè. 2013. "Cognitive Styles and Mental Rotation Ability in Map Learning." *Cognitive Processing* 14 (4): 1-9. doi: 10.1007/s10339-013-0572-2.

Peponis, John, Craig Zimring, and Yoon Choi. 1990. "Finding the Building in Wayfinding." *Environment and Behavior* 22: 555-590. doi: 10.1177/0013916590225001

Perry, Chad. 1995. "A Structured Approach to Presenting Phd Theses: Notes for Candidates and Their Supervisors." ANZ Docotoral Consortium. University of Sydney.

Pinto, Maria Rita, Stefania De Medici, Andre Zlotnicki, Alfredo Bianchi, Clarke Van Sant, and Claudio Napou. 1997. "Reduced Visual Acuity in Elderly People: The Role of Ergonomics and Gerontechnology." *Age and Ageing* 26 (5): 339-344. doi: 10.1093/ageing/26.5.339.

Pollet, Dorothy, and Peter Haskell. 2003. "Wayfinding." In *The Nyc Guidebook to Accessibility and Universal Design*, ed. D. Levine, 59-77. New York, NY: Center for Inclusive Design and Environmental Access.

Prideaux, Simon. 2006. *Good Practice for Providing Reasonable Access to the Physical Built Environment for Disabled People: An Analysis of the Legislative Structures and Technical Expressions of Discrimination and Disability in the Context of the Built Environment in Six European and Two Non-European States*. Leeds: The Disability Press.

Purser, H., E. Farran, Y. Courbois, D. Mellier, P. Sockeel, and M. Blades. 2012. "Route Learning and Landmark Use in Typical Development, Down Syndrome and Williams Syndrome, in Virtual Environments." *Cogn. Process.* 13: S67-S67.

Purser, Harry, Emily Farran, Yannick Courbois, Axelle Lemahieu, Pascal Sockeel, Daniel Mellier, and Mark Blades. 2015. "The Development of Route Learning in Down Syndrome, Williams Syndrome and Typical Development: Investigations with

Virtual Environments." *Developmental Science* 18 (4): 599-613. doi: 10.1111/desc.12236.

Queensland Health. 1996. "Building Guidelines for Queensland Mental Health Facilities." Brisbane: Queensland Health.

Queensland University of Technology. 2017. Capital Development - Signage. QUT. Accessed 23 May 2017, http://www.fmd.qut.edu.au/capital_works/signage.jsp.

Rainville, Constant, Romedi Passini, and Nicolas Marchand. 2001. "A Multiple Case Study of Wayfinding in Dementia of the Alzheimer Type: Decision Making." *Aging Neuropsychology and Cognition* 8: 54-71. doi: 10.1076/anec.8.1.54.846

Ramanujam, Priti. 2006. "Prospect-Refuge Theory Revisited: A Search for Safety in Dynamic Public Spaces with a Reference to Design." Master in Landscape Architecture, Graduate School, University of Texas at Arlington. https://uta-ir.tdl.org/uta-ir/bitstream/handle/10106/67/umi-uta-1277.pdf?sequence=1&isAllo.

Raubal, M., and M. Egenhofer. 1998a. "Comparing the Complexity of Wayfinding Tasks in Built Environments." *Environment and planning B, Planning and design* 25: 895-913.

Raubal, Martin. 2001a. "Human Wayfinding in Unfamiliar Buildings: A Simulation with Cognizing Agents." *Cognitive Processing* 2: 363-389.

———. 2001b. "Ontology and Epistemology for Agent-Based Wayfinding Simulation." *International Journal of Geographical Information Science* 15 (7): 653-665. doi: 10.1080/13658810110061171

Raubal, Martin , and Stephan Winter. 2002. "Enriching Wayfinding Instructions with Local Landmarks." In *Geographic Information Science. Lecture Notes in Computer Science*, eds M Egenhofer and D Mark, 243-259. Berlin: Springer.

Raubal, Martin, and Max Egenhofer. 1998b. "Comparing the Complexity of Wayfinding Tasks in Built Environments." *Environment and Planning B: Planning and Design* 25 (6): 895-913. http://www.envplan.com/abstract.cgi?id=b250895.

Raubal, Martin, and Michael Worboys. 1999. "A Formal Model of the Process of Wayfinding in Built Environments." In *Spatial Information Theory - Cognitive and Computational Foundations of Geographic Information Science, International Conference COSIT, Stade, Germany.*, edited by C. Freska and D. Mark, 381-399.

Read, Marilyn. 2003. "Use of Color in Child Care Environments: Application of Color for Wayfinding and Space Definition in Alabama Child Care Environments " *Early Childhood Education Journal* 30 (4): 233-239.

Reck, Sarah G., Alycia M. Hund, and Steven Landau. 2010. "Memory for Object Locations in Boys with and without Adhd." *Journal of Attention Disorders* 13 (5): 505-515. doi: 10.1177/1087054708329970.

Riley, Susan. 1995. "Spatial Cognition and Wayfinding in Adults with Mental Retardation ". Doctoral dissertation, The University of Wisconsin - Madison, Ann Arbor, MI.

Ritcher, Kai-Florian. 2007. "A Uniform Handling of Different Landmark Types in Route Directions." In *Spatial Information Theory, 8th International Conference, COSIT*

2007, Melbourne, Australia, September 19-23. edited by S Winter, M Duckham, L Kulik and B Kuipers, 373-389.

Ritchie, Jane, Jane Lewis, and Gillian Elam. 2003. *Qualitative Research Practice : A Guide for Social Science Students and Researchers*. Edited by Jane Ritchie and Jane Lewis. First Edition ed. Thousand Oaks, California, USA SAGE Publications.

Roof, K., and N. Oleru. 2008. "Public Health: Seattle and King County's Push for the Built Environment." *Journal of Environmental Health* 71 (1): 24-27. http://search.proquest.com.dbgw.lis.curtin.edu.au/docview/219710110?accountid=10382

Roskos-Ewolsen, Beverly, Frances Conners, Julie Atwell, and Jillian Prestopnik. 2006. "Visual Imagery Scanning in Young Adults with Intellectual Disability " *American Journal on Mental Retardation* 111 (1): 35-47. doi: 10.1352/0895-8017(2006)111[35:VISIYA]2.0.CO;2

Rousek, Justin, and Susan Hallbeck. 2011a. "The Use of Simulated Visual Impairment to Identify Hospital Design Elements That Contribute to Wayfinding Difficulties." *International Journal of Industrial Ergonomics* 41 (5): 447-458. doi: 10.1016/j.ergon.2011.05.002.

Rousek, Justin., and Susan Hallbeck. 2011b. "Improving and Analyzing Signage within a Healthcare Setting." *Applied Ergonomics* 42 (6): 771-784. doi: 10.1016/j.apergo.2010.12.004.

Royal National Institute of Blind People. 2016. Homes for People with Learning Disabilities and Sight Loss: A Guide to Providing Safe and Accessible Environments. Accessed 26 June 2017, https://www.rnib.org.uk/sites/default/files/ADPDF-COU061501_Homes%20for%20People%20with%20Learning%20Disabilities-ENG.pdf.

SAI Global. 2009. *As/Nzs 1680.0:2009 : Interior Lighting: Safe Movement*. https://www-saiglobal-com.dbgw.lis.curtin.edu.au/online/autologin.asp.

Salmi, Patricia. 2005. Exploring Wayfinding. *Universal Design*, July 2005, 1, 10 and 11.

———. 2006. "Buildings for Everyone: Wayfinding for Varied Capabilities (Session Summary)." In *Interiors06: The ASID Conference on Design, Nashville, Tennessee,* 16-19 March 2006. http://www.asid.org/interiors06/sims.htm#wayfinding.

———. 2007a. "Identifying and Evaluating Critical Environmental Wayfinding Factors for Adults with Intellectual Disabilities." ProQuest Dissertations and Theses, University of Minnesota. http://search.proquest.com.dbgw.lis.curtin.edu.au/docview/304840069.

———. 2007b. "Wayfinding Design - Hidden Barriers to Universal Design " *Implications* 05 (08). http://www.informedesign.org/_news/aug_v05r-p.pdf.

Salmi, Patricia, Delores Ginthner, and Denise Guerin. 2004. "Critical Factors for Accessibility and Wayfinding for Adults with Intellectual Disabilities." In *Designing for the 21st Century III: An International Conference on Universal Design, Rio de Janeiro, Brazil*. http://www.designfor21st.org/proceedings/proceedings/forum_salmi.html.

Saunders, Mark. 2009. *Research Methods for Business Students / Mark Saunders, Philip Lewis, Adrian Thornhill*. Edited by Philip Lewis and Adrian Thornhill. 5th ed. ed. Harlow, U.K.: Harlow, U.K. : Financial Times- Prentice Hall.

Sawyer, Ann, and Keith Bright. 2007. *The Access Manual : Auditing and Managing Inclusive Built Environments / Ann Sawyer, Keith Bright*. Edited by Keith Bright. 2nd ed. Oxford: Oxford : Blackwell Pub.

Schmid, Falko, Kai-Florian Richter, and Denise Peters. 2010. "Route Aware Maps: Multigranular Wayfinding Assistance." *Spatial Cognition & Computation* 10 (2-3): 184-206. doi: 10.1080/13875861003592748.

Schreibe, Susan. 2007. "Enigmatic Light: An Exploration into the Role of Lighting Characteristics and Path Preference." Interdisciplinary Design Institute, Washington State University.

Seale, Jane, and Melanie Nind. 2009. *Understanding and Promoting Access for People with Learning Difficulties : Seeing the Opportunities and Challenges of Risk / Edited by Jane Seale and Melanie Nind*. Edited by Jane Seale and Melanie Nind. Abingdon, Oxon

New York, NY: Abingdon, Oxon

New York, NY : Routledge.

Secchi, Simone, Antonio Lauria, and Gianfranco Cellai. 2017. "Acoustic Wayfinding: A Method to Measure the Acoustic Contrast of Different Paving Materials for Blind People." *Applied Ergonomics* 58: 435. doi: 10.1016/j.apergo.2016.08.004

Sechrest, Lee. 1992. "Roots: Back to Our First Generations." *Evaluation Practice* 13 (1): 1-7. doi: 10.1016/0886-1633(92)90018-7

Sheehan, Bart, Elizabeth Burton, and Lynne Mitchell. 2006. "Outdoor Wayfinding in Dementia." *Dementia* 5 (2): 271-281. doi: 10.1177/1471301206062254

Shiffrin, Richard, and Robert Nosofsky. 1994. "Seven Plus or Minus Two." *Psychological Review* 101: 357-361.

Shiffrin, Richard, and Walter Schneider. 1977. "Controlled and Automatic Human Information Processing: Ii. Perceptual Learning, Automatic Attending and a General Theory." *Psychological review* 84 (2): 127-190. doi: 10.1037/0033-295X.84.2.127

Silbert, Annette, PeterH Wolff, and Janet Lilienthal. 1977. "Spatial and Temporal Processing in Patients with Turner's Syndrome." *Behavior Genetics* 7 (1): 11-21. doi: 10.1007/bf01067172.

Silva, Carlota, Francisco Rebelo, Elisângela Vilar, and Paulo Noriega. 2015. "Preliminary Study About Social Influence over Wayfinding Decisions." *Procedia Manufacturing* 3: 5920-5926. doi: 10.1016/j.promfg.2015.07.905.

Sjolinder, Marie. 1998. "Individual Differences in Spatial Cognition and Hypermedia Navigation." In *Exploring Navigation: Towards a Framework for Design and Evaluation of Navigation in Electronic Spaces*, ed. N. Dahlbäck, 59-71. SICS Technical Report T98:01 March 1998.

Smith, Alastair D. 2015. "Spatial Navigation in Autism Spectrum Disorders: A Critical Review." *Frontiers in psychology* 6: 31. doi: 10.3389/fpsyg.2015.00031.

Smith, D, and B Adkins. 2006. "The Environmental Experience of Shopping with Cognitive Impairment." *IDEA Journal 2006*: 72-86. http://www.idea-edu.com/Journal/2006/2006-IDEA-Journal.

Smith, D. 2009. "Spatial Design as a Facilitator for People with Less Visible Impairments." *Australasian Medical Journal* 2 (13): 220-227. doi: 10.4066/AMJ.2009.123.

Smith, Dianne. 2003. "Environmental Colouration and/or the Design Process." *Color Research & Application* 28 (5): 360-365. doi: 10.1002/col.10182.

———. 2008. "Color-Person-Environment Relationships." *Color Research & Application* 33 (4): 312-319. doi: 10.1002/col.20424.

Sohlberg, McKay, Stephen Fickas, Pei-Fang Hung, and Andrew Fortier. 2007. "A Comparison of Four Prompt Modes for Route Finding for Community Travellers with Severe Cognitive Impairments." *Brain Injury* 21 (5): 531-538. doi: doi:10.1080/02699050701311000.

Sohlberg, Mckay, Bonnie Todis, Stephen Fickas, Pei-Fang Hung, and Rik Lemoncello. 2005. "A Profile of Community Navigation in Adults with Chronic Cognitive Impairments." *Brain Injury* December 2005, 19 (14): 1249-1259. doi: 10.1080/02699050500309510

Sperandei, Sandro. 2014. "Understanding Logistic Regression Analysis." *Biochemia Medica* 24 (1): 12-18. doi: 10.11613/BM.2014.003.

Spiers, Hugo, and Eleanor Maguire. 2008. "The Dynamic Nature of Cognition During Wayfinding." *Journal of Environmental Psychology* 28 (3): 232-249. doi: 10.1016/j.jenvp.2008.02.006.

Stamps III, Arthur. 2004. "Mystery, Complexity, Legibility and Coherence: A Meta-Analysis." *Journal of Environmental Psychology* 24: 1-16. doi: 10.1016/S0272-4944(03)00023-9

———. 2007. "Mystery of Environmental Mystery: Effects of Light, Occlusion, and Depth of View." *Environment and Behavior* 39: 165-197. doi: 10.1177/0013916506288053.

Stanton, Danae, Nigel Foreman, and Paul Wilson. 1998. *Uses of Virtual Reality in Clinical Training: Developing the Spatial Skills of Children with Mobility Impairments*. Edited by G Riva, B Wiederhold and E Molinari. Vol. 58, *Virtual Environments in Clinical Psychology and Neuroscience: Methods and Techniques in Advanced Patient-Therapist Interaction* Amsterdam: Ios Press.

Strobl, Carolin; James Malley; and Gerhard Tutz. 2009. Supplement to ‘an Introduction to Recursive Partitioning: Rational, Application, and Characteristics of Classification and Regression Trees, Bagging, and Random Forests. Accessed 11 March 2017, http://dx.doi.org/10.1037/a0016973.supp.

Tam, Mei-ling, and William H. K. Lam. 2004. "Determination of Service Levels for Passenger Orientation in Hong Kong International Airport." *Journal of Air Transport Management* 10 (3): 181-189. doi: 10.1016/j.jairtraman.2003.10.011.

Tapp, Jon. 2003. Procoderdv Manual. Vanderbilt Kennedy Centre, Vanderbilt University, Tennessee, USA. Accessed 8 April 2009, http://procoder.vueinnovations.com/sites/default/files/public/d10/ProcoderDVManual_0.pdf.

Tashakkori, Abbas, and Charles Teddlie. 2010. "Pragmatism and the Philosophical Foundations of Mixed Methods Research1." In *Sage Handbook of Mixed Methods in Social & Behavioral Research*, 95-118. Thousand Oaks, California: SAGE Publications, Inc.

The Centre for Genetics Education (online). 2017a. Fact Sheet 36 | Trisomy 21 - Down Syndrome. Accessed 20 May 2017, www.genetics.edu.au.

———. 2017b. Fact Sheet 46 | Autistic Spectrum Disorder. Accessed 20 May 2017, www.genetics.edu.au.

———. 2017c. Fact Sheet 50 | Alzheimer Disease. Accessed 20 May 2017, www.genetics.edu.au.

———. 2017d. Fact Sheet 54 | Fragile X Syndrome. Accessed 20 May 2017, www.genetics.edu.au.

The Information Design Unit of Enterprise IG, . 2005. "Wayfinding: Effective Wayfinding and Signing Systems - Guidance for Healthcare Facilities (Supersedes Htm 65 'Signs')." edited by NHS Estates, Harrowgate, UK.: The Stationery Office.

The R Foundation. 2017. The R Project for Statistical Computing. Accessed 10 March 2017, https://www.r-project.org/about.html.

Thorndyke, P., and B. Hayes-Roth. 1982. "Differences in Spatial Knowledge Acquired from Maps and Navigation." *Cognitive Psychology* 14: 560-589. doi: 10.1016/0010-0285(82)90019-6

Torrado, Juan C., Germán Montoro, and Javier Gomez. 2016. "Easing the Integration: A Feasible Indoor Wayfinding System for Cognitive Impaired People." *Pervasive and Mobile Computing* 31: 137-146. doi: 10.1016/j.pmcj.2016.02.003.

Treisman, Anne. 1964. "Selective Attention in Man." *British Medical Bulletin* 20: 12-16.

Tsai, Shih-Kai. 2007. "Wader: A Novel Wayfinding System with Deviation Recovery for Individuals with Cognitive Impairments" *Proceedings of the 9th international ACM SIGACCESS conference on Computers and accessibility, Tempe, Arizona, USA*, 1296843: ACM. doi: 10.1145/1296843.1296906.

Tversky, Barbara. 2005. "Functional Significance of Visuospatial Reprsentations." In *The Cambridge Handbook of Visuospatial Thinking*, eds P. Shah and A. Miyake, 1-34. New York, NY: Cambridge University Press.

UK Department for Children Schools and Families. 2008. "Building Bulletin 102: Designing for Disabled Children and Children with Special Educational Needs." The Stationery Office, UK

VanderKlipp, Mark. 2006. "Develop a Successful Wayfinding System." *Buildings* 100 (4): 28. doi: 1032942671.

Veitch, Jennifer. 2001. "Psychological Processes Influencing Lighting Quality." *Journal of the Illuminating Engineering Society* 30 (no. 1): 124-140.

Wayfinding: Pointers for the Future 2011. *Design Week*, 35.

Weisman, Jerry. 1981. "Evaluating Architectural Legibility: Way-Finding in the Built Environment." *Environment and Behavior* 13: 189-204. doi: 10.1177/0013916581132004

Wener, Richard, and Robert Kaminoff. 1983. "Improving Environmental Information: Effects of Signs on Perceived Crowding and Behavior." *Environment and Behavior* 15 (1): 3-20. doi: 10.1177/0013916583151001.

Werner, Steffan, and Laura Schindler. 2004. "The Role of Spatial Reference Frames in Architecture: Misalignment Impairs Way-Finding Performance." *Environment and Behavior* 36 (4): 461-482. doi: 10.1177/0013916503254829

Werner, Steffen, and Paul Long. 2003. "Cognition Meets Le Corbusier — Cognitive Principles of Architectural Design " In *Lecture Notes in Artifical Intelligence: Spatial Cognition 3*, 112-126. Heidelberg: Springer Verlag, Berlin.

Wiener, Jan M., Simon J. Büchner, and Christoph Hölscher. 2009. "Taxonomy of Human Wayfinding Tasks: A Knowledge-Based Approach." *Spatial Cognition & Computation* 9 (2): 152-165. doi: 10.1080/13875860902906496.

World Insitute on Disability. 1999. *Telecommunications Problems and Design Strategies for People with Cognitive Disabilities*. https://worldinstituteondisabilityblog.files.wordpress.com/2016/01/telecommunications-problems-and-design-strategies-for-pwcogd.pdf.

Yalon-Chamovitz, Shira. 2009. "Invisible Access Needs of People with Intellectual Disabilities: A Conceptual Model of Practice." *Intellectual and Development Disabilities* 47 (5): 395-400. doi: 10.1352/1934-9556-47.5.395

Appendices

Appendix A Cognitive Processing Requirements for Wayfinding

Wayfinding requires cognitive processing ability to focus attention, to memorise and recall information, to process information, to solve problems and to make decisions (Algase et al. 2004; Passini 1984b). The extent to which individuals can perform these tasks will impact on their success in wayfinding.

1. Information processing

Information processing relates to the way in which information is acquired, compacted, encoded and eventually transformed into a series of actions (Moore, Burton and Myers 2001). According to Passini (1984b), problems with information processing are the cause of most difficulties in wayfinding. Poor processing may be due to incomplete or ambiguous information (Passini 1984b) or lack of attention to relevant detail (Moore, Burton and Myers 2001). An information processing system uses three storage structures within the mind: sensory receptors, short term memory (also called working memory) and long-term memory (Moore, Burton and Myers 2001). The sensory receptors receive stimuli from the environment (in auditory or visual form) and hold the information until it is recognised or lost (Moore, Burton and Myers 2001). Whilst being held, the information is matched with previously acquired knowledge retrieved from long term memory (Moore, Burton and Myers 2001). If matching occurs, then the information is passed to short term memory where it is held and utilised (Moore, Burton and Myers 2001). In passing the information to short term memory it is transformed from raw data into its recognised form (Moore, Burton and Myers 2001). The capacity of short term memory is limited to handling seven (plus or minus two) chunks of information at any one time (Miller 1956; Shiffrin and Nosofsky 1994). Once information is no longer required by short term memory it is passed to the third structure - long term memory. This completes the cycle.

2. Maintaining attention

The type and extent of attention afforded to incoming messages is directly linked to the amount of information that progresses through and into memory. Attention, therefore, can affect which information will be retained for further processing (Broadbent 1958, 1965;

Mackay 1973; Moore, Burton and Myers 2001; Norman 1968; Shiffrin and Schneider 1977; Treisman 1964). Goldstein (2008) describes three types of attention that can be given to environmental information;

- selective (where the focus is on one message at the expense of all others)
- divided attention (where a person learns to focus on two or more sources of incoming information). The level of cognitive processing demanded to manage the simultaneous information may be beyond the capacity of a person who already has limited cognitive capabilities, and
- visual attention (where visual stimulation affects the focus of attention). Appropriately designed objects, therefore, could help focus a person's attention on the appropriate cues (e.g., signs) required for wayfinding

3. Using working memory

The human brain uses different types of memory for different activities but, for wayfinding, it uses working memory (also called short term memory) to store and recall the necessary environmental information (Meilinger, Knauff and Bulthoff 2008). Working memory provides "an interface between perception, long term memory and action" (Baddeley 2003, 829). It is also involved in the processes of reasoning, learning and comprehension (Baddeley 2003). Working memory comprises a central executive (responsible for controlling the sub-systems and selecting reasoning and storage strategies) and two storage systems: the phonological loop (PL) which is responsible for handling verbal information; and the visuo-spatial sketch pad (VSSP) which is responsible for handling both visual and spatial information (Baddeley 2003; Meilinger, Knauff and Bulthoff 2008).

4. Acquiring spatial knowledge

There are two ways in which spatial knowledge can be acquired: (a) by travelling through the environment and acquiring knowledge using a set of procedural rules or (b) by learning the environment either using overlooking viewpoints to identify the layout or by using maps and the like (Golledge 1999a; Ishikawa and Montello 2005). Cognitive mapping is then used to process the acquired information (Passini et al. 2000). Because not all information is acquired in one attempt, it may necessitate several attempts to collect the spatial information (Passini 1984b). Once collected the information may need some interpretation, manipulation and restructuring before being incorporated into existing information (Passini 1984b). Spatial knowledge is "usually partial and is error prone" (Golledge 2003, 17).

Appendix B Interview Document

BUILDING ACCESS RESEARCH PROJECT

Thank you for taking part in the visit to xxxxxxxxxxx Hospital. I would like to ask you some questions about your visit

---

1) PARTICIPANT DEMOGRAPHICS

a) Participant's name from the observation exercise ..... Code No. /.....

b) Date of visit:…… Time of visit: ……

c) Gender: *Male Female*

d) Age range: *18-25 26-30 31-35 36-40 41-45 over 45*

e) Have you previously visited the hospital? *YES / NO*

f) Was it less than: *1 week 1 month 1 year 5 years*

g) Do you go to a different hospital? *YES / NO*

h) How often do you go? Once every: *week two weeks month year longer*

---

2) GENERAL WAYFINDING

a) How easy was it to find the Outpatients Clinic?

1	2	3	4	5	6
Impossible	very hard	hard	reasonably easy	easy	very easy

Why?.....

Can you remember what you looked for?
First: .....
Second: .....
Third: .....
Fourth: .....
Fifth: .....

b) How easy was it to find Ward G64 after visiting Outpatients?

1	2	3	4	5	6
Impossible	very hard	hard	reasonably easy	easy	very easy

Why?.....

Can you remember what you looked for?
First: .....
Second: .....
Third: .....
Fourth: .....
Fifth: .....

c) What was the major difference between finding your way to the Outpatients and to the Ward?

Comments.....

d) How easy were the corridors to use?

1----------2----------3----------4----------5----------6

Impossible	very hard	hard	reasonably easy	easy	very easy

Why?.....

e) How easy was it to use the lift?

1----------2----------3----------4----------5----------6

Impossible	very hard	hard	reasonably easy	easy	very easy

Why?.....

f) How easy was it to see what was coming up (could you see where to go from a distance)?

1----------2----------3----------4----------5----------6

Impossible	very hard	hard	reasonably easy	easy	very easy

Why?.....

g) Can you tell me how to get to the

i) Outpatients Clinic from the rear entrance
.....

ii) Ward G 64 from the Outpatients Clinic:
.....

iii) Outside the building from Ward G64
.....

h) Do you think you could get outside the building in a hurry from Ward G 64?

Comments.....

i) Would you be happy to find the locations on your own? YES / NO

Comments.....

j) How much of the time did you feel you knew where to go:

1	2	3	4	5
none of the time	very little of the time	some of the time	most of the time	all of the time

Comments.....

k) Do you think there was more than one way you could have got to each location?

YES / NO

Comments.....

l) How much do you LIKE using each of the following when finding your way in a building?

	1	2	3	4	5
Signs:	Not at all	a tiny bit	a little	quite a lot	a great deal
Landmarks:	Not at all	a tiny bit	a little	quite a lot	a great deal
Map:	Not at all	a tiny bit	a little	quite a lot	a great deal
Directories:	Not at all	a tiny bit	a little	quite a lot	a great deal
People:	Not at all	a tiny bit	a little	quite a lot	a great deal
Colour coding:	Not at all	a tiny bit	a little	quite a lot	a great deal
Texture:	Not at all	a tiny bit	a little	quite a lot	a great deal

Are there any other things you like to use?.....

m) Which one of these do you like using the most?

Signs	Landmarks	Maps	Directories	Asking People	Following colour coding	Following textured coding

Why?.....

n) How difficult was it to ACTUALLY use the following in the building?

i) Signs

1----------2----------3----------4----------5----------6
Impossible very hard hard easy reasonably easy easy very

Why?.....

ii) Landmarks

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

iii) iii) Maps

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

iv) Directories

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

v) Asking people

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

vi) Colour coding

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

vii) Texture

1----------2----------3----------4----------5----------6
Impossible very hard Hard reasonably easy easy very

Why?.....

3) ENVIRONMENTAL CONSIDERATIONS

a) As you were finding each location how much of the time did you feel:

Nervous:

1----------2----------3----------4----------5

none of the time	very little of the time	some of the time	most of the time	all of the time

Did this affect where you went? *Yes* *No*

How?.....

Unsafe:

1----------2----------3----------4----------5

none of the time	very little of the time	some of the time	most of the time	all of the time

Did this affect where you went? *Yes* *No*

How?.....

Helpless (*feeling lost)***:**

1----------2----------3----------4----------5

none of the time	very little of the time	some of the time	most of the time	all of the time

Did this affect where you went? *Yes* *No*

How?.....

b) How much did the following things make your wayfinding more DIFFICULT?

i) Amount of noise:

1----------2----------3----------4----------5

Not at all	a tiny bit	a little	quite a lot	a great deal

Why?.....

ii) Amount of light:

1----------2----------3----------4----------5

Not at all	a tiny bit	a little	quite a lot	a great deal

Why?.....

iii) Texture on surfaces:

1----------2----------3----------4----------5

Not at all	a tiny bit	a little	quite a lot	a great deal

Why?.....

iv) Smell:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

v) Crowds of people:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

vi) People moving in a specific direction

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

c) How much did the following things HELP you find your way?

i) Colour (*sufficient contrast)*

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

ii) Amount of light:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

iii) Smell:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

iv) Texture on surfaces:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

v) People moving in a specific direction:

1----------2----------3----------4----------5
Not at all | a tiny bit | a little | quite a lot | a great deal

Why?.....

4) GENERAL CONSIDERATIONS

a) What was the MOST HELPFUL thing in finding your way? (Signs, maps, landmarks, people, etc)

.....

b) What was the MOST ANNOYING thing when finding your way?

.....

c) If you could tell the Hospital how to make it easier to find your way, what would you say?

.....

Is there any other information you think could help us better understand the difficulties in finding your way around the building?

.....

.....

---

5) WAYFINDING FOR THOSE WITH AN INTELLECTUAL DISABILITY

a) What SPECIFIC problems do you think someone with an ID would have in accessing this building?

.....

.....

Appendix C Ethics Consent

1. Curtin University Human Research Ethics approval

This study has been approved by the Curtin University Human Research Ethics Committee at Curtin University of Technology SMEC 20070021. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth or by telephoning xxx-xxxx.

2. Hospital Human Research Ethics Committee

This research project has been approved by the xxxxxxxxx Hospital Research Governance Unit and the Hospital Human Research Ethics Committee under study number 2008-044. (A copy of the ethics approval can be provided by the author of this study, if required)

Appendix D Classification of Research Schemes

This Table shows the approach used by Onwuegbuzie and Collins (2007, 284) to classify research sampling schemes and has been adapted to include a ranking of frequency (also provided by the authors).

Table D.1 Matrix crossing type of sampling scheme by research approach

		Qualitative components	
		Random sampling	Non-random sampling
Quantitative components	Random sampling	Rare combination (Type 1) (Least common)	Occasional combination (Type 2) (Second most common)
	Non-random sampling	Very Rare combination (Type 3) (Rare)	Frequent combination (Type 4) (Most common)

Appendix E Information and Consent Forms

Participants from both groups were provided with an information sheet and consent form that were worded using simple and clear terms. Each participant was asked to return a completed and signed copy of the consent form. At the point of recruiting people for the main group (people with ID), the researcher discussed the content of the forms and the research generally with the participant. With the approval of participants, the researcher also discussed the research study, objectives and requirements for participating with the person's carer, sibling and/or parents so that they were aware of the consequences of involvement and could help in ensuring the potential participant was similarly aware. If, at any time, the person with ID showed any sign of reluctance or concern about participating then all recruitment and/or research activity was ceased and support given to the person to ensure no adverse impact had occurred. The information sheets provided to all participants gave information about who to contact for further advice about the research and also offered access to counselling should a participant feel this was required. All consent forms from both groups were signed and returned, either at the time of recruitment or at the research location prior to any activity occurring.

CURTIN UNIVERSITY OF TECHNOLOGY
MAIN GROUP PARTICIPANT INFORMATION SHEET

Research project: Equitable building access for adults with intellectual disability

Researcher: Lindsay Castell, Lecturer, School of the Built Environment Art and Design (Tel: xxxx-xxxx or xxxx-xxxx Mobile: xxxx-xxx-xxx)

Date:

My name is Lindsay Castell and I teach at Curtin University of Technology. It is my job to teach people how to build houses, schools, hospitals and other buildings.

AIM

I am doing a project to make it easier for certain people to get into and find their way around buildings such as hospitals, TAFE colleges and other government offices.

TAKING PART IN THIS PROJECT

I need to know a bit about you to see if you can help me in my project. Please answer these questions: *(if you are not sure of your answer you can ask your parent/guardian/carer to help)*:

(Put a tick in the box which is correct)

- Are you between 18 years and 65 years old? Yes ☐ No ☐
- Do you have an IQ between 50 and 70? Yes ☐ No ☐
- Can you walk without difficulty? Yes ☐ No ☐
  (you can tick "yes" if you can easily move around using a wheelchair)
- Can you see clearly? Yes ☐ No ☐
  (You can also tick "yes" if you use glasses/contact lenses)
- Can you hear clearly? Yes ☐ No ☐
  (You can also tick "yes" if you use hearing aids)
- Can you talk to people and let them know what you want? Yes ☐ No ☐
- Do you speak English all the time? Yes ☐ No ☐
- Can you understand signs that mean "stop", "exit", "toilets"? Yes ☐ No ☐

If you have answered **"No" to any questions**, unfortunately I cannot ask you to take part this time. You do not need to read through the rest of this information.

If you have answered **"Yes" to all these questions**, then you could help me in my project. Please read through the rest of this information.

ROLE

I will ask you (and a parent/carer/guardian if you wish) to visit xxxxxxxxxxx hospital **on a day during _____ at a time that is OK for you**. At the hospital, I will ask you to find three locations within the hospital building/s. Your parent/carer/guardian can remain at the hospital whilst you undertake the visit but you will need to find the location without their help. A research assistant and I will observe and record (by videotape) your progress and the actions you take as you go through the building/s. Afterwards, I would like to talk with you about what you found easy or difficult. It is expected that the visit and discussion will last no more than one and a half (1½) hours, excluding travel time. I can help organise your travel and/or arrange to collect you and take you to and from the hospital. I will give you a $25 Coles-Myer gift card for spending time helping me with this project.

CONFIDENTIALITY

The information collected during your visit and discussion will be kept private. I will know who you are but your name will not appear in the project report. In accordance with the University policy the visit information and transcript of the discussion will be kept in a locked cupboard.

CONSENT TO PARTICIPATE

You do not have to take part in this project if you do not want to. You can stop at any time without it affecting your rights or my responsibilities. If you sign the attached consent form I will assume that you have agreed to take part and will allow me to use your information from the visit in the report. If you agree to take part then I will arrange to talk with you and a parent/carer/guardian in order to discuss the specific arrangements for the visit.

RISKS AND BENEFITS

I think that the benefit to you for taking part in this project is that it will allow the people who design buildings to make it easier for you to visit a hospital doctor, or a specialist, or find someone in a building to talk about employment, study, etc.

I don't think there will be any risk to you in taking part in this project. However, if you feel any worry or concern after the visit then I can arrange for you to have a free and confidential meeting with Dr. xxxxxxx xxxxxxx (Psychologist) to talk about your visit.

FURTHER INFORMATION

This project has been reviewed and given approval by the Human Research Ethics Committee at Curtin University of Technology. However, if you have any concern about the conduct of this study you may contact the secretary of the committee on tel: xxxx-xxxx or email xxxx@xxxxxx.edu.au.

If you need any further information please contact me by phone (xxxx-xxxx or xxxx-xxx-xxx) or by email (xxxxxxxxx@xxxxxx.edu.au). Alternatively, you can contact my supervisor (Associate Professor xxxxxxx xxxxxxx) by phone (xxxx-xxxx) or by email (xxxxxxxxx@xxxxxx.edu.au.

******* IF YOU WOULD LIKE TO TAKE PART IN THIS PROJECT *******

Please contact me by phone (xxxx-xxxx or xxxx-xxx-xxx) or by email (xxxxxxxxx@xxxxxx.edu.au) as soon as possible so that I can discuss details about the visit.

Please also complete the attached consent form which I will collect from you before or at the beginning of the visit to the hospital.

Thank you very much for your involvement in this project, your participation will be greatly appreciated.

CURTIN UNIVERSITY OF TECHNOLOGY

Research project

Equitable building access

CONSENT FORM

(PARTICIPANT – Main Group)

- I have read the information sheet about the project on building access.
- I have asked questions about the things I wanted to know more about.
- I know I do not have to work on this project if I don't want to.
- I know that it is OK for me to stop working on this project if I change my mind.
- I understand that no one will know who I am when the results of the project are made into a report.
- I would like to take part in this project.

NAME: _____ (Please print)

TELEPHONE NUMBER: _____

SIGNATURE: _____

Date:_____

CURTIN UNIVERSITY OF TECHNOLOGY
CONTROL GROUP PARTICIPANT INFORMATION SHEET

Research project: Equitable building access for adults with intellectual disability

Researcher: Lindsay Castell, Lecturer, School of the Built Environment Art and Design
(Tel: xxxx-xxxx or xxxx-xxxx Mobile: xxxx-xxx-xxx)

Date:

My name is Lindsay Castell and I am a lecturer in the construction management department at Curtin University of Technology.

AIM

I am doing a project to make it easier for people with intellectual disability to get into and find their way around buildings such as hospitals, TAFE colleges and other government offices.

TAKING PART IN THIS PROJECT

I am looking for volunteers to take part in this project. If you are interested can you please answer these few simple questions to see if you would be eligible to participate:

(Put a tick in the box which is correct)

- Are you between 18 years and 65 years old ? Yes ☐ No ☐
- Are you fully ambulatory or able to easily move around using a wheelchair? Yes ☐ No ☐
- Do you have normal vision or vision corrected to a normal level *(ie. glasses or contact lenses) ?* Yes ☐ No ☐
- Do you have normal hearing or hearing corrected to a normal level *(ie. hearing aids) ?* Yes ☐ No ☐
- Can you communicate effectively to let others know what you want? Yes ☐ No ☐
- Do you use English as your native language? Yes ☐ No ☐

If you have answered **"No" to any questions**, unfortunately I cannot ask you to take part this time. You do not need to read through the rest of this information.

If you have answered **"Yes" to all these questions**, then you could help me in my project. Please read through the rest of this information.

ROLE

I will ask you to visit xxxxxxxxxx hospital at **a convenient date and time during _____.** At the hospital, I will ask you to find three locations within the hospital building/s. A research assistant and I will observe and record (by videotape) your progress and the actions you take as you go through the building/s. Afterwards, I would like to talk with you about what you found easy or difficult. It is expected that the visit and discussion will last no more than one and a half (1½) hours, excluding travel time. I can help organise your travel and/or arrange to collect you and take you to and from the hospital. I will give you a $25 Coles-Myer gift card for spending time helping me with this project.

CONFIDENTIALITY

The information collected during your visit and discussion will be kept private. I will know who you are but your name will not appear in the project report. In accordance with the University policy the visit information and transcript of the discussion will be kept in a locked cupboard.

CONSENT TO PARTICIPATE

You do not have to take part in this project if you do not want to. You can stop at any time without it affecting your rights or my responsibilities. If you sign the attached consent form I will assume that you have agreed to take part and will allow me to use your information from the visit in the report. If you agree to take part then I will arrange to talk with you in order to discuss the specific arrangements for the visit.

RISKS AND BENEFITS

I think that the benefit to you for taking part in this project is that it will help inform the people who design buildings so that they can make it easier for all of us to find our way around buildings.

I don't think there will be any risk to you in taking part in this project. However, if you feel any worry or concern after the visit then I can arrange for you to have a free and confidential meeting with Dr. xxxxxxx xxxxxxx (Psychologist) to talk about your visit.

FURTHER INFORMATION

This project has been reviewed and given approval by the Human Research Ethics Committee at Curtin University of Technology. However, if you have any concern about the conduct of this study you may contact the secretary of the committee on tel: xxxx-xxxx or email xxxx@xxxxxx.edu.au.

If you need any further information please contact me by phone (xxxx-xxxx or xxxx-xxx-xxx) or by email (xxxxxxxx@xxxxxx.edu.au). Alternatively, you can contact my supervisor (Associate Professor xxxxxxx xxxxxxx) by phone (xxxx-xxxx) or by email (xxxxxxxx@xxxxxx.edu.au).

******* IF YOU WOULD LIKE TO TAKE PART IN THIS PROJECT *******

Please contact me by phone (xxxx-xxxx or xxxx-xxx-xxx) or by email (xxxxxxxxx@xxxxxx.edu.au) as soon as possible so that I can discuss details about the visit.

Please also complete the attached consent form which I will collect from you before or at the beginning of the visit to the hospital.

Thank you very much for your involvement in this project, your participation will be greatly appreciated.

CURTIN UNIVERSITY OF TECHNOLOGY

Research project

Equitable building access for adults with intellectual disability

CONSENT FORM

(PARTICIPANT – control group)

- I have read the information sheet about the project on building access.
- I have asked questions about the things I wanted to know more about.
- I know I do not have to work on this project if I don't want to.
- I know that it is OK for me to stop working on this project if I change my mind.
- I understand that no one will know who I am when the results of the project are made into a report.
- I would like to take part in this project.

NAME: _____ (Please print)

CONTACT TELEPHONE NUMBER: _____

SIGNATURE: _____ Date:_____

Appendix F Use of Anonymous Participant Codes

To maintain participant anonymity in the analysis and discussions, each participant was given a unique identifier code. This code comprised a prefix of ‘M’ (main group member) or ‘C’ (control group member) followed by a consecutive number for each group (1 up to 33), then followed by an ‘M’ (for male) or ‘F’ (for female). In order to refer to a particular participant’s journey, his or her personal identifier was then suffixed with an ‘a’ (for the journey to the reception counter), ’b’ (for the journey to Ward G64) or ‘c’ (for the journey to get out of the building).

Appendix G Explanation of Random Forest Classification

Random forest classification was used in the analysis of results to determine the influence of wayfinding features on successful wayfinding (using time taken as the measure of success). Random forest classification depends on creating and using decision trees (Breiman 2001) . A decision tree describes the decisions needed to achieve a given outcome. These decisions can be assigned probabilities in relation to their contribution in achieving the outcome. They comprise an initial node that is split into sub-nodes and these nodes then split into further sub-nodes. To construct the tree, however, it is first necessary to determine which variable to use as the top node. There are many ways to achieve this, one of which is called the GINI-INDEX. This comprises calculating the GINI value for the whole system and then calculating a GINI value for each individual variable (i.e., variables X01 to X26). The GINI-GAIN value is then calculated for every variable by subtracting its GINI value from the system GINI value. The variable with the highest residual score is defined as the splitting variable and is placed at the top of the tree. The data from where this variable is extracted, is then investigated for further splitting. For instance, rows where the variable was used by participants could then be split into the different attributes 1 to 6 (based on probability of successful use of a feature) and then a GINI calculated for each of these. The process is iterative until the agreed lowest level of splitting is reached. The model at this stage is untested, but would represent a potential model that could be expected to predict the outcome of the set of decisions in the tree.

Random forest classification for this current study used the “R” software. R is a software environment for statistical computing and graphics which provides a wide variety of statistical and graphical techniques including random forest classification (The R Foundation 2017). Random forest classification uses the decision tree process described above to create a model, but instead of one tree, it uses many, hence the term ‘forest’. The initial data set is divided, two-thirds for use in creating and training the model and the remaining third for testing the model. The forest of trees is created by the process of bootstrapping (i.e., randomly selecting subsets of the data based on set parameters, described below) and the forest is used to create and train the model.

As noted above, three parameters need to be defined in order to run a random forest classification; the number of trees within the forest, the node size and the number of variables to be used in calculating Gini-Gain (called “mtry”). A sensitivity analysis was performed to determine the most appropriate values for these parameters and the results are shown in figure G.1 below.

Main Group
Mean time of each trip: (Trip a: 396.00 s), (Trip b: 663.33 s), (Trip c: 310.00 s),
67 observations

1. Trial different number of trees in program

Scenario 1:
Independent variables : x01-x26
Target/dependent variable: a) <=396 success (1) and >396 fail (0)
: b) <=663.33 success (1) and >663.33 fail (0)
: c) <=310 success (1) and >310 fail (0)

2. Check OOB error rates and use the number of trees that provides the lowest error rate (e.g. 20.09 therefore 100 trees)

Sensitivity test of random forest parameters:

Number tree =100		Number tree =200		Number tree =500	
Size of node	Error (%)	Size of node	Error (%)	Size of node	Error (%)
1	23.88	1	23.88	1	25.37
2	26.87	2	23.88	2	20.9
3	29.85	3	26.87	3	26.87
4	28.36	4	25.37	4	23.88
5	20.9	5	23.88	5	25.37
6	26.87	6	25.37	6	26.87
7	25.37	7	26.87	7	26.87
8	23.88	8	25.37	8	26.87
9	26.87	9	28.36	9	23.88
10	31.34	10	31.34	10	25.37

3. The lowest error, identifies the size of node (e.g. '2' means nodes can be split until the last node has only 2 sets of data in it)

This figure is called the MTRY. See below for further explanation

Model Performance:

Call:
randomForest (x = train_RF, y = target_train_RF, ntree = 100, nodesize = 5, importance = T)
Type of random forest: classification
Number of trees: 100
No. of variables tried at each split: 5

OOB estimate of error rate: 20.9%
Confusion matrix:
0 1 class, error
0 19 8 0.2962963
1 6 34 0.1500000

4. OOB stands for "Out of bag" error. See below for explanation

Figure G.1 Random forest sensitivity analysis

The OOB error defines the error between the outcomes from the actual data (the 'third' of the data set aside for testing) and the predicted outcomes for that data using the random forest classification model. An error of 20.9% means an accuracy of 79.1%. The sensitivity analysis shows the OOB (Out Of Bag) estimate of error rate associated with a choice of different number of trees within the forest and the size of node. The aim is to minimise the

error and therefore the sensitivity analysis suggests using a forest of 100 trees with a node size of 5 (the number of lines of data still remaining in the lowest node on the decision tree)

As mentioned at the beginning of this explanation, GINI-GAIN needs to be calculated for all variables in order to find the variable that will be deemed the splitting variable (top node) for each decision tree. This can require substantial analysis where there are numerous variables to test. Rather than testing all variables, the square root of the number of variables has been suggested (Brieman and Cutler No date; Strobl 2009). This is termed Mtry in Figure G.1.

1. Interpreting results

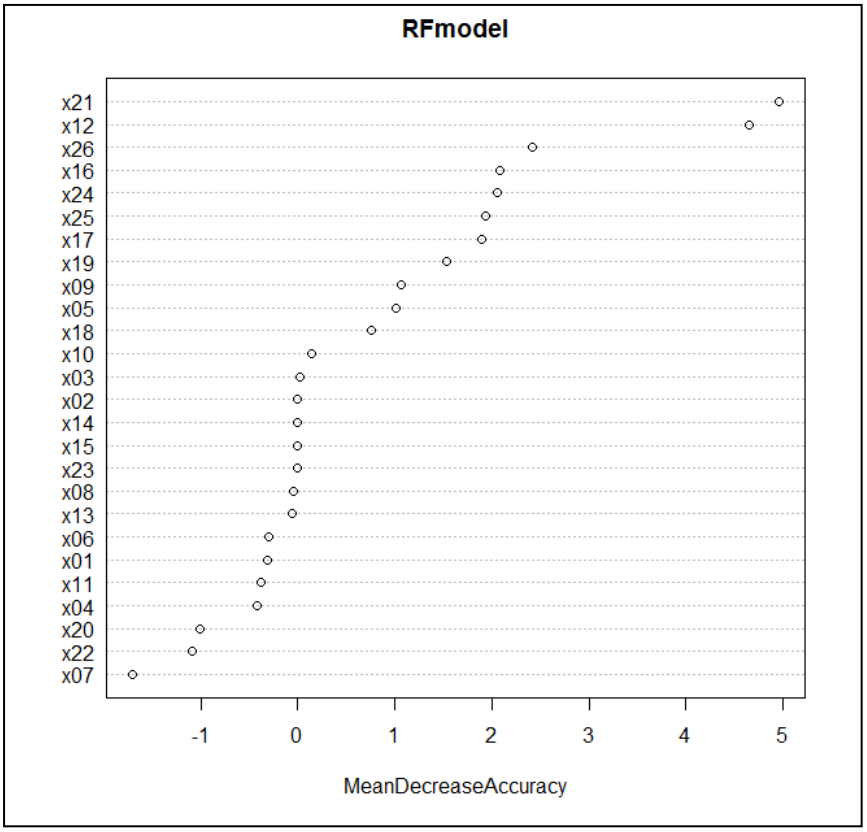


Figure G.2 Variable importance

Figure G.2 shows the outcome of the random forest classification based on the Main Group (for all trips). To minimise the OOB estimate of error rate, the analysis created 100 trees. This prediction provides an accuracy rating when tested of 79.1%, which is a reasonably high level of accuracy. The ‘mean decrease accuracy’ is a measure of how sensitive the

model is to changes in data. Thirty random lines of data from the observation are picked and checked using the model to see if they correctly predict the outcome (success or fail) (for example, it may show 21 correctly predicted out of 30). Then, using the same thirty lines, the data for one variable is randomly shuffled and the model run again on the reshuffled data. In this instance, only 18 out of 30 may be correct, and if done again, it may show 20 correct and if done again 19 correct. The mean decrease in accuracy is then [(21-18) + (21-20) + (21-19)]/3 = 2. This result is then shown in Figure G.2. Where variables have scored 0, it means they are not affected by changes in data and therefore do not have much influence on the model (i.e., on the prediction of success). The figures to the right of the column of zeros indicate they do have influence. Consequently, figure G.2 shows the varying influence each of the variables has on the model predicting success.

Appendix H Results from Inter-rater Reliability Test

SPSS Results - Reliability

Table H.1 Reliability statistics

Case Processing Summary

		N	%
Cases	Valid	52	100.0
	Excluded[a]	0	.0
	Total	52	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.972	2

Table H.2 Reliability statistics

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0	
		Lower Bound	Upper Bound	Value	df1
Single Measures	.946[a]	.908	.969	36.127	51
Average Measures	.972[c]	.952	.984	36.127	51

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Appendix I Results for Overall Trip

1. Percentage of participants completing trips within time frame (Category 1 trips)

(Result tables shown in Chapter 5)

2. Time taken – completed trips only (Category 1)

The duration of all trips was recorded during video of participants. Table I.1 shows the average times taken for completed trips only.

Table No. I.1 Time taken - completed trips only (Category 1)

	Trip a		Trip b		Trip c	
	ID	TD	ID	TD	ID	TD
No of completed trips (out of 30)	25	29	18	30	24	30
Average time taken (in minutes)	6.6	3.9	11.1	8.3	5.2	4.4
Percentage slower	69.2%		33.7%		18.2%	
Independent samples t-test significance	t = -2.946 df = 41.493 *p* = .006		t = -3.195 df = 46 *p* = .003		t = -1.153 df = 52 *p* = .254	

3. Distance travelled - completed trips only (Category 1)

Table No. I.2 Distance travelled - completed trips only (Category 1)

	Trip a		Trip b		Trip c	
	ID	TD	ID	TD	ID	TD
No of completed trips (out of 30)	25	29	18	30	24	30
Average distance travelled (steps) based only on completed trips	332	226	596	454	326	222
Percentage longer	46.9%		31.3%		46.9%	
Independent samples t-test significance	t = -2.161 df = 52 *p* = .035		t = -2.980 df = 46 *p* = .005		t = -2.559 df = 38.786 *p* =.015	

4. Complexity based on number of decision points - completed trips only (Category 1)

Table No. I.3 Complexity based on number of decision points – completed trips only (Category 1)

	Trip a		Trip b		Trip c	
	ID	TD	ID	TD	ID	TD
No of trips completed	25	29	18	30	24	30
Total No. of Decision Points (based only on completed trips)	640	534	892	1181	473	519
Average per trip	25.6	18.4	49.6	39.4	19.7	17.3
Percentage more on average	39.1%		25.9%		13.9%	
Independent samples t-test significance	t = -2.056 df = 52 *p* = .045		t = -2.175 df = 46 *p* = .035		t = -1.417 df = 33.867 *p* =.166	

Table I.3 provides data about the total number of decision points used by each group for each trip (irrespective of whether the information at the decision point was relevant or irrelevant).

5. Number of times participants referred to the destination card – completed trips only (Category 1)

Participants were given a card at the beginning of each trip which showed the name of the destination. Participants kept the card with them for the duration of each trip and could refer to it as necessary during wayfinding. The number of times participants in both groups referred to the destination card is recorded in table I.4 below. Participants were not asked each time to explain the reason for looking at the card as this may have interfered with the spontaneity of their wayfinding actions.

Table No I.4 Number of times participants refer to the destination card

	Trip a		Trip b		Trip c	
	ID	TD	ID	TD	ID	TD
No of trips completed	25	29	18	30	24	30
Total No. of times participant refers to destination card (based only on completed trips)	264	196	260	297	68	40
Average per trip	10.6	6.8	14.4	9.9	2.8	1.3
Percentage more on average	55.9%		45.5%		115.4%	
Independent samples t-test significance	t = -1.838 df = 33.236 p = .075		t = -1.414 df = 19.813 p = .173		t = -1.765 df = 29.765 p =.088	

6. Degree of difficulty in finding locations

a) Trip "a" to the Outpatients eye clinic reception counter

Table I.5 Results for Question 2a - How easy was it to find the Outpatients eye clinic

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	2 (6.7%)	1 (3.3%)	3 (10.0%)	16 (53.4%)	4 (13.3%)	4 (13.3%)	30 (100.0%)
TD	0 (0.0%)	1 (3.3%)	8 (26.7%)	13 (43.3%)	8 (26.7%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated only a marginally significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 9.92, p = .08. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .40, indicated no significant trend difference.

Table I.6 Aggregated data from Table I.5 about finding the Outpatients eye clinic reception counter

Group	Relatively Hard	Relatively Easy	No of participants successfully reaching the destination (from the video observations)
ID	6 (20.0%)	24 (80.0%)	25 (83.3%)
TD	9 (30.0%)	21 (70.0%)	29 (96.7%)

Table I.7 Responses to question 2a - What made it easy or hard to find the Outpatients eye clinic reception

Reason	No. of participants mentioning feature which made finding the Outpatients eye clinic reception counter:			
	Relatively easy		Relatively hard	
	ID	TD	ID	TD
Signs	10	16	4	6
Asking for help	7	3	1	
Directories	1			
Person giving directions	4		1	
Colour coding	1			
Level of familiarity with hospitals	1	3	2	1
Knowing where everything is	1			1
Being on the same level in the building	1			
Been taught to what to look for	1			
Map		2		
Well lit		1		
Confused with Lions Eye Institute destination				3
Finding bearings			1	1
Nervous				1

Table I.8 Responses to interview question 2a – What did you look for to help find the Outpatients eye clinic reception counter

Feature looked for	No. of participants mentioning feature where finding Outpatients eye clinic reception counter was:			
	Relatively easy		Relatively hard	
	ID	TD	ID	TD
Signs	17	20	2	5
Asking for help	9	4	4	2
Directories	3	6	1	1
Colour coding	3	1		
Something familiar		3		
Map	1	5		1
Well lit		1		
Finding bearings		1		
Information desk	1		1	2
Using memory	1			
Place with lot of people		1		

b) Ward G64 after visiting Outpatients

Participants were asked to rate, using a Likert scale, how hard or easy it was to find Ward G64 enquiries counter.

Table I.9 Results of Question 2b - How easy was it to find Ward G64 after visiting outpatients?

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	0 (0.0%)	7 (23.3%)	12 (40.0%)	6 (20.4%)	4 (13.3%)	1 (3.3%)	30 (100.0%)
TD	0 (0.0%)	3 (10.0%)	9 (30.0%)	16 (53.4%)	1 (3.3%)	1 (3.3%)	30 (100.0%)

A chi-square test was performed which indicated only a marginally significant difference between the perception of the ID and TD groups, X2 (4, N = 60) = 8.37, p = .08. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .18, indicated no significant trend difference.

Table I.10 Aggregated data from Table I.9 about finding Ward G64

Group	Relatively Hard	Relatively Easy	No of participants successfully reaching the destination (from the video observations)
ID	19 (63.3%)	11 (36.7%)	18 (60.0%)
TD	12 (40.0%)	18 (60.0%)	30 (100.0%)

Table I.11 Responses to interview question 2b - What made it easy or hard to find Ward G64

Reason	No. of participants mentioning feature which made finding Ward G64:			
	Relatively easy		Relatively hard	
	ID	TD	ID	TD
Signs	1	7	2	6
Asking for help/Had to ask for help	3	5	2	
Person giving directions		2		
Confused with given directions			7	1
Did not listen to instructions				1
Directories	1	1		3
Colour coding	2			
Not being on the same level in the building			1	2
Map			1	6
Just hard to get to			2	1
Managed to find lifts	3			
Confused by lifts				1
Lifts took a long time			1	
Can't find heading				1
Not sure what they should be looking for			1	
Knowing/Not knowing where everything is		3	3	2
Made correct assumptions about naming, directions		4		
Level of familiarity of familiarity with hospitals		1	1	1
Able to retrace		4		
Can't learn so much			1	
Got a feel for the area		2		
Was more relaxed on this trip		1		

Table I.12: Responses to interview question 2b – What did you look for to help find Ward G64

Feature looked for	No. of participants mentioning feature where finding Ward G64 was:			
	Relatively easy		Relatively easy	
	ID	TD	ID	ID
Signs	5	13	9	8
Common areas because there would be signs		1		
Colour coding		3	1	
Asking for help	4	5	6	3
Directories		5	3	2
Something familiar		3		
Map	1	7	2	6
Lifts	2			
An entrance	1			
Button to press	1			
Information desk		1		1
Using memory		1		1
Had to guess				1

c) Major differences between finding the Outpatients eye clinic reception counter and Ward G64 enquiries counter

Table I.13 Ease/difficulty in getting to each location

Overall perception	No. of participants		
	ID	TD	Total
Outpatients was harder	2	1	3
Ward G64 was easier	4	7	11
Outpatients Clinic was harder - Total	6	8	14
Outpatients was easier	13	13	26
Ward G 64 was harder	8	9	17
G64 was harder - Total	21	22	43
Perception that there was no difference in difficulty - Total	3	0	3

Table I.14 Responses to 2c – Major differences making finding Ward G64 enquiries counter harder

Component of environment	**Feature making difference**	**No. of participants mentioning feature where:**			
		Outpatients was easier to find		**Ward G64 was harder to find**	
		ID	**TD**	**ID**	**TD**
Spatial	Very big area		1		1
	There is a pathway showing you exactly where it is	1			
	Less further away	1	2		
	Lot more walking to do			1	
	Was on the ground floor		3		
	Had to go up in lift			7	4
	Had to go up levels and around corners				4
	Had to go from block to block				1
	Would be near Emergency Dept so knew it would easy to find		1		
	Wasn't so hidden		2		
	Wasn't so obvious				1
	Because sliding doors closed			1	
	In the same block where trip started		1		
	Some wards are tucked away				1
	Narrow corridor on 6th floor				1
Visual	Signs	7	4		
	Wasn't many signs			3	2
	Had to look quite a bit for signs			3	
	Had to find a sign "G"			1	1
	Didn't know what G64 meant				3
	Outpatient word is quite clear		2		
	Less need to look at maps and signs	1			
	Was on the map		2		
	Was not on maps				3
	Misread instructions				1
Supportive	Because had to ask someone			1	
	Was given directions to Outpatients	1			
	Couldn't find reception to ask				3

Table I.15 Responses to 2c - Major differences making finding Outpatients eye clinic reception counter harder

Component of environment	Feature making difference	No. of participants mentioning feature where:			
		Outpatients was harder to find		Ward G64 was easier to find	
		ID	TD	ID	TD
Spatial	Could go up in lift				1
Visual	Signs			3	7
	Outpatients not labelled		2		
	Did not actually say "Eye Clinic"		2		
	Was on the map				1
	Colour				1
Supportive	Given verbal instructions				2
Personal abilities	Familiarity with hospital			1	
	Picture in head				1

d) Getting outside of the building in a hurry from Ward G64

Table I.16 No. of participants who succeeded in getting out of the building

No. of participants who:	ID group		TD group	
	No.	%	No.	%
Found their way out of the building (in less than 15 minutes)	24	80.0	30	100.0
Found their way out of the building (in excess of 15 minutes)	1		-	-
Did not undertake the trip	1	0.03	-	-
Could not get out of the building	4	16.7	-	-
Total	30		30	

Table I.17 Responses to 2h - Getting out of building in a hurry from Ward G64

Group	No	Maybe	Yes	Total
ID	9 (30.0%)	1 (3.3%)	20 (66.7%)	30 (100.0%)
TD	8 (26.7%)	6 (20.0%)	16 (53.3%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X2 (2, N = 60) = 4.08, p = .13. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .39 indicated no significant trend difference.

Table I.18 Comments in response to question 2h – Getting out of the building in a hurry

Component of environment	Comments from participants who believed they could not get out in a hurry	
	ID participants	**TD group**
Spatial	"Not if the lift was very, very slow"	"the steps took for ever, and that looked like the closest exit"
	"You have to wait for the lift"	"the way I went, took a fair while going down all the stairs. I assume another way would be to go back down the elevator and back through the corridors. And that was even a fairly long way to get out of the building."
		"it's not the most straightforward … it's very easy to get confused with where you're lying, with the, umm, lifts, cos you got them on both sides. So, umm, I, think it would be kind of hard, depending on your state of mind"
	"There's a lot of exits around and, there probably I couldn't find which, which one was probably the right one to go down there"	"Is too long. Is long way"
		"you're six floors up (laughs) and, it was not, kinda in the middle of the building, so you have to go quite a way to get to an exit"
Visual	"The arrows pointed one way but then if I wasn't sure so then, it was very confusing"	"by the time we went through the whole thing, I was a bit confused about the, where we entered from and, umm, and even like the is-, even though they've got the exit signs, there's nothing to indicate exiting to this area, exiting to that area, so, if you're in-, if I was in a rush, I would probably just run towards the nearest exit"
		"it could have more... umm, more signs saying exit this way, (to that way), there were-, I didn't see any major signs"
Personal abilities	"Cos, I don't know it's in the back of my head"	"I would obviously be in a bit of a panic, and I think if I was going to panic I would find it, hard to find my way out"
	"Probably have a look at the signs, see which way to go, so you'll probably remember the next time"	
	"Not being a familiar place, it would be hard for me"	
	No because I'm a slow person"	

7. How much do participants like using certain features?

Participants were asked to say which feature they liked using the most from a pre-determined list of commonly occurring wayfinding features based on previous research about wayfinding such as Salmi (2007a) and ODPM (2006). Table I.19 shows the results.

Table I.19 Results of Question 2m – Which one of these do you like using the most?

Group	Signs	Landmarks	Maps	Directories	Asking people	Following colour coding	Following textured coding*	Total
ID	14 (46.7%)	1 (3.3%)	4 (13.3%)	2 (6.7%)	6 (20.0%)	3 (10.0%)	-	30 (100.0%)
TD	14 (46.7%)	3 (10.0%)	10 (33.3%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	-	30 (100.0%)

* this feature received no votes

A chi-square test was performed which indicated no significant difference between ID and TD groups in the popularity of features, X2 (5, N = 60) = 8.91, p = .11.

Table I.20 Results of Question 2m – Ranking of most like features (based on No. of responses)

Group	1st	2nd	3rd	4th	5th	6th
ID	Signs	Asking people	Maps	Following colour coding	Directories	Landmarks
TD	Signs	Maps	Landmarks	Asking people	Directories	Following colour coding

Appendix J Spatial Component Information

This appendix contains data from observation and interviews relating to the spatial wayfinding features experienced by participants in this research study. As the research seeks to identify issues relating to wayfinding by people with ID, analysis of interview conversations focusses mainly on responses from participants with ID.

1. Generally

Table J.1 collates the responses by participants with ID to a number of questions (as listed). These comments have been collated under this section as they all relate to the overall spatial /building layout.

Table J.1 Spatial features discussed in general interview questions - ID participants only shown

Spatial feature	Question	Category 1	Category 2	ID Participants	No
layout	How easy was it to find the Outpatients clinic	Relatively easy	General comments	it took a while	1
				lucky cos only two corridors	1
			What did you look for	Just walked	1
				Orientation	1
		Relatively hard	Why hard	Just hard to get to	1
	How easy was it to find Ward G64	Relatively hard	Why hard	Just hard to get to	1
	What was the major difference between finding your way to the Outpatients and to the Ward	Outpatients	Outpatients easier - why	Less further away	3
				Very big	1
		G64	G64 easier - why	Very big	
		G64	G64 harder - why	Because sliding doors closed	1
				Lot more walking to do	1
				Finding a location in such a big place	1
				Had to go up levels and round corners	4
				Had to go from block to block	1
				Narrow corridors on 6th floor	1
				Some wards are tucked away	1
	Do you think you could get outside the building in a hurry from Ward G 64	No		Steps took forever	1
				Too long and too many ways that show me you can get out	1
				Bit confusing even though have exit signs not clear where exiting - would rush to car park	1
				Not the most straightforward - signs but just bolt if emergency- confused in relation to location of lifts - depend on state of mind	1

				Cos 6 levels up and in middle of building so quite a way to go	1
				Was very restricted - not know where you are - need more exit signs - didn't notice any	1
Entry/ exit	How easy was it to find Ward G64	Relatively easy	What did you look for	An entrance	1
Entry/ exit	Do you think you could get outside the building in a hurry from Ward G 64	Yes		Would find the exit	1
Lifts	What was the major difference between finding your way to the Outpatients and to the Ward	G64	G64 easier - why	Lifts	2
			G64 harder - why	Go up elevator	11
	Do you think you could get outside the building in a hurry from Ward G 64	No		Not if the lift was very slow	1
				Lift or stairs take a long time	1
		Maybe		Not in a hurry especially the lifts - so getting to ground floor problem - but could find emergency exit - plenty of exits on ground floor	1
				Not if using lifts - didn't see any stairs but if you knew where then ok	1
				Lifts were a concern - didn't look for exit signs but actual direction was fine	1
		Yes		Can go down lifts and out exit	2
				Yes, but problem if lift doors shut	1
				Go from the lift	1
				Yes, and would be other people heading in right direct - but not if need to use lift	2
				But, also depending on the walk and lifts not waiting too long	1
				There were exit signs to follow and I would go towards where car is parked - But elevators very slow	1
				Lifts slow you down - but ok if you've observed exit signs along the way - not a mass of exit signs	1
				There were quite a few exit signs - faster by stairs than lift - wide stairs	1
Stairs	Do you think you could get outside the building in a hurry from Ward G 64	Maybe		Not sure in a hurry though - not sure where stairs are	1
				Probably not cos on 6th floor - not sure where stairs are - exits are quite visible so could be quick	1
		Yes		Use stairs if no elevator	1
				There might be stairs	1
				Could go down lifts or stairs	1
				May panic but would follow other people - not hard but in hurry not easy	1

2. Building layout

Table J.2 How easy was it to see what was coming up

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	0 0.0%)	0 (0.0%)	7 (23.3%)	13 (43.3%)	6 (20.0%)	4 (13.4%)	30 (100.0%)
TD	0 (0.0%)	0 (0.0%)	3 (10.0%)	17 (56.7%)	6 (20.0%)	4 (13.3%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X2 (3, N = 60) = 2.13, p = .55. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .34, indicated no significant trend difference.

Table J.3 Aggregated data for what was coming up

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	7 (23.3%)	23 (76.7%)
TD	3 (10.0%)	27 (90.0%)

Throughout this appendix, tables (such as J.4, below) have been used to summarise the responses from participants to specific interview questions and the process of analysing themes is described in Chapter 4, figure 4.7. The table is divided vertically between answers from the two participant groups. In many cases, participants would not only provide information about a topic within the specific questions asked about that topic, but would also discuss that topic when responding to other questions. Tables such as J.4, therefore, collate comments about a topic which may have come from responses to several different questions. The questions from which the comment came, are identified (e.g., ‘f - How easy was it to see….). If the question started with a Likert scale question to judge a facet of the topic (e.g., how easy…”relatively easy, easy”), then the table divides participant responses to open-ended questions according to how they rated the feature in the Likert scaled question (relatively easy, easy, etc). Further divisions were also made dependent on the question (e.g., did the question require a ‘yes’ or ‘no’ response). In this case, responses would be further divided according to whether a participant had answered yes or no. Table J.4 has then identified themes and given frequency of similar responses. Other tables, however, do not collate the frequency, but give the various individual responses. Note: The statements used to describe themes are abbreviated to simplify the theme (e.g., could see into distance). This

does not imply that participants used these specific words, but that their responses fell within this overall description.

Table J.4 How easy was it to see what was coming up

Comments relating to how easy it was to see what was coming up, extracted from open-ended interview question responses			
ID Participants	**No.**	TD Participants	**No.**
f) How easy was it to see what was coming up		**f) How easy was it to see what was coming up**	
Relatively easy		Relatively easy	
Could see into the distance	19	Could see into the distance	22
Couldn't see into the distance	3	Couldn't see into the distance	7
Says EXIT and heading is up the top	1		
Didn't want to see a naked person	1		
A bit crowded	1		
Inviting and interesting comfortable going down (Corridors?)		**Inviting and interesting comfortable going down (Corridors?)**	
a) Yes		**a) Yes**	
No comment	4	Walk just a little bit	1
Some corridors	1	Nothing scary	1
I wanted to go down there	4	Showed me where to go	1
OK but a little nervous	3	Downstairs OK as well lit	1
If I saw something I walked towards it	1	Reasonably inviting cos curious person	1
Felt comfortable because I like doing things - did not get nervous	1	Yes, cos sign down bottom	1
I was fine	1	yes, there was a sense of that	1
Wanted to explore cos paintings on door	1	Big ones encouraged	1
		Far and long invited you to go	1
		Have worked underground so not worried about dark	1
		Corridor to G65	1
		In Outpatients	1
		Big corridors inviting	1
		If Enquiry office area know that is inviting	1
		Did not perceive corridors as threatening	1
b) No		**b) No**	
Too far	1	Too small	1
A bit dark	1	Wasn't large print	1
Some didn't feel comfortable	1	Some no because not sure where to go from there	1
I was there to do a job not go down any corridors	1	they were hiding what was there	1
A little bit	1	Bit unsure	1
Cos shocking but couldn't explain	1	Some quite busy	0
		One corridor quite scary	1
		Some long corridors without signs made uncertain	1
		Worried private area	1
		Patient area very dark	1
		Were not inviting because already knew where to go	1
		Not in weird areas	1
		Side corridors not so inviting	1
		In G64 going towards patient areas darker	1
		Getting out of lift at level 6	1
		Lions Eye too narrow	1
		Seemed disjointed so not encouraging	1
		Narrower not inviting	1
		Some corridors not encourage	1
		Patient areas not inviting	1
c) Not asked	**3**	**c) Not asked**	4
No answer	1	No answer	0
a) Relatively hard		b) Relatively hard	**3**

Could see into the distance	2	Could see into the distance	**0**
Could see into the distance for some	2		
Couldn't see into the distance	3	Couldn't see into the distance	3
Specifics	0	Specifics	2
Inviting and interesting comfortable going down corridors and the like?		**Inviting and interesting comfortable going down Corridors and the like?**	
Yes		**Yes**	
Some corridors	2	Yes, unless wrong way	1
No		**No**	0
Looked both ways cos not sure	1		
Not really	1		
Probably a couple didn't feel comfortable	1		
Not sure if how to get out	1		
I was a bit nervous	1		
Not asked	**3**	**Not asked**	2
No answer	0	No answer	0

Table J.5 Do you think there was more than one way to go

Question	Group	Yes	No
Do you think there was more than one way to go?	ID	16 (53.3%)	14 (46.7%)
	TD	28 (93.3%)	2 (6.7%)

Table J.6 Do you think there was more than one way to go

Comments relating to complexity of layout, extracted from open-ended interview question responses			
ID Participants	**No.**	**TD Participants**	**No.**
What SPECIFIC problems do you think someone with an ID would have in accessing this building~		**What SPECIFIC problems do you think someone with an ID would have in accessing this building~**	
Would have difficulty			
Complexity		Complexity	
Frustrating to figure out ...I have to go here, I have to go...this way, that way	1	Some with ID would not know where the corridors were going and with self-confidence or self-esteem issues because of their disability would find it quite hard to go down a very long corridor	1
Problem knowing how to get out	1	Spread building no logical order in signs	1
		The assumption that you had to make to leave E block to find G would be a large problem	1
		There's a lot of places which is more confusing and intimidating	1
		Very difficult to comprehend so many places at one time	1
		Being able to get to places further away - left turn, right turn and the like, get and follow all the right directions could be quite hard	1
What was the MOST ANNOYING thing		**What was the MOST ANNOYING thing**	
Complexity		Complexity	
Its a little bit far	1	Long corridor	1
It was really hard to find	1	Such a big area, want to turn back and look again at directory just to make sure	1
		Too many pathways	1

		The eye institute location being different from outpatients	1
Do you think there was more than one way you could have got to each location		**Do you think there was more than one way you could have got to each location**	
No	14	No	2
Maybe	2	Maybe	0
Yes	1	Yes	0
Why		Why	
There were several ways	1	Not for OP but aware of other ways to G block and exit	2
Usually other ways	1	From looking at map	1
Lots of corridors	1	Usually in public places have to have at least 2 exits entries	1
Could probably use the lift	1	Could have used stairs or lift	**2**
Could be another way	2	So many entry points	2
Level 6 didn't go the same way came in	1	So many corridors	3
Could have come by stairs or different paths	1	Was told there was another way	1
Could have been another way get out	1	Cos you get to and from more than one side	1
just had a feeling	2	Would be some way to get to wards if went up another lift	1
Could have been different ways to get to the lift	1	Grid-like so likely	1
Could have been - depends where you are	1	Ward one way, others more than one way	1
No explanation though	2	No explanation though	1
No response	0	No response	0

Table J.7 How easy were the corridors to use

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	0 (0.0%)	0 (0.0%)	1 (3.3%)	11 (36.7%)	12 (40.0%)	6 (20.0%)	30 (100.0%)
TD	0 (0.0%)	0 (0.0%)	3 (10.0%)	8 (26.7%)	13 (43.3%)	6 (20.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X2 (3, N = 60) = 1.51, p = .68. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .50, indicated no significant trend difference.

Table J.8 Aggregated data for how easy the corridors were to use

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	1 (3.3%)	29 (96.7%)
TD	3 (10.0%)	27 (90.0%)

Table J.9 How easy were the corridors to use

Comments relating to use of corridors, extracted from open-ended interview question responses			
ID Participants	**No.**	**TD Participants**	**No.**
d) How easy were the corridors to use		**d) How easy were the corridors to use**	
No comments		General comments	
		People might panic that they're going the wrong way cos long and no signs	1
		Need to mark them so I remember where they are	2
		Felt like going round in circles	1
		Daunting	1
Relatively easy		Relatively easy	
No specific comment	15	Wide	12
I found my way	1	Signage was good except one corridor	7
Comfortable	1	First didn't have continuous signs - other one did	0
Little uncertain	1	Sense that there wasn't anywhere else to go-so had to go to end	1
Not a lot of signs	3	Felt like going round in circles so I had to find a map	1
I'm used to walking down corridors	2	May not be good for wheelchair	1
They had signs up there	1	If you were lost there are people who work in hospital close by to ask	1
Once you knew where you were going	2	Signs everywhere - quite confusing - could be hard for old person	1
They taught me how to get to certain places	1	Wasn't too busy	1
Not sure which was the right corridor	1	Signs closely colour to background	2
Paintings made it feel really comfortable	1	Enough room to pass	1
		Not too well lit	1
		Signs at every junction	2
		If busy the narrow corridors would come into effect	2
		Lots of things going on and dont want to walk into wrong spot	1
		Were quite well lit	2
		Confusing little switch	1
		Needs consistent colour coding	1
		Pleasant with artwork	1
		May not be wide enough for everyone	1
		Signs should be bigger	1
b) Relatively hard		**b) Relatively hard**	
They're all over the place	1	Quite wide	1
		Not very welcoming	1
		Don't help with knowing where going	1
		Scary - too long	1
		Too many doors to outside	1
		Did not feel comfortable going down them perhaps into restricted areas	1

NOTE:

Table J.10, and subsequent similar tables, show the observer's responses to events that were identified during the coding process. These tables describe actions and environmental issues affecting specific participants (identified by the first two columns) and have been coded (right column) into categories relating to the research study.

Table J.10 Video observation about building layout

Observations from video coding				
Group	No.	**Explanation**	**Remarks of interest**	
C	6	"You wouldn't want to be running late in this building at all"		complexity
C	7	"This would be terrible for someone who is late for an appointment"	terrible for someone who is late to appointment	complexity
C	7	"There's a lot of lifts"	comment on number of lifts	complexity
C	7	It's not made easy at all; it's quite hard		complexity
C	9	She says there are too many ways I have to go		complexity
C	9	Says she's going down main corridor because clearer for her (towards C Block)		complexity
C	11	She says, "glad I'm not in a hurry"		complexity
M	15	Goes all the way past cafe to car park direction and sees the sign saying exit either way. But when he goes through doors, he doesn't turn left or right but keeps going. Carried on going until right out in the car park		lack of spatial understanding
M	17	Interesting that she went all the way through G block out past cafe which is where she went before. She didn't find anything that time so why go again this time?	repeats a wrong direction, so not registering	lack of spatial understanding
M	17	After leaving the building and looking at her card she says, "I've done it again"		lack of spatial understanding
M	12	Absence of "layout" decision points means needing to use “visual” cues more		layout
C	7	Says it would be difficult with people with cognitive processing problems because of the hospital layout and size	hospital layout and size difficult for someone with cognitive processing problems	layout
M	19	No issue except didn't realise she was out of the building until trying to get back into the Pathwest offices and was told she couldn't		outside
M	27	She says it is a "big hospital"		size
C	1	I've never been in such a big hospital before	comments on how big hospital is	size
C	2	Walking to blue lift says, "it's such a big area here"	comments on how big hospital is	size
C	3	Says you don't realise the vastness of the building from the outside. Think things are miles away-would need a bicycle to get there	comments on how big hospital is	size
M	23	When asked if she knows what floor she is on she says, "I'm on number eight, so I'm on the wrong floor, I have to go back down again"		spatial understanding
M	23	She says "oh, it's exactly where I started" turns around and heads back for exit near blue lift lobby		spatial understanding
M	24	Had gone left on Watling Street and after going through door said, "gone too far"		spatial understanding
M	24	Asks if she has been this way before (which she had). She thought the sign she was looking for was up here (which was wrong)		spatial understanding
M	24	After getting out and looking round level eight, she says "I think we have to go back downstairs"		spatial understanding
C	3	Anticipates enquiry counter could not be too far from left because they didn't give instructions after level six		spatial understanding
C	7	Although told to go to the blog, she sees a block and says a block was on original directory		spatial understanding

C	3	Sees M/entry sign and uses that to get out down G Street. Also going this way because it is when a car is parked. Is a sense of Watling street running full length of hospital		survey

3. Barrier-controlled doors

No information

4. Dead end with door

Table J.11 Video observations about dead ends with doors

Observations from video coding				
Group	No.	Explanation	Remarks	
M	22	Stops almost at the end of C and says, "can't go that way cause it's raining"		Dead end
M	17	Gets to end of corridor and says "Damn, done it again,		dead-end

5. Enter/Exit point

Table J.12 Personal video observations about Entry/Exit point

Observations from video coding				
Group	No.	Explanation	Remarks	Spatial
M	20	He has already gone past the G street ME turn off and ignored it. He now says he recognises where he is and all the signs (is coming up to shop)	Misses exit	exit

6. Junction

Table J.13 Personal video observations about Junctions

Observations from video coding				
Group	No.	Explanation	Remarks	Spatial
M	18	She confirms using the lift in Watling Street/G Street junction to know to turn left		junction
M	18	No relevant information at junction just before G64 inquiry count		junction

7. Prospecting points

No additional information

8. Room off main

No additional information

9. Vertical using lift

Table J.14 How easy was it to use the lifts

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (6.7%)	17 (56.6%)	11 (36.7%)	30 (100.0%)
TD	0 (0.0%)	1 (3.3%)	0 (0.0%)	6 (20.0%)	11 (36.7%)	12 (40.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X2 (3, N = 60) = 4.33, p = .19. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .22, indicated no significant trend difference.

Table J.15 Aggregated data for How easy was it to use the lifts

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	0 (0.0%)	30 (100.0%)
TD	1 (3.3%)	29 (96.7%)

Table J.16 Problems using lifts (consolidated from interview responses)

ID		TD	
No sign to say where you press the button+ No sign to say where to go out of lift	2	Signs on lifts not good + need time to read	2
Slow	1	Slow	4
Crowded	1	Cramped	1
Not sure which button to press to open it	2	Confusing colour	2
Could be scared	1	don't know going right way + put direct in lift + not sure which level to go to	5
		Long walk to get to them + difficult to find	5
		Lifts being reserved + Not sure if for everyone	2
		Need audible warning inside	1
		Not sure if use in emergency	2
		No level indicator for when lift coming + level indicator not working	5
		Faded Nos. inside	1
		Too many	1
		Misread instructions	1
		Thought all the same	1

Table J.17 Helpful aspects of lifts (consolidated interview responses: "+" means combined themes)

ID	TD

Just have to press button + take you where you want to go + yep + sixth floor + went left + know where to go + went left	18	Just had to press button+ Knew where to go + to get to level 6 + familiar with them	13
Good signs (Clear nos. lift sign + outside + nos. up top + had buttons + had nos. + saw sign+ big G + signs on wall and ceiling + easy due to colour coding	21	Indicator outside + buttons easy to use + Colour coding for right lift+ “way out” on level indicator + clear signs where to go + signs right there as you leave	12
Just looked outside	1	Lift already called	1
Good direction indicators +could see+	6	Lots of them	4
When outside asked	1	Not busy	1
No comment + unclear	8	Good instructions from lady	3

Table J.18 Improvements suggested for lifts (consolidated from interview responses)

Wouldn't know which lift to use	1
Uncertain about which level to go to	1
More lifts	1
Put G signs and others when you go up lifts	1

Table J.19 Observations from video coding – Using lifts

Observations from video coding			
Group	No.	Explanation	Remarks
C	3	Were you aware about lift not working (being used for deliveries – no)	
M	1	Processed lift lobby directory OK and which way to go in lift	
M	2	Says she's looking for lifts	
M	2	She did not press for up or down outside lift and did not look at the directory	
M	2	Suggests going to lift's (gold)	
M	2	She is totally lost in the gold lift lobby, then makes a decision to press the down button. She had to press GF because she was lost and going to the basement which is off limits	
M	5	Signs said blue lifts but this was not relevant because he did not know about using blue lifts. NOTE incredible number of times he reads the card	
M	5	Stopped recording in gold lift as participant could not find any way to proceed. could not get out. Did not understand use of lift to get out	could not exit 6th floor
M	6	Lift doors did not work and needed pushing shut. sign on ground floor said "lift out of older" but didn't say it upstairs. made nervous	lift doors broken
M	6	Participant goes completely opposite way out of outpatients department. up to first-floor. takes lift	
M	6	Entered lift going wrong way but pressed correct but	
M	6	In lift and asked participant why they chose ground floor and they said, "no idea"	
M	6	Participant says, "don't like elevators very much"	
M	7	Participant got out at fifth floor and went around	
M	7	Asked participant to explain how they would know which lift was going up, was there anything to indicate that and they just pointed upwards, so gave no indication they knew what to look for	
M	7	Did not press a button in lift	
M	7	Pressed floor one button	
M	8	For some reason participant turned at Watling Street and went into lift that only goes to 1st floor	
M	8	Participant then asks what do "B" and "G" stand for on lift buttons on first floor	not understanding lift buttons
M	8	Reception says, "blue lift, six floor" P then takes these instructions	
M	8	Says she used signs that said "lift" to get to lift (which is not way out, so she has made a connection between lift and Wayout)	has linked lift with way-out
M	9	Thinks up to G floor which is wrong	
M	9	Wants to find "the closest lifts"	
M	9	As she only said find the lifts, a sign that shows three different colour lifts will be misleading	
M	9	Although he was looking for G floor when we get into the lift he realises this is G4	

M	9	Says he turned down corridor (towards blue left) to find the closest lifts, but actually walks past them	
M	9	Says going to ground floor	
M	9	Says ground floor button says "Wayout"	Notes "way out" on lift button -
M	10	Participant turns left okay at yellow bin (although it doesn't say that) and then goes to lift up to 1st floor. Tries to get in lift but doors shut	
M	10	Stands at lift buttons and points to level one but	
M	10	Gets into lift but doesn't press any buttons.	
M	10	He says he needs the lift (which is correct)	
M	10	Stands in front of lift button on level six, not sure which way to press	
M	10	Presses wrong direction (up arrow) for lift call	
M	10	Lift going up shows on lift indicator but he gets into another lift going down and says he is going to G	
M	11	Confidently finds ward G 64 main directory but then can't see where lift is to take	
M	11	Finds the lift to level one	
M	11	Presses the down lift	
M	11	Cannot decide which button in lift	
M	11	Presses G in lift because "G" 64, lift is now shut I'm going nowhere, looked for level six in lift buttons but isn't one	
M	11	When gets into the lift blue lift lobby on level one the participant asks, "where are we?"	
M	11	Participant only looks at one bank of lift doors. This could delay the lift coming meaning a participant forgets the instructions	
M	11	Participant gets in lift and then presses level 2 even though they've been told six	not following instructions
M	11	Plethora of lift bells going confuses participant	
M	11	Asked why she pressed down and lift lobby, she said that is where the bottom is	
M	12	Turned into blue lifts because he said "G" (thinking G of G 64)	
M	13	Looked at floor indicators all the way up in the lift	
M	14	Gets in lift to 1st floor but doesn't press button, just looks at notices on lift	
M	14	Sees "B" by buttons and says "B" for blog (which is wrong)	
M	14	Has got out at basement	Could not use lift appropriately
M	14	Got back in lift but did not press buttons and goes to ground floor	Could not use lift appropriately
M	14	Gets in lift again (talking about the – block first floor?)	Could not use lift appropriately
M	14	Still wants to press B	Could not use lift appropriately
M	14	Door closes, door opens on the same floor	Could not use lift appropriately
M	14	Tries to press one of the screw heads above the buttons in the lift. Door close? Presses one	Could not use lift appropriately
M	15	Says he is now looking for the lift (which indicates he is still following instructions)	
M	15	Some confusion with doors closing when he gets to lift lobby ground floor, also presses to go down	
M	15	Participant gets out at second floor	
M	15	This time he looked at the floor indicator and counted up to 6	
M	15	Goes very quickly back to blue lift and presses down because he says exit is down. You can't always go out from the top	Links exit with down
M	16	Presses button-down in lift lobby because it's going down and that will help find the way out	links down in lift with wayout
M	16	When gets in lift however he says he wants level two (Having looked for some time at the inside lift buttons)	
M	16	Now says it is either one or three but not two. Does not understand floor numbers	
M	16	In fact, gets not right floor	

M	18	When asked why she needed to find a lift she said to get up to level six. When asked why she needed to get to level six she came back and pointed to level six on main directory (interesting that she didn't see the blue lift heading to the directory)	
M	18	So she turns down G Street(?) Because she knows there's lifts (she's seen lift signs, but they are the wrong ones)	
M	19	She says, usually when she goes to hospital she finds where the lift is	
M	22	Asks and is told you can take any left up to the sixth floor	
M	22	Gets into the lift lobby and says "now we are going down" (wrong)	
M	22	She is in lift, the door has opened on an unknown floor and now it has shut, she is not sure whether she wanted that floor	
M	22	Says go to the left and press the ground button, but walks past the lift turning	
M	23	Even though on level six she says she has to go in the blue lift to level six (to find G 63 that would be close to G 64), she hasn't seen that she is already on level six, despite getting out of lift after pressing that she wanted level 6	Not sure how to use lift
M	23	"When a lift comes up you must press six again". But she doesn't attempt to press a lift call button and doesn't realise she is already on level six (despite looking directly at three different number six signs as she looks around) it's as if she thinks she can get to another "six" which will be close to G 63.	
M	23	"I'm not sure how to get it (the lift), so I'll just have to wait until one comes". Maybe she doesn't know how to call a lift. She then says there is normally a button but she can't find it and she doesn't want to risk pressing the wrong one.	
M	23	Just before getting into lift she says G 64 is on level six and still gets into lift that she thinks will go to level six (even though she's on level six already)	
M	23	She goes up to 8th floor. Finds directory with G 64 saying level six, looks around in blue lift lobby but doesn't seem to realise she is on level eight	
M	24	Asks me which lift call button to press (up or down). I said, whichever you think	confused in lift
M	24	Once inside the lift, although she knows it is G 64, she does not know that it is level six she wants	
M	25	She says she's looking for a lift but not any particular one (so obviously she hasn't identified blue lift)	
M	25	Even though six floor button was pressed, it didn't light up. That is really off-putting	
M	27	Participant asks which side of lifts (four or other four) will go up to level six. She's told anyone	
M	27	Participant did not press any outside call button not button in left	
M	29	Waiting a long time at Green lifts. Presses lift call although already lit. Does this mean you wait for the up lift to come up to you or is it showing the direction you want to go?	
M	29	Now presses up button	
M	30	Participant can't work out where to go in blue lift so he says he would just take one lift anyway	Not know how to use lifts
M	30	Once in lift he says he knew to go up but didn't know which lift button to press inside left	
M	30	Lift starts with others in and he says, "oh well I'll just ask someone"	
M	30	Gets out of lift on floor five and goes to an inquiry counter asks "now, do you know where this place is?"	wrong floor
M	30	Very quick to get down to ground floor blue lift	
C	3	Happy to stand waiting cause not can see cos can see downlights is still pressed	
C	3	Seems a long time to wait	
C	3	Now seen sign that lift is for exclusive use by caterer (not bold print)	
C	3	Asked about how she felt about lifts and the like and participant said all that waiting, in the event of an emergency doesn't make you feel safe	
C	5	Sees ward G 64, level six and then goes to lift which goes up first floor (even though directory said Blue lift)	trouble using lifts
C	5	Gets in lift but of course it doesn't have six and gets out on first floor	trouble using lifts

C	5	Goes back to lift saying she's got to go up even though there was only one floor	trouble using lifts
C	5	Doesn't understand that there is no six on lift outside	trouble using lifts
C	5	Participant didn't press button in list	trouble using lifts
C	5	Went down to the basement, pressed up and went back to the first floor	trouble using lifts
C	5	Press the first floor button when on first floor right (she doesn't seem to understand which floor lift is right. I think the problem was a lack of numbers on the buttons inside the left	trouble using lifts
C	5	Eventually gets back to ground floor. Looks at directory but still can't process information. So, says she will ask someone	trouble using lifts
C	5	Gets in blue left to 6th floor but gets out on number one	trouble using lifts
C	6	She explains that she is pressing G 64 mean G block	
C	6	Ground floor in green lifts-no indication which way to go to get out of lift lobby ,	
C	7	Lifts don't allow a lot of access time for people to get in and out	
C	7	Suggests a sound in lift to say which floor	need audio in lift
C	8	Gets motion sickness in lift's	
C	11	Chose level five in gold lift because she didn't press when she got in and it was the next floor at the point when she decided to press the button	
C	11	She says: "seeing as I came by lift, I'm sure I'll find the lift fairly soon"(even though she has gone in completely opposite direction from lift signs)	
C	13	Said hesitated when came into lift lobby because didn't know if you could use lifts both sides of Lobby	not sure if can use lifts both sides of lobby
C	15	Voice talks in left (note very useful)	voice in lift?
C	15	No problems-just a long wait to get down blue…	
C	18	Checks all signs in blue lift to make sure no lift says it does not have access to 6 floor	
C	19	He sees directory in lift, then presses the button on that side "just to be safe"	
C	21	Lift lobby for gold lift is full	
C	21	Eventually read sign that says gold lift off for critical patients	gold lift for patients
C	21	Gets back down to ground floor out of stairs and says he's looking for some other lifts	
C	21	Says he is looking for Green lift but goes into blue lift. No reason why using blue lift	
C	22	"blue lifts sound good" (note: of course she said blue)	
C	22	Gets into blue lift lobby on level six and says, “I’m thinking we've got to get down in the lifts"	
C	22	"Good that they've got that otherwise you could go to LG or…". (Way out sign beside G on lift button in lift). When asked what would make him go to LG he says; "it sounds even closer to the ground than G"	way out next to button in lift
C	22	Say "G" on the light indicators over the lift door (very important notes)	lights for level indicator in lifts very important
C	23	Says he decided to use lifts instead of going downstairs because it would save walking	
C	26	Says may have to wait for next lift because there is a large bed	
C	26	He didn't press button call after full lift left, but fortunately someone else did	
C	26	He seems to indicate he may not even get in the next (may end up using stairs	
C	28	She came out of gold lifts because there was a sign that said patients only	lift patient only
C	28	To be safe, I'll use the ones I know	
C	30	Still looking for lifts	

10. Vertical using stairs

Table J.20 Observations from video coding – Using stairs

Observations from video coding			
Group	No.	Explanation	Remarks
M	13	He obviously couldn't find "the stairs" when he got out of the building. So, he went back in	
M	13	Is still trying to find the stairs he thought were in the instructions he was given	
M	25	Goes down stairwell corridor but turns back	
M	28	Gets to ground floor for G 66 stairs but the door won't open	Exit door wont open
C	1	No up or down sign in stairwell. Also needs reinforcing as you go down because ID may think they have gone wrong if they don't get reinforcement along the way	no wf reinforcement in stairs
C	3	Cos so long, now wondering where the stairs are. But can't see signs of any stairs	
C	3	Decides to use stairs	
C	4	Decides not to go out exit near G 65 because a lot of stairs	
C	6	Still seems to think she couldn't go down except for stairs (interesting fear)	
C	11	Stops because doesn't want stairs (interesting that exit would often means stairs?)	chooses not to use stairs for exit?
C	13	Says 5.keep closed and I guess I can still get out of here	
C	13	She says there are no signs (in the stairwell) to tell her to go to the ground floor	
C	13	Floor signs in lift well are hard to see as they are the same colour as the wall. She then says: "if you look for the door that says exit by the ground floor"	
C	13	She sees a sign (off-camera) that is on the back of an exit door on level 2 that says exit on ground floor and repeats this in conversation later	
C	13	Tries to get out exit but can't open door	Can't get out fire door
C	13	She says jokingly (?) "We're locked in"	Can't get out fire door
C	13	She says she's not sure if the ground floor door was locked or whether she was just not strong enough to open it	Can't get out fire door
C	21	Decides to go in stairs	
C	30	What made you choose this way? (Note: the stairs). She says, "it is quicker". Also, in case of an emergency as well"	uses stairs to get out cos quicker and also in emergency

Appendix K Visual Features

1. Controlled door button

Table K.1 Collated responses to interview questions

ID Participants	No.	TD Participants	No.
What SPECIFIC problems do you think someone with an ID would have in accessing this building			
No comments		Location of button and what to do could be confusing	1

Table K.2 Observation from video coding – Controlled door button

Group	No.	Explanation	Remarks
M	25	She is beside sign for G 61 and sees a big button (note: this is a button to open the controllable doors). The button says, "please press silver button". It doesn't say why	Can't exit cos can't find how to get out
C	11	(Note: difficulty for me to get through controlled doors that actually shut on me)	confusion with controlled doors
C	28	Asked her if the need to press the control door button worried that's all… Not really	

2. Colour

Table K.3 How much do you like using colour coding

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	1 (3.3%)	6 (20.0%)	4 (13.3%)	11 (36.7%)	8 (26.7%)	30 (100.0%)
TD	2 (6.7%)	3 (10.0%)	12 (40.0%)	10 (33.3%)	3 (10.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 7.65, p = .11. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .15, indicated no significant trend difference.

Table K.4 Aggregated data for how much participant likes using colour coding

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	11 (36.7%)	19 (63.3%)
TD	17 (56.7%)	13 (43.3%)

Table K.5 - How difficult was it to use colour coding

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	8 (26.7%)	1 (3.3%)	1 (3.3%)	4 (13.3%)	14 (46.7%)	2 (6.7%)	30 (100.0%)
TD	6 (20.0%)	4 (13.3%)	5 (16.7%)	7 (23.4%)	4 (13.3%)	4 (13.3%)	30 (100.0%)

A chi-square test was performed which indicated a significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 11.79, p = .04. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .26, indicated no significant trend difference.

Table K.6 Aggregated data for how difficult participant found using colour coding

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	10 (33.3%)	20 (66.7%)
TD	15 (50.0%)	15 (50.0%)

Table K.7 How much did colour coding help you find you way

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	4 (13.3%)	6 (20.0%)	7 (23.3%)	11 (36.7%)	2 (6.7%)	30 (100.0%)
TD	8 (26.7%)	5 (16.7%)	7 (23.3%)	10 (33.3%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.47, p = .48. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .12, indicated no significant trend difference.

Table K.8 Aggregated data for how much colour coding helped you find the way

Group	Not at all, A tint bit, A little	Quite a lot, A great deal
ID	17 (56.7.0%)	13 (43.3%)
TD	20 (66.7%)	10 (33.3%)

Table K.9 Collated responses to interview questions about colour

ID Participants	No.	TD Participants	No.
a) What SPECIFIC problems do you think someone with an ID would have in accessing this building			
Would have difficulty			
Colour coding			
Couldn't get to the blue lifts	1	Would be quite helpful	1
		May be a universal colour that goes though very much as the basis	1
		The colour coding would be very hard for them to find	1
		Colour coding of walls to match map colour coding	1
a) What was the MOST HELPFUL thing			
Colour coding			
Generally	1	No comments	0
Yellow squares on ground	1		
Blue	1		
c) How much did the following things HELP you find your way			
No clear response	2		
Not at all	3	Not at all	8
A tiny bit		A tiny bit	
No explanation	2	Colour coding in lift helped a bit	2
Blue lifts	3	Not really conscious thing, but colour on signs and stuff had different colours	1
Green lift	1	The lifts	1
A Little		A Little	
No explanation	1	No clear explanation	**2**
Blue lifts	1	Colours in terms of lift, I knew I was going in the right direction	1
Gold green and blue lifts	1	Colour of wards, you knew you were safe and blues and greys sort of helped me	1
White and to G blue doors	1	Blue lifts	1
The lift	1	The lifts	1
Looked for green exit signs and used colour of lifts	1	Remembered the area going brown and the blue lifts	1
		The lifts and the walls along corridors changed colour	1
Quite a lot		Quite a lot	
Green Exit sign lead you to outside and Blue	2	Colour of the sign - knew I was going to blue lift	1
No clear explanation	3	Not a clear explanation	1
The lift	1	Clarity with signs	3
The signs	1	Blue was really good and contrast was really good	1
Wall colour, floor colour, doors, red and white telling you where to go	1	Signs are all of a similar colour so you know what you're looking for	1
Different coloured lifts	1	Blue lifts	1
Huge blue signs	1	Reflection off the floor	1
Colour on floor to eye clinic	1	The lifts and brighter colours indicated more activity	1
Black white and blue signs	1		
A Great deal		A Great deal	0
Could see the colour on the ground (May relate to yellow)	1		
If you could tell the Hospital how to make it easier to find your way, what would you say			
Colour coding		Colour coding	
Put squares on the ground	1	Colour coding things on floor	1
Colour strips on path	1	Easier to understand and show how it works	1
Put colours on board and map at main entrance	1		
l) How much do you LIKE using each of the following when finding your way in a building~		**l) How much do you LIKE using each of the following when finding your way in a building~**	

Colour coding		vi) Colour coding	
Did use yellow path	1	a) Think it is quite useful, but not wild about it	2
not good cos can't really use only colours, they're hard to find and other places with same colour confusing	1	b) at least you know you're in the right area	1
		c) Do take note of these things	1
		d) Don't really come across it that much	2
		e) Depends how set up - blue lift, red lift but needs improvement to way it is signed	2
		f) Don't mind it - good for general feeling, not precise destination	2
		g) Secondary source	1
		h) Helpful in big hospitals	1
		i) Would have been great at hospital if buildings painted different colours	1
		j) Personally, find colour strips on floor don't always make sense	1
		k) good to find the blue lifts	1
viii) Are there any other things you like to use		**viii) Are there any other things you like to use**	
a) Braille	1	e) Colour lines on the floor	1
b) More tips, more help	1	i) Ways to give greater delineation of areas	1
m) Which one of these do you like using the most		**m) Which one of these do you like using the most**	
e) Colour coding		Nil about colour	0
i) Cos its the greens or the blue, lines I can follow	1		
ii) Bit easier to find, places to go round	1		
n) How difficult was it to ACTUALLY use the following in the building		**n) How difficult was it to ACTUALLY use the following in the building**	
vi) Colour coding		vi) Colour coding	
Relatively easy		Relatively easy	
a) Used it all the time, look at arrows was colour coded, blue	1	a) The blue lifts you couldn't miss and signs were blue and so on	1
b) Saw red	1	b) Blue lifts - was very helpful	3
c) The red sign	1	c) Cos you had to go through a whole lot of different colour - the lifts were all colour coded	1
d) The blue elevator	1	d) Finding blue lifts easy cos all the blue lift signs were blue, ward signs being peachy colour	1
e) Colour green - but participant couldn't say where	1	e) Clear indication that says you go to the blue lift	2
f) used blue lifts, but was not specifically looking for colour, but looking for actual lift sign	1	f) I was looking for the blue and found it	1
g) No verbal response	1	g) Blue lifts had a blue door indicating they were the blue lifts	1
h) Used yellow for eye thing (Outpatients), pink for the wards	1	h) I was put well onto the blue lifts, says colour coding at top of the maps so that made a lot of sense	1
i) Used red dot, G block near lift (not sure what Participant was referencing)	1	i) Just follow where I could see the blue and find it easily	1
j) Colours on the wall (not sure what participant means)	1	j) Was the lifts, deliberately coloured blue	1
k) Colour in lift	1	k) Colour coding on green lifts, made me alert when we came to the yellow lifts	1
l) Saw blue	3	l) For the lifts, told me exactly what to look for, looked at all the blue signs that were telling me where to go	1

m) Said blue lift and all the wards under the blue lifts, gold under gold lifts	1		
n) The colour coding on the lifts	1		
o) Colours on floors and walls - like a greeny colour	1		
p) Sign up top said Blue lift and different signs up saying red lift, yellow lift as well	1		
q) She said to the blue lifts, so I looked for the blue sign, good cos also yellow and green lifts	1		
r) No clear explanation	1		
Relatively Hard		Relatively hard	
a) Point where I try to find on at blue sign, just looking at arrows	1	a) Would be quite difficult here - require a huge range of colour	1
b) Didn't use colour	5	b) No explanation provided	1
c) Saw blue lifts but colour coding didn't help	1	c) Didn't use	2
d) After the blue lift made it a bit harder when I came in	1	d) Cos I didn't take it into account - I was lookin for signs	1
e) except for the green lift	1	e) I don't distinctively remember seeing any colour coding	2
f) Didn't see any colour coding	1	f) Not a lot of colour-coding apart from the blue lifts - would be hard if you were a colour coding person	1
		g) Didn't really notice any	3
		h) Didn't know how to use it initially so didn't know what I was looking for	1
		i) Although there were blue lifts I did not see any blue stripes heading towards the lifts	1
		j) I wouldn't like to try and navigate the hospital just by colour coding	1
		k) I Couldn't understand, they didn't have..., but blue lifts were easy but was only one lot of colouring	1
		l) Should have had colour coding for wards	1
		m) It's confused me cos I didn't know what it means	1

Table K.10 Observation from video coding – Colour coding

Observations from video coding about colour-coding				
Group	No.	Explanation	Remarks	Visual
M	5	Signs said blue lifts but this was not relevant because he did not know about using blue lifts. NOTE incredible number of times he reads the card		colour-coding
M	8	Reception says, "blue lift, six floor" P then takes these instructions		colour-coding
M	9	He says he chose this way because of the blue lifts		colour-coding
M	11	Walked away from lift saying, "follow the yellow carpet tiles" but turned the wrong way (the sign didn't say which way to go)		colour-coding
M	11	Asked "where are the yellow tiles…"		colour-coding
M	13	11.12.64 person volunteers directions and explains G 64 is G-block sixth floor. Says go down "where it says G block, grab blue lifts on right side and go to 6th floor"		colour-coding
M	14	10.04.88 is helped - told to "follow corridor all the way to the end and then take the blue lift to the sixth floor"		colour-coding

M	25	After looking at E Street/Watling Street directory, she found G 64 was on level six, but didn't link it to blue		colour-coding
M	25	Has seen Green left side and seems confident		colour-coding
M	30	Ask how participant will find blue. He says he will find himself this time (i.e., no asking)		colour-coding
M	33	Participant kept going past the outpatients department turn off because the yellow squares went past the turn off	yellow squares went past eye clinic	colour-coding
M	33	Main visitor desk helped with very clear instruction using colour coding (yellow squares and red line on carpet)	very clear directions	colour-coding
C	11	Using yellow squares "to see where they take me" (then stops and goes back to directory) (important colour coding) new line 3.39.46		colour-coding
C	12	Sees different colour to lift signs and says, "I don't know what the different coloured lifts are for"		colour-coding
C	15	Asked participant how he found blue lift's. He said sign outside also blue lift and blue doors (note colour coding)		colour-coding
C	21	Decides for some reason, to follow green and gold left arrow is down G Street		colour-coding
C	22	"Blue lifts sound good" (note: of course she said blue)		colour
C	25	Missed the lady's cue for lift "yellow tiles"		colour-coding

3. Directory

i) How much do you like using directories?

K.11 How much do you like using directories

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	3 (10.0%)	0 (0.0%)	6 (20.0%)	14 (46.7%)	7 (23.3%)	30 (100.0%)
TD	1 (3.3%)	3 (10.0%)	10 (33.3%)	12 (40.0%)	4 (13.4%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 5.97, p = .20. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .24, indicated no significant trend difference.

K.12 Aggregated data for how much participant likes using directories

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	9 (30.0%)	21 (70.0%)
TD	14 (46.7%)	16 (53.3%)

ii) How difficult was it to use directories?

K.13 How difficult was it to use directories

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	6 (20.0%)	2 (6.6%)	3 (10.0%)	5 (16.7%)	11 (36.7%)	3 (10.0%)	30 (100.0%)
TD	3 (10.0%)	1 (3.3%)	8 (26.7%)	11 (36.7%)	4 (13.3%)	3 (10.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 9.12, p = .10. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .50, indicated no significant trend difference.

Table K.14 Aggregated data for how difficult participant found using directories

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	11 (36.7%)	19 (63.3%)
TD	12 (40.0%)	18 (60.0%)

Table K.15 Summary of open-ended questions about Directories

ID		TD	
Problems with directories			
Hopeless for people with ID	1	Need ability	1
Still can go wrong way	1	Good for maps	1
Don't know where to look on board	1	Confuse (2), too vague, need clearer, complicated, mixed up meaning,	7
Don't tell me much	1	None around, not common	2
		Too general, no detail	2
		Signs are better	1
		Can't find information, limited information	2
		Not helpful, difficult, have to guess	3
		Poor layout	2
Helpful			
Gives where to go	6	Give information (direct, detailed, exact, lots on each floor	4
Can read names	4	Give direction (where going (2), if going wrong, find places)	5
ON each floor	2	Clear (4), well organised	5
Possible improvements			
Tells me what I'm doing	1	Make more friendly	
		Ask you where you want to go	
		Bigger	
		More specific + relate to maps	
		More of them	

Place at entrances

Table K.16 Observation from video coding – Directories

Observations from video coding about directories				
Group	No.	Explanation	Remarks	Visual
M	1	Participant processed info on main Watling street directory sufficient to know it was Blue Lifts she wanted and the direction of the blue lifts		directory
M	1	Processed lift lobby directory OK and which way to go in lift		directory
M	8	Asked why she now thinks it is the wrong way she goes and looks at directory on first floor		directory
M	10	Participant now points to places on same directory, but not relevant		directory
M	10	Says "64" and looks back at same directory		directory
M	10	Comes back down to the ground gets out and go straight back to same directory board (does not look at other signs?)		directory
M	11	Participant misreads directory and thinks G 64 is on level five	problem with understanding G64	directory
M	14	While looking at the directory, she points at the board with one finger and then points it to the left		directory
M	15	Participant looks at directory realises it is level six		directory
M	20	He then sees G 64 which says "six" and starts to look around (I don't think he has linked it to the blue lift at the top of the list)		directory
M	20	At Green lift the directory say ward		directory
M	27	At block G main directory she found ward G 64 but then looked for location of enquiry counter on directory. She says the directory/map was a bit complicated	Did not show G64 enquiry counter location	directory
M	29	Asked what he's looking for on the board (directory) he says, "which way to get out"		directory
M	29	He looked a long time at the board until he saw the ME/WO ceiling sign and then he felt happy to go out		directory
M	30	Even though he saw directory with G 64, he still can't work out what to do		directory
M	31	Participant looking on directory board, cannot see "Eye"	Can't see "Eye"	directory
M	31	Said he wanted to go and look at board but completely ignored the board in E street		directory
M	31	Saw Watling Street/East Street directory, found ward G64 and knows it is Blue lift		directory
M	32	Participant says, "I guess we just got go up to" (without looking at directories)		directory
M	32	When asked where she's going up to she stops and goes to look at directory		directory
M	33	Participant looked on directory and found open "Lions Eye Institute"		directory
M	33	Then reading all different department names		directory
M	33	Now in gold lift lobby, looking at directory, not at locations, but for a number six in the levels column		directory
C	1	Looking for something on that directory to indicate where the wards are		directory
C	1	Going to Watling Street because another directory is there. Remembering location of information.		directory

C	1	Looks at Watling/G street directory and notes G block, six level and blue lift and indicates blue lift to left		directory
C	2	Looking at E Street/outpatients department directory but can't make link to block G		directory
C	2	Sees main Watling directory and thinks Green lift but has seen wrong ward number		directory
C	2	After processing wrong information, participant then picks up ward G 64, blue lift and to the left. (still concerned that it did not say enquiry counter)	not used the words enquiry counter on directory	directory
C	3	Looks at directory in level six blue left just to see different locations. Seems okay no real problems-does go past G Street Exit though		directory
C	5	So, she will go back to mainboard because she saw wall G 64 she thought		directory
C	7	Looks at directory and although sees outpatients department, is stuck because it doesn't say Eye clinic	doesn't say Eye clinic	directory
C	10	Can't work out directory outside outpatients department. Going to main corridor because participant thinks signs will be down that way. Sees new sign to G in Watling Street which he says is not very clear		directory
C	14	Directory at Watling/G says blue lift		directory
C	16	Looking at directory, the street says G ground and the like. Therefore looking for G 64 on the ground floor	confusion G64	directory
C	19	Decide to find a directory		directory
C	21	Goes back to the street signboard because familiar with		directory
C	22	Says he will now go back to where the board was		directory
C	22	Stops in front of G Street mainboard and asks why he can't find ward G 64, then finds it. Does not understand what six means on directory. "Six floor, I'm guessing". He says he needs to catch a lift and looks all around (and in fact the directory has blue lift at the top). Doesn't know if he wants gold left or green or blue. Asks me "why does it have different coloured lifts, maybe some of the doctors and dying people and some are for visitors". He now says, "she did say to that and then turn left"	confusion G64	directory
C	22	"There is no sign of way out on the floor lists, so… It would be good to have something say whether LG, G, or the like was the bottom floor	No "way out' noted on directory	directory
C	24	Looking for inquiries counter on directory		directory
C	24	Turns away from Watling down G street because directory doesn't have enquiry counter on it. Eventually, goes back up G Street to Watling	Enquiry counter not shown	directory
C	24	Realises he should have checked directory at G Street/Watling Street		directory
C	24	He looked at directory back on Watling Street and missed the reference to G 64		directory
C	25	After staring at both directories in blue lift he finally sees G 65 and says okay we have to go to level six		directory
C	26	Goes out to G Street/outpatients department board		directory
C	26	Goes back to G Street/Watling map and still doesn't look at directories either side		directory
C	27	Sees directory at Watling/East and that blue lift six, in G		directory
C	29	At East Street/Watling signboard he gleans: blue lift, Ward 64, level six and directions of lifts		directory

C	30	At directory, East Street/outpatients department looks for "enquiry counter"	directory
C	30	Looks at G reception directory mainboard. Sees G 64 but looks for Green left. Then stops and goes back towards blue left but when asked has no idea gold or blue…	directory

4. Landmark

i) How much do you like using:

Table K.17 How much do you like using landmarks

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	3 (0.0%)	4 (0.0%)	8 (0.0%)	9 (0.0%)	6 (0.0%)	30 (100.0%)
TD	0 (0.0%)	4 (0.0%)	7 (0.0%)	11 (0.0%)	8 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.55, p = .51. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .11, indicated no significant trend difference.

Table K.18 Aggregated data for how much participant likes using landmarks

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	15 (50.0%)	15 (50.0%)
TD	11 (36.7%)	19 (63.3%)

ii) How difficult was it to use:

Table K.19 How difficult was it to use landmarks

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	16 (0.0%)	1 (0.0%)	2 (0.0%)	3 (0.0%)	6 (0.0%)	2 (0.0%)	30 (100.0%)
TD	8 (0.0%)	5 (0.0%)	5 (0.0%)	7 (0.0%)	5 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated a marginally significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 10.31, p = .07. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear

association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .30, indicated no significant trend difference.

Table K.20 Aggregated data for how difficult participant found using landmarks

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	19 (63.3%)	11 (36.7%)
TD	18 (60.0%)	12 (40.0%)

Table K.21 Summary of open-ended questions about landmarks

ID		TD	
Problems with landmarks			
Prefer asking	1	Not recognise them	8
Wouldn't look for them	1	Can't rely on them	1
Café didn't help	1	Can have different meaning	2
		Too many ways leading from landmark	1
		Too similar	1
Helpful			
Sushi bar	1	Kiosk	1
Used a painting machine	1	ATM	1
Café sign	3	Café	3
Meet me in food hall	1	Exit sign	1
Paintings on wall	1	Picture or painting	2
People eating	1		
		Help people with ID	1
		If you know the area	1
		Never change	1
		Good for retracing	1
		Helps orientate	3
		Can assist getting top location	1
		If you find a familiar one	1
		Useful when giving instructions	1
Possible improvements			
None		None	

Table K.22 Observation from video coding – Landmarks

Observations from video coding about landmarks				
Group	No.	Explanation	Remarks	Visual
M	1	Sees café past G block and decides to turn back		landmark
M	7	Has to wait for receptionist to ask someone else how to get to outpatients. given a landmark of shops to look for		landmark
M	10	Holds card against each of three vending machines to check if right	using word patterns?	landmark
M	10	Told to turn left by yellow bin, and down to blue lift up to 6th floor. Participant repeats "sixth floor		landmark
M	15	Person behind counter gives instructions how to get to outpatients including landmarks "ATM" and "cafe". Draws directions. Note participant did remember that landmark he was given		landmark
M	15	Participant kept saying about "C" for why he was heading to outpatients along Corridor. Then he said he was near the hairdressers landmark, they said		landmark

M	15	Acknowledges hairdresser again, although this time is walking past it in wrong direction		landmark
M	15	Also, similarly notes the cafeteria		landmark
M	15	He says (as he goes back) that he "remembers the pot plants here" (outside)		landmark
M	15	He is told-main hospital-Go back past ATMs, straight down, then go through to blue lifts, and take it to the sixth floor		landmark
M	16	Given complex, confusing instructions, including looking for ATM and café. They say, "just read the signs"	Complex instructions	landmark
M	22	Instructions to get to outpatients are very complicated.do say past "newsagent". But she didn't use this landmark. She used a sign to direct her past the cafe or similar.	complex instructions	landmark
M	22	NOTE: it's interesting that the B/C sections of Watling are so different from the E section and yet participant reckons it is right at the end of this very long corridor which they never used to come into the building		landmarks
M	26	Remembers aboriginal paintings (landmark)		landmark
M	28	Participant turns at sushi bar		landmark
C	8	Refers to aboriginal paintings but didn't really noticed them before		landmark
C	9	Going down the street sees cafe/sushi corridor and halts, saying that it is now coming back to her. She says coffee shop was familiar (landmark)		landmark
C	19	To suggest "the shop we passed"-using a landmark. participants see sign to outpatients department straight on, but takes turning beside chemist		landmark
C	20	Says painting along Watling street just before G Street helps him know where he is		landmark
C	25	Participants saw yellow tiles and ATM landmark		landmark
C	26	When asked how he knew the eye clinic was down here he said because he had seen a lot of glossy photos and clinics have glossy photos	linked glossy photos with eye clinic	landmark

5. Functioning buttons

No further information

6. Lift indicator

No further information

7. Map

i) How much do you like using:

Table K.23 How much do you like using maps

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	5 (16.7%)	5 (16.7%)	4 (13.3%)	10 (33.3%)	6 (20.0%)	30 (100.0%)
TD	0 (0.0%)	3 (10.0%)	6 (20.0%)	15 (50.0%)	6 (20.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 6.90, p = .14. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .04, indicated a significant trend difference.

Table K.24 Aggregated data for how much participant likes using maps

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	14 (46.7%)	16 (53.3%)
TD	9 (30.0%)	21 (70.0%)

ii) How difficult was it to use:

Table K.25 How difficult was it to use maps

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	17 (56.6%)	2 (6.7%)	3 (10.0%)	3 (10.0%)	5 (16.7%)	0 (0.0%)	30 (100.0%)
TD	7 (23.4%)	3 (10.0%)	6 (20.0%)	9 (30.0%)	4 (13.3%)	1 (3.3%)	30 (100.0%)

A chi-square test was performed which indicated a marginally significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 9.48, p = .09. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .02, indicated a significant trend difference.

Table K.26 Aggregated data for how difficult participant found using maps

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	22 (73.3%)	8 (26.7%)
TD	16 (53.3%)	14 (46.7%)

Table K.27 Consolidated interview responses about maps

ID		TD	
		Problems	
Some can't read	4	Can't read	1
Difficulty understanding + get confused	4	Get confused	3
Not enough and not clearer	10	Need colour coding	2
Can't picture in head	2	Orientated the wrong way	7
Not enough appropriate information	2	Only provide general information	8
Not sure which map to look at	1	Was too anxious	1
Easier to use signs	2	Only if no signs	1
		Not enough information	1
		Helpful	
Easy to use, give all information	6	Gives idea of the whole picture	6
For large locations	1	Good if with colour coding	2
Easy to find directions	1	Easy to read	2
		Gives relationship of everything	1
		Easy to see where going	3
		Better than people as people may not be reliable	1
		Don't have to ask	2
		Helps remember	1
		Improvement	
More words and places and numbers	1	To be orientated the right way	1
		Give more local information	1
		General improvement	1
		Place at entrances	2
		Provide grid layout so can find directory locations	1
		Provide more directories	1
		Some at wards with you-are-here	1
		Clearer	1

Table K.28 Observation from coding – Maps

Observations from video coding about maps				
Group	No.	Explanation	Remarks	Visual
M	11	Puts card up to fire escape plan to check where to go	using word patterns?	map
M	12	Looking at map/knows where he wants to be, not where he is now		map
M	12	Participant really can't establish where they are on the map and what they see around them. Says "it's a bit confusing"		**map**
M	12	Says map is telling him to "go this way" (towards Watling Street). Eventually chose which way to go - thought the map was confusing. "Trying to imagine inside my head where is the sort of place"		**map**
M	14	Participant looking at map suddenly points to E block		map
M	14	She places card on map beside the "you are here" words	reads card alongside map	map
M	14	She seems to be trying to work out where to go on the map		map

M	26	She is trying to find where she is on the map it is helping her find where she needs to go		map
C	4	Now looking at map says, "it's a little bit hard". Note; maps were all the same, not oriented to the specific location.	hard cos not oriented correctly	map
C	4	Although starts off, goes back to map because not sure if correct. Seems to have trouble with map orientation	hard cos not oriented correctly	map
C	4	She actually says the map is not in the right orientation	hard cos not oriented correctly	map
C	6	Participant explains difficulty in interpreting where to go in relation to the map		map
C	11	Can't work out orientation of Map		map
C	12	Big map now outpatients department "doesn't say eye is"	map not giving detailed info	map
C	12	Suggests as G 64 is not on directory, but G61, G62 are, perhaps if you went to those, you could get there	G64 not on map	map
C	13	Great difficulty understanding orientation of map		map
C	15	Was looking for someone to help him, but has found a map		map
C	18	Says plan to get to outpatient department then look for iconic from there		map
C	18	Map told him relative positions of E and G and also that there is a walkway between the two		map
C	18	Came down Watling because wide open area and if get lost, more chance to find map or the like.		map
C	19	Suggests map shows multilevel and/or single level. Has to assume		map
C	20	He had no problem reading the map outside outpatients department and used the G to decide where to go		map
C	20	Turn left onto Watkins Street, remembering what map said		map
C	21	Went back to map because not sure of his judgement. Found an internal walkway. Also, said he remembers the map up at Watling Street that will serve as a check		map
C	22	The first part, participant says "a map would be very nice to find"		map
C	24	On map, thinks inquiry counter maybe near as the front of G block. He then decides he knows where he has got to go		map
C	24	Goes to Main board at E Street/Watling Street to confirm on map he's going the right way		map
C	24	Thinks the dash line on the map could represent the vinyl path along Watling Street		map
C	26	Participant wants to find a map of some signs		map
C	26	Can't tell whether white on that is the path or not		map
C	26	Now goes down G street because he says on the map this looks like (more,) G. Also, going to main entrance because that's usually where inquiry counter is. "Enquiry counter" confuses people	Enquiry counter confuses people	map
C	27	Going back to "big one" (presumably main area). (Spatial memory)	Spatial cognition	map
C	27	Even though I may be going wrong way I'm still going back to a big map		map

8. Combined map and directory

Table K.29 Observation from video coding – Maps & Directories

Observations from video coding about Map & Directories				
Group	No.	Explanation	Remarks	Visual
M	5	Walked past main sign directory/map in G block without stopping		directory&map
M	29	Participant stands in front of map/directory a long time then points to where it should be on map, but when asked had not seen outpatients on the board (even though it is there)		directory&map
M	29	Participant looks at G block Watling Street map/directory and for the first time sees ward G 64 mentioned. It doesn't seem to process the sixth level or blue left		directory&map
M	29	Now runs finger across ward G 64 to find six. Looks up from six and then tries to find level six on map. (He walks towards blue left)		directory&map
C	7	Looking at main map/directory. Can see Lions Institute block A, but doesn't know what block she is in		directory&map
C	14	Problem now outpatients department with large directory/map. She cannot find "eye clinic"		directory&map
C	15	Found outpatients department on directory and then used to map to find where it is		directory&map
C	18	Says "sign" open (means Map/directory) is useless for what he wants to do		directory&map
C	18	Interesting that he did not look any directory only the map		directory&map
C	19	Checks how big map (near G block) displays information i.e., is it alphabetical?		directory&map
C	22	Spent a long time in front of board and can't work out which way the map is orientated. Says he is confused	map orientation	directory&map
C	24	Directory by outpatients department turning shows for next 1 to 3 and 4 to 6, but not I clinic. Looking at "the sign (means 'map') but it's not making too much sense to me yet"		directory&map
C	26	Looks at G Street/Watling Map/directory briefly but then carries on towards blue lift just checking "doors and things like that". He does not have the G 64 information yet. He is looking for "word" indicators on doors so he hasn't identified G 64 as being sixth floor	confusion over G64	Directory&map
C	28	Has considerable difficulty with directory/map in East Street/outpatients department		directory&map

9. Sign

i) How much do you like using:

Table K.30 How much do you like using signs

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	2 (6.7%)	2 (6.7%)	7 (23.3%)	11 (36.6%)	8 (26.7%)	30 (100.0%)
TD	0 (0.0%)	0 (0.0%)	2 (6.7%)	13 (43.3%)	15 (50.0%)	30 (100.0%)

A chi-square test was performed which indicated a marginally significant statistical difference between the perception of the ID and TD groups, X^2 (2, N = 60) = 9.08, p = .06. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .002, indicated a significant trend difference.

Table K.31 Aggregated data for how much participant likes using signs

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	11 (36.7%)	19 (63.3%)
TD	2 (6.7%)	28 (93.3%)

ii) How difficult was it to use:

Table K.32 How difficult was it to use signs

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	0 (0.0%)	3 (10.0%)	10 (33.4%)	7 (23.3%)	7 (23.3%)	3 (10.0%)	30 (100.0%)
TD	0 (0.0%)	1 (3.4%)	6 (20.0%)	7 (23.3%)	9 (30.0%)	7 (23.3%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.85, p = .43. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .03, indicated a significant trend difference.

Table K.33 Aggregated data for how difficult participant found using signs

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	13 (43.3%)	17 (56.7%)
TD	7 (23.3%)	23 (76.7%)

Table K.34 Collated responses to interview questions about signs

ID		TD	
PROBLEMS			
Hard to find directions	1	Confusing	11
Some will not be able to read them	7	Not clear	9
More helpful than maps	1	Writing too small	2
Need more	5	Cannot read	7
Hard to understand	7	Too high	1
Too high	1	No symbols	4
Writing too small	1	Not logical	2
Too vague	2	Unusual words	1
Too big	1	Too many	1
Didn’t know words	2	Not enough	5
Too many	1	Not enough information	1
		Should not be on both sides of sign	2
		Too small	2
		Not well lit	1
HELPFUL			
Taught where to go	15	Consistent	4
Specific	2	Taught me where to go	6
Easier to perform	1	Been taught to use	1
Big	3	Well signposted	1
Easy to see	8	Good signs	1
Available	1	Frequent	9
Don’t have to ask	1	Well presented	12
Easy to follow	1	Easy to find	1
Point in right direction	1	Don’t have to ask	1
		Easy to use	8
IMPROVEMENTS			
Be more specific	1	Better presented	7
Bigger	2	More	5
More	3	Bigger	1
Better presented	4	Colour coded	6
Clearer wording	2	Easier to use	1
		Positioning	1
		Improve layout	1
		Use visual cues	1
		Use key words	1

Table K.35 Observations from coding about signs

Observations from video coding about signs				
Group	No	Explanation	Remarks	Visual
M	2	She obviously can't recognise lifts and hasn't seen the overhead signs		sign-ceiling
M	2	Goes to exit sign in G 66 but can't work out to go down stairs		sign-exit
M	5	Sees sign and reads it but goes in the opposite direction		sign-gen
M	5	Points and comments on toilet door		sign-door
M	5	Says he is trying to find that letter		sign-gen
M	5	Says he can see G on sign. now he will look for 64		sign-gen
M	5	Sets off okay and looks EXIT in distance		sign-exit
M	5	Sees Way out Sign and acknowledges it and keeps going		sign-exit
M	5	Say “Exit" and looks down green lift corridor		sign-exit
M	5	Looks down corridor (to green lifts) and smiles widely. Think he has seen the exit sign and proceeds to go towards green lifts		sign-exit

M	6	When asked how she knew it was an exit she pointed back to a sign (but that told her to go left and she is continuing onto car park exit)		sign-gen
M	7	Standing beside "outpatients" sign but did not see it		sign-gen
M	7	Saw G on an "external window"		sign-gen
M	7	Gets to ‘EXIT' sign near lifts and it seems like he thinks he has to find an EXIT sign. Does Not get out of the building	Person does not get out of building	sign-exit
M	8	She says (just before going in building) "this is G block"		Sign
M	8	Turns left out of blue lift lobby because she thinks the exit is that way. She says there is no sign		sign
M	9	No real issues. Did see the outpatient sign near to outpatients. Did see the "outpatients E block sign" in the main corridor		sign-gen
M	9	Participant says he will have to find the lifts and go up to the sixth floor so he understands what G 64 means	understanding G64	sign-gen
M	9	Struggled with final turn because it doesn't say which way to the counter		sign-gen
M	9	Use is lift/layout signs to get back to blue left, so has made the link between way out and using lifts	link way out and using lift	sign-gen
M	9	Uses "main entrance" sign. So again has made the link between ME and way out		sign-gen
M	10	Holds card up with both hands so they can compare it with the overhead sign	using word patterns?	sign-gen
M	10	Ditto	using word patterns?	sign-gen
M	10	Stands in Watling Street outside blue lift and looks at various signs but can't decide		sign-gen
M	11	Turn left out blue lift because she says ME sign. Means she links ME with WAY out	Being able to link Main Entrance with Way Out	sign
M	12	Says will go to GF where there is an exit. So he has made connection with GF and Exit	Connection made between GF and Exit	**sign**
M	12	Sees sign on GF to ME. Reckons that can also be the exit. No real problems	Being able to link Main Entrance with Exit	**sign**
M	14	Participant points to sign on ceiling		sign-ceiling
M	14	She looks at the side which has no relevant locations but repeats with her head the direction to each location listed on the sign		sign-gen
M	15	Says "always recognise signs"		sign-gen
M	15	Participant gives their understanding of what each letter "C", "D" and the like means. (i.e., if you need to give blood)		sign
M	16	Going along Watling Street sees G block signed which helps him but he says, "it's not the right one," he wants G 64	confused by G64	sign-gen
M	16	Says he can see a green sign that says exit but he actually goes past exit. it is at G Street		sign-exit
M	17	Although she appears to be walking aimlessly down the corridor, she does look up at signs and then read the card, so she has some concept of needing to find clues		sign-gen
M	17	Goes straight to fire stair exit sign. stops looks but can't work out from ceiling sign, which way to go (even though there is an arrow on the sign)	Can't work out where to go	sign-exit
M	18	When she looks again at directory and G 64, she also looked up and saw blue lift. So, presume she now has more information		sign

M	18	As she goes along corridor it is possible that she is reacting to lift signs but there is no indication, and she also turns and looks back after blue lift signs so it seems they haven't been used		**sign-lift**
M	18	For some reason, she turns around before getting to the blue lifts. So, she obviously doesn't register that they are what she wants (or she didn't see the sign?)		sign
M	19	Did not see pink sign to go right at G 64		sign-gen
M	20	Admits that he saw an "E" against outpatients and has turned back because he went wrong way		sign
M	20	At a sign, he stops, says G must be back here and turns around. So, he is now looking for G and for number six		sign-gen
M	20	Could not process information at junction where G is on door. He knew it was G he wanted but couldn't link to the lift and didn't see the ward G 64 written there	not seeing information	sign
M	20	Now thinks it is the green lift he needs because it had green lifts on sign. He doesn't seem to know which lift will get him to G 64 although it says on the directory	not seeing information	sign
M	20	after seeing main entrance directory (he didn't see the words G 64 under blue lift) has decided to go via the green left		sign
M	20	Started off towards G 65 but turned around and went to lifts. He says he changed because no lift signs down other corridor		sign-lift
M	20	Says he can see ME sign. I asked what he links ME with and he said exit	has linked ME with exit	sign
M	22	First concern occurs when she says she has to find ground 64	misunderstood G64	sign
M	22	Participant decides "out" is on the ground floor	links Out with GF	sign
M	22	Despite looking at relevant signs, she continues to walk to the end of C Watling		sign-gen
M	22	She says she is trying to find the word exit on the bottom of the doors?	Trying to find exit on bottom of doors	sign-gen
M	22	Participant is asked if she would go out the door if it wasn't raining and she says yes, so we go back to the door (not record any wayfinding decision points for this). Even though there is an exit sign, she says "there's no sign there". She's obviously looking for something else		sign
M	23	Actually, one of few participants who saw yellow sign saying to outpatients, but she noted it didn't actually say the same as card	Didn't same as card	sign-gen
M	23	"Can't see any lettering anyway, A, B, C, D or G"		sign
M	23	Concerned she can't find a, B, C, D or the like		sign
M	23	"There is nothing that says "ward"		sign
M	23	Points to lift sign and says go this way because it says exit. (in fact, she is pointing to the furthered it)	Links lift sign and exit	sign-exit
M	23	She stops and says the exit sign doesn't point to anywhere (note but in fact it points to stairs). She then says it was a door but wasn't sure if that was another ward	Exit doesn't point to anywhere so doesn't know how to exit	sign-exit
M	23	Has seen exit sign for stairs but walks under and passed it		sign
M	23	She has not seen exit at the end of G 65 corridor but turns towards blue lifts because that has exit sign at entry to lifts from ward G 65		sign
M	23	Sees exit out other side of blue lift lobby so ignores all lifts and heads for Exit out of lobby		sign
M	23	Sees exit sign down corridor to G 63 so heads that way		sign

M	23	She stops and says all exits have led out to here and there's no more signs		sign
M	23	Interesting: coming in direction of G 64 past the Exit sign, there is no further indication of where to exit	Doesn't get out	sign
M	24	She says it was on the sign but still went further away		sign-gen
M	25	Sees the multi-lift sign (past door with G on) but turns left to find Green – Gold lift for some reason, not the blue		sign-gen
M	25	Sees the sign for green and gold lift		sign-gen
M	25	Sees sign for gold lift, but goes past		sign-gen
M	25	When she got to enquiry counter G 62 she thought that was it, but hadn't seen the G 62		sign
M	25	She says she is going this way to find a lift to the ground floor but goes past lift corridor and sees the accident sign, but again goes straight under and past it. Now sees exit past G 65 reception	Can't exit cos can't find how to get out	sign-exit
M	25	Continues to follow except signs even though she looked at the fire stair door but ignored. She is also ignoring lift and way out signs and has seen another exit down G 63	Can't exit cos can't find how to get out	sign-exit
M	25	Sees "way out" on sign and is following that	Can't exit cos can't find how to get out	sign-exit
M	25	Turns at way out sign but doesn't seem comfortable with the decision	Can't exit cos can't find how to get out	sign
M	25	This is mad because the sign said way out this way but there is nothing at the doors to say go through	Can't exit cos can't find how to get out	sign
M	25	Now she sees exit sign again		sign
M	26	Looking at the signs		sign
M	26	She says she is reading the signs (and this is from some way before the outpatients to the left side)		sign
M	26	Uses signs saying ME to get out	Links ME and exit	sign
M	27	When looking down Watling Street from the art gallery says: "there's a lot of directions"	Too many?	sign-gen
M	27	On the ground floor blue lift lobby, she uses ME sign to show her the way	links ME with exit	sign
M	29	He stopped near cashier in outpatients department because he saw a G above the doorway. G above doors which he thinks relates to the G in front of the 64	confused about G64	sign-gen
M	29	I think he has seen a sign with G block and has realised that she is referring to G block		sign-gen
M	29	(he walks towards blue left) he says the sign told him to come this way (but there was no indication from him?)		sign
M	29	Started off confidently heading for exit in G 66 but after looking at fire door decided to keep going		sign-exit
M	29	Is at ME and stops. He reads and repeats the words on the card which say any exit. He is looking at an exit sign but doesn't seem to want to go out the ME.	can't link exit and ME	sign
M	29	Says he needs to know if this is main exit		sign
M	30	Says he is confused about where to go (and points at all the ceiling signs at the junction with Watling Street and corridor down past cafe and bracket	confused by all the signs	sign-ceiling
M	30	Again, says confused from all the signs	confused by all the signs	sign-ceiling
M	30	Going well right up to final corridor to outpatients department. And then doesn't seem to see the big "Outpatients department" sign. Almost as if the	confused	sign-ceiling

		signs say that the intersection is the outpatients department.		
M	30	Participant missed blue lift signs just after door with G on		sign
M	30	Finds blue lift by guess because does not see blue lift sign. Says he is in right place because of G on walls in blue lifts??		sign-gen
M	32	Participant says, "it should be on one of these" (she approaches Watling Street (one of the signposts she adds)		sign-wall
M	32	Says "here's G block it must be somewhere up there". Seen a sign		sign-gen
M	32	Do you think it is in G block? She says yes because it says ward G64		sign
M	33	He goes to G65, turns around and sees the same accident sign, for G65 stairs. He then turns and sees Exit end of G65	can't find exit	sign-exit
M	33	Does the same thing in fire stairs for G63, comes out of stairwell again. He says it is "the wrong one". And he says it is the wrong one because it says, "day one" (??)	can't find exit	sign-exit
M	33	He sees word way out sign and goes all the way to end of ward G61 to the fire exit. But he looks at the door and says "no. It's not that one". He then looks around. Then he sees fire stair says, "stare at three". Sees second door open and says, "I think I've found it" and goes forward to stairwell. He went downstairs but didn't look in doorways	can't find exit	sign-exit
C	1	Reading signs a long way off down corridor		sign
C	1	"Long passages without any signs", "going quite far before you find out where you"	long passages without signs	sign-gen
C	1	Sees G on glass door from long distance away		sign-door
C	1	Has to bend down to see inquiry counter sign	Has to bend down	sign-gen
C	1	Because card says Exit she's looking for exit signs	Different wording?	sign-exit
C	1	Looks for Green exit sign because it is universal		sign-exit
C	1	She is following exit signs to see where they lead to. (Even though there are no exit signs in the stairwell)		sign-exit
C	1	At G in stairs there are no signs		sign
C	2	Participants saw sign from some distance back along the corridor		sign
C	3	Participant looks for Questcor "Asian eye clinic" station sign at junction of Watling Street and corridor, but can't find it		sign-gen
C	3	Guess this is right direction, because no sign to say go anywhere else		sign-gen
C	3	New line despite seeing outpatients department signs, still can't see anything to say I clinic	nothing to Eye Clinic	sign-gen
C	3	Was worried which way to go thinking about block letters and alphabet, which way it runs		sign
C	3	Notes (once in G block and bracket it only shows are the block letters on sign so (if you don't know this is G) you can't see		sign
C	3	She goes back to lifts. She reads the sign beside the lifts that says, "in the event of a fire please raise the alarm, do not use the Lifts, follow the green Exit signs"		sign-gen
C	3	Says she knows G Street therefore doesn't need to read any further signs		sign-gen
C	4	"Not quite sure what 64 is"	unclear of G64	sign
C	4	"says looking for a sign that might have numbers" (but she is standing right beside directory)		sign-gen

C	5	Says she is following the signs. Missed really obvious outpatients department signs because she was looking for a high	looking in wrong location for signs	sign-gen
C	6	Going to blue lift purely because they will get up to 6 she thinks, (not because she can see the blue left sign above ward G 64)		sign
C	6	Went out through G 64 because participants or green except sign. Says it might be just except from this world (?) Not familiar with international symbol for exit?	not familiar with international Exit sign	sign-exit
C	6	Realises it is a fire exit then sees the word stairs and goes through door. When it sees exit sign says, "Fire door" and turns back	Exit says fire door so doesn't go	sign-exit
C	7	Notes no signs this way but it's the way she's been told to go		sign
C	8	Uses sign with M/E (to go down G Street) and parking sign to find way out (assumes they are the way out)	links parking sign with way out	sign
C	9	Even though participant has seen outpatients department sign, she is still not sure if it is the right way to the eye clinic		sign-gen
C	9	She is looking for the word… "Eye"		sign-gen
C	10	Older person would struggle with sign because not well lit		sign-gen
C	10	He mutters, now "is 64 a room or…? "	confusion over g64	sign
C	10	Has followed all the way out signs and as he is walking along Watling Street he says it will probably take me to the main entrance		sign-gen
C	10	Note my note interesting: that Jesus Street entry say MP but then adds way out to the signs of way down		sign
C	10	When finding ward G 64 he had to look at small print on the wall		sign-gen
C	11	Looking for G down Watling Street		sign-gen
C	11	Sees lift signs (note: so has assumed lift is out)		sign-gen
C	11	Sees Exit outside green lift which she says makes her feel she's going the right way		sign-gen
C	11	At Green lift lobby, she says she saw exit sign but "assumed it was out here" as she heads for reception. This is a strange comment as the exit sign was clearly over door, not the one she's using		sign-gen
C	12	There's not much in the way of signs		sign-gen
C	12	Finds G 64 level six in blue lift but (although sign at top says which way to blue left), she can't find which way for left		sign-gen
C	13	Says there is a big concentration of signs all in one area (i.e., nearly outpatients department turning) but in between there is nothing: Note- if this is a problem it will show in stats		sign-gen
C	13	Sign for blue lift above door on G street as you go into Watling, is cut off from site		sign-gen
C	13	First lift to say sixth floor		sign
C	13	Just as she leaves lobby she sees the sign in the lobby pointing to G64/G65		sign-gen
C	13	says exit sign (G65 stairs) is slightly obstructed by other signs		sign-gen
C	13	She says there are no signs (in the stairwell) to tell her to go to the ground floor		**sign-gen**
C	13	Floor signs in lift well are hard to see as they are the same colour as the wall. She then says: “if you look for the door that says exit by the ground floor"		sign-gen
C	14	There is not much signage to say where everything is		sign-gen
C	14	Says going back to Watling street because more signs (note: didn't want to go out)		sign-gen

C	14	Points towards shop and says, "just got to follow the X it signs"		sign-gen
C	16	He thinks it is ward 64 in the G block, but can't really explain why he thinks that		sign
C	17	Can see outpatient department sign from a long distance down the corridor		sign-gen
C	17	Trying to find what G means	confusion over G	sign-gen
C	17	"Must be more signs to point you in the right direction" as she is going down the street		sign-gen
C	17	Describes why turned down Watling towards G. She says G 64 maybe ground G and 64 or G block 64 and thinks the latter. She has also seen "patient reception" for G block and thinks this may be close to "enquiry counter"?	confusion over G	sign-gen
C	17	Turn right down G Street but uses the ME sign	links ME and way out	sign
C	18	Stratify wayfinding i.e., first outpatients department, second eye clinic… Is this possible for everyone? (this was something a lot of participants had difficulty with)	stratifying wf?	sign
C	18	Participant didn't proceed with his own idea of getting to outpatients department then looking. He stopped at turning to outpatients department and did not react to the sign say where outpatients department was, down corridor. He went towards outpatients department down corridor assuming it might be down there		sign-gen
C	18	Has G in front-seemed logical G is G block		sign
C	19	Went past turning for outpatients department because decided he would look for patient by a sign (which he had in fact passed on his way out of the Art Gallery)		sign
C	19	"I'm sort of losing signs. There were signs back there saying patient services and now there's nothing much going on"		sign-gen
C	19	"Don't understand the structuring of the lettering of Wards"	confusion over G64	sign
C	21	Outpatient department on directory meant the street. Which he said was also on the sign		sign
C	21	But the sign "doesn't say department"	confusion of words used	sign
C	21	Not as much signage as hoped (junction along G Street with MRI)		sign-gen
C	21	Leaving blue lift ground floor lobby, he turns towards Café exit because he has seen a sign, saying you could pretty much go either way		sign-gen
C	22	Thinks he will assume it is G		sign
C	23	I guess, says outpatients		sign
C	23	Had to bend down to see inquiry sign in G 64	blocked sign	sign-gen
C	24	Saw sign before when he came in		sign-gen
C	25	When asked why he came upstairs and through doors has seen the sign. I think the sign says to the lions eye Institute		sign-gen
C	25	Spends much time following large signs and arrows to lions eye Institute		sign-gen
C	25	Going back using memory. However, he walked straight past lift lobby and exit but talks about seeing exit signs when he came up to G 64		sign-gen
C	25	But turns round and goes back to lift. He says he saw exit but it didn't tell him to come into the lifts (where he is currently)		sign
C	25	"I usually look for exits" (but ignored all the exit information at G Street)		sign
C	25	He's looking for a door with an E on it (??)		sign-gen

C	26	Heading for exit sign because it means and pensions and there's usually a reception		sign-exit
C	26	Says he will continue to check signs along Watling Street to make sure he is going the right way (sequential processing-breaking info down in stages)	sequential info processing	sign-gen
C	26	When he gets to G block he will have to find out words system	confusion over G64	sign
C	26	He's following main entrance signs as well		sign-gen
C	26	"Lots of signs" in lift lobby		sign-gen
C	26	Gets out at six. Then goes to G 65 "because usually near to G 64". (Doesn't see any signs in this lift lobby)		sign-gen
C	27	When first reaching Watling Street says, "there's a lot of signs in here". No other real problems		sign-gen
C	28	Says going down corridor to outpatients department because signs point upwards and that usually means going forward	sign pointing upwards means going forward	sign-gen
C	28	She saw 'F' on building, so she wants G, so we should be heading in right direction		sign
C	28	She came out of gold lifts because there was a sign that said patients only	lift patient only	sign-gen
C	30	Went wrong way in outpatients department saying because of a sign but then said the sign didn't have anything relevant on it		sign-gen
C	30	Says she will go back to which signs work		sign-gen

10. Visible door

No further information

11. Distraction

Table K.36 Observation from video coding – Distractions

Observations from video coding about distractions				
Group	No.	Explanation	Remarks	Visual
M	2	P distracted by pictures	pictures are distracting	distraction
M	5	P is affected by police sign about abuse of staff	Police sign upsets	distraction
M	5	Describing irrelevant objects		distraction
M	7	General: keeps describing non-relevant signs		distraction
M	17	She's thinking about her socks (distraction)		distraction
M	17	Looks up at Mirrorball in ceiling and salutes		distraction

Appendix L Sensory Features

1. Light

i) How much did light help you find your way:

Table L.1 How much did light help you find your way

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	7 (23.3%)	1 (3.4%)	7 (23.3%)	10 (33.3%)	5 (16.7%)	30 (100.0%)
TD	3 (10.0%)	0 (0.0%)	8 (26.7%)	10 (33.3%)	9 (30.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.81, p = .43. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .06, indicated a marginally significant trend difference.

Table L.2 Aggregated data for how much did light help you find your way

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	15 (50.0%)	15 (50.0%)
TD	11 (36.7%)	19 (63.3%)

ii) How much did light make your wayfinding more difficult:

Table L.3 How much did light make wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	24 (80.0%)	1 (3.3%)	5 (16.7%)	0 (0.0%)	0 (0.0%)	30 (100.0%)
TD	19 (63.4%)	9 (30.0%)	1 (3.3%)	1 (3.3%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated a statistically significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 10.65, p = .01. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .37, indicated no significant trend difference.

Table L.4 Aggregated data for how much did light make wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	30 (100.0%)	0 (0.0%)
TD	29 (96.7%)	1 (3.3%)

Table L.5 Responses to open-ended interview questions about lighting

Comments relating to lighting, extracted from open-ended interview question responses			
ID Participants -		**TD Participants**	
a) What was the MOST HELPFUL thing		**a) What was the MOST HELPFUL thing**	
a1) Other - NOT most helpful - general comments		a1) Other - NOT most helpful - general comments	
No comments		No comments	
		ii) Lighting	
		a) Was very light	1
b) How much did the following things make your wayfinding more DIFFICULT		b) How much did the following things make your wayfinding more DIFFICULT	
ii) Amount of light		ii) Amount of light	
0. No response	1		
1. Not at all	23	1. Not at all	19
2. A tiny bit	0		
a) Bit too dark opposite eye clinic	1	a) No explanation	1
		b) Coming out of lift on 6 floor - signs changed colour	1
		c) Had it been more lit up I might have been able to see the signs	3
		d) Made me hesitate when went into ward cos dark	2
		e) Pushed me in wrong direction due to assumption	1
		f) Some areas darker than others	2
3. A Little	0	3. A Little	0
a) Just a bit too bright	2		
b) A little too dark in places	1		
c) Dark coming out of lifts to go to G64	1		
d) A little dark going down hallways	1		
4. Quite a lot	0	4. Quite a lot	
		a) Find natural light a lot easier to read things	1
5. A Great deal	0	5. A Great deal	0
c) How much did the following things HELP you find your way		**c) How much did the following things HELP you find your way**	
ii) Amount of light		ii) Amount of light	
1. Not at all	7	1. Not at all	3
2. A tiny bit	0	2. A tiny bit	0
3. A Little	0	3. A Little	0
a) No explanation given	6	a) Light from outside	2
b) I could see light at the end	1	b) Got brighter as you went out the building	1
c) Cos light on	1	c) Cos if it were completely dark, you know, there was enough light	1
		d) Signs were lit up	1
		e) Not clearly explained	2
		f) If dark wouldn't be able to find my way	1

		g) Helped that there was some light	1
4. Quite a lot	0	4. Quite a lot	0
a) Cos when dark, cannot hardly read signs	1	a) Makes the building feel more open	1
b) No explanation given	6	b) Cos in the dark I had to stop	1
c) It was bright enough	1	c) Where there was natural light from outside - easier to read things	0
d) Made you look where you are going	1	d) If it was dark it would be pretty hard	1
e) Finding directions	1	e) Enough light for me to read everything	2
f) If it was dark it would be a lot harder	1	f) If it's lighted then you feel you're going the right way	1
		g) Could see the signs and they provide visual clues about whether you're supposed to be going down a corridor	1
		h) Was good lighting	1
		i) Could see all the signs in general	1
5. A Great deal	0	5. A Great deal	0
a) Cos I could find my way around	1	a) To be able to look where you are going	2
b) The more light you have the better you can see	1	b) Needed light to see signs	3
c) No explanation	1	c) Couldn't see anything otherwise	4
d) In the dark you can't see	1		

2. Noise

i) How much did noise make your wayfinding more difficult?

Table L.6 How much did noise make wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	22 (73.3%)	2 (6.7%)	4 (13.4%)	1 (3.3%)	1 (3.3%)	30 (100.0%)
TD	25 (83.3%)	2 (6.7%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.33, p = .51. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .22, indicated no significant trend difference.

Table L.7 Aggregated data for how much did noise make wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	28 (93.3%)	2 (6.7%)

Table L.8 Responses to open-ended interview questions about noise

Comments relating to noise, extracted from open-ended interview question responses			
ID Participants -		**TD Participants**	
b) How much did the following things make your wayfinding more DIFFICULT		**b) How much did the following things make your wayfinding more DIFFICULT**	
i) Amount of noise		Amount of noise	
1. Not at all	24	1. Not at all	23
2. A tiny bit	0	2. A tiny bit	0
a) People talking	1	a) Heard something and thought shouldn't go that way	1
b) Noises in ward	1	b) Noisy around entrance to Ward G - distracted me a little	1
c) No clear explanation	1	c) People walking and talking but did not affect me	1
3. A Little	0	3. A Little	0
a) People talking	1	a) Couldn't hear lady at G reception	1
4. Quite a lot	0	4. Quite a lot	0
a) No explanation	1	a) Need to focus when reading directories	1
5. A Great deal	0	b) Hard to concentrate	1
a) No explanation	1	5. A Great deal	0
b) What was the MOST ANNOYING thing		**b) What was the MOST ANNOYING thing**	
No comments		v) Noise	
		f) Other people around and you can't really wipe out the noise	1
l) How much do you LIKE using each of the following when finding your way in a building~		**l) How much do you LIKE using each of the following when finding your way in a building~**	
No comments		viii) Are there any other things you like to use	
		a) Maybe sounds	1

3. Touch/Texture

i) How much did texture make your wayfinding more difficult?

Table L.9 How much did texture make wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	26 (86.7%)	1 (3.3%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	30 (100.0%)
TD	27 (90.0%)	2 (6.7%)	0 (0.0%)	1 (3.3%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 1.69, p = .64. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .30, indicated no significant trend difference.

Table L.10 Aggregated data for how much did texture make wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	29 (96.7%)	1 (3.3%)

j) How much did texture help you find your way?

Table L.11 How much did texture help you find your way

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	20 (66.6%)	2 (6.7%)	3 (10.0%)	2 (6.7%)	3 (10.0%)	30 (100.0%)
TD	24 (80.0%)	4 (13.3%)	2 (6.7%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 6.23, p = .18. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .02 indicated a significant trend difference.

Table L.12 Aggregated data for how much did texture help you find your way

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	25 (83.3%)	5 (16.7%)
TD	30 (100.0%)	0 (0.0%)

i) How difficult was it to use texture?

Table L.13 How difficult was it to use texture

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	19 (63.3%)	0 (0.0%)	2 (6.7%)	2 (6.7%)	5 (16.7%)	2 (6.7%)	30 (100.0%)
TD	20 (66.7%)	3 (10.0%)	3 (10.0%)	4 (13.3%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated a significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 10.89, p = .05. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .07, indicated a marginally significant trend difference.

Table L.14 Aggregated data for how difficult was it to use texture

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	21 (70.0%)	9 (30.0%)
TD	26 (86.7%)	4 (13.3%)

ii) How much do you like using texture?

Table L.15 How much do you like using texture

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	8 (26.7%)	3 (10.0%)	8 (26.7%)	5 (16.6%)	6 (20.0%)	30 (100.0%)
TD	15 (50.0%)	4 (13.3%)	4 (13.3%)	7 (23.4%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated a significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 9.94, p = .04. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .02, indicated a significant trend difference.

Table L.16 Aggregated data for how much do you like using texture

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	19 (63.3%)	11 (36.7%)
TD	23 (76.7%)	7 (23.3%)

Table L.17 Responses to open-ended interview questions about texture

Touch - Comments relating to touch, extracted from open-ended interview question responses			
ID Participants -		**TD Participants**	
How much do you LIKE using each of the following when finding your way in a building~		**How much do you LIKE using each of the following when finding your way in a building~**	
Are there any other things you like to use		**Are there any other things you like to use**	
Braille	1	No comments	
What SPECIFIC problems do you think someone with an ID would have in accessing this building~		**What SPECIFIC problems do you think someone with an ID would have in accessing this building~**	
No comments		Texture	
		Would help for vision impaired people	1
		Texture on floors might help them better than colour	0
How much did the following things make your wayfinding more DIFFICULT		**How much did the following things make your wayfinding more DIFFICULT**	
Texture on surfaces		Texture on surfaces	
No verbal response	2		

Not at all	26	Not at all	28
A tiny bit	0	A tiny bit	
		They could have separated the type of carpet, or whichever	1
A Little		A Little	0
No explanation	2		
Quite a lot	0	Quite a lot	
		Because the way the texture was, looked a bit more sterile and serious	1
A Great deal	0	A Great deal	0
How much did the following things HELP you find your way		**How much did the following things HELP you find your way**	
Texture on surfaces		Texture on surfaces	
Not at all	20	Not at all	26
A tiny bit		A tiny bit	
No explanation	1	In corridors, cos know carpet	1
Cos carpet in wards knew where going	1	Might be more comfortable for patients to be	1
A Little		A Little	
No explanation	2	No explanation	2
Difference in surface identified where going in hospital	1		
Quite a lot		Quite a lot	0
No Explanation	1		
Change in texture when went outside - when we went too far	1		
A Great deal		A Great deal	0
No explanation	1		
Different in hospital cos use vinyl	1		
Explanation not clear	1		
How much do you LIKE using each of the following when finding your way in a building~		**How much do you LIKE using each of the following when finding your way in a building~**	
Texture		Texture	
May be good for people who are blind	1	Could give a sense I'm on right track	1
		Never encountered	1
		Don't really think about it	3
		Don't pay attention to floor for it to be effective	3
		Not sure how it would work	1
		May be useful after you've become familiar with building	1
		Could use different surface textures for corridor, main areas and patient - good visual cue	2
		use it in conjunction with colour	1
		Carpet has more of a general feel, more specialised areas look for vinyl	3
		Can define what happens in area	1
Are there any other things you like to use		Are there any other things you like to use	
Braille	1	Ways to give greater delineation of areas	1
More tips, more help	1		

How difficult was it to ACTUALLY use the following in the building		**How difficult was it to ACTUALLY use the following in the building**	
Relatively easy		**Relatively easy**	
No specific explanation	7	Would have been easy I suppose	
Used it in corridors	1	Preconceptions of what things mean, carpeted areas special, lino means something beds going up and down	

Had stuff for Braille people on ground but didn't use it	1	Don't stick carpet near lift, etc. so might have helped but not as much as other things	
Relatively hard		**Relatively hard**	
No explanation given	9	Hard in this building (did not explain why)	1
Didn't make any difference	1	No explanation given	1
Didn't really look at texture	9	Cos, it wasn't part of the way to go	1
Didn't see it	2	Not use at all	8
		Didn't see anything	6
		Cost it was all carpeted so I didn't know where going through wards, but lifts more like a vinyl	1
		Didn't think that texture would indicate relationship with places, but if aware would have been useful	5
		No indication how to use texture to find locations	1
		Can't remember using it, but may be subconsciously	1
		Saw different surfaces but didn't tell you where to go	1
		Not sure change of textures was even allowed to be in there, so not helped to find locations	1
		Didn't notice it really, but vinyl, for instance, could indicate different areas	1

4. Smell

i) How much did smell help you find the way

Table L.18 How much did smell help you find your way

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	24 (80.0%)	2 (6.7%)	2 (6.7%)	1 (3.3%)	1 (3.3%)	30 (100.0%)
TD	27 (90.0%)	3 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 4.38, p = .36. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .06, indicated a marginally significant trend difference.

Table L.19 Aggregated data for how much did smell help you find your way

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	30 (100.0%)	0 (0.0%)

ii) How much did smell make wayfinding more difficult

Table L.20 How much did smell make your wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	24 (80.0%)	1 (3.3%)	4 (13.4%)	1 (3.3%)	0 (0.0%)	30 (100.0%)
TD	28 (93.4%)	1 (3.3%)	1 (3.3%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 3.11, p = .38. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .07, indicated a marginally significant trend difference.

Table L.21 Aggregated data for How much did smell make your wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	29 (96.73%)	1 (3.3%)
TD	30 (100.0%)	0 (0.0%)

Table L.22 Responses to open-ended interview questions about smell

Comments relating to smell, extracted from open-ended interview question responses			
ID Participants -		**TD Participants**	
b) How much did the following things make your wayfinding more DIFFICULT		**b) How much did the following things make your wayfinding more DIFFICULT**	
iv) Smell		**iv) Smell**	
1. Not at all	25	1. Not at all	28
2. A tiny bit	0	2. A tiny bit	
		a) Hospital smell not nice, so may have put a little off	1
3. A Little	0	3. A Little	
a) Food smell made it a little difficult	1	a) Smells in the wards put you off a bit, I wanna get out	1
b) Food smell made me hungry	3		
4. Quite a lot	0	4. Quite a lot	0
a) Smell of patients	1		
5. A Great deal	0	5. A Great deal	0
c) How much did the following things HELP you find your way		**c) How much did the following things HELP you find your way**	
iii) Smell		iii) Smell	
1. Not at all	24	1. Not at all	27
2. A tiny bit	0	2. A tiny bit	0
a) No clear explanation	2	a) Passed cafe and all hospitals have distinctive smell, particularly in wards, so know getting nearer	1
		b) Around the kiosk there was smell of food, so knew in familiar territory	1
		c) Wards have hospital smell	1
3. A Little		3. A Little	0
a) Made me go somewhere	1		

b) Because I can smell food	1		
4. Quite a lot		4. Quite a lot	0
a) No clear explanation	1		
5. A Great deal		5. A Great deal	0
a) Especially in cafeteria - lets go that way	1		

5. Heat

No information

6. Crowdedness

i) How much did crowds of people make your wayfinding more difficult

Table L.23 How much did crowds of people making your wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	21 (70.0%)	4 (13.3%)	3 (10.0%)	2 (6.7%)	0 (0.0%)	30 (100.0%)
TD	16 (53.3%)	9 (30.0%)	5 (16.7%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 5.10, p = .17. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .381, indicated no significant trend difference.

Table L.24 Aggregated data for How much did crowds of people making your wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	30 (100.0%)	0 (0.0%)

Table L.25 Responses to open-ended interview questions about crowdedness

Comments relating to crowdedness			
ID Participants		**TD Participants**	
b) How much did the following things make your wayfinding more DIFFICULT		**b) How much did the following things make your wayfinding more DIFFICULT**	
v) Crowds of people		v) Crowds of people	
0. Not answered	1	0. Not answered	0
1. Not at all	20	1. Not at all	2 0
2. A tiny bit	0	2. A tiny bit	0
a) Too many people walking around	2	a) Vehicles carrying people make me nervous	1
b) No clear explanation	2	b) At the lifts, didn't want to hold all the people up	1
		c) Had to move for a person who was passing	1
		d) At the lift couldn't get in a couple of times because hospital beds	1
		e) Bit of movement along corridors when trying to stop and start along corridors looking for signs	1
3. A Little	0	3. A Little	
a) Hard to get into a lift cos crowded	2	a) In the wards, quite a few people moving through the corridors	1
b) No specific explanation	1	b) From the beginning, too many people	1
		c) Walking down corridors had to watch out not walk into people, so walked slower	1
		d) Should I get in the lift or wait for another one	2
4. Quite a lot	0	4. Quite a lot	0
a) No specific explanation	1		
b) Lot of people in wards and stuff	1		
5. A Great deal	0	5. A Great deal	0

7. People moving in a specific direction

i) How much did people moving in a specific direction help you find your way

Table L.26 How much did people moving in a specific direction help you find your way

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	21 (70.0%)	3 (10.0%)	4 (13.3%)	0 (0.0%)	2 (6.7%)	30 (100.0%)
TD	19 (63.4%)	3 (10.0%)	7 (23.3%)	1 (3.3%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.92, p = .42. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .50, indicated no significant trend difference.

Table L.27 Aggregated data for How much did people moving in a specific direction help you find your way

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	29 (96.7%)	1 (3.3%)

ii) How much did people moving in a specific direction make your wayfinding more difficult

Table L.28 How much did people moving in a specific direction make your wayfinding more difficult

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	26 (86.6%)	2 (6.7%)	0 (0.0%)	2 (6.7%)	0 (0.0%)	30 (100.0%)
TD	23 (76.6%)	5 (16.7%)	2 (6.7%)	0 (0.0%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 5.47, p = .14. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .50, indicated no significant trend difference.

Table L.29 Aggregated data for How much did people moving in a specific direction make your wayfinding more difficult

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	28 (93.3%)	2 (6.7%)
TD	30 (100.0%)	0 (0.0%)

Table L.30 Responses to open-ended interview questions about people moving in a specific direction

people moving in a specific direction			
ID Participants		**TD Participants**	
b) How much did the following things make your wayfinding more DIFFICULT		**b) How much did the following things make your wayfinding more DIFFICULT**	
vi) People moving in a specific direction		**vi) People moving in a specific direction**	
1. Not at all	**26**	1. Not at all	**23**
2. A tiny bit	**0**	2. A tiny bit	
a) Cos, I followed them when I don't want to	**1**	a) People trying to get past at the ward	**1**
b) Ward G64, doctors rushing a bit	**1**	b) May get drawn into the crowd	**1**
		c) Only in the lifts	**1**
		d) A bed coming through so had to move out of the way	**1**
3. A Little	**0**	3. A Little	
		a) When everyone is getting out of the lift	**2**
		b) When contending with oncoming traffic	**1**
4. Quite a lot	**0**	4. Quite a lot	**0**
a) No explanation	**2**		
5. A Great deal	**0**	5. A Great deal	**0**

c) How much did the following things HELP you find your way		**c) How much did the following things HELP you find your way**	
v) People moving in a specific direction		v) People moving in a specific direction	
1. Not at all	20	1. Not at all	19
2. A tiny bit	0	2. A tiny bit	0
a) No explanation	2	a) People moving in same direction gave comfort if got lost	1
b) People in lift when I was going to G64 and I pressed six that that was easy after that	1	b) When you see lot of people on ward, likely to be reception	1
		c) If no one around you're probably going wrong way	1
3. A Little	0	3. A Little	0
a) If you have to get out quickly, then you can ask them	1	a) People going up to wards, so know where	1
b) No explanation	3	b) Cos, I followed a vehicle	1
c) Following people who I thought were going to find the blue lifts	1	c) Saw people moving in a direction and thought they may be going to reception	1
		d) People walking in the direction of the lifts	1
		e) Follow someone cos you guess they're going in certain direction	1
		f) People were going up in the lift so I got in as well	2
4. Quite a lot	0	4. Quite a lot	0
		a) Everyone was following so I just followed	1
5. A Great deal	0	5. A Great deal	0
a) Cos, I followed people who I thought were going same way as me	2		

8. Sensory with no relevant information

No information

Appendix M Supportive Features

1. Asking

i) How difficult was it to ask people?

Table M.1 How difficult was it to ask people

Group	Impossible	Very Hard	Hard	Reasonably Easy	Easy	Very Easy	Total
ID	7 (23.3%)	2 (6.7%)	2 (6.7%)	1 (3.3%)	9 (30.0%)	9 (30.0)	30 (100.0%)
TD	3 (10.0%)	2 (6.7%)	4 (13.3%)	6 (20.0%)	8 (26.7%)	7 (23.3%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (5, N = 60) = 6.15, p = .29. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .39, indicated no significant trend difference.

Table M.2 Aggregated data for how difficult was it to ask people

Group	Impossible, Very hard and Hard,	Reasonably easy, Easy and Very easy
ID	11 (36.7%)	19 (63.3%)
TD	9 (30.0%)	21 (70.0%)

ii) How much do you like using people to help you find your way?

Table M.3 How much do you like using people to help you

Group	Not at all	A tiny bit	A little	Quite a lot	A great deal	Total
ID	1 (3.3%)	4 (13.3%)	8 (26.7%)	6 (20.0%)	11 (36.7%)	30 (100.0%)
TD	1 (3.3%)	10 (33.3%)	6 (20.0%)	8 (26.7%)	5 (16.7%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 5.39, p = .25. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .06, indicated a marginally significant trend difference.

Table M.4 Aggregated data for How much do you like using people to help you

Group	Not at all, A tiny bit, A little	Quite a lot, A great deal
ID	13 (43.3%)	17 (56.7%)
TD	17 (56.7%)	13 (43.3%)

Table M.5 Responses to open-ended interview questions about asking

Responses to open-ended questions about asking			
i) ID Participants		**TD Participants**	
ii)			
a) What SPECIFIC problems do you think someone with an ID would have in accessing this building~		**a) What SPECIFIC problems do you think someone with an ID would have in accessing this building~**	
1. Could do ok			
i) Asking	9		
2. Would have difficulty			
viii) Asking people		vii) Asking people	
a) Frustrating for them to have to ask people	1	a) Don't think they would have capability of asking someone and making that person understand them	1
b) Would be easier if they knew someone	1	b) People being asked may see someone like that and go like stair at them and go err, and kinda don't answer them	1
c) Wouldn't be clear for some people with ID to know who worked at hospital	1	c) If get lost may not feel so comfortable asking for someone or may not know where to ask	1
d) Ability to ask and comprehend would depend on stage of learning disabilities	2	d) Wouldn't have the skills	1
e) Don't where to go unless ask, but may not be able to ask	1	e) Might have trouble verbalising their questions of the specifics, so if they have a map or something to show them where	1
f) Depends if they're nervous type	1	f) Would be difficult because no help at the back entrance apart from being able to find someone to ask	1
g) Possible problem understanding	2	g) Get confused, so very difficult for them to approach somebody	1
h) Problem finding, if given directions	1	h) Would be helpful if someone there to assist them	1
i) Wouldn't know where to ask people	1	i) There are numerous people walking around to help them	1
j) Wouldn't want to ask	1	j) May not be keen to ask	1
k) Have people at entrances to ask and guide where to go	1	k) If you could ask people, that would be the easiest way	1
		l) But if you ask, what's your comprehension like, or what they say, would have to be lead there, such a variable kinda thing to work with	1
		m) May not ask the person as reception as there was a large glass panel in front of them	1
		n) There are some certain disabilities that would find it really hard to communicate with people	1
		o) Difficulty with communicating with nurse or someone who works in the hospital and being able to get clear information, clear directions and understanding	1
		p) Asking could be pretty daunting without assistance from staff	1

		q) More information desks	1
		r) Were people to ask, but not sure whether they would understand directions as so many corridors, like a maze and if weren't clear would have been even more stressful	1
		s) Relying on people to give direction maybe bit difficult depending on their ID	1
a) What was the MOST HELPFUL thing		**a) What was the MOST HELPFUL thing**	
ii) Asking people		v) Asking people	
a) Generally	5	a) Generally	1
b) Helped me where to go	2	b) Verbal instructions	2
c) Find it more easy asking people for directions	1	c) Sent me in the right direction	1
d) When people teach me how to walk right to the hospital	1	d) People who helped me	1
		e) Could explain to me where to go	1
b) What was the MOST ANNOYING thing		**b) What was the MOST ANNOYING thing**	
vii) Asking		vi) Asking	
o) The man who was quite rude to me	1	h) Asking people - didn't know anything was	1
		i) Person asked just assumed I would know where G block was, or the map, expect more things when you ask someone	1
		z1) No information desk at back entrance	1
c) If you could tell the Hospital how to make it easier to find your way, what would you say		**c) If you could tell the Hospital how to make it easier to find your way, what would you say**	
xi) Asking		iiii) Asking	
xx) Asking someone who knows the hospital well	1	a) To ask questions	1
xxiii) Ask people	1	b) At entrance	1
		c) Person next to gate doing nothing else but helping	1
d) Is there any other information you think could help us better understand the difficulties in finding your way around the building		**d) Is there any other information you think could help us better understand the difficulties in finding your way around the building**	
v) Asking		ii) Asking people	
a) Have a lady to ask	1	a) Customer service counters around so lost people would have friendly services	1
		b) To watch and if someone looks lost offer to help	1
l) How much do you LIKE using each of the following when finding your way in a building~		**l) How much do you LIKE using each of the following when finding your way in a building~**	
v) People		v) People	
a) Helpful if you're not familiar	1	0) really don't see the need to ask	0
b) Depends if there was straight signage	1	a) freeze when asking - ideal prefer to just go by signs - don’t really like approaching people	2
c) Ask cos may not know where to go	1	b) feel quite comfortable asking	1
d) If people are not trying to understand what I'm saying then its better asking my parents rather than making you look silly	1	c) depends on the person you ask	1
e) Because people know their way around	1	d) If I can't find what I'm looking for	1
f) look for right people to ask, wearing badge, or at counter, information desk	1	e) I'm really bad at hearing instructions	1
g) like to ask because you can conversations with people	1	f) If I'm in a hurry, but otherwise don't want to bother people	1

h) Didn't ask people cos they were busy	1	g) Quite a reliable source	1
i) Know person to ask if they work at the location	1	h) Only a little cos male pride getting in way	1
j) Try to find first	1	i) gives confirmation you're on the right track	1
k) Just don't like asking people, but will if have to	2	j) Prefer to know where I am going before I get there	1
		k) Usually pretty confident that I can do it without asking	1
		l) partly due to the fact that my Mum does it	1
		m) find more comfort in finding it myself	1
		n) if will eventually find it, then not worth interrupting what they are doing	2
viii) Are there any other things you like to use		viii) Are there any other things you like to use	
No comments	0	c) Picture of people so know where they work	2
		h) Person to take you there	1
m) Which one of these do you like using the most		**m) Which one of these do you like using the most**	
b) Asking people		d) Asking people	
i) Makes you want to find your way	1	i) Time is such a thing for me and they could tell me immediately	2
ii) People can be a lot of help and they can lead you	1		
iii) Cos you have to ask if never been there before	1		
iiii) They've been at the hospital for a long time and they'll know where it is	1		
v) Because they know where to go	1		
vi) Don't know why - give which way to go, gives info better	1		
n) How difficult was it to ACTUALLY use the following in the building		**n) How difficult was it to ACTUALLY use the following in the building**	
v) Asking people		v) Asking people	
ID-relatively easy		**TD-relatively easy**	
a) No explanation given	3	a) Didn't ask anyone	2
b) Did not ask anyone	1	b) No clear explanation	2
c) Asked doctor because they will like know a lot more about G ward	1	c) Cos there were people around	1
d) No clear explanation	1	d) But not sure who to ask	1
e) Cos they help you out	1	e) Everyone was pretty nice, or found someone if they not know, one not helpful still gave general area	1
f) Cos I found it no problem	1	f) Cos everyone around here are very kind	1
g) But they didn't respond, didn't bother me cos I knew they would be busy	1	g) There were people everywhere	1
h) But didn't feel the need to use them	1	h) In corridors people moving around so easy to ask, but back of hospital couldn't find someone	1
i) Cos I had to ask someone, some look too busy though, but some had tags on	1	i) People around and willing to talk to us	1
j) Because it was easy, I'm a brave young man, know who to ask cos of their badge	1	j) So long as had someone who works here should've been fine	1
k) Cos they send me where to go, easy to ask, knew who to ask cos they were nice	1	k) Staff seem very accommodating	1
l) Cos people are friendly at the hospital, but some instructions were a bit too much	1	l) Receptionist had heard question before	1
m) Easy to try and to ask some people	1	m) But some people were on the phone, so apprehensive, am I meant to be asking	1
n) Person just looked like a nice man that might have known his way around	1	n) My communication skills are good, found it easy to ask, they were better giving directions than someone walking down corridor	1

o) Cos they gave me clear instructions from how to get there, chose because receptionist	1	o) Cos people knew the place, one reception is being barren for a little bit, most were helpful	1
p) Gave the information needed, although had to wait, didn't mind	1	p) But didn't see many to ask and they seemed busy so wouldn't want to bother them	1
q) But I like to do things on my own, only one person didn't help, he wasn't very helpful either	1	q) Weren't a great deal of people around but could have gone back to reception	1
r) The people were easy to talk to	1	r) Didn't ask but saw great deal of people around for me to ask	1
		s) Didn't ask, but if I had to I didn't feel threatened by anyone, saw receptionist and at cafe	1
		t) There were plenty of people there	1
ID-relatively hard		**TD-relatively hard**	
a) They don't understand me, cos you have to speak up and the rest	1	a) No clear explanation	1
b) No response provided	1	b) Didn't feel anyone there that I could ask	1
c) Didn't ask cos I do it myself	1	c) Nobody available, some people seemed busy so didn't feel comfortable approaching them	1
d) Didn't see anyone to ask	2	d) No one seemed interested, no one showed concern and no one there to ask	1
e) Didn't ask anybody, there were only some patients and doctor now and then but not someone you would ask	1	e) Didn't really see anyone, then found maps and confident	1
f) I don't really ask people that much, also not many people around	1	f) One desk was shut down	1
g) Didn't actually see because I was thankful for the right place, it would be easier if the person looked friendly	1	g) Could have asked at shop or similar but didn't	1
h) Only ask if get stuck, not ask cause people around me and I get embarrassed	1	h) Don't think people made themselves necessarily readily available	1
i) Because I had all the maps and signs telling me where to go, saw nurse, would have asked her if I needed to	1	i) It's hard for me, first person was in rush so a bit apprehensive to ask	1

2. Person assisted

Table M.6 Responses to open-ended interview questions about person-assisted features

Responses to open-ended interview questions about person-assisted features			
ID Participants		**TD participants**	
a) What SPECIFIC problems do you think someone with an ID would have in accessing this building		**a) What SPECIFIC problems do you think someone with an ID would have in accessing this building**	
No comments		**xxiiii) Person-assisted**	
		i) Person with ID would need help	1
		j) Could they find the locations	1
		m) Not being able to do this independently would take away their independence so it would be nice for someone to come and be able to be taken or for them to find their own way by signage or the like	1
		w) Could probably get to the places cost someone would stop and help them	1

		y) May need someone to take them, especially if they have high level of stress	1
c) If you could tell the Hospital how to make it easier to find your way, what would you say		**c) If you could tell the Hospital how to make it easier to find your way, what would you say**	
v) Person-assisted		No comments	
iiii) Help someone to get out	1		
xxx) Need someone to teach about maps, map tips	1		
l) How much do you LIKE using each of the following when finding your way in a building~		**l) How much do you LIKE using each of the following when finding your way in a building~**	
v) People		**v) People**	
a) Helpful if you're not familiar	1	0) really don't see the need to ask	0
b) Depends if there was straight signage	1	a) freeze when asking - ideal prefer to just go by signs - don't really like approaching people	2
c) Ask cos may not know where to go	1	b) feel quite comfortable asking	1
d) If people are not trying to understand what I'm saying then its better asking my parents rather than making you look silly	1	c) depends on the person you ask	1
e) Because people know their way around	1	d) If I can't find what I'm looking for	1
f) look for right people to ask, wearing badge, or at counter, information desk	1	e) I'm bad at hearing instructions	1
g) like to ask because you can conversations with people	1	f) If I'm in a hurry, but otherwise don't want to bother people	1
h) Didn't ask people cos they were busy	1	g) Quite a reliable source	1
i) Know person to ask if they work at the location	1	h) Only a little cos male pride getting in way	1
j) Try to find first	1	i) gives confirmation you're on the right track	1
k) Just don't like asking people, but will if have to	2	j) Prefer to know where I am going before I get there	1
		k) Usually pretty confident that I can do it without asking	1
		l) partly due to the fact that my Mum does it	1
		m) find more comfort in finding it myself	1
		n) if will eventually find it, then not worth interrupting what they are doing	2
viii) Are there any other things you like to use		**viii) Are there any other things you like to use**	
b) More tips, more help	1	h) Person to take you there	1

Appendix N Emotional Factors Affecting Wayfinding

1. How much of the time did you feel nervous?

Table N.1 Results of Question 3a - How much of the time did you feel nervous?

Question	Group	None of the time	Very little of the time	Some of the time	Most of the time	All of the time
How much of the time did you feel nervous?	ID	7 (23.3%)	7 (23.3%)	9 (30.0%)	5 (16.7%)	2 (6.7%)
	TD	4 (13.4%)	12 (40.0%)	10 (33.3%)	3 (10.0%)	1 (3.3%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (4, N = 60) = 3.02, p = .55. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .41, indicated no significant trend difference.

Table N.2 Results of Question 3a - Did being nervous affect where you went?

Question		Group	Where participants felt nervous: None of the time	Very little of the time	Some of the time	Most of the time	All of the time	**Totals**
Did it affect where you went	Yes	ID	0	3	5	3	0	11
	No		7	4	4	2	2	19
	Yes	TD	1	6	5	3	1	16
	No		3	6	5	0	0	14

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (1, N = 60) = 1.68, p = .19. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .15, indicated no significant trend difference.

Table N.3 Interview comments about “Feeling nervous” and “Specific problems for people with ID in accessing this building”

Collated themes from responses to Question 3a (What made participants feel nervous?)

Component	ID participants		TD participants	
	Theme	No. of times used	Theme	No. of times used
Spatial	It’s like a maze	1	Using wrong lift or incorrectly	3
			Small corridors	2
Visual	Difficulty with map made me nervous	1	Had to use maps more than like to do	1
	Unclear signs	1	Unclear signs	3
	Went into the wrong place (no signs)	1	Not sure where going	1
Supportive	When asking people	1		
Personal issues	Lack of familiarity	5	Lack of familiarity	1
	When thinking about getting lost	1	When being watched	2
	People around me that I don’t know	2	Getting confused	1
			Not thinking about what to do	1
			Lack of confidence	1

Collated themes from responses to Question 5 (What specific problems would people with ID have in accessing this building?)

	ID participants		ID participants	
Component	Theme	No. of times used	Theme	No. of times used
Spatial	No comments about being nervous	0	Long corridors would make them nervous	1
		0	Locations on different levels in the building making them nervous	1
Visual		0	Lack of signs could make them nervous	3
Supportive		0	Feel anxious because they would need help	1

Table N.4 Researcher observations from video coding

Researcher observations from video coding (making participants nervous)		
Component	**ID participants**	**TD participants**
Visual – Sign	Participant is affected by police sign about abuse of staff (M05)	
Visual -Sign	At the end of the short way-out corridor are double doors with an exit over the top (but they are closed, look formidable and don't look like they should be opened). She says "No, they're a fire door" and turns round (M25)	
Visual – Sign		Says it is very confronting with all the arrows pointing and words… (C06)
Spatial – dead end	Participant did not want to go through door at end of short corridor (M06)	
Spatial – vert lift	Lift doors did not work and needed pushing shut. sign on ground floor said "lift out of order" but didn't say it upstairs. made nervous (M06)	She came out of gold lifts because there was a sign that said patients only. To be safe, I'll use the ones I know (C28)
Spatial - corridor	Went down a corridor behind green lifts but she stopped and turned round because she was not happy with going down the corridor because it went to the emergency department and she saw a sign saying that (M25)	
Spatial – door off main		She didn't want to open the door because that she was nervous about it (C13)
Sensory - sound	Very loud banging when participant was at dead end of corridor. She did not seem happy (M17)	
Personal	Said his heart rate is going up (M31)	
Personal	Not happy about seeing a sick patient wheeled past in the bed. Upset (M05)	
Personal		Says, on ward, you feel like you are invading privacy (C03)
Personal		With people on beds, feel like I ought not to be here (C26)

2. How much of the time did you feel unsafe?

Table N.5 Results of Question 3a - How much of the time did you feel unsafe?

Question	Group	None of the time	Very little of the time	Some of the time	Most of the time	All of the time
How much of the time did you feel unsafe?	ID	22 (73.3%)	5 (16.7%)	2 (6.7%)	1 (3.3%)	0 (0.0%)
	TD	23 (76.7%)	6 (20.0%)	1 (3.3%)	0 (0.0%)	0 (0.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 1.45, p = .70. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .28, indicated no significant trend difference.

Table N.6 Results of Question 3a - Did feeling unsafe affect where you went?

Question		Group	Where participants felt unsafe: None of the time	Very little of the time	Some of the time	Most of the time	All of the time	**Totals**
Did it affect where you went	Yes	ID	0	3	1	1	0	5
	No		22	2	1	0	0	25
	Yes	TD	2	3	1	0	0	6
	No		21	3	0	0	0	24

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (1, N = 60) = .91, p = .74. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .50, indicated no significant trend difference.

Table N.7 Interview comments about "Feeling unsafe"

Collated themes from responses to Question 3a (What made participants feel unsafe?)				
Component	**ID participants**		**TD participants**	
	Theme	No. of times used	Theme	No. of times used
Spatial	If you go in there you think, am I going to be unsafe	1	Felt less safe when outside the building	1
			Have a thing about lifts	1
			Stepped out of lift but unsure so went straight back	1
			Saw small narrow corridor and thought I would stay away	1
			Went down stairs and door hard to get out off, two other doors were locked, yellow one was alarmed and blue one locked, very stressful	1
Supportive	When I had to wait for instructions I felt a little bit unsafe	1	Feeling intimidated, cos alone and unsure	1
Personal issues	Didn't want to get into something I wasn't meant to	1	Security made me feel safe so I knew I would be alright even if I got lost	1
	Thought someone might hurt you in the wards	1	Feeling intimidated because alone	1

Table N.8 Researcher observations from video coding

Researcher observations from video coding (making participants feel safe/unsafe)		
Component	**ID participants**	**TD participants**
Spatial – prospect refuge	Stops at double doors and prospects/refuge from behind doors to look down the remainder of the corridor (M18)	
Personal feeling		Goes into G 65 but says it feels like a ward, so won't go further in (C03)
Personal feeling		There was a sign about use of the gold lifts, therefore to be safe they will use the ones they know (green lifts) (C28)
Personal feeling		Being in hospital I feel safer (C08)

3. How much of the time did you know where to go and how much of the time did you feel helpless/lost

Table N.9 How much of the time did you feel you knew where to go?

Group	None of the time	Very little of the time	Some of the time	Most of the time	All of the time	Total
ID	0 (16.7%)	8 (40.0%)	13 (36.6%)	7 (6.7%)	2 (0.0%)	30 (100.0%)
TD	0 (6.7%)	7 (53.3%)	11 (33.3%)	12 (6.7%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 3.55, p = .34. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .44, indicated no significant trend difference.

Table N.10 Comments about why participants felt they knew where to go

Collated themes from responses to Question 2j (Knew where to go most/all of time because:)				
Component	ID participants		TD participants	
	Theme	No. of times used	Theme	No. of times used
Spatial			Knew rough direction	1
Visual	Followed the signs	2	Knew signs would help	1
			Confident reading signs	1
			Had direction arrows on signs	1
			Just needed to follow signs	1
			Figured out map and then everything else pointed in right direction	1
			Good signs	1
Supportive	Asked if necessary	1	Good directions	1
Personal abilities	Familiarity with where to go	4	Familiarity grew with each trip	2
	Didn't feel lost at all	1	Familiarity with structure of hospitals	1

Table N.11 How much of the time did you feel helpless or lost?

Group	None of the time	Very little of the time	Some of the time	Most of the time	All of the time	Total
ID	5 (16.7%)	12 (40.0%)	11 (36.6%)	2 (6.7%)	0 (0.0%)	30 (100.0%)
TD	2 (6.7%)	16 (53.3%)	10 (33.3%)	2 (6.7%)	0 (0.0%)	30 (100.0%)

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (3, N = 60) = 1.91, p = .59. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to assess whether there is a significant difference in the trend between the two groups. In this case, the result, p = .44, indicated no significant trend difference.

Table N.12 Did feeling helpless or lost affect where you went?

Question		Group	How much of the time did it affect where you went?					**Totals**
			None of the time	Very little of the time	Some of the time	Most of the time	All of the time	
Did it affect where you went	Yes	ID	0	5	5	2	0	12
	No		5	7	6	0	0	18
	Yes	TD	0	8	7	1	0	16
	No		2	8	3	1	0	14

A chi-square test was performed which indicated no significant difference between the perception of the ID and TD groups, X^2 (1, N = 60) = 1.07, p = .30. However, as the results are based on ordinal data it is also possible to use (1-sided) linear-by-linear association to

assess whether there is a significant difference in the trend between the two groups. In this case, the result, $p = .22$, indicated no significant trend difference.

Table N.13 Comments about what made participants feel helpless/lost

What made participants feel helpless/lost?				
Component	ID participants		TD participants	
	Theme	No. of times used	Theme	No. of times used
Spatial	Didn't know where they were	1	Not knowing where to go	7
	Got stuck on second trip	1	Could not get good sense of direction	1
	Outpatients was harder to find than G64	1	Lot of trial and error	1
			Going to wrong eye clinic	1
Visual	Signs only people at hospital would understand	1	Not many signs on level 6	1
	Lack of signs until you build it up by looking at signs	1	Lack of signs	2
	Signs all over the place, so I had to ask	1	Not sure signs would take me where I wanted to go	1
			Very little help at entrance at back of hospital	1
			Didn't know on map if it was the right place to go	1
			Not sure where I was in relation to map	1
Supportive	Had to ask	1		
Personal abilities	Lack of familiarity	1	Lack of familiarity	3
	Feeling uncertain	2	Lack of confidence	3
			Not being able to remember which way to go to get to elevators	1

Table N.14 Comments about how feeling helpless/lost affected where participants went

How did it affect where you went?				
Component	ID participants		TD participants	
	Theme	No. of times used	Theme	No. of times used
Spatial	I walked straight past where I was supposed to go	1	Made me wonder if I was going the wrong way	1
	Had to make my way through	1		
Visual	Made me go and find a directory which would help me	2	Made me look for a map	1
			Made me focus on signs more	1
Supportive	Made me ask	2	Made me ask	3
Personal abilities			Made me feel self-conscious, so went somewhere, wrong place, without thinking, random decisions	3
			Made me stop and think	1

Table N.15 Researcher observations from video coding

Researcher observations from video coding (participants feel helpless/lost) (each line is a separate event)	
	ID Participants
M01	• seems in a trance • just staring ahead • completely lost • decided it was in G block, which was why she was going this way, but no idea why and no idea why going this way to G block • just lost
M02	• can't recognise lifts and hasn't seen overhead signs • says she's looking for lifts • goes all the way down corridor almost to Watling St. and then says should have gone the other way • suggests going to lifts (gold), she is totally lost in the gold lift lobby, then makes a decision to press the down button, but going to the basement which is off limits
M05	• says he is trying to find that letter • looked at sign and said where is B block then researcher asked, "Do you think it is in B block" and he said no • is coming back down corridor and says, "I think it will be G64" • says "I don't know where it is" • stops and points down gold lift corridor and says, "is it that way out?" and then says, "I think it is this way" and keeps going • sees Way Out Sign and acknowledges it and keeps going • says "Exit" and looks down green lift corridor • looks down corridor (to green lifts) and smiles widely. Think he has seen the exit sign and proceeds to go towards green lifts • stopped recording in gold lift as participant could not find any way to proceed, could not get out and did not understand use of lift to get out
M06	• got into lift going the wrong way • goes completely opposite way out of Outpatients department, up to first-floor, takes lift • says she turned right out of the blue lift lobby because it was the way "we came in". This is not true • when asked how she knew it was an exit she pointed back to a sign (but that told her to go left and she is continuing to car park exit) • in lift and asked participant why they chose ground floor and they said, "no idea"
M07	• got out at fifth floor and went round • did not press a button in lift • pressed floor one button • gets to 'EXIT' sign near lifts and it seems like he thinks he has to find an EXIT sign. Does not get out of the building
M08	• asked why she now thinks it is the wrong way she goes and looks at directory on first floor • for some reason turned at Watling Street and went into lift that only goes to 1st floor • turns left out of blue lift lobby because she thinks the exit is that way. She says there is no sign • she continues on outside, going into a garden area for example, until realising this was "out" of the building
M09	• says he thinks he's come the wrong way and he gets to outside doors on East Street • in G 65 area he decides he will go straight to the exit? Why? • now thinks he's gone too far • goes to G 63 Junction, can't decide, goes back and walks straight past lift again. He seems focused on looking to the end of the corridor, not really sideways • says he turned down corridor (towards blue left) to find the closest lifts, but actually walks past them
M10	• walks through Outpatients department in wrong direction and back, constantly saying "G64" as if it would be in this area • is wandering back around Outpatients department again • now points to places on same directory, but not relevant
M11	• says "I don't know what to do" • missed Eye clinic counter • participant got to final G64 sign and turned wrong way

	• presses G in lift because "G" 64, lift is now shut, says" I'm going nowhere", looked for level six in lift buttons but isn't one • when gets into the blue lift lobby on level one the participant asks, "where are we?" • gets in lift and then presses level 2 even though they've been told 6
M13	• now says "turn right she said", (but this was once he was out of the building-so he is totally confused) • gets to end of long corridor and turns around to come back • despite getting into block G, turns around and heads back towards the street saying he will ask someone • he obviously couldn't find the stairs when he got out of the building, so he went back in • is still trying to find the stairs he thought were in the instructions he was given
M15	• gets out at second floor
M16	• says he can see a green sign that says exit but he actually goes past exit. It is at G Street
M17	• says she thinks she might have passed it • gets to end of corridor and says "Damn, done it again, • although she appears to be walking aimlessly down the corridor, she does look up at signs and then reads the card, so she has some concept of needing to find clues
M18	• turns down G Street because she knows there's lifts (she's seen lift signs, but they are the wrong ones)
M20	• in front of directory at Watling Street he can't see the ward G 64, although it is there. He says he is having difficulty finding it
M22	• by the time she goes past the blue lift it is obvious that she is not sure how to get to the enquiry counter • she is in lift, the door has opened on an unknown floor and now it has shut, she is not sure whether she wanted that floor • says go to the lift and press the ground button, but walks past the lift turning
M23	• when asked if she knows what floor she is on she says, "I'm on number eight, so I'm on the wrong floor, I have to go back down again" • after starting and having some difficulty, she admits that she doesn't know whether they are here (Outpatients department) • I have no idea where the ward is • says, "can't see any lettering anyway, A, B, C, D or G" • concerned she can't find a, B, C, D • says "I'm not sure" • goes past lift lobby, heads for exit sign, goes past and up toward G 63
M24	• says "gone too far"
M25	• wants to go to the enquiry counter near the entrance to the East Street. But when she gets there says "oh, that's the voluntary…" • she thought enquiry counter was what she was looking for, not G64 enquiry counter • she is totally confused because it also said lifts towards the closed doors • she seems lost and is now looking anywhere for an Exit sign • turns left out of lifts at ground floor… It didn't look right, so she goes back into the lift lobby
M29	• he had considerable difficulty in knowing which way to get out of the Outpatients department • it took him over six minutes to get out of the Outpatients department area
M30	• goes past Art Gallery. He's not remembered • continues down Watling Street • now says he thinks he's gone the wrong way but it doesn't matter. Thinks he's supposed to be down one floor (which is not correct) • thinks it is the wrong way
M33	• at first junction, he says he is confused (obviously has not understood instructions) • stops in stairwell lobby because he can't work out which door to use to get to stairs. He eventually came out of stairwell lobby and back into G64
	TD Participants
C01	• although exits, is not comfortable that it is an appropriate exit (second floor bridge to car park)
C04	• admits she got carried away and doesn't know where she is going now
C07	• gets to the first junction after G 64 and he's lost • says, if you had orientation issues it would be a real problem-because everything looks so similar
C11	• says she thinks she is at the back of the building (wrong)
C12	• gets to other side of door and says, "I've lost the G block"
C13	• as she goes down G Street, she says "we haven't come across anything remotely lift like"

	• says, "I assume to get out I have to be on the ground floor, but other than that I don't know when I get to the ground floor"
C14	• she thinks she has come in the wrong direction • she has reached the door with G on but doesn't know which lift. She does know it is level six
C16	• is a little concerned. Only knows the outpatient department is down this way (not sure if it is also where the eye clinic is)
C19	• says, "I've totally lost bearings actually"
C22	• although seeing a lot of signs/maps/directory, was still not sure Eye clinic was in the direction of Outpatients department
C25	• has taken wrong turning based on what they thought before starting the exercise • when asked why he came upstairs and through doors, says he has seen the sign. I think the sign is for the Lions Eye Institute
C26	• goes down in front of sushi bar, then stops and comes back because he doesn't recognise down there
C30	• thinks G block reception is the destination. Says "can't see 64". Says it is "enquiry counter" but it actually says "inquiries" • still looking for lifts

4. Would you be happy to find the locations on your own?

Table N.16 Results of Question 3a - Would you be happy to find the locations on your own?

Question	Group	Yes	No
Would you be happy to find the locations on your own?	ID	25 (83.3%)	5 (16.7%)
	TD	25 (83.3%)	5 (16.7%)