Improving the understanding of the innate abilities and navigational strategies (NSs) of visually impaired people (VIP): An analysis and modelling of the variables and their spatial navigational abilities, to assist in the design of the built environment

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A thesis submitted to The Glasgow School of Art for the degree of Doctor of Philosophy

Declaration

I, Ji-Wei Wu, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

There may be a predominant tendency that current researchers and design practitioners approach research and designing for visually impaired people (VIP) by using a ‘deficit-based’ approach or model, which concentrates on addressing their disabilities or limitations resulting from visual impairment (VI), and through the kinds of design strategies and methods they use. Even though these kinds of deficit-based approaches may assist designers to get a sense of the limitations of impaired vision, they are not helpful for designers to understand the more resourceful ‘assets’ and strategies that VIP may already have developed and use in everyday life.

Rather than addressing their disabilities, this research has used an ‘asset-based’ approach to develop a deeper understanding of VIP’s innate capabilities and to establish the extent to which variables such as age, when and how VI occurred, and the kinds of environments they encounter which can affect their use of different kinds and combinations of navigational strategies (NSs), when making a variety of journeys within familiar and unfamiliar environments.

A qualitative methodology was employed. A methodological framework was derived from the literature review to establish a convincing and robust qualitative study and used for interview and case study analysis to provide rich data. Two sets of semi-structured interview were conducted (i.e. one set with VIP and the second with professionals) and the data obtained from the two groups of participants is coded and analysed through the methodological framework. From the review of professional practice and research, four case studies were

selected for analysis using the same methodological framework.

The analysis of the interviews with VIP participants reveals the extent to which VIP use their abilities to navigate around different kinds of environments using a number of NS. These NSs are used in different combinations in different environments. The analysis of the professionals' interviews demonstrated that the professional participants were neither fully aware of the complex variables of each individual VIP nor did they fully understand how VIP navigated around the built environment using these NSs.

According to an analysis of four selected case studies, it was identified that although some design research and practice already recognises that VIP have certain assets (e.g., residual vision) and provide very useful design guides and/or design solutions for strengthening VIP's abilities, there appears to be no literature available for the design community at present that has fully developed an overview and understanding of the 'compensatory' strategies that VIP use, their complexity, and how these strategies are used in different combinations in different kinds of environments when navigating.

The findings from this research shows that there are gaps between what VIP participants demonstrated they were *able* to do (either tacitly, or more consciously) and what the professional participants considered VIP were able to do, which clearly highlights the limitations of the professional participants' understanding of the complexities of VI, and the NS used by VIP. It is also identified the fragmented nature of the research by professionals in this field, a lack of an overview, and the need for appropriate information for professionals involved in the design of the built environment for VIP.

Through revealing and discussing the complexity of NS and the sophistication of their use by VIP, the results of my research here, if presented in an accessible format to professionals, may allow professionals to begin to understand the complexities not only of VI but also to begin to understand VIP's compensatory strategies, that is, a view of the world from the VIP's perspective, and to consider taking a more asset-based approach to designing for VIP. The format of the presentation of the VIP's compensatory strategies is also found to provide a helpful overview for VIP themselves potentially assisting the enhanced discussion of their assets with professionals. This type of approach may also be of value for application in other areas of Inclusive Design and design for impairment, and not limited to VI.

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List of Abbreviations

WHO	World Health Organisation
YLD	Years Lost due to Disability
ID	Inclusive Design
UD	Universal Design
VI	Visual impairment
VIP	Visually impaired people
RNIB	Royal National Institute of Blind People
POAG	Primary open angle glaucoma
AMD	Age-related macular degeneration
ToM	Theory of Mind
CS	Coping strategy
NS	Navigational strategy
GDBA	Guide Dog for the Blind Association
FAST	The Foundation for Assistive Technology
AT	Assistive technology
CWUAAT	Cambridge Workshop in Universal Access and Assistive Technology
CEDC	Cambridge Engineering Design Centre
E1	Environment 1 – the intimate personal environments
E2	Environment 2 – the more public but still familiar environments
E3	Environment 3 – the unfamiliar and unpredictable environments

1. Introduction

Although the author of this thesis is not a designer by training, early in her postgraduate training in product design she developed an interest in the field of inclusive design and in this study, the author would like to explore this without the preconceptions or assumptions that designers might have about how to approach this.

1.1 Summary

This chapter introduces the background to the research. It begins with an overview of demographic changes globally and points out the epidemiological consequences resulting from the ageing population phenomenon. An overview of the development in the field of Design is provided as an investigation of how design communities respond to these issues. The aims of this thesis are then described and the sequence and continuity between each chapter is introduced.

1.2 Research background

1.2.1 Dynamic change in population demographics

According to a report of the U.S. Census Bureau (Kinsella and He, 2009), the global population is now ageing rapidly and the decline in fertility together with the improvement of health and longevity have caused rising numbers and proportions of the older population in most of the world. Kinsella and He (2009) indicate that the population of older people (i.e., 65 and over), especially those who are the oldest old (i.e., 80 and over), in most developed and many developing countries, is increasing dramatically due to the results of high fertility levels after World War II and the reduction of death rates at older ages. Although the level and pace of population ageing differs within different geographic regions, all nations are now actually experiencing an increase in the numbers of their older populations.

Table 1.1 (U.S. Census Bureau, 2008 cited in Kinsella and He, 2009, p.11) illustrates aggregate proportions of older populations projections in major world regions between 2008 and 2040. According to Kinsella and He (2009), Eastern and Western Europe have the highest population proportions aged 65 and over and it is estimated that more than 1 in every 4 Europeans is likely to be at least age 65 by 2040, and 1 in 7 is possibly to be aged 75 years or over. In 2008, the proportions of older population in Northern America and Oceania also appear relatively higher than the rest of the others and by 2040 it is estimated that more than 1 in 5 people in Northern America is likely to be 65 years old or even older. Older populations in Asia, Latin America/Caribbean and Northern Africa by 2040 are estimated to be at least twice than that in 2008. Although the population in Sub-Saharan Africa appears to be the youngest, the proportion of its older population is still growing modestly from 3 per cent in 2008 to an estimated 4.2 per cent in 2040.

Table 1. 1 Percentage of older population by region: 2008 to 2040 (U.S. Census Bureau, 2008 cited in Kinsella and He, 2009, p.11)

Percent Older Population by Region: 2008 to 2040

Region	65 years and over	75 years and over	80 years and over
Northern Africa			
2008	4.9	1.6	0.7
2020	6.7	2.2	1.1
2040	12.8	5.0	2.5
Sub-Saharan Africa			
2008	3.0	0.9	0.3
2020	3.3	1.0	0.4
2040	4.2	1.4	0.6
Asia (excluding Near East)			
2008	6.8	2.4	1.1
2020	9.3	3.3	1.7
2040	16.2	6.8	3.7
Near East			
2008	4.6	1.7	0.8
2020	5.7	2.0	1.1
2040	9.9	3.8	2.0
Eastern Europe			
2008	14.5	6.0	3.0
2020	17.3	6.9	4.3
2040	24.4	12.6	7.8
Western Europe			
2008	17.8	8.5	4.9
2020	20.9	10.1	6.2
2040	28.1	15.0	9.3
Latin America/Caribbean			
2008	6.5	2.5	1.2
2020	8.8	3.3	1.8
2040	15.3	6.6	3.7
Northern America			
2008	12.8	6.2	3.8
2020	16.5	6.9	4.0
2040	20.8	11.6	7.3
Oceania			
2008	10.8	4.9	2.9
2020	13.7	5.7	3.3
2040	18.5	9.1	5.5

According to Kinsella and He (2009), Figure 1.1 illustrates the world's 25 'oldest' countries with the percentage of the population aged 65 and over ranging from 15 per cent to 21 per cent in 2008. It can be seen that Japan is the oldest country of the world's major nations with more than 21 per cent of all the Japanese aged 65 or older. Italy, Germany, Greece and Sweden are also with higher proportions of older people ranging from 18.3 per cent to 20 per cent. The United Kingdom is also one of the world's oldest countries which had (at 2008) 16 per cent of people aged 65 and over.

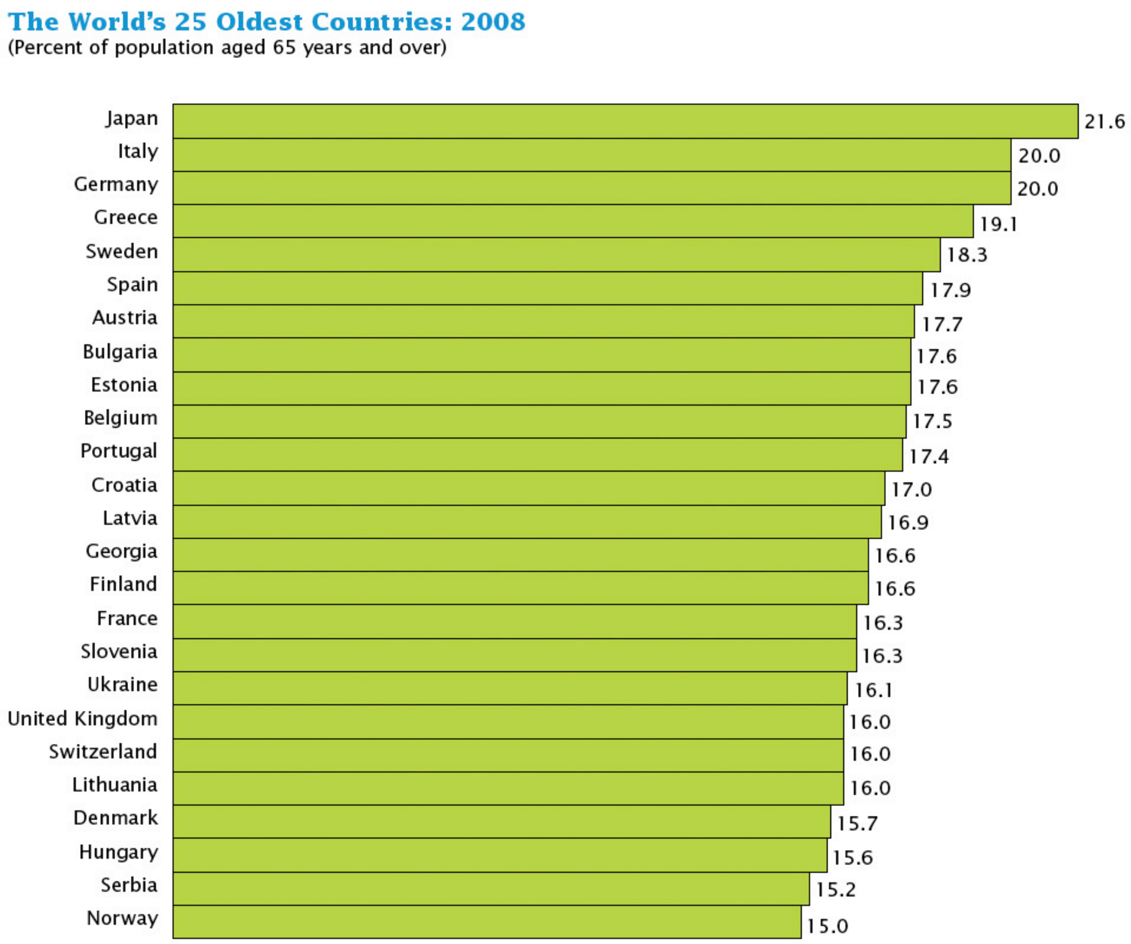


Figure 1. 1 The world's 25 oldest countries: 2008 (U.S. Census Bureau, 2008 cited in Kinsella and He, 2009, p.12)

The population in the UK is continually ageing and the numbers of older people is growing gradually. According to the Office for National Statistics (ONS) (2009), it is projected that the average (median) age in the UK is rising from 39.3 years in 2008 to 40.0 years in 2018 and 42.2 years by 2033 (Table 1.2). The numbers of people aged 60 to 74 is projected to rise from 8.8 million in 2008 to 10.0 in 2018 and to 11.9 by 2033. Those aged 75 and over are projected to increase from 4.8 million to 5.8 in 2018 and 8.7 by 2033. It is indicated that the population of people aged 85 and over is likely to be the age group to increase the fastest from 1.3 million in 2008 to 1.8 million and to 3.3 million by 2033, i.e., projected to increase more than double over 25 years.

Table 1. 2 Projected population by age, United Kingdom, 2008 to 2033 (Office for National Statistics, 2009, p.3)

Projected population by age, United Kingdom, 2008 to 2033

millions

Ages	2008	2013	2018	2023	2028	2033
0-14	10.8	11.0	11.5	11.9	11.9	12.0
15-29	12.3	12.7	12.3	12.1	12.3	12.8
30-44	13.0	12.5	12.8	13.8	14.2	13.8
45-59	11.8	12.7	13.2	12.6	12.2	12.5
60-74	8.8	9.4	10.0	10.5	11.4	11.9
75 and over	4.8	5.2	5.8	7.0	7.9	8.7
75-84	*3.4*	*3.7*	*4.0*	*4.8*	*5.2*	*5.3*
85 & over	*1.3*	*1.5*	*1.8*	*2.2*	*2.6*	*3.3*
All ages	61.4	63.5	65.6	67.8	69.8	71.6
Median age (years)	39.3	40.0	40.0	40.5	41.3	42.2

1.2.1.1 Epidemiological consequences resulting from the ageing demographics

While much research indicates that we are stepping into a rapidly ageing society, one of the major epidemiological trends accompanying the changes in the population structures is the rise of chronic and degenerative diseases in nations throughout the world (World Health Organisation, 2011a).

The World Health Organisation (WHO) (2012a) considers death at any age younger than the highest observed life expectancies as premature, and this can be quantified as “Years of Life Lost” according to how many years earlier than the highest life expectancies it occurred. The Years of Life Lost for people aged 60 and over is examined and the 15 major diseases are identified (Figure 1.2). In spite of the different income levels, the three main diseases that cause premature death in older people aged 60 and over are noncommunicable diseases (NCDs) which include ischaemic heart disease, cerebrovascular disease (stroke) and chronic obstructive pulmonary disease (WHO, 2012a). It can be seen that the burden of premature death caused by NCDs is much higher in low- and middle-income countries than that in high-income countries.

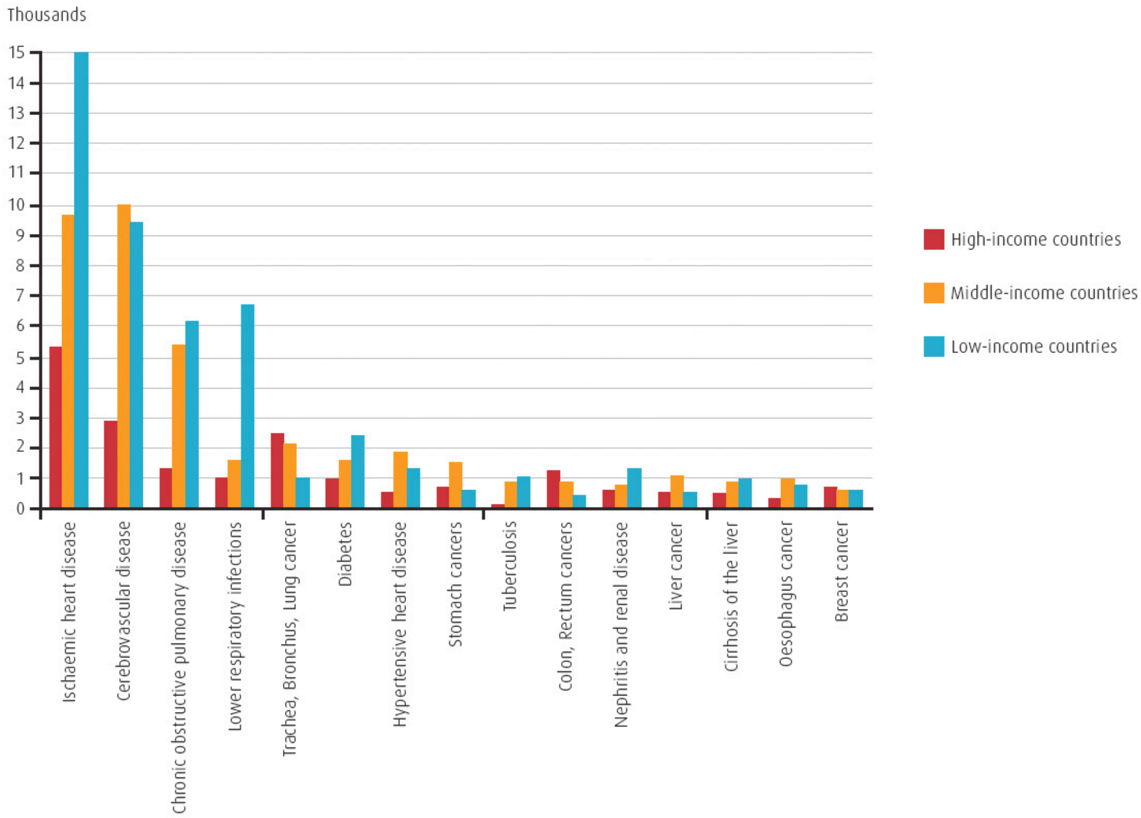


Figure 1. 2 Years of Life Lost due to death per 100,000 adults aged 60 years and over by country income group (WHO, 2012a, p.14)

On the other hand, older people demonstrate higher rates of disability and it is estimated that more than 46% of people aged 60 and over have disabilities. (WHO, 2008 cited in WHO, 2012a, p.14). Figure 1.3 illustrates the 15 major causes of disability in older people by country income group. This uses the concept of "Years Lost due to Disability" (YLD) and is estimated from the incidence of non-fatal disease and a weighting factor reflecting the disease severity (WHO, 2012a, p.15). It can be seen that visual impairment, dementia, hearing loss and osteo arthritis are the four main causes of disability throughout the three country income groups. Visual impairment is indicated as the biggest cause of disability among those aged 60 and over in low- and middle-income countries; meanwhile, the number of older people suffering from visual impairment in low-income countries is more than three times greater than that in high-income countries. According to this YLD analysis, refractive errors, cataracts, glaucoma and macular degeneration are indicated as the main types of visual impairment.

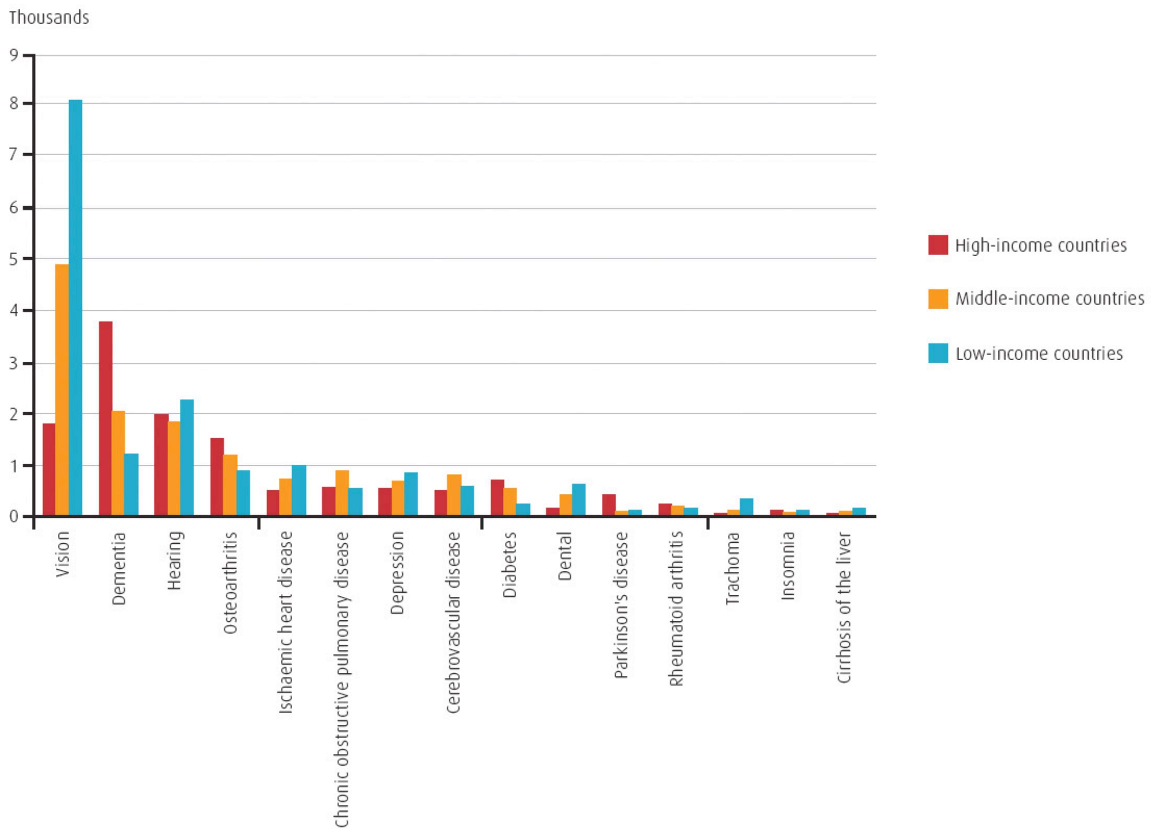


Figure 1. 3 Years Lost due to Disability (YLD) per 100,000 adults aged 60 years and over by country income group (WHO, 2012a, p.15)

Here, in this thesis, the present study will focus on issues arising from visual impairment (VI).

1.2.2 The development of Inclusive Design (ID) / Universal Design (UD) design concepts

To respond to ageing and disability issues, the field of Design developed particular philosophies or approaches to Design to address these issues. Clarkson, et al. (2003) have provided a useful overview of the development of ID/UD, and a brief summary of the development and evolution of these movements is provided here.

1.2.2.1 The US and Universal Design

According to Clarkson, et al. (2003), the development of the ID/UD design concept can be traced from the Second World War. In the US, the war created a strong civil rights movement due to the awareness of equality and civil liberties for black Americans. The success of this activity was the spur for the equally militant disability rights movement arising from the high proportion of wounded who survived after the Vietnam War which brought an increase in the number of young disabled people, especially wheelchair users. The phenomenon emerged that these young disabled people had different needs compared with ‘normal’ people due to the mismatch between the built environment and their physical disabilities. The concept of ‘barrier-free design’ for the disabled appeared in late 1950s which aimed to remove barriers in the built environment for disabled people, especially wheelchair users (Ostroff, 2001). This movement then led to the concept of ‘Universal Design’ (UD). Ron Mace, as the most recognised developer of the UD movement, established the Centre for Accessible Housing at the College of Design at North Carolina State University in 1989 and which was later renamed as the Centre for Universal Design. UD, with its seven principles introduced by the

Centre for Universal Design, was then an innovative design standard for modern times. The Institute for Human-Centered Design[1] continues some of this work today.

1.2.2.2 Europe and Design for all

At the end of the war and with the desire in 1950s for a lasting peace, European countries tended to be more united and expressed a new sense of shared responsibility, with a focus on the individual as part of a more caring community. With this trend, in 1967, the concept of ‘design for all’ was used increasingly around Europe. The idea not only considered people with disabilities but also included all sectors of the population. The ‘design for all’ concept of, with its emphasis on social inclusion, was distinctive from the ‘universal design’ concept of the US which focused on individual rights (Clarkson, et al., 2003). A more comprehensive overview of the European approaches of design for all is also introduced in ‘A European Perspective’ by Coleman, Bendixen and Tahkokallio (2003).

1.2.2.3 Inclusive Design in the UK

In the UK, inclusive design (ID) emerged in the mid 1990s (Clarkson and Coleman, 2013) from the cooperation between design and disability communities. It is considered as an advanced and goal-orientated process through supporting business decision-makers and design practitioners to realise and meet the needs of the whole population.

[1] http://www.adaptiveenvironments.org/

Without compromising between the business profit and consumer satisfaction, the inclusive approach is to include as many people as possible through enlarging the target user of products or services. Its focus is not just on issues of age and disability but on inclusivity at a social level in order to accommodate the whole population without stigma by a range of products and services.

An important dimension of adopting ID approach is opposing design exclusion. Distinguishing why and how many users cannot access a product or service may immediately make apparent the extent of the exclusion issues and encourage business decision-makers and design practitioners to address such exclusion. Keates and Clarkson (1999 cited in CEDC, 2005) introduce the 'inclusive design cube' which not only illustrates the user who is included by each design approach but also who is excluded. More detailed discussion about this ID model will be provided in section 3.2.2.

Led by the Helen Hamlyn Research Centre at the Royal College of Art and the Engineering Design Centre at the University of Cambridge, the ID community in the UK also devotes its efforts to the creation and provision of design tools and techniques for improving the understanding of products, environments and services users (Clarkson, et al., 2003).

1.2.2.4 UD developments in the Far East

Kose (2003) points out that Japan's is the most rapidly ageing population. The rapid ageing tendency pushed Japan to start to deliberate earlier than other Asia countries about how to advance the environment to be accessible by people with different abilities. Their original design concept was solving problems for people with 'special needs' but shifted to 'design-for-all' gradually over the years. Kose (2003) indicates that traditional ideas of barrier-free design, or special-needs design, are no longer valid as everyone has to accept the fact that ageing is one's unavoidable future. Japan is one of the developed countries in Asia which has popularised the universal design concept successfully with the general public. In a development of Mace's seven UD principles, Kose – in 2002 – defined the six Japanese UD requirements of good design which are: safety; accessibility; usability; affordability; sustainability; and aesthetics. The first three are common to barrier-free design, but affordability is essential in universal design as it is related to economic factors. Kose (2003) believes that the most important factor in popularising universal design to the general public is the economic incentive and also the key factor of Japan's success in the universal design movement. More recent developments of UD can be also found in 'International Association for Universal Design' (IAUD)[2], which is one of the current forums promoting UD in Japan.

1.3 Aims of the research

As a consequence of long with the transition of the changing demographic, the population of older people is growing throughout the world and an ageing society is becoming a common phenomenon in many countries. Due to the specific characteristics of, and issues arising from, this population, some design movements (such as those summarised briefly in section 1.2) with their particular

[2] http://www.iaud.net/global/

methodologies and strategies, have been developing during recent years in order to address these issues with the ambition of making, through 'inclusive' design, a more 'whole' society which includes as many people as possible.

At the same time, with reference to one consequence of the ageing demographic, that of sensory impairment, and in particular for the focus of study in this thesis, the increasing incidence of visually impaired people (VIP), it is important to consider how to understand VIP's needs in relation to the built environment and how to make the built environment fit for purpose according to their physical and emotional needs.

Rather than focusing solely on their disabilities, this research aims to develop a deeper understanding of VIP's innate capabilities and to establish the extent to which variables influence these, and also the extent to which professionals understand these, through the following questions:

- What are the range of capabilities and strategies that VIP use when navigating environments?
- How do these capabilities and strategies vary from individual to individual?
- How can one categorise these capabilities and strategies?
- How do these strategies depend on the degree of the VIP's familiarity with - and the kinds of - the environment to be navigated (from those which they know intimately to those which are completely unfamiliar to them)?
- To what extent are 'inclusive' designers aware of VIP's capabilities and strategies?
- Would this knowledge be of value to designers of the built environment?

1.4 Outline of thesis

This thesis consists of nine chapters.

Chapter 1 provides the research background through discussing the causes of ageing phenomena and how design communities have been taking account of people with different capabilities through ‘inclusive’ design movements.

Chapter 2 provides an in-depth literature review of visual impairment (VI) and visually impaired people (VIP). It reviews the prevalence of VI globally, and also investigates the impacts of the onset of VI and how people react to and adjust to the impairment. A review of ‘coping strategies’ (CSs) that are used by VIP in their daily living as well as their abilities in terms of navigation is provided. Through this comprehensive review of the literature, a set of CSs used by VIP and their navigational abilities are identified and form the basis a methodological framework used ultimately to design the research and analyse the data. From this emerge important findings which suggest that the present study begins to look at the capabilities that VIP possess rather than place the focus on their disabilities.

Chapter 3 begins with a review of the development of design models which have evolved and are discussed quite widely in the ID/UD literature and used by the ID/UD community. It identifies that these design approaches have a tendency to stress – compensate for – individuals’ disability rather than capability. This deficit-based approach can be problematic with little focus on improving or exploiting individuals’ strengths and capabilities. Of interest here will be to explore what ‘assets’ VIP possess which may be potentially exploitable by designers. Through the review of current research into the design of the built environment for VIP, the emergence of different types of environment, with varying degrees of familiarity and predictability, that VIP encounter in their daily lives helps this research to explore the strategies that VIP use when navigating within different types of environments and the extent of professionals' understanding of these strategies.

Chapter 4 introduces the methodology adopted in this study. The set of CSs identified from Chapter 2 is structured and developed as a methodological framework and the strategies that VIP use while navigating around the built environment are re-named as navigational strategies (NSs) as a subset of CS. As a result of the review of practice conducted for Chapter 3, four case studies have been selected. The distinctive types of the environments are also defined. The intention of this approach is to enable the researcher to codify and discuss data acquired from VIP's semi-structured interviews in a manner which would reveal the NS used by different individuals in different environments. The potential participants of the semi-structured interviews and the data capture methods are also described.

Chapter 5 describes the design, set-up and analysis of interviews with both VIP and professionals with the intention of comparing the NS that VIP discuss with professionals' understanding of VIP's NS. The profiles of the two groups of participants are provided and initial coding and analysis of interview data are described. Findings from the analysis of VIP and professionals' interviews are summarised.

Chapter 6 provides discussions of preliminary research findings from the VIP participants. Through initially analysing the data according to the three categorised environments, the results from the coding and analysis of interview data suggest that the hypothesis (see section 4.4.3) can be supported.

Chapter 7 uses the same approach to discuss and analyse the data captured from the designer participants. The findings shows that the participants have different levels of understanding of VIP and the results from the coding and analysis of interview data suggest that the hypothesis (see section 4.4.4) can be supported.

Chapter 8 offers a more in-depth analysis of the data to identify the extent to which NS are used by VIP and how they differ (from individual to individual, and as used within each of the three environments), by looking at the variables in the use of NS. At the same time, further discussions of the way that professionals used to approach VIP, and the extent of professionals' knowledge and understanding of VI and VIP's capabilities and strategies for navigating in a number of types of environments are provided. This chapter also discusses the data from the case studies, providing data about professionals' practice (as distinct from interview data) of designing for VI and other disabilities.

Chapter 9 concludes with the main findings, and the strengths and limitations of the study are stated. This research has been able to develop and use a methodological framework which was derived from the literature and case study review for establishing a convincing and robust qualitative study. VIP's strengths and abilities have been identified, and the complexity of VI and the inter-relatedness of different strategies and variables used by VIP have been demonstrated. The present study also distinguished current design models, approaches and tools that have been commonly used by the inclusive design community which appear to be largely deficit-based. According to the research findings, VIP's strategies and assets in the context of navigating different categories of environment have been discussed. The study also contrasted this finding with the limited understanding that designer participants have about VIP's strategies and innate abilities. The fragmented nature of the research by professionals in this field has been demonstrated and there is a need for appropriate information for professionals involved in the design of the built environment for VIP which reflects the complexity and variance of VI and the types of strategies VIP use.

2. Literature Review 1: Visual Impairment (VI) and Visually Impaired People (VIP)

2.1 Introduction

This chapter introduces the background to the research. Due to the particular focus of this study, it begins with a detailed discussion of visual impairment (VI) prevalence globally, various conditions caused by different factors and consequences associated with this. Through the review of the prevalence and the types of VI, a significant difference in the nature of visually impaired people (VIP) at different onset (of VI) age stages is initially identified. This then leads the researcher to begin to investigate other potential variables in VI and VIP.

During the review of literature, it is recognised that although current research in the field of VI provides highly useful knowledge, there were quite a few useful references for this enquiry but the information appears fragmented and often focuses on specific issues. For example, research in the aspects of: i) VIP's spatial cognition is discussed by Ungar (2000 cited in section 2.5.2); ii) congenital VI children's psychological characteristics and social abilities is discussed by Pring (2008 cited in section 2.3.3.1); and iii) older VIP's coping abilities is discussed by Boerner (Boerner, 2004 cited in section 2.3.3.3; Popivker, Wang and Boerner, 2010 cited in section 2.3.3.2; Boerner, et al., 2010 cited in section 2.4.2). Welsh and Tuttle's (1997) research is identified as one of the key references as i) it provides a high quality review of the literature and a more comprehensive discussion of VIP which is particularly relevant to this enquiry; ii) it exhibits the complexities of VI and clearly differentiates a clear set of variables of VI and VIP which significantly affects the adjustment to VI and the development of strategies to cope with the impairment.

Through reviewing Welsh and Tuttle's research in-depth, the present study begins to identify how VIP actually cope with their impairment in daily living. The research conducted by Boerner and colleagues (2010) provides an insight into the use of a conceptual framework for a systematic assessment of VIP's coping strategies (CSs). Meanwhile, Lee and Brennan's (2002) research is identified as another key reference and they identify a set of CSs used by VIP. The last section of this chapter focuses on the investigation of VIP's abilities in terms of navigation and the strengths and capabilities possessed by VIP are identified.

This chapter provides a more in-depth analysis of the latent capabilities of the visually impaired, identifying opportunities for further enquiry, giving rise to research questions and what informed/influenced my early proposal.

2.2 Visual impairment

2.2.1 Introduction

This section provides an overview of visual impairment (VI). It begins to clarify the definitions of VI and blindness according to the data provided by the World Health Organisation (WHO) (2012b). Different levels of VI and blindness are illustrated in the categorisation of VI (Table 2.1) and are noted with acuities in each degree. The main causes and types of VI are discussed. The global prevalence of visually impaired people (VIP) in 2002 and 2004 are demonstrated. This also indicates the main causes of VI and blindness in 2002 and 2010. VI can be caused by disease, age-related condition, and adventitiously. Research identified that the increasing numbers of VI is related to the increased number of the population aged 60 and over; it is also indicated that it is the older adult age group which is the most vulnerable to common eye disorders.

2.2.2 Definition of visual impairment

Visual acuity is acuteness or clearness of vision, which is dependent on the sharpness of the retinal focus within the eye, the sensitivity of the nervous elements, and the interpretative faculty of the brain. The measurement of visual acuity is usually through reading down an eye chart that comprises a number of rows of letters, which is called the Snellen scale (Figure 2.1). Through the Snellen test, a person with standard vision would have a score of 6/6; according to the Royal National Institute of Blind People (RNIB) (2010), the first number given represents the distance (metres) from the eye chart while someone reads it. Normally it is 6 (for 6 metres), however, it would be 3 if someone sits closer to the chart, i.e., 3 metres away. On the other hand, the second number given represents the number of lines that someone is able to read on the chart. The biggest letters are showed on the top line, which correspond to 60, and the numbers correspond to the lines turn smaller when someone read down the chart. The last line on the bottom of the chart corresponds to the number 6 (RNIB, 2010).

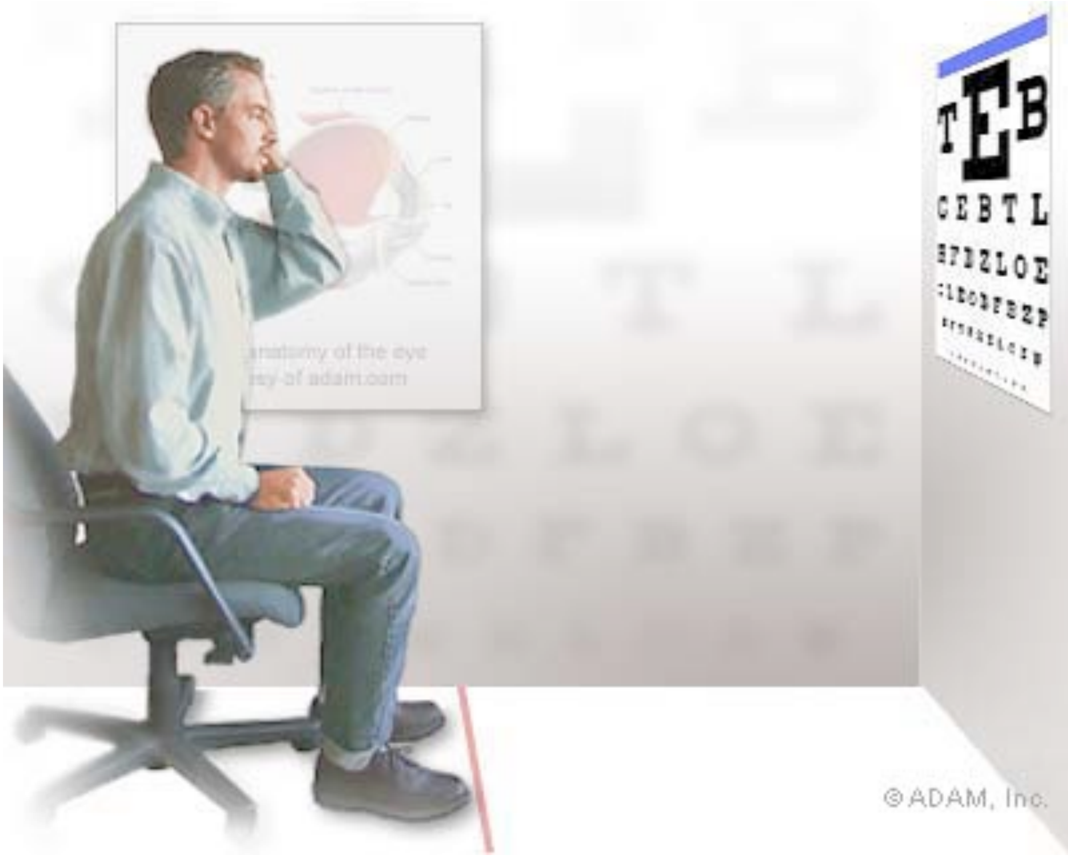


Figure 2. 1 The measurement of visual acuity (A.D.A.M. Medical Encyclopedia, 2013)

The World Health Organisation (WHO) (2012b) defines low vision as “visual acuity less than 6/18 and equal to or better than 3/60 in the better eye with best correction”. Blindness is defined as “those who have “irreversible” blindness (no perception of light) and those that have light perception but are still less than 3/60 in the better eye”. Based on the ICD-10 (the International Classification of Diseases 10th Revision) (WHO, 2003), visual impairment (VI) is categorised as in Table 2.1, which consists of category 0 for mild or no VI, category 1 for moderate VI, category 2 for severe VI, category 3, 4 and 5 for blindness, and category 9 for unqualified VI. Moderate and severe VI (i.e., category 1 and 2) are classified under low vision, and low vision together with blindness represents the term “visual impairment”.

Table 2. 1 The categorisation of visual impairment (WHO, 2003, p.9)

Categories of Visual Impairment	**Presenting distance visual acuity**	
	Worse than:	**Equal to or better than:**
0 Mild or no visual impairment		6/18 3/10 (0.3) 20/70
1 Moderate visual impairment	6/18 3/10 (0.3) 20/70	6/60 1/10 (0.1) 20/200
2 Severe visual impairment	6/60 1/10 (0.1) 20/200	3/60 1/20 (0.05) 20/400
3 Blindness	3/60 1/20 (0.05) 20/400	1/60* 1/50 (0.02) 5/300 (20/1200)
4 Blindness	1/60* 1/50 (0.02) 5/300 (20/1200)	Light perception
5 Blindness	No light perception	
9	Undetermined or unspecified	
	*Or counts fingers (CF) at 1 metre	

2.2.3 The main causes and types of visual impairment

To assist later discussion, VI can be caused:

- by disease
- by age-related conditions
- adventitiously

These are discussed in more detail in the following sections.

2.2.3.1 Global causes of visual impairment

According to the report of the WHO (Resnikoff, et al., 2004), the estimated number of VIP worldwide in 2002 was more than 161 million: the number of blind people was 37 million, and the estimated number of VIP was 124 million (Table 2.2). Meanwhile, there were about 1.4 million of blind people below the age of 15, about 5.2 million aged between 15 and 49, and approximately 30.3 million of blind people aged 50 and older. It was indicated that although blindness in childhood (those below the age of 15) is a vital issue, the number of blind people aged 50 and more is more remarkable with its greater proportion (Resnikoff, et al., 2004).

Table 2. 2 Global estimate of visual impairment by WHO sub-region in 2002 (Resnikoff, et al., 2004, p.847)

WHO subregion	Total population (millions)	No. of blind people (millions)	Prevalence of blindness (%)	No. of people with low vision (millions)	Prevalence of low vision (%)	No. of persons visually impaired (millions)
Afr-D	354.324	3.646	1.0	10.715	3.0	14.361
Afr-E	360.965	3.642	1.0	10.573	3.0	14.215
Amr-A	322.309	0.694	0.2	4.029	1.2	4.723
Amr-B	456.432	1.392	0.3	7.600	1.7	8.992
Amr-D	73.810	0.332	0.5	1.488	2.0	1.820
Emr-B	142.528	1.076	0.8	3.580	2.5	4.656
Emr-D	144.405	1.406	0.97	4.116	2.9	5.522
Eur-A	415.323	0.937	0.2	5.435	1.3	6.372
Eur-B1	169.716	0.618	0.4	2.546	1.5	3.164
Eur-B2	53.130	0.142	0.3	0.590	1.1	0.731
Eur-C	239.717	1.035	0.4	4.219	1.8	5.254
Sear-B	405.313	4.214	1.0	9.669	2.4	13.883
Sear-D	1394.045	8.344	0.6	28.439	2.0	36.782
Wpr-A	150.867	0.393	0.3	1.883	1.2	2.276
Wpr-B1	1374.838	7.731	0.6	26.397	1.9	34.128
Wpr-B2	148.469	1.229	0.8	2.898	1.9	4.127
Wpr-B3	7.677	0.025	0.3	0.090	1.2	0.115
World	**6213.869**	**36.857**	**0.57**	**124.264**	**2**	**161.121**

Afr, WHO African Region; Amr, WHO Region of the Americas; Emr, WHO Eastern Mediterranean Region; Eur, WHO European Region; Sear, WHO South-East Asia Region; Wpr, WHO Western Pacific Region.

On the other hand, the percentage of worldwide causes of blindness in 2002 is illustrated as Figure 2.2. It is clear that the primary cause of blindness was cataracts (47.8%) which occupied almost half of the total blindness population in

2002; meanwhile, it was also the major cause of low vision. Glaucoma was indicated as the second leading cause of blindness throughout the world, which revealed 12.3% of the total, as well as in most areas. The third leading cause globally in 2002 was age-related macular degeneration (AMD), and it was also indicated as the principal cause of blindness in the developed countries. Other causes of blindness such as diabetic retinopathy, childhood blindness and other corneal opacities are demonstrated with approximately the same proportion of 4-5%. It is indicated that ‘the largest proportion of blindness is necessarily related to ageing’ (Resnikoff, et al., 2004, p.849).

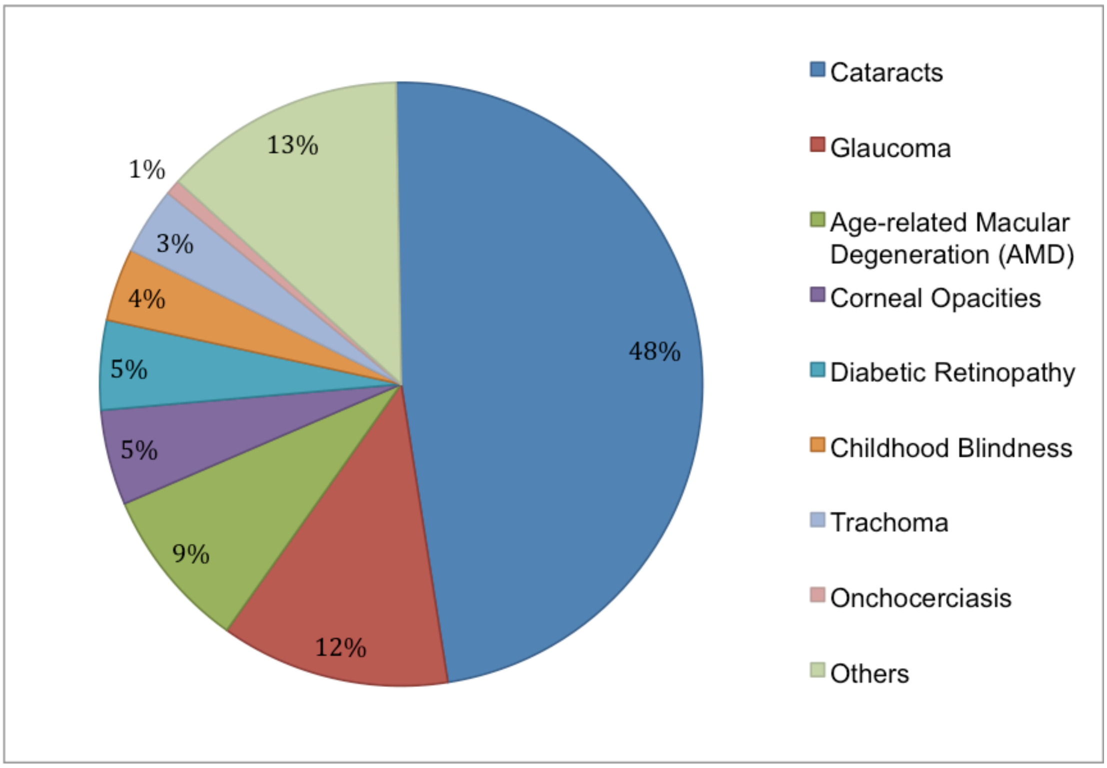


Figure 2. 2 Global causes of blindness in 2002 (Resnikoff, et al., 2004, p.849)

In 2012, the WHO published the most recent data which estimated the global prevalence of visual impairment and its major causes for the year 2010 (WHO, 2012c). The data shows that the numbers of people with VI and blindness are lower than expected; the distribution differs in different WHO regions, and the causes also have significant changes.

According to WHO (2012c), the data shows an estimated number that there were 285 million people with visual impairment in the world in 2010; among them, 39 million were blind and 246 million had low vision (Table 2.3). Meanwhile, it was indicated that 65% of those with visual impairment and 82% of those who were blind are aged 50 and older.

Table 2. 3 Global estimate of VI by WHO region and country in 2010 (WHO, 2012c, p.5)

		Blindness	Low vision	Visual Impairment
WHO Region	Total population (millions)	No. in millions (percentage)	No. in millions (percentage)	No. in millions (percentage)
Afr	804.9 (11.9)	5.888 (15)	20.407 (8.3)	26.295 (9.2)
Amr	915.4 (13.6)	3.211(8)	23.401 (9.5)	26.612 (9.3)
Emr	580.2 (8.6)	4.918 (12.5)	18.581 (7.6)	23.499 (8.2)
Eur	889.2 (13.2)	2.713 (7)	25.502 (10.4)	28.215 (9.9)
Sear (India excluded)	579.1 (8.6)	3.974 (10.1)	23.938 (9.7)	27.913 (9.8)
Wpr (China excluded)	442.3 (6.6)	2.338 (6)	12.386 (5)	14.724 (5.2)
India	1181.4 (17.5)	8.075 (20.5)	54.544 (22.2)	62.619 (21.9)
China	1344.9 (20)	8.248 (20.9)	67.264 (27.3)	75.512 (26.5)
World	6737.5 (100)	39.365 (100)	246.024 (100)	285.389 (100)

In terms of the global causes of VI (Figure 2.3), uncorrected refractive errors were indicated as the primary cause of VI (42%); cataracts presented as the second leading cause with 33% of the total visually impaired population. The third leading cause was glaucoma (2%). Other causes of VI included AMD, diabetic retinopathy, trachoma, corneal opacities, and childhood blindness which occupied 1% each of the total visually impaired population. Undetermined causes represented a large proportion (18%).

Cataracts were also indicated as the main cause of blindness in the world which exceed half of the total blindness population (51%) (Figure 2.4). Other causes included glaucoma (8%), AMD (5%), childhood blindness (4%), corneal opacities (4%), uncorrected refractive errors (3%), trachoma (3%), and diabetic retinopathy (1%). Undetermined causes occupied 21% (WHO, 2012).

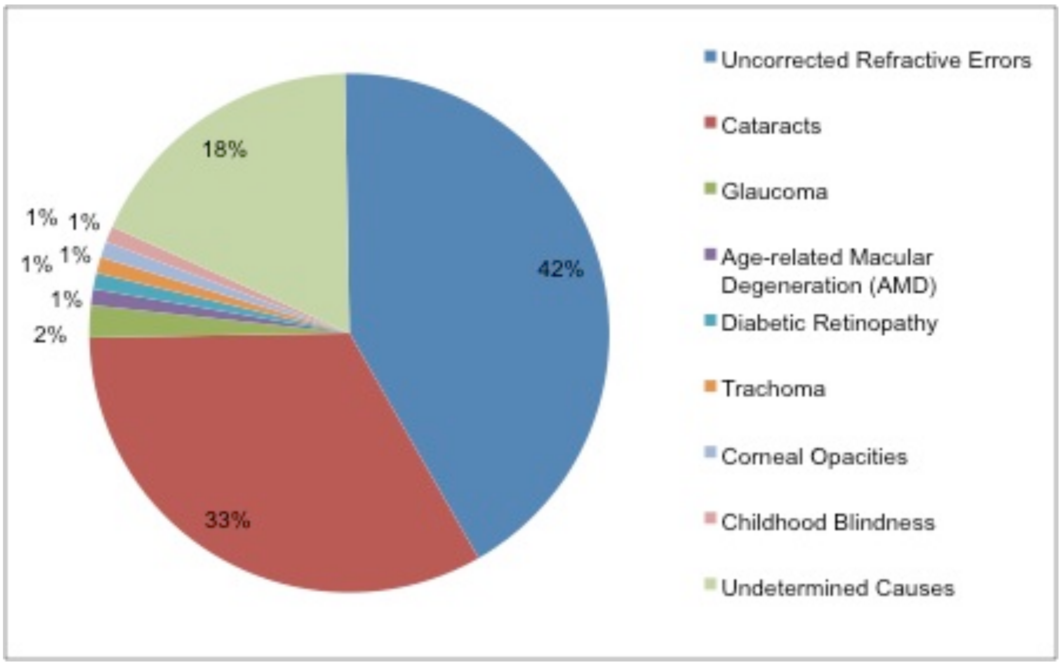


Figure 2. 3 Global causes of visual impairment in 2010 (WHO, 2012c, p.6)

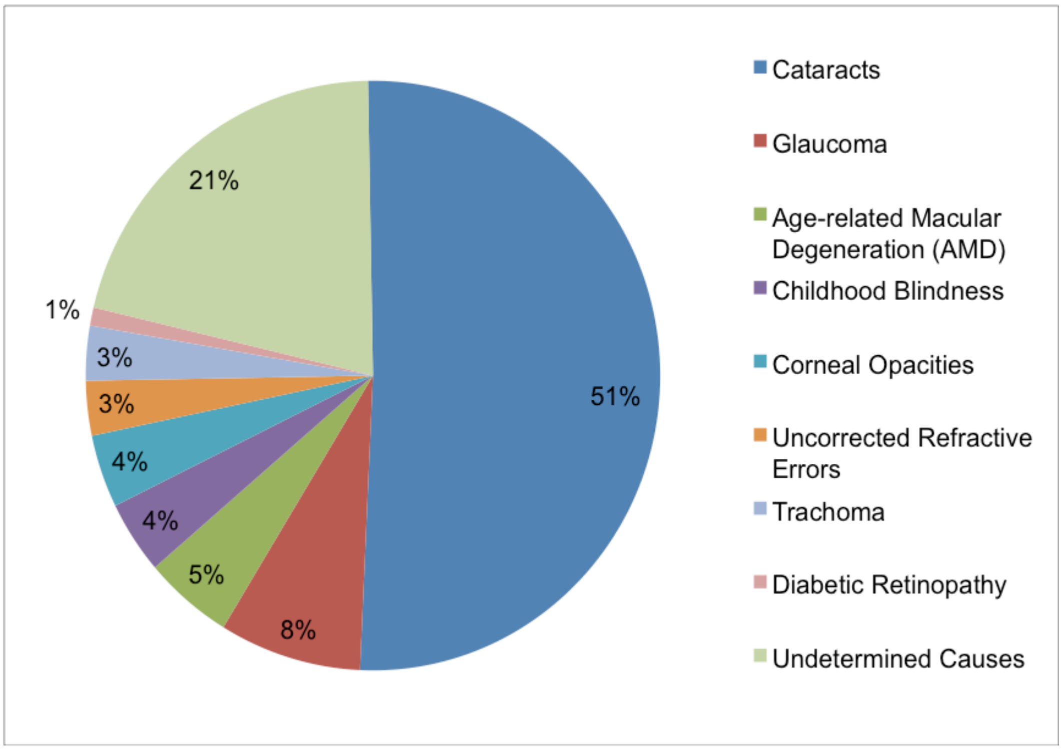


Figure 2. 4 Global causes of blindness in 2010 (WHO, 2012c, p.6)

Although the population of those aged 50 and older is increasing rapidly, it is demonstrated that the number of people with VI in the same age group is lower than expected, and it is explained by the results of a) the improved socio-economic development; and b) the investments of Governments; as well as c) the interventions of international partners (WHO, 2012c). On the other hand, “the proportion of the total visual impairment and blindness from age related macular degeneration, glaucoma and diabetic retinopathy is currently greater than from infective causes such as trachoma and corneal opacities”; therefore, the development of eye care systems is significant in order to cope with chronic eye diseases through the rehabilitation, education and related support service, stated by WHO (2012c, p.4).

2.2.3.2 Regional trends

Resnikoff, et al. (2004) state that excluding China and India, the number of blind people in the developing countries was estimated to be 18.8 million in 1990 and increased 3% to 19.4 million in 2002. On the other hand, in the developed countries, the number of people who were blind was 3.5 million in 1990 and this rose to 3.8 million in 2002, with an increased proportion of 8.5%. During the same period, the population of people who aged 50 and older within these countries had increased 16%. The number of people who had low vision was estimated to be 10 million in 1990, with a more significant increase in number of 18 million in 2002. Resnikoff, et al. (2004) indicated that the raised numbers of VI is necessarily related to the increased number of the population aged 60 and over.

2.2.3.3 Congenital

VI can be caused by congenital and adventitious (see section 2.2.3.4) factors. People who are congenitally blind may have different life experiences so that their demand can be distinguished from those who are adventitiously blind. According to Welsh and Tuttle (1997, p.60), congenital VI refers to “a condition of blindness or severe visual impairment that is present at birth or occurs at an age when the absence of vision probably will alter a person’s conceptual development”. Visual memory is significant in that it provides important building blocks for developing many basic and important concepts; nevertheless, visual memory will not be retained if the onset of blindness is before the age of 3 or 4, indicated by Lowenfeld, (1981) as cited in Welsh and Tuttle (1997, p.60). On the other hand, developmental delays (e.g., social skills, concept development) may also lead to serious consequences in VI children; however, it is remediable and if an early intervention can be made before their adulthood, the characteristics of developmental delays can be well modified (Welsh and Tuttle, 1997).

2.2.3.4 Adventitious

Adventitious VI refers to “individuals who at one time were sighted but who have subsequently lost some, if not all, of their vision” (Welsh and Tuttle, 1997, p.67). The nature of adventitious VI is diverse and includes a wide range of conditions. Some people lose their vision suddenly through an accident, whilst others lose their vision gradually over months or even throughout their life. In some cases, adventitious visual impairment causes individuals to lose their central vision, but retain good peripheral sight; however, some other VI may keep the central acuity, but have poor or no peripheral vision. For some people, it is essential to have higher levels of illumination to see things better, whereas some others may find some situations have too much glare and require lower levels of illumination. Each of the visually impaired or blind people is unique, and their preferences of lighting are highly individualised (Welsh and Tuttle, 1997).

2.2.4 Incidence of visual impairment among people of different ages

2.2.4.1 Childhood incidence

According to the WHO (2007), it was estimated that among 1.4 million children who are blind in the world, 1 million are living in Asia and 300,000 are in Africa. The prevalence ranges of blind children who are aged 0-15 years is from 0.3/1000 children in rich countries to 1.5/1000 children in very poor countries (i.e., five times the rate in developing countries). Meanwhile, it is indicated that there are 500,000 children who become blind each year (approximately one per minute), and most of the children are congenitally blind or become blind by their fifth birthday. Many blind children die in their childhood because of: “measles, meningitis, rubella, prematurity, genetic diseases and head injuries”, and “about 40% of the causes of childhood blindness are preventable or treatable”, revealed by the WHO (2007, p.21).

The WHO (2011b) defines childhood blindness as “a group of diseases and conditions occurring in childhood or early adolescence, which, if left untreated, result in blindness or severe visual impairment that are likely to be untreatable later in life”. At the meantime, the leading causes of childhood blindness are vary in different regions and are based on their “socioeconomic development and the availability of primary health care and eye care services”. The leading causes in high-income countries are “lesions of the optic nerve and higher visual pathways predominate”; “corneal scarring from measles, vitamin A deficiency, the use of harmful traditional eye remedies, ophthalmia neonatorum [neonatal conjunctivitis], and rubella cataract” are the main reasons of childhood blindness in low-income countries; in those middle-income countries, retinopathy of prematurity is the main cause, demonstrated by the WHO (2011b).

2.2.4.2 Age-related visual impairments

According to Stuen and Offner (2001), the older adult is the age group which is the most vulnerable to have common eye disorders, such as cataract, glaucoma, macular degeneration, and diabetic retinopathy. These are also the most common age-related eye diseases which can be discussed as follows.

2.2.4.2i Cataracts

Cataracts are a very common eye disease which can form at any age. RNIB (2009) states that “diabetes, trauma, medications (e.g., steroids), eye surgery for other eye conditions, and other eye conditions” may cause the growth of this condition. Meanwhile, “tobacco smoking, lifelong exposure to sunlight, and having a poor diet lacking antioxidant vitamins” may also reflect the development of cataracts, addressed by the RNIB (2009). Nevertheless, the most common reason for the development of cataracts is ageing. Usually, the lens of the eye changes and turns opaque gradually when people are aged 65 or over, and then leads to an over-blur in the visual field (Figure 2.5).

Cataracts may occur in one or both eyes, and the condition may develop at different rate if both eyes are infected (Lighthouse International, 2009). The vision becomes cloudier and more washed out when a cataract progresses. Objects become more difficult to identify (e.g., edges of stairs) and people with this condition may feel like to have more lights when they are reading smaller print. However, bright lights may cause glare for those with cataracts, in addition their colour vision may be affected and cause things to look more yellow than before (RNIB, 2009).

Along with the increase of life expectancy over the world, the number of people with cataracts is growing. Cataracts can be removed easily by operation; however, WHO (2009) indicates that it is still the major cause of blindness due to the lack of surgical services in many countries. Meanwhile, cataracts are also the leading cause of low vision not only in the developing regions but also in developed countries. WHO (2009) reveals that "long period spent waiting for operations and barriers to surgical uptake, such as cost, lack of information, and transportation problems" are also the reasons of the prevalence of cataracts.

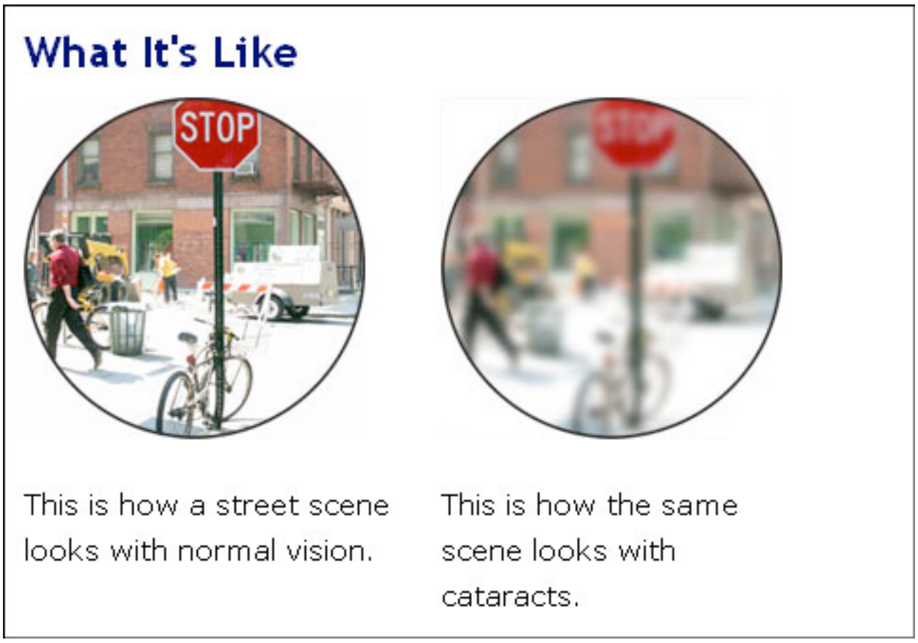


Figure 2. 5 Cataracts (Lighthouse International, 2009)

2.2.4.2ii Glaucoma

Glaucoma is one of the common age-related eye disorders that causes the impairment of peripheral or side vision (Figure 2.6). Glaucoma may be caused by "raised eye pressure or a weakness in the optic nerve", or "an eye pressure within normal limits but the damage occurs because there is a weakness in the optic nerve" (RNIB, 2009). Glaucoma can be classified into four main types which are: i) primary open angle glaucoma (POAG) or chronic glaucoma, ii) acute angle closure glaucoma, iii) secondary glaucoma, and iv) developmental glaucoma.

There are different types of glaucoma. The most common type is primary open angle glaucoma (POAG) or chronic glaucoma. The RNIB (2009) indicated that it becomes more common when one is aged 40 or over and that “about five per cent of people over the age of 65 have primary open angle glaucoma”; meanwhile, one would be at a higher risk of developing POAG if: one’s close relative has this condition; one is with very short sight or with diabetes; one is of African origin.

POAG is a chronic eye disease which causes peripheral vision damage gradually. According to RNIB (2009), people who lose their peripheral vision usually begin with an arc shaped blank area which is a little above and/or below the central vision. The condition is also called “tunnel vision” as the central vision field remains until last and results in vision like looking through a long tube. The blank area will extend not only outwards but also inwards if the condition grows without treatment. “Treatment cannot repair or improve damage that may have already been caused by high pressure before it was found”, and all the treatments for glaucoma are for stopping further damage to vision (RNIB, 2009).

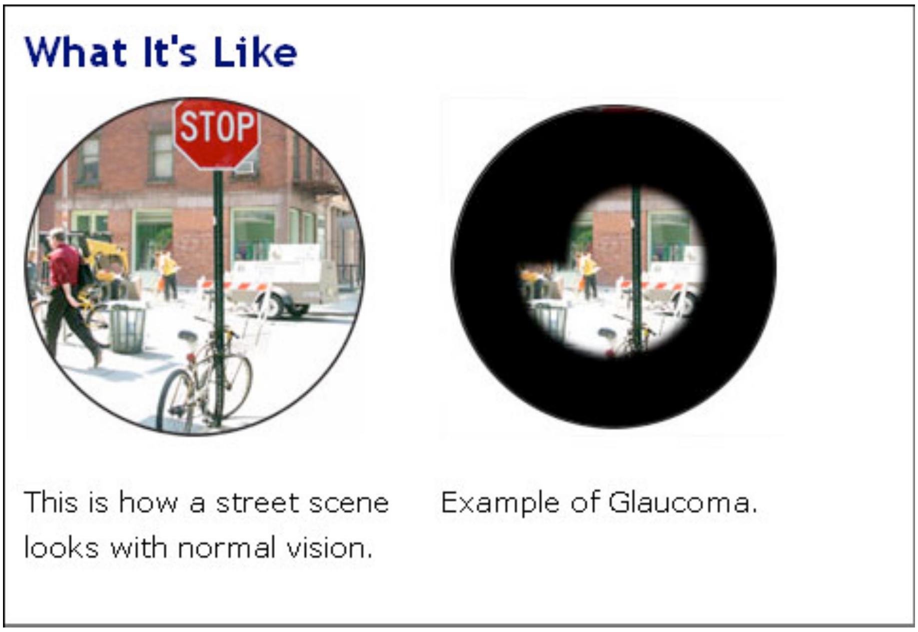


Figure 2. 6 Glaucoma (Lighthouse International, 2009)

2.2.4.2iii Age-related macular degeneration (AMD)

Age-related macular degeneration (AMD) is the damage to the macula area of the retina, which leads to problems in central vision (Figure 2.7). However, the development of the condition is not painful and does not cause complete sight loss. According to the RNIB (2009), the symptoms of the condition vary; however, people with AMD may find some symptoms such as: difficulty in seeing detail even with glasses (e.g., reading small print); a slight smudge, a small blurred area or a little bump in the vision; straight lines look wavy or twisted; susceptible to bright light; unreal shapes and lights.

AMD can be classified into two main types which are “dry” AMD and “wet” AMD. Dry AMD is more common than the other, and there are about 10-15 per cent of people who develop AMD have wet AMD. Dry AMD usually progresses gradually over a number of years to turn into its final stage, yet wet AMD can cause the damage on the central vision in a very short time. Meanwhile both of the two main types of AMD usually infect both one’s eyes, and when they are aggravated, the damage results on both of one’s eyes a blank patch in the central vision, nevertheless, the peripheral vision will not be infected so that they will not cause a total sight loss.

Although people now still cannot explain the cause of AMD precisely, there are some reasons that may put one in a higher risk to develop the condition. The RNIB (2009) indicates that though AMD can develop in one’s mid-life during the forties and fifties, for older people who are aged 65 or over it is the most common age group for development of AMD. Meanwhile, women have a greater incidence of AMD than men, which may be due to the tendency of women’s longer lifespan. Family history of AMD (more than one family member) may also put one in a higher risk of the condition; however, not all AMD is caused by the inheritance factor. On the other hand, smoking and high level of sunlight exposing over a long period of time may also raise the risk (RNIB, 2009).

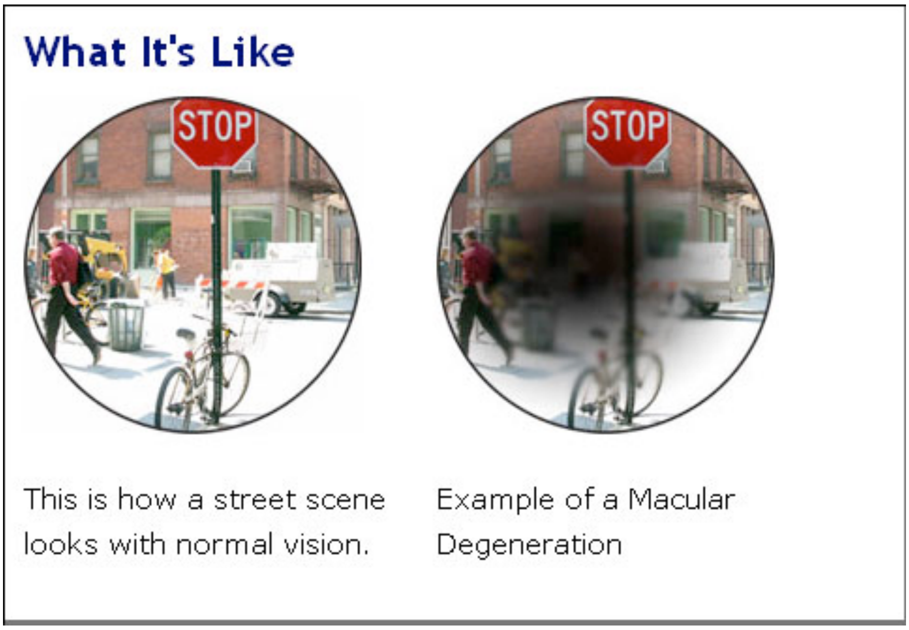


Figure 2. 7 Age-related macular degeneration (Lighthouse International, 2009)

2.2.4.2iv Diabetic retinopathy

Diabetic retinopathy is another common age-related eye condition which leads to vision becoming patchy or splotchy (Figure 2.8). According to The Guide Dogs for the Blind Association (2009), diabetes occurs when one's pancreas cannot generate enough insulin, or one's body cannot process insulin correctly. When the blood vessels in the retina are impaired by the progression of diabetes, diabetic retinopathy is developed. At this early stage, the arteries in the retina leak from small and dot-like haemorrhages, which often leads to swelling and causes a decrease in vision, and if the condition leads to macular Oedema, vision will become blurred. It will become proliferative diabetic retinopathy once the impairment progresses, and the retina will be starved of oxygen or ischemic so that the blood circulatory system will start to develop new blood vessels in order to provide oxygen for the retina. However, the new vessels are easily haemorrhaged and cause the blood leaks into the retina and the fluid inside the eye. The condition will reduce one's vision and one may see spots or floater (The Guide Dogs for the Blind Association, 2009).

WHO (2009) indicates the risk factors of diabetic retinopathy development are: "duration of diabetes, level of glycemia, presence of high blood pressure, dependence on insulin, pregnancy, levels of selected serum lipids, nutritional and genetic factors". Medical treatment is helpful for reducing the risk that diabetic retinopathy may bring to the vision. Meanwhile, glycemia restraining can not only lower the incidence but also decrease the development of retinopathy.

The Guide Dogs for the Blind Association (2009) indicates that people with the diabetic retinopathy may feel 'the blurred vision, floaters and flashes', however, these symptoms can progress and then meliorate within the day. Therefore, people who had these symptoms sometimes ignore the condition which causes serious consequences to their vision. It is recommended to have an eye test once the condition occurs, meanwhile, about "90% of those with advanced diabetic retinopathy can be prevented from losing their sight", indicated by The Guide Dogs for the Blind Association (2009).

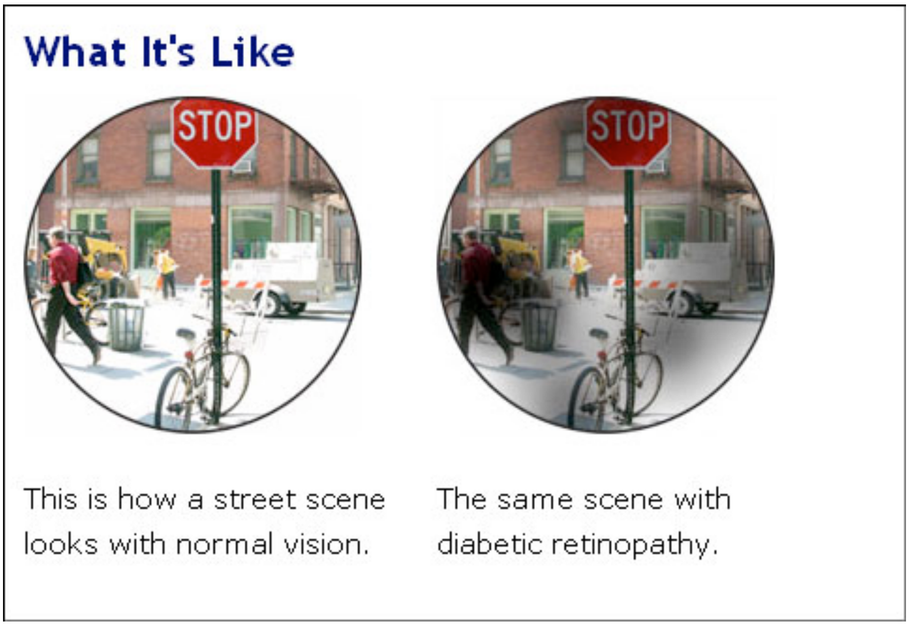


Figure 2. 8 Diabetic retinopathy (Lighthouse International, 2009)

2.3 The capabilities of visually impaired people

2.3.1 Introduction

The previous section discussed the causes and types of VI in general and initially identified VI in the two different categories (i.e., congenital and adventitious VI). This section focuses more on visually impaired people (VIP) and intends to understand more about the capabilities they develop when coping with visual loss. A further literature review of congenital and adventitious VI is undertaken in order to examine the impacts of the onset of VI and how people respond to these two different situations. In addition, three age groups of VIP, i.e. i) VI from birth and early childhood, ii) VI in mid-life, and iii) VI in old age, are sampled as a further investigation of the variability of VI and how VIP cope with their conditions and everyday challenges.

2.3.2 Impact of visual impairment in different age stages

2.3.2.1 Introduction

Individuals who have VI from birth or early childhood and who grow up with partial or no vision may encounter developmental delays in many aspects such as behavioural and cognitive development, whereas those who have adventitious VI in later life may encounter great impacts in their daily living, which usually requires a period of time to adapt to the physical and emotional changes. This section begins to investigate factors relating to VI and considers separately those VIP with congenital VI and those with adventitious VI for a clearer understanding of how individuals react and cope with their impaired vision. A review of Welsh and Tuttle's (1997) research is conducted here which clearly distinguishes significant differences between these two types of VIP.

2.3.2.2 Factors related to congenital visual impairment

According to Welsh and Tuttle (1997), people with adventitious VI usually spend a considerable amount of time dealing with the effects of the traumatic loss of vision. This type of emotional reaction generally does not occur in those with congenital VI. Nevertheless, certain life experiences may make congenitally blind people realise the differences between their sighted peers and themselves, moreover, 'this new realisation can have the same type of traumatic effect on a person who is congenitally blind that the sudden loss of vision can have on a person who becomes adventitiously blind', stated by Tuttle and Tuttle (1996) cited in Welsh and Tuttle (1997, p.64).

Sensory abilities

It is often misapprehended that people with congenital VI are born to have superior skills in terms of using their senses other than vision; nevertheless, Welsh and Tuttle (1997) suggest that their better performance in the use of their sensory systems is due to practice. Hammill, and Crandall (1970), as cited in Welsh and Tuttle (1997, p.61), reveal that there is no auditory discrimination difference when comparing congenital VI children, aged between 6 to 10, to their sighted peers. However, congenital VI teenagers were found to have superior auditory skills than their sighted compeers, and it is explained that the former group had learned for a number of years how to rely more on their sense of hearing so that they have better auditory stimulation (Witkin, et al., 1971 cited in Welsh and Tuttle, 1997, p.61). In terms of tactile discrimination, some differences do appear in those blind children compared to sighted, however, these are not significant (Warren, 1994 cited in Welsh and Tuttle, 1997, p.61).

Cognitive abilities

One's concepts are usually formed when he or she perceives information that is provided by the sense of vision, especially in terms of reflecting distance, colour, and size. Three areas are identified to be effected significantly as an individual grows up without visual input: i) the range and variety of experiences the individual has had, ii) the ability to get around, and iii) the interaction of the individual with the environment (Lowenfeld, 1950 cited in Welsh and Tuttle, 1997, p.62). Although the senses of hearing and touch can provide a portion of information, relying on others' verbal descriptions may limit congenitally blind people's conceptual development and lose its accuracy and richness. As a consequence, certain abstract concepts are not fully developed and those who grow up without vision may sometimes encounter functional difficulties (e.g., mobility, leisure activities, or work). It is suggested that when a congenitally blind person can verbally describe a task or a skill but unable to perform the actual skill, specific instruction or hands-on experience may be helpful to address the gap in conceptual development (Welsh and Tuttle, 1997).

Motor abilities

According to Welsh and Tuttle (1997), it is indicated that learning to travel independently is beneficial for VIP to overcome any mobility-related limitations. Meanwhile, the home environment, including neighbourhood settings and parents' attitudes, is believed to have a significant impact on VI children when they attempt to use mobility skills they have learnt. Among infants with blindness, a tendency of developmental delay in the skills of reaching for and grasping an object is identified (Fraiberg, 1977 cited in Welsh and Tuttle, 1997, p.63). One typical characteristic of VI children is that they are unable to explore objects by using their fingers efficiently; and a tendency of maintaining hands at their shoulder height is another. It is also identified that neither do they appear to reach and grasp an object at the appropriate time nor present interests in exploration when toys are put into their hands. Many blind or VI children may not have skills for reading Braille or performing other tactile tasks due to not habitually using their hands to make sensitive discriminations and explore objects. Consequently, it is often suggested that children receive training to develop sensory awareness and tactile discrimination (Welsh and Tuttle, 1997).

Psychosocial abilities

Bonding is the foundation of the development of other human relationships; when the psychosocial problems occur in those with congenital blindness, it is caused by a lack of bonding between an infant and parent, stated by Fraiberg (1977 cited in Welsh and Tuttle, 1997, p.63). The attitudes of sighted people toward VIP in general are usually stereotyped and sometimes negative. When VIP develop and grow up in environments that frequently reflect this kind of attitude, it usually results in negative impacts on their self-esteem. On the other hand, it is demonstrated that role models who are blind are significant for children with blindness since they provide feedback when the children behave inappropriately. Nevertheless, due to the low incidence of blindness at this age, those who are blind usually grow up without adequate role models which leads the children as well as their parents to confront difficulties to sort out acceptable attitudes to blindness (Welsh and Tuttle, 1997).

2.3.2.3 Factors related to adventitious visual impairment

Many people react to the onset of an impairment in similar ways and Welsh and Tuttle (1997) describe these responses in terms of adjusting, adapting, and coping phases. Nevertheless, the phases are not hierarchical but dynamic and fluid, which means that one phase may overlap another by a significant amount. It is not necessary to fully complete one phase before moving to another; therefore, some individuals may not go through all these phases and some may not even experience any of them. Welsh and Tuttle (1997, p.74) also suggest that “the manner in which the individual has previously responded to important life changes will usually suggest how that person will respond to the onset of an impairment".

Reactions

Cholden (1958), as cited in Welsh and Tuttle (1997, p.69), indicates that "individuals who lost their sight experienced shock, and frequently, depression before recovery was possible". The shock period is described as "a period of protective emotional anaesthesia which is available to the human organism under such stress", and the period may endure for a few days, or even a few weeks. Mourning endures for a short period followed by shock, which is described as "grieving for their dead eyes", and it is believed that "the successful accomplishment of some quickly attainable short-term goals and tasks facilitated the movement out of depression" (Cholden, 1958 cited in Welsh and Tuttle, 1997, p.69). On the other hand, Carroll (1961), as cited in Welsh and Tuttle (1997, p.69) summarises the losses of adventitious VI as follows:

1. Basic losses to psychological security (involving physical integrity, confidence in the remaining senses, reality contact with environment, visual background, and light security)
2. Losses in basic skills (involving mobility and techniques of daily living)
3. Losses in communication (involving ease of written communication, ease of spoken communication, and informational progress)
4. Losses in appreciation (involving visual perception of the pleasurable and visual perception of the beautiful)
5. Losses concerning occupation and financial status (involving recreation, career, vocational goal, job opportunity, and financial security)

6. Losses to the whole personality (involving personal independence, social adequacy, obscurity, self-esteem, and total personally organisation)

Both Cholden (1985) and Carroll (1961), as cited in Welsh and Tuttle (1997, p.69), tend to use the 'loss' model to consider the onset of VI and characterise the adjustment process as "a total reorganisation of the self with the emergence of a new person"; whilst Tuttle and Tuttle (1996 cited in Welsh and Tuttle, 1997, p.70), believe that the adjustment process is "a normal, healthy process used by all persons in responding to a severe trauma or crisis in their lives", moreover, the personality, behaviour characteristics, interests and abilities of a person should be necessarily the same before and after the onset of VI.

Psychological trauma

Welsh and Tuttle (1997, p.71) refer to trauma as an "event or series of events that produces a sense of disequilibrium, incongruity, or vulnerability, creating stress and making a person anxious or upset". At the same time, "experiencing the initial onset of a vision loss or subsequent losses, meeting new psychological situations or old unresolved problems that resulted from the loss of vision, and, encountering the devaluing stigma of blindness frequently expressed by society" are suggested as factors that may accelerate psychological trauma. It is indicated that the adjusting process would be less disruptive once individuals are mentally and emotionally prepared for confronting any or all of these psychological traumas (Welsh and Tuttle, 1997). The trauma may occur while those who are adventitiously blind or visually impaired are notified of the loss of their vision by the doctor in the hospital. It is indicated that at this sensitive and vulnerable time, "the disconcerting news be shared with kind and gentle understanding, with direct and simple frankness, and without pity or condescension", and "the rehabilitation counsellor is encouraged simply to provide physical and emotional support rather than yielding to the temptation to provide immediate direct intervention" (Welsh and Tuttle, 1997, p.71).

Shock and denial

Shock may be the first reaction when hearing the loss of sight, and Welsh and Tuttle (1997, p.71) refer this term to 'a psychic anaesthesia that numbs the mind, preventing disintegration'; meanwhile, denial was explained as 'one method to escape coping with the requirements and implications of the disequilibrium caused by the onset of an impairment'. If people who are with recent acquired impairments experience shock and denial only temporarily, this was believed to be a natural and even healthy response. If the denial continues, skills can be adopted to help people confront the reality of their situations (Welsh and Tuttle, 1997).

Mourning and withdrawal

People may be conscious of a general state of incongruity or a global sense of loss when the shock starts to wear off. During this phase, mourning and self-pity are characterised as the features and are usually followed by withdrawal and isolation. Riffenburgh (1967 cited in Welsh and Tuttle, 1997, p.71) believes that expressing sadness may be therapeutic thus people should be allowed to mourn their loss of vision. Nevertheless, Welsh and Tuttle (1997) indicate that individuals who are experiencing self-pity have a tendency of cutting themselves off from others, which can lead to feelings of isolation and perpetual loneliness; meanwhile, hostility and anger toward others may also occur.

People who are experiencing the phase of mourning and withdrawal may not only lose their confidence but also struggle with low self-esteem and a sense of inadequacy because of the recent loss of vision and/or the negative and devaluing attitudes from others. At the same time, they may also experience a troublesome sense of “being more different from – rather than being the same as – others”, stated by Welsh and Tuttle (1997, p.72).

Succumbing and depression

Welsh and Tuttle (1997) demonstrate that mulling over the implications of the loss of vision may begin along with the continuing wearing off of shock. This is indicated in the phase of ‘I can’t’. The way how people perceive what they can and cannot do is usually distorted and unrealistic. As a consequence, degrees of depression may occur due to the pessimistic and negative perceptions of themselves and their abilities; nevertheless, it is believed that this kind of depression is common and usually temporary during this phase. Similar to those with vision loss in early childhood, the use of role models and biographies are believed to be beneficial for people to develop a more positive and realistic self-statement. Welsh and Tuttle (1997, p.72) state that “when this happens, they are usually ready to begin identifying their assets and strengths, permitting a shift from ‘I can’t’ to ‘I can’”; meanwhile, “taking responsibility for their own behaviour is encouraged and making excuses for irresponsible behaviour is not acceptable”.

Reassessment and reaffirmation

People who are in the phase of reassessment and reaffirmation begin to re-evaluate their personal attributes, goals, and values, which may lead to the exploration of personal identity and the meaning of life (Welsh and Tuttle, 1997). "The individual becomes aware that some challenges can be avoided, some can be prevented by restructuring prior circumstances, and still others can be conquered through the development of adaptive and coping skills", described by Welsh and Tuttle (1997, p.72).

Coping and mobilisation

This is the phase that people concentrating on developing suitable coping skills and adaptive behaviours. To achieve this, it is indicated that people have to mobilise their internal and external resources. Welsh and Tuttle (1997, p.73) described that "the goal is to enable individuals who have acquired visual impairments to manage more effectively the daily demands in their physical and social environment"; meanwhile, progressing coping skills was indicated to be beneficial for individuals to develop both self-assurance and self-confidence.

Self-acceptance and self-esteem

It is proposed that rehabilitation should not stop at the coping and mobilisation phase but continue to address further psychological issues, the needs of self-acceptance and self-esteem. Welsh and Tuttle (1997, p.73) explain that "people can learn to live with their impairments without ever accepting themselves, much less developing any sense of self-worth"; therefore, individuals should learn to accept their impairment as well as themselves as human. Self-acceptance includes "feelings of being comfortable with themselves, being at peace with themselves, and liking themselves, feelings that can be encouraged and nurtured" (Welsh and Tuttle, 1997, p.73). Self-acceptance frees individuals to accept others first and, therefore, to be accepted and valued by others, which the exchange is indicated as the basis of self-esteem; and Vash (1981 cited in Welsh and Tuttle, 1997, p.73) suggests that this level of the disability experience is "transcending the disability".

2.3.3 Innate capabilities and coping strategies

According to Welsh and Tuttle (1997), the onset of VI at different age stages can cause different types of issues and impacts. To investigate this, this section attempts to distinguish VIP in more detail into three age groups which are: i) VI from birth and early childhood; ii) VI in mid-life; and iii) VI in old age. Issues that are identified from the review of literature will be organised into a matrix (see Section 2.3.4, Figure 2.9) in order to examine issues for each group and compare the onset of age differences between VIP.

2.3.3.1 Visual impairment from birth and early childhood

Vision is an early coordinating sense which plays an important role in the social-cognitive development of early childhood (Dale and Salt, 2008). Pring (2008, p.159) proposes the Theory of Mind (ToM) understanding, which is "the term used to encapsulate young children's ability to understand others' thoughts, beliefs and desires". It is indicated that sighted children are able to manage simple ToM tasks explicitly when they are about four or five years of age. Their development of this ability appears to rely a lot on vision, and the roles of eye-gaze, pointing, and joint visual attention are highlighted as early important precursors (Pring, 2008).

Whereas most of the VI children demonstrate difficulty in developing ToM, and Pring (2008, p.160) explains that "a visual impairment restricts the chance to associate emotional and mental states with their behavioural correlates, since it is generally through watching others, and other situations, that such associations are learnt". Due to the delay in ToM development, many children with vision loss do not present the same ability as their sighted peers do until they are about age of 12. The deficits of ToM can bring about significant consequences, especially in autism, that can be often seen among children with VI (Pring, 2008). Keeler (1958) and Wills (1979), as cited in Dale and Salt (2008, p.136), identify the features of autism within children with congenital VI such as social isolation, non-functional play, frequent use of imitations and formulaic speech, lack of initiation of conversation, stereotyped behaviours and lack of symbolic play.

Although vision plays a critical role for the development of ToM, it is stated that "the primary way in which children get to know the contents of other people's minds is through language" (Tager-Flusberg, 1993 cited in Pring, 2008, p.160). Research into early social-language mechanisms (Brown et al., 1996; Hughes and Dunn, 1998; Cutting and Dunn, 1999; Dunn, 2000 cited in Pring, 2008, p.161) suggests that when compared with parent-child language, child-child interactions appear more significant for social understanding due to more mental state language being involved. The quality of sibling relationship is also influential and conversations between siblings are believed to have a positive impact for children to learn about others' minds; moreover, it is indicated that not only siblings but also playing with friends in pairs employs a lot of imagination and mental state terms, which is more than the experience with mothers and teachers can do.

Developmental setback is described as "some children who were making good developmental progress in the first year of life appeared to stop moving forward or even lost skills in the following few years" (Dale and Salt, 2008, p.137). According to Dale and Salt (2008, p.138), specific difficulties that are observed in children with developmental setbacks are classified under the three domains of a) social interaction (e.g., social avoidance and lack of social approach, rejection of social contact and social tactile defensiveness, anxiety during social overtures); b) language and communication (e.g., poor communicative use of language, immediate and delayed repetitive language (echolalia), a prolonged use of learned phrases and word associations, weak response to communication by others); and c) behaviour (e.g., limited in functional purpose or showing unusual exploratory elements, lacking in a symbolic or social dimension, restricted in interests).

The risks for developmental setback include any visual disorder, male gender, multiple brain lesions, the nought to two year age period and profound visual impairment (Dale and Salt, 2008); profound visual impairment under 10-16 months and adversity in the psychosocial and familial environment are also believed as the potential factors (Sonksen and Dale, 2002; Dale, 2005 cited in Dale and Salt, 2008, p.140). Early intervention is significant for strengthening young children's ability and avoiding potential threats arising from the VI. Due to the risk of a developmental setback period, intensive support is vital which should be obtainable from birth to three years of age as the minimum; a health/educational partnership is also highlighted as the ideal delivery model (Dale and Salt, 2008).

Although children with visual impairment have initial delays in many developmental aspects, “fortunately these children often learn to compensate for vision loss and achieve similar levels of intellectual and education attainment as their sighted counterparts” (Pring, 2008, p.161). It is demonstrated that not only children but also adults who are blind show superior performance in many memory-related situations than their sighted peers. A more convincing explanation to their memory advantages is indicated that “relatively greater resources are allocated to auditory processing for those without vision, and this greater attentional effort is likely to lead to better retention of the material”; meanwhile, “an outcome of the increased attention to such material may be to store it for longer-term retrieval in a ‘verbatim form’ – a memory strategy that might be far less common amongst the sighted” (Pring, 2008, p.162). The advantages of short term memory include remembering the sequence of items, literal and inferential ability, recall of taped words (auditory presentation) and brailled words and tactile pictures, superior pitch memory, and more accurate recollections of personal semantic memory. The advantages of memory recall may be able to explain why VI children are usually interested in music, good pitch memory, and potentially absolute pitch abilities, suggested by Pring (2008).

2.3.3.2 Visual impairment in mid-life

According to Maurer, Lewis and Mondloch (2005), “when the visual input is missing permanently because of congenital blindness, the visual cortex becomes specialised for the processing of touch and sound instead of vision". However, Sadato, et al. (2002), as cited in Cattaneo, et al. (2007) suggest that "the age of 16 years is likely to be a critical cut-off for a functional shift of the primary visual cortex from processing visual stimuli to processing tactile information", and "the efficacy of the compensatory mechanisms associated to their late visual impairment might be reduced compared to earlier visual deficits' onsets". Meanwhile, Baus (1999, p.41) also points out that "someone who only has 50% vision as a result of a sudden loss may feel more restricted than a person who has lived for a long time with 10% vision and has adjusted to it". It is more difficult to adapt for adults who have late-onset (e.g., working-age) visual impairment when compared to those whose onset occurred in early childhood.

"An individual's life goals is closely linked with health and well-being" (Popivker, Wang and Boerner, 2010, p.1128); meanwhile "individuals in midlife typically balance multiple responsibilities and life goals. Maintaining or progressing one's career is often a top goal, and many middle-aged adults feel the psychological, financial and pragmatic weight of multiple family responsibilities" (Bumpus and Aquilino, 1995 cited in Popivker, Wang and Boerner, 2010, p.1128). On the other hand, younger adults with the onset of VI during working-age have showed higher risk of developing mental health issues than those who are older; this may be because of the occurrence is too early during this life stage, and the impairment intrudes into the pursuit of their life goals (e.g., career goals, supporting a family) and also seriously interrupts their daily routine and leads to emotional distress (Boerner and Cimarolli, 2005).

According to the life goals investigation among middle-aged adults with vision impairment, it is identified that functional aspects of living (e.g. daily tasks, mobility, career and financial security) and relationship-related goals (e.g. taking care of family, maintaining relationships with friends and significant others) are the two most concerned with life goals, which are far more important than psychological goals (e.g. preserving a positive life quality, adjusting to vision loss, achieving spiritual or religious endeavours and working on self-improvement) (Popivker, Wang and Boerner, 2010).

According to Popivker, Wang and Boerner (2010), rehabilitation programmes should begin with a systematic evaluation of VIP's personal goals and then provide guidance and counsel to help to mange and engage with these goals, which are challenging but remain feasible. Rehabilitation programmes are also suggested to not only focus on social and psychological goals but additionally on those which are functional (Popivker, Wang and Boerner, 2010).

2.3.3.3 Visual impairment in old age

As discussed in section 2.2.4.2, vision loss during old age may be caused by age-related macular degeneration, cataracts, chronic open-angle glaucoma, and diabetic retinopathy. It is indicated that about one third of older people with VI experience "clinically significant depressive symptomatology" (Horowitz and Reinhardt, 2000 cited in Boerner, 2004, p.35). The onset of VI in old age may significantly interrupt one's behaviour patterns and social interaction in a considerable range of psychological domains, i.e., "body image, self-concept and other forms of self-awareness", as well as social domains such as "communication, mobility, work and reaction" (Kirtley, 1975 cited in Brenan and Cardinali, 2000, p.327).

The focus of coping with sensory loss among those who are older is suggested as an aspect of the improvement of successful ageing rather than "advocate the passive acceptance of the limitations arising from diseases" (McCallum, Mathers and Freeman, 1992, p.11). Successful ageing is considered as "the degree to which one is able to optimise choice through avoiding disease and dependency" (Balthes and Balthes, 1998 cited in McCallum, Mathers and Freeman, 1992, p.11). Threefold processes of adaptation to successful ageing are introduced (McCallum, Mathers and Freeman, 1992, p.11), as: i) the selection of increasingly restricted functional abilities to perform preferred activities, ii) the optimisation of these choices by enriching reserve capacities, and iii) the compensation for loss of function when it is a barrier to desired activity, such as adaptive devices.

2.3.4 Conclusions from survey of issues arising from VI and capabilities of visually impaired people

The literature review above differentiated between congenital and adventitious VI and then began to distinguish VIP in different groups according to the age of onset, which includes VI occuring in i) early childhood, ii) mid-life, and iii) old age. Although these three groupings represent a crude sub-division by age (for example, there could be a further category for VI in late childhood), sufficient information was provided from the literature to demonstrate clearly the differences made by the age of onset of VI. The elementary matrix (Figure 2.9) is developed to describe the results of this investigation. Issues identified from the literature are preliminarily categorised into difficulties and adjustment, etc. It can be seen that people in these three broad age groups encounter different problems due to their physical abilities and mental conditions. According to the survey above, this research begins to recognise the complexity of VI and VIP's strength and abilities are also identified. The next section attempts to distinguish further variables of VI and to explore coping strategies (CSs) that VIP use in adapting to VI.

Issues \ People	VI from birth and early childhood	VI in mid-life	VI in old age
Difficulties	Difficulty in developing ToM; features of autism (e.g., social isolation, non-functional play); features of developmental setback (e.g., social avoidance and lack of social approach, poor communicative use of language)	Reduced efficacy of the compensatory mechanisms; higher risk of developing mental health issues; interruption of life goals pursuit	Psychological problems (e.g., body image, self-concept); social problems (e.g., communication, mobility)
Adjustment	Child-child interactions; good quality of sibling relationship; playing with friends in pairs; early intervention; intensive support; compensate through learning	Receiving rehabilitation programmes to help to manage and engage with significant life goals	Selection of increasingly restricted functional abilities to perform preferred activities; optimisation of these choices by enriching reserve capacities; compensation for loss of function when it is a barrier to desired activity

Figure 2. 9 Variables in onset age.

This figure intends to be illustrative and indicative, rather than detailed and exhaustive, at this early stage, of some of the differences in issues between the three broad age categories.

2.4 Modelling visually impaired people’s capabilities and experiences: categories and variables

2.4.1 The variables of visual impairment

The simple elementary matrix developed in the previous section (Figure 2.9) began to indicate that people who acquire VI at different age stages may encounter different kinds of problems due to their different physical abilities, mental conditions and experiences. Nevertheless, it is demonstrated that “the extreme variability in the nature and extent of vision loss is not always understood by either professionals or the general public, and may become a basis for misunderstanding and confusion” (Welsh and Tuttle, 1997, p.67). VI, and its consequences, is not simple but complex and needs a much more comprehensive understanding. This elementary matrix is insufficient to address the complexity of issues. The degree of difficulty presented by VI is affected, for example, not only by the age at onset but also by other variables such as the type of VI, the length of time of impairment, the severity of the impairment, and the visibility of the impairment, all of which can have significant impacts on an individual’s ability to deal with life changes caused by VI, and on every aspect of their daily lives. As a consequence, a further exploration of the literature is required to identify a taxonomy of strategies which could be used as a basis to understand how VIP have adjusted to loss of vision and how they are able to cope with daily challenges.

2.4.1.1 Adjustment to loss of vision

According to Welsh and Tuttle (1997), people with no residual vision resulting from a severe VI generally demand significant and more extensive adaptive behaviours and skills than those with moderate visual loss. In addition, the stability of vision is also influential. Some unstable conditions that are changing from one day to another and from one situation to another can cause significant feelings of anxiety and fear; however, people whose vision declines gradually over a period of months or years may not go through shock and depression or other phases of the adjustment process until the vision is severe enough to interfere with daily functioning (Welsh and Tuttle, 1997). On the other hand, additional conditions or disabilities also complicate the issues of adjustment and the adaptation to VI may become more difficult. For example, Barron, (1973) as cited in Welsh and Tuttle (1997, p.75), identifies that people with sight loss caused by retinitis pigmentosa generally adjust better and develop better coping skills when compared with those with visual impairment cause by diabetes, which is associated with multiple health problems.

2.4.1.2 Adjustment to loss of vision: personality type

Personal characteristics which can have a significant impact on the process of adjustment to vision loss include “gender; interests, values, goals; activities, remaining resources, and other personality variables” (Welsh and Tuttle, 1997, p.76). It is identified that VIP who appear less depressed are viewed as “assertive, independent, stubborn, venturesome, uninhibited, experimenting, free-thinking, aggressive, socially bold” before the onset of their impairment; contrary to that, VIP who are viewed as “humble, mild, obedient, conforming, shy, restrained, conservative” may experience severer depression (Greenough, et al, 1978 cited in Welsh and Tuttle 1997, p.76). On the other hand, prior coping experiences of traumas or crises are seen to be beneficial for establishing one’s coping style and problem solving pattern, indicated by Emerson, (1981) as cited in Welsh and Tuttle (1997, p.76). One’s prior attitudes toward blindness is another factor that can impact on adjustment. These attitudes are usually developed unconsciously and incidentally through the description of media or literature, through conversations among others within one’s social environment, or in one’s own imagination. The prior attitudes of those who recently acquire visual impairment are usually established long before the actual onset of the impairment thus they are more detached and abstract; whereas for those who have been visually impaired for a period, these attitudes may be more personalised and refer to personal characteristics (Welsh and Tuttle, 1997).

2.4.1.3 Adjustment to loss of vision: environmental factors

Environmental factors are significant and are sorted into “the immediate environment (i.e., family acceptance and support, income, available community resources)”, and “the broader cultural environment (i.e., technological support, agencies and services)” (Welsh and Tuttle, 1997, p.77). When VI occurs, all the family members and friends are acting as an individual’s personal support network, and they also have to fight with their previously held stereotypes as well as other issues with regard to adjustment (Gardner, 1982; Neu, 1975; Schulz, 1980; Scott et al., 1997 cited in Welsh and Tuttle, 1997, p.78). Meanwhile, Moos and Tsu, (1997) as cited in Welsh and Tuttle (1997, p.78) state that “family members and friends, as well as patients, are affected by the crisis, may encounter many of the same or closely related adaptive tasks, and may use the same coping skills". It is demonstrated that understanding, acceptance, and respect from "significant others cannot only boost people in adjusting to their impaired vision healthily but also contribute to their more positive self-esteem. Nevertheless, "giving too much assistance can contribute to succumbing (i.e., giving in to the disability) and hinder the development of coping skills" (Wright, 1990 cited in Welsh and Tuttle, 1997, p.78).

A number of the variabilities of VI and suggestions for achieving a successful adjustment have been discussed above. These variables of VI significantly affect VIP's behaviours during the adaptation process and the development of coping skills. In order to have a further understanding of the extent of VIP's capabilities, the next section intends to explore how people with VI develop and use strategies to cope with their impaired vision and for managing everyday challenges.

2.4.2 Coping strategies used in adaptation of visual impairment

This section intends to identify coping strategies (CSs) that are identified as used by VIP through the review of literature. It begins with a review of Boerner and colleagues' work (Boerner, et al., 2010) which examines control-related behaviour in older people with VI. To identify CSs used by VIP in more details, research conducted by Brennan and Cardinali (2000) and Lee and Brennan (2002) are also reviewed. These provide a rich array of CSs categorised under the three domains of behavioural, psychological, and social coping, which may be valuable for the present study to use as a conceptual framework for identifying CSs that are adopted by VIP for different daily living tasks (e.g., navigation). This provides an insight into the range of strategies potentially useful for the development and use of a conceptual framework for a systematic comprehensive assessment of CSs used by VIP.

Life-span theory of control (Heckhausen and Schulz, 1995; Heckhausen and Schulz, 1996 cited in Heckhausen, 2001, p.2722) refers to “the desire to extend control over one’s environment and thus realise primary control rules the system of control behaviour”. Control-related behaviour, as defined in the life-span theory of control, is categorised into primary or secondary and selective or compensatory (Boerner, et al., 2010). According to Boerner, et al. (2010, p.23), the intention of primary control strategies is to “actively change the external environment”, whilst the intention of secondary control strategies is “adaptation of internal process (e.g., goals or interpretations)”. Selective control strategies refer to “the focused investment of internal resources in a chosen goal either in terms of behavioural resources such as effort or time (selective primary control) or motivational resources such as goal commitment (selective secondary control)”. Compensatory strategies are used to “respond to a dearth of resources to attain a given goal either in terms of bolstering behavioural resources by external means (compensatory primary control) or by disengaging from the unattainable goal through self-protective strategies (compensatory secondary control)”.

Research conducted by Boerner and colleges (Boerner, et al., 2010) adopted the life-span theory of control (Heckhausen and Schulz, 1995; Heckhausen and Schulz, 1996 cited in Heckhausen, 2001, p.2722) as the conceptual framework for examining strategies used by older people with macular degeneration. In order to distinguish specific strategies that are used for the daily challenges, their interview questions reflected the three psychosocial domains of adaptation and classified them into functional challenges, social challenges, and psychological challenges. The narrative data was coded through the use of the definitions of the four main strategy groups (i.e., selective primary control, compensatory primary control, selective secondary control, and compensatory secondary control) and subcategories (e.g., for selective secondary control: enhance control, enhance value, initiate affective support, and accept affective support) (Figure 2.10). The theoretical definitions were enhanced with additional explanations for a more effective data coding; in the meantime, some of the subcategories were added under the four main categories. According to their findings (Table 2.4.), compensatory primary control strategies were reported by almost all of the participants (99.7%). Compensatory secondary control strategies were the second most frequently reported (77%). About half of the participants indicated selective primary control strategies (53%), and there were only 21% of them mentioned selective secondary control strategies.

“Differences in strategy use depending on level of vision impairment were the most pronounced within the category of compensatory primary control for strategies that involved using help from others and alternative means. Within the category of selective secondary control, effort to maintain a positive outlook was associated with higher impairment levels, whereas within the category of compensatory secondary control, attempts not to dwell on problems related to vision were associated with lower impairment levels”. (Boerner, et al., 2010, p.22)

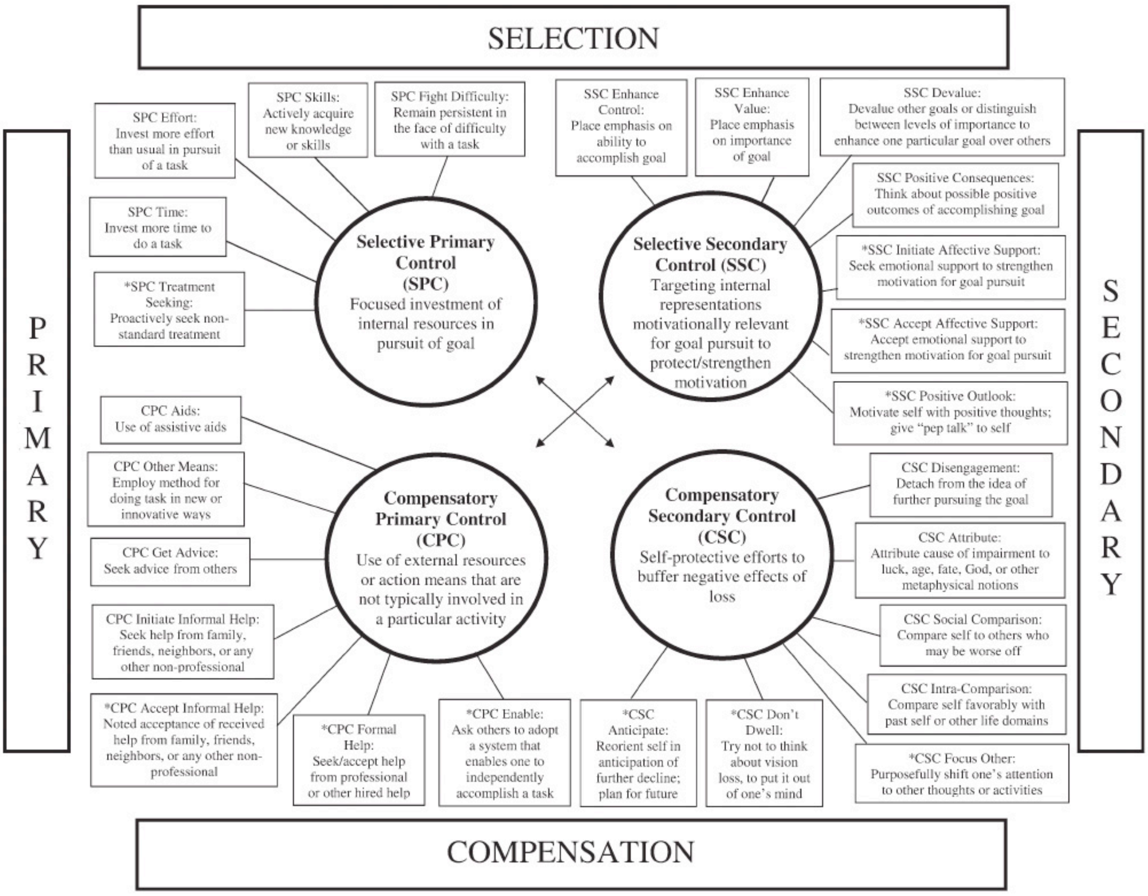


Figure 2. 10 Control-related behaviour strategies (Boerner, et al., 2010, p.26)

Table 2. 4 Sample quotes (Boerner, et al., 2010, p.28)

Control Strategy	*N*	%	Quote
Compensatory Primary (CPC)			
CPC Other Means	353	97	I make contrast everywhere, I just bought new white mugs so I can see where the coffee is and I'm constantly figuring out contrast.
CPC Aid	343	94	Reading, writing my checks, my bills. I use magnifying glasses and additional light.
CPC Informal Help Initiated	276	76	Well if I go out to dinner, I ask somebody else to read the menu to me.
CPC Informal Help Accepted	258	71	My friend comes and will prepare my meals for me because I don't have sufficient sight to do them properly. I'm really very fortunate.
CPC Help Formal	164	45	I have somebody come in once a week. She goes to the supermarket with me and she can read the labels for me.
CPC Enable	28	8	If I meet somebody, I'll always say, "Hello, nice to meet you. When you see me, say hello first because I won't recognize you."
CPC Advice	2	3	I have a friend who's a geriatric psychologist. I asked her and she said, "no, you don't have depression. You're sad because you lost something." That I understood.
Compensatory Secondary (CSC)			
CSC Intraindividual Comparison	139	38	I thank my lucky stars that it isn't worse. Everything is relative. I wouldn't want a fatal disease either, so this isn't so bad.
CSC Focus Other	136	37	I try to think of something else. I might look at the trees and the shadows of the trees.
CSC Social Comparison	109	30	This guy has Alzheimer's. I am thinking what am I feel sorry for, at least I know where I am.
CSC Attribute	66	18	I think just aging regardless of the vision is a challenge. It's all part of the aging process.
CSC Disengage	66	18	It's not life and death to give up playing tennis, it's just something I enjoyed and I now enjoy watching it. I try to watch as much as I can and appreciate it.
CSC Don't Dwell	23	6	I try to not have it annoy me. I put it in the back of my mind.
CSC Anticipate	13	4	I feel that I have to go through all my papers as much as I can, as long as I can still see them to some extent.
CSC Humor	6	2	In the ballet it's amusing because I keep going but the ballerinas have no feet. It makes it a very interesting show, like angels floating. I probably never could see what their feet
Selective Primary (SPC)			
SPC Effort	114	31	I push myself to do things. I try to be as self-sufficient as I can.
SPC Fight Difficulty	71	20	I'm a very determined person. I'm not going to let anything stop me.
SPC Skills	39	11	I try to find out as much information as I can. I try to imagine scenarios, and what is available in those situations to take care of it.
SPC Time	28	8	The hardest thing I have to do is try to read or make my bills. I just have to take my time.
SPC Seeking Treatment	27	7	I'm trying to find some way to recover some of it. I do see all kinds of doctors regularly and I try different things.
Selective Secondary (SSC)			
SSC Positive Outlook	29	8	I can see where I can really become very bitter but I have found that it serves no purpose, so I try to keep my slant on my shortcoming on the upbeat.
SSC Enhance Value	19	5	The reading is very important to me. I live alone, I don't love television, and I can't be read to. . .I have to read myself.
SSC Devalue	16	4	It's silly for me to subscribe to magazines that I can't read, and do other things like that.
SSC Affective Support Accepted	12	3	I do have one friend who's in the same situation. In fact, she's further advanced in deterioration than I am. So we compare notes and we give each other hints.
SSC Enhance Control	8	2	I function. I function in everything that I have to do. Whatever I want to do I can do.
SSC Affective Support Initiated	5	1	Well, I was angry, I spoke to my daughter and she said, "You have to cope with it."
SSC Positive Consequences	2	0	Sometimes I can sign my name or will struggle to write a check myself. When I look at the check like this and finish writing it I feel like I've accomplished something.

Note: Percentages are based on $N = 364$.

Hultsch and Plemons (1979), as cited in Brennan and Cardinali (2000, p.327), define stressful life events as "occurrences that are indicative or require significant life change in the ongoing life pattern of the individual or experiences involving a role transformation, changes in status or environment, or impositions of pain". From the perspective of life-span development, "change throughout the life course is both continual and embedded in multidimensional contexts (i.e., biological, psychological, sociocultural, and historical)", stated by Lerner and Busch-Rossnagel, (1981) as cited in Brennan and Cardinali (2000, p.327). According to this person-environment perspective, "it has been posited that it is this lack of fit between a person’s abilities and needs and environmental conditions and demands that leads to variability in adaptational outcomes” (Carp, 1987; Kahana, 1982; Wahl, Oswald and Zimprich, 1999 cited in Brennan and Cardinali, 2000, p.327).

From the viewpoint of life-span development, “coping with stressful life events comprises a subset of these ongoing adaptational transactions between the person and the environment” (Stewart, 1982 cited in Brennan and Cardinali, 2000, p.327). “A stressful event, by its very definition, suggests a disruption between the person and the environment that becomes the focus of coping processes”, indicated by Lazarus and Folkman, (1984) as cited in Brennan and Cardinali (2000, p.327). Meanwhile, Horowitz et al. (1998) and Lerner and Busch-Rossnagel, (1981) as cited in Brennan and Cardinali (2000, p.327) conceptualise the influences of stressful life events as “a disturbance in the equilibrium in an individual’s life space, comprising a series of nested domains representing the biological, psychological, and socio-environmental contexts”.

“Coping begins with an appraisal of the degree of perceived threat arising from a particular stressful event” (Hultsch and Plemons, 1979; Lazarus and Folkman, 1984 cited in Brennan and Cardinali, 2000, p.327). The perceived threat may be caused by “the extent to which one has had previous experience in dealing with a particular event and/or the extent to which the implications of the event are not congruent with extant information, values, goals or behaviour”, described by Hultsch and Plemons, (1979) as cited in Brennan and Cardinali (2000, p.327). It is demonstrated that “initial attempts at adaptation are made through the use of pre-existing coping strategies following this appraisal” (Brennan and Cardinali, 2000, p.327). Nevertheless, when these strategies cannot satisfy the needs or only make slight improvement, “novel ways of coping may be explored, searching for new solutions, seeking out and evaluating new information, and reappraising current assumptions and life goals” (Hultsch and Plemons, 1979 cited in Brennan and Cardinali, 2000, p.327).

People who acquire visual impairment in old age are distinct from those with early-onset or congenital visual impairment. This is because older people have the experience of being a "normal’ sighted person for most of their lives and “with well-established familial, work, and other social roles” (Brennan and Silverstone, in press cited in Brennan and Cardinali, 2000, p.328). Stewart (1982) as cited in Brennan and Cardinali (2000, p.328) indicates that these kinds of unfamiliar situations encountered by older people may strongly stimulate the use of novel CSs to deal with life stress.

Brennan and Cardinali (2000) conducted a combination of qualitative and quantitative analysis techniques to identify the use of pre-existing and novel CSs among people with age-related vision loss. According to the narrative data, CSs that are used to respond to visual impairment, described as recent adopted activities or only applicable to visual impairment such as the use of optical/non-optical devices, are regarded as novel CSs. These CSs are unlikely to have been used in the past due to the fact that all the respondents had experienced recent onset of age-related visual impairment (Brennan and Cardinali, 2000). On the other hand, if the CSs are being used before the onset of visual impairment or represented as an enduring state/quality of a person/situation, they are considered as preexisting CSs. Based on the criteria above, if the CSs cannot be defined as either novel or preexisting, they are excluded from the analysis (Brennan and Cardinali, 2000). In order to accord with “the life-span developmental perspective of adaptation being embedded in multidimensional context” (Lerner & Busch-Rossnagel, 1981 cited in Brennan and Cardinali, 2000, p.330), CSs are also categorised into three domains which are behavioural, psychological, and social coping. Behavioural coping is described as ‘overt, observable actions’; psychological coping is described as “involving emotions or cognitions”; and social coping is conceptualised as “involving members of the informal social network or formal service providers” (Brennan and Cardinali, 2000, p.330).

According to Brennan and Cardinali (2000), people with age-related vision loss do develop novel coping strategies during their adaptation process. They begin to explore other strategies while their vision degenerates continually and the previous ways of coping are no longer satisfactory. Nevertheless, it is identified that preexisting CSs also improve over time, in other words, the development of novel CSs is more likely to complement rather than substitute for the accustomed coping methods. Meanwhile, the increase of both novel and preexisting CSs in the psychological domains over time points out the importance of psychological adjustment in long-term adaptation of age-related visual impairment (Brennan and Cardinali, 2000).

It is identified that CSs in the behavioural domain are the most likely to be novel, followed by the psychological domain; whereas social CSs are more likely to be preexisting. Thus Brennan and Cardinali (2000, p.333) explain that “the behavioural and psychological life-space domains, which are most directly under an individual’s control, might be the most amenable to experimentation and modification"; whereas "in the social life-space domain over which the person has limited control, there may be a greater tendency to rely on preexisting coping mechanisms". Gender and age seem not to be a factor to interfere the use of novel strategies, indicated by Brennan and Cardinali (2000).

Lee and Brennan (2002) conduct further research, based on the previous work of Brennan and Cardinali (2000), into age and gender in order to clarify the CSs that are used among older people with visual impairment. Older people are classified into three age groups, which are young-old (65-74 year-old), middle-old (75-84 year-old), and old-old (85+ year-old). The narrative data is also coded and categorised into the three domains as Brennan and Cardinali (2000), which are behavioural (i.e., overt, observable actions), psychological (i.e., involving emotions or cognitions), and social coping (i.e., involving members of the informal social network or formal service providers).

CSs identified in the behavioural domain (Table 2.5) indicate that "seeking and using optical devices were the most frequently cited coping behaviours across all age groups" (Lee and Brennan, 2002, p.395). The young-old show a greater tendency of using their residual vision by "moving closer to objects to see" and by "using optical devices" when comparing with their older counterparts (p.395). Nevertheless, it is noted that the young-old grudgingly use non-optical adaptive devices such as telephones with larger numbers, talking machines, and talking books to aid their impaired vision. The concerns of social stigma attached to VIP are reflected by this kind of behaviour, consequently, the young-old tend to cope with this perceived stigma by "acting like things were normal", indicated by Lee and Brennan (2002, p.395). Different from the young-old, the old-old are more active in putting effort into maintaining prior activities. They also display the use of the sense of touch to compensate, however, the old-old appear to rely less on memory to compensate when compared to their younger counterparts. In terms of gender in behavioural coping, it is found that more women than men "(a) tried to act like things were normal, (b) maintained prior activities, (c) relied on sound to compensate, (d) moved closer to see, (e) used optical devices, (f) sought optical devices, and (g) sought other services to learn new skills", stated by Lee and Brennan (2002, p.396).

Table 2. 5 Behavioural coping strategies (Lee and Brennan, 2002, p.398-399)

	Age Group						Gender			
	Young-Old		Middle-Old		Old-Old		Men		Women	
Coping Strategies	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Acts like things are normal	12	(6.0)	12	(3.9)	4	(3.7)	9	(3.1)	19	(7.5)
Acts more cautiously	3	(1.5)	12	(3.9)	3	(2.8)	9	(3.1)	9	(3.6)
Eats	1	(0.5)	0	(0.0)	0	(0.0)	0	(0.0)	1	(0.4)
Learns new skills	7	(3.5)	9	(2.9)	3	(2.8)	15	(5.2)	4	(1.6)
Moves closer to see	14	(7.0)	18	(5.8)	4	(3.7)	13	(4.5)	23	(9.1)
Optimizes lighting for task	7	(3.5)	7	(2.2)	5	(4.7)	8	(2.8)	11	(4.4)
Relies on memory to compensate	11	(3.6)	9	(2.9)	1	(0.9)	13	(4.5)	8	(3.2)
Relies on remaining vision to compensate	4	(2.0)	5	(1.6)	2	(1.9)	9	(3.1)	2	(0.8)
Relies on smell or taste to compensate	2	(1.0)	0	(0.0)	0	(0.0)	1	(0.4)	1	(0.4)
Relies on sound to compensate	8	(4.0)	19	(6.1)	5	(4.7)	12	(4.2)	20	(7.9)
Relies on touch to compensate	5	(2.5)	12	(3.9)	11	(10.3)	12	(4.2)	16	(6.3)
Restricts geographic range of activity	2	(1.0)	2	(0.6)	0	(0.0)	3	(1.0)	1	(0.4)
Seeks adaptive devices	5	(2.5)	15	(4.8)	3	(2.8)	10	(3.5)	13	(5.1)
Seeks advice or help from doctor	4	(2.0)	6	(1.9)	1	(0.9)	5	(1.7)	6	(2.4)
Seeks counseling or support	4	(2.0)	4	(1.3)	3	(2.8)	7	(2.4)	5	(2.0)
Seeks information about eye condition	2	(1.0)	6	(1.9)	1	(0.9)	3	(1.0)	6	(2.4)
Seeks information about services	2	(1.0)	2	(0.6)	2	(1.9)	2	(0.7)	4	(1.6)
Seeks low vision exam	5	(2.5)	0	(0.0)	1	(0.9)	3	(1.0)	3	(1.2)
Seeks medication/treatment	1	(0.5)	1	(0.3)	0	(0.0)	0	(0.0)	2	(0.8)
Seeks optical devices	17	(8.5)	27	(8.7)	10	(9.3)	23	(8.0)	31	(12.3)
Seeks services to learn new skills	17	(8.5)	31	(9.9)	8	(7.5)	24	(8.3)	32	(12.6)
Stays at home or avoids unfamiliar places	10	(5.0)	12	(3.9)	5	(4.7)	11	(3.8)	15	(5.9)
Takes meals out or reduces cooking	0	(0.0)	2	(0.6)	0	(0.0)	0	(0.0)	2	(1.8)
Tries to maintain prior activities	11	(5.5)	12	(3.9)	9	(8.4)	14	(4.9)	18	(7.1)
Uses adaptive device	9	(4.5)	25	(8.0)	9	(8.4)	22	(7.6)	21	(8.3)
Uses optical device	17	(8.5)	27	(8.7)	10	(9.4)	23	(8.0)	31	(12.3)
Uses system for crossing streets	2	(1.0)	4	(1.3)	2	(1.9)	4	(1.4)	4	(1.6)
Uses system for finding things	1	(0.5)	1	(0.3)	0	(0.0)	1	(0.4)	1	(0.4)
Uses system to identify clothes	3	(1.5)	0	(0.0)	1	(0.9)	2	(0.7)	2	(0.8)
Uses system for medications	3	(1.5)	6	(1.9)	2	(1.9)	6	(2.1)	5	(2.0)
Uses system for handling money	4	(2.0)	12	(3.9)	2	(1.9)	11	(3.8)	7	(2.8)
Voluntarily reduced or stopped driving	7	(3.5)	14	(4.5)	0	(0.0)	14	(4.9)	7	(2.8)

Young-old N = 142; Middle-old N = 241; Old-old N = 115. Males N = 227; Females N = 271

In terms of CSs in the psychological domain (Table 2.6), “strong belief in independence” and “self-reliance” are two of the most common CSs being used across both of age and gender groups. Nevertheless, the middle-old and the old-old groups appear to have a greater tendency to stick to such beliefs and Lee and Brennan (2002, p.397) demonstrated that “they chose to keep problems to themselves rather than ask for help”. Meanwhile, the old-old tend to be more hesitant to use their sense of humor and have a more negative attitude toward their recovery process. “Neither emotion-focused coping strategies (e.g., expressions of anger or self-blame) nor wish-fulfilling fantasies (e.g., hoping for a cure for vision loss) appeared to be related to age”, demonstrated by Lee and Brennan (2002, p.397). In terms of gender, women are more self-reliant and have a stronger social sensibility of keeping problems to themselves in comparison to men. Whereas men appear to more “actively avoid negative feelings” and “focus on their abilities rather than their disabilities”. Nevertheless, distinctions between “gender differences in terms of positive reappraisal (e.g., realising that other things were worse than vision loss) and empathising (e.g., recognising others have similar problems) were not apparent” (Lee and Brennan, 2000, p.397).

Table 2. 6 Psychological coping strategies (Lee and Brennan, 2002, p.400-401)

	Age Group						Gender			
	Young-Old		Middle-Old		Old-Old		Men		Women	
Coping Strategies	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Accepts limits imposed by vision loss	12	(5.2)	25	(4.9)	8	(4.3)	24	(5.9)	21	(4.2)
Accepts vision loss with resignation	11	(4.8)	28	(5.5)	10	(3.2)	21	(5.1)	28	(5.6)
Accepts vision loss in general	4	(1.7)	25	(4.9)	6	(3.2)	20	(4.9)	15	(3.0)
Actively avoids negative feelings	7	(3.0)	15	(2.9)	5	(2.7)	18	(4.4)	9	(1.8)
Actively tries to adjust	9	(3.9)	23	(4.5)	8	(4.3)	20	(4.9)	20	(4.0)
Appreciates partial vision	4	(1.7)	16	(3.1)	1	(0.5)	7	(1.7)	14	(2.8)
Believes in independence or self-reliance	47	(20.4)	117	(22.9)	54	(28.6)	90	(22.0)	128	(25.6)
Believes in perseverance	5	(2.2)	13	(2.5)	6	(3.2)	6	(1.5)	17	(3.4)
Believes vision loss caused by age	3	(1.3)	7	(1.4)	3	(1.6)	7	(1.7)	6	(1.2)
Cries or weeps	2	(0.9)	7	(1.4)	1	(0.5)	5	(1.2)	5	(1.0)
Distracts self or doesn't think about vision loss	1	(0.4)	2	(0.4)	2	(1.1)	4	(1.0)	1	(0.2)
Expresses anger in general	5	(2.2)	6	(1.2)	5	(2.7)	5	(1.2)	11	(2.2)
Expresses anger towards others	1	(0.4)	9	(1.8)	3	(1.6)	6	(1.5)	7	(1.4)
Expresses anger towards self	1	(0.4)	1	(0.2)	0	(0.0)	1	(0.2)	1	(0.2)
Expresses blame towards God	0	(0.0)	0	(0.0)	1	(0.5)	0	(0.0)	1	(0.2)
Expresses blame towards others	0	(0.0)	1	(0.2)	2	(1.1)	0	(0.0)	3	(0.6)
Expresses self-blame	3	(1.3)	3	(0.6)	0	(0.0)	4	(1.0)	2	(0.4)
Expresses self-pity	3	(1.3)	4	(0.8)	2	(1.1)	2	(0.5)	7	(1.4)
Focuses on abilities	14	(6.1)	36	(7.0)	8	(4.2)	34	(8.3)	23	(4.6)
Hopes for cure for vision loss	10	(4.3)	15	(2.9)	5	(2.7)	12	(2.9)	18	(3.6)
Hopes for positive rehabilitation outcome	7	(3.0)	15	(2.9)	1	(0.5)	13	(3.2)	12	(2.4)
Keeps problem to self or doesn't bother others	33	(14.3)	66	(12.9)	37	(19.6)	49	(12.0)	86	(17.2)
Learns from past experience	3	(1.3)	1	(0.2)	2	(1.1)	3	(0.7)	3	(0.6)
Plans for future regarding vision loss	1	(0.4)	2	(0.4)	1	(0.5)	1	(0.2)	3	(0.6)
Other things worse than vision loss (experiential)	2	(0.9)	4	(0.8)	3	(1.6)	5	(1.2)	4	(0.8)
Other things worse than vision loss (general)	6	(2.6)	15	(2.9)	5	(2.7)	15	(3.7)	11	(2.2)
Recognizes others have similar problems	0	(0.0)	3	(0.6)	1	(0.5)	2	(0.5)	2	(0.4)
Relies on denial	2	(0.9)	1	(0.2)	1	(0.5)	3	(0.7)	1	(0.2)
Relies on humor	5	(2.2)	13	(2.5)	2	(1.1)	13	(3.2)	8	(1.6)
Relies on patience	0	(0.0)	0	(0.0)	1	(0.5)	0	(0.0)	1	(0.2)
Relies on positive attitude or personality	11	(4.8)	23	(4.5)	3	(1.6)	17	(4.2)	19	(3.8)
Relies on religious consolation	9	(3.9)	15	(2.9)	2	(1.1)	2	(0.5)	14	(2.8)

Young-old N = 142; Middle-old N = 241; Old-old N = 115. Males N = 227; Females N = 271

In the social coping domain (Table 2.7), many older people indicated the use of informal support through their social networks to receive assistance and emotional support to compensate for the loss of vision. It is found that the middle-old are the most active in asking for visual information (e.g., reading mail and news) from others such as friends and family. The young-old demonstrated a "more frequent initiation of actions resulting in receipt of not only instrumental assistance with tasks of daily living (e.g., help with paperwork, housework, transportation) but emotional support" (Lee and Brennan, 2000, p.402). On the other hand, although the old-old appear more dependent on their family members, including children, they are indicated to have a tendency of being “less likely to rely on their spouse, to talk over problems, or to learn from others with visual impairment”. In terms of gender, many of them believed that “their quality of life could be worse if not for their significant others” (Lee and Brennan, 2000, p.402). Among them, men appear to rely more significantly on their spouse than women. Although it is identified that “women were more flexible than men about receiving informal support from sources other than their immediate families, including friends and neighbours”, there are no apparent differences in gender when asking for social support, stated by Lee and Brennan (2000, p.402).

Table 2. 7 Social coping strategies (Lee and Brennan, 2002, p.403)

	Age Group						Gender			
	Young-Old		Middle-Old		Old-Old		Men		Women	
Coping Strategies	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Activates formal help in general	3	(1.6)	4	(1.2)	0	(0.0)	1	(0.4)	6	(1.6)
Activates formal help for services for the disabled	1	(0.5)	1	(0.3)	0	(0.0)	1	(0.4)	1	(0.3)
Activates informal help in general	18	(9.5)	25	(7.5)	7	(4.9)	20	(7.0)	29	(7.7)
Activates informal help for advice	2	(1.1)	5	(1.5)	0	(0.0)	2	(0.7)	5	(1.3)
Activates informal help for emotional support	10	(5.3)	13	(3.9)	5	(3.5)	9	(3.1)	19	(5.1)
Activates informal help for low vision aids	1	(0.5)	1	(0.3)	1	(0.7)	2	(0.7)	1	(0.3)
Activates informal help for sighted guide	1	(0.5)	6	(1.8)	2	(1.4)	2	(0.7)	7	(1.9)
Activates informal help for visual information	6	(3.2)	20	(6.0)	7	(4.9)	12	(4.2)	21	(5.6)
Attends counseling, support group or meeting	1	(0.5)	0	(0.0)	3	(2.1)	2	(0.7)	2	(0.5)
Relies on children	5	(2.7)	11	(3.3)	15	(10.5)	11	(3.8)	19	(5.1)
Relies on family but not friends	24	(12.7)	45	(13.6)	21	(14.7)	38	(13.2)	51	(13.6)
Relies on friends but not family	8	(4.2)	9	(2.7)	8	(5.6)	5	(1.7)	19	(5.1)
Relies on sister or brother	1	(0.5)	2	(0.6)	1	(0.7)	1	(0.4)	3	(0.8)
Relies on spouse	24	(12.7)	50	(15.1)	14	(9.8)	59	(20.6)	28	(7.5)
Seeks companionship or friendship	7	(3.7)	10	(3.0)	3	(2.1)	6	(2.1)	13	(3.5)
Seeks companionship with sighted people	1	(0.5)	0	(0.0)	0	(0.0)	1	(0.4)	2	(0.5)
Talks over and explains problems with others	49	(25.9)	79	(23.8)	23	(16.1)	71	(24.7)	81	(21.6)
Talks or learns from others with vision loss	12	(6.4)	18	(5.4)	4	(2.8)	11	(3.8)	24	(6.4)
Withdraws socially	15	(7.9)	33	(9.9)	29	(20.3)	33	(11.5)	44	(11.7)

Young-old N = 142; Middle-old N = 241; Old-old N = 115. Males N = 227; Females N = 271

2.5 Modelling visually impaired people's navigation

This section intends to develop a comprehensive understanding of VIP's spatial navigational abilities through identifying how they a) perceive their surroundings; b) process received information and construct mental maps; and c) navigate in different types of spaces. To achieve this intention, this section begins with an overview of the perceptual systems in relation to space and discusses how the perception systems function and what kind of information they provide for VIP to understand their surroundings. Factors that are distinct and significant for spatial cognition are identified which include 1) near vs. far (haptic vs. locomotor) space; 2) early vs. late onset; and 3) memory vs. inferential tasks. Finally, small-scale space and locomotor (movements of a body across space) space are discussed. Distinguishing potential navigational strategies (NSs) in this section may contribute to the primary research described in a later chapter (see more details in Chapter 4.3.2).

2.5.1 An overview of perceptual systems of space

Although people with VI adopt the same perceptual and cognitive processes as sighted do, they have to refer to different information sources and collect different sense data to respond to and interact with their immediate physical and social environment (Foulke and Hatlen, 1992). This section investigates how perceptual systems function differently and the types of information they provide. From the findings from the work of Foulke and Hatlen (1992), Lahav and Mioduser (2000), and Gardiner and Perkins (2005), sensory information distributed in space could be perceived by different senses as follows: i) sense of vision; ii) sense of hearing;

iii) sense of touch; and iv) sense of smell. These are now discussed in turn and in details below.

Visual system = spatial knowledge = spatial system

Vision is the most important perceptual system for distinguishing spatial anchors or landmarks (Couclelist, et al., 1987 cited in Gardiner and Perkins, 2005, p.89). The visual system is considered as the spatial system which is beneficial for analysing spatial patterns and acquiring sensory information distributed in space (Foulke and Hatlen, 1992). Through this perceptual system, the information about ‘the extent of space, the distribution and movement of objects in space, and the shapes, textures and other characteristics of those objects’ is obtained without the requirement of physical contacts (Foulke and Hatlen, 1992, p.44).

Most of the activities that we deal with demand us to move intentionally through space. For example, objects that we look for, operate and avoid are within a space; people that we interact are also within a space. Nevertheless, without sufficient spatial concepts the ability of interpreting spatial data may decrease (Foulke and Hatlen, 1992). Significant impacts on an individual who grows up without visual input have been described in Section 2.3.2.2 (cognitive abilities).

An auditory system needs to be complemented by other perceptual systems

Both the visual system and the auditory system do not essentially require physical contact with the thing that is perceived. Acoustical energy can be received by the auditory system from a considerable distance from all directions. However, when compared to luminous energy, which is received by the visual system, spatial information provided by acoustical energy is much less adequate.

“The patterns of illumination from which the visual system acquires information about space are patterns that vary in time and space, whereas the patterns of acoustical energy from which the auditory system acquires information vary only in time. The auditory system is therefore by design well suited for the acquisition and analysis of time-varying signals (consider, for instance, its ability to process speech signals), but much of the spatial information that is so effectively expressed in spatial patterns cannot be conveyed effectively by temporal patterns”, explained by Foulke and Hatlen (1992, p.45).

Although the auditory system is advantageous for estimating the distances and directions of sounds, it is indicated that “the information contained in patterns of acoustical energy does not, except by way of learned association with the spatial information supplied by other perceptual systems, make it possible to identify the objects responsible for those sounds”. Practice progresses the ability of gaining spatial information through the auditory system, although it is indicated that it cannot provide rich information about the characteristics of physical surroundings (Foulke and Hatlen, 1992, p.45).

Haptic information complementing auditory information

Distinct from visual and haptic perceptions, the patterns of acoustic energy processed by the auditory system do not explain features of objects precisely such as shape, size, texture and colour. Those who cannot see objects have to move from one location to another for exploring the features of objects; in the meantime, they seek and associate potential information which is obtained by haptic and auditory perceptions (Foulke and Hatlen, 1992).

The limitations of haptics, kinaesthesia and proprioception

“Haptic perception, or the perception of shape by touch, depends on excitation of kinesthetic receptors and tactile receptors” (Howard, 1973 cited in Foulke and Hatlen, 1992, p.45). For those who are visually impaired, it is stated that haptic information can be acquired through: i) the cane for low-resolution scanning of their immediate environment; ii) their palms and fingers for fine recognition of objects’ form, textures and location; and iii) their legs regarding surface information. On the other hand, the auditory system provides complementary information regarding: i) events; ii) the presence of other people (or machines or animals) in the environment; iii) materials which objects are made of; or iv) estimates of distances within a space (Hill, Rieser, Hill, Halpin and Halpin, 1993 cited in Lahav and Mioduser, 2000, p.53).

“Proprioception, or perception of the body’s orientation in the gravitational field, depends on excitation of equilibratory receptors and kinesthetic receptors”. Meanwhile, vision may also be of help to proprioception if it is available (Lee and Aronson, 1974 cited in Foulke and Hatlen, 1992, p.45).

Functioning haptic, kinesthetic and equilibratory systems all together provide the same kind of spatial information as the vision system does. These three systems provide blind observers information not only about the shapes and the textures of objects, but also about their relative positions within space. Nevertheless, Foulke and Hatlen (1992) indicate significant drawbacks of this conglomerate system when compared to the visual system.

One of the issues is its poor capacity for pattern resolution. Those who rely on touch may not be able to perceive some details that are very obvious for visual observers. In addition, it is an essential condition for perception to physically contact the thing that is perceived; therefore, the volume of a space that is observable by touch at one time and from one position is very limited when compared to that perceived by vision.

It is indicated that only when the object is very small, "haptic observers must resort to serial observation; that is, they must observe parts of an object, and then integrate these perceptions of parts to achieve an image of the whole" (Foulke and Hatlen, 1992, p.45).

Smell

Sometimes, olfactory system can also provide spatial information. For example, blind pedestrians may know that they are approaching a bakery due to the smells emanating from a door of a building (Foulke and Hatlen, 1992).

According to Gardiner and Perkins (2005, p.89), "aromas are ephemeral but they can enhance understanding of other sensory stimuli by association". For example, when a VI observer perceives the sound made by a block of trees but unable to recognise what it is, the smells of woodland may assist the observer to interpret the sound that they heard previously.

Sound, texture and shape

Through the sense of touch, those who have learned the shape of a ball can develop an association according to the shape's feel and the sound it makes when it bounces (Foulke and Hatlen, 1992). Even though the bouncing sound does not contain any information about the shape or the surface texture of a ball, those who have practiced proper association skills may recognise an object is nearby when they hear a certain sound which is made by the object itself (e.g., a ball). "Objects are not abstractions. They have spatial extension, and they are somewhere in space" (Foulke and Hatlen, 1992, p.48).

Sound, distance and direction

According to Foulke and Hatlen (1992, p.48), "sounds provide clues concerning the distance and direction of their sources". Thus, it is indicated that when a blind individual is learning to connect the feeling of the shape of an object (e.g., a ball) with the sound it makes (e.g., bouncing sound), she or he is also learning something regarding its position in space.

2.5.2 Understanding visually impaired people's spatial navigational abilities

2.5.2.1 Distinctions of spatial cognition

Ungar (2000) points out some important distinctions of spatial coding in VIP which are 1) near vs. far (haptic vs. locomotor) space; 2) early vs. late onset; and 3) memory vs. inferential tasks. Research on spatial coding usually identifies environments as 'near' and 'far' space, which is an important distinction for spatial tasks performance when vision is impaired. According to Ungar (2000, p.2), within "areas that can be explored without changing the location of the body", the locations of objects can be represented through corresponding to one's own body, that is, the haptic exploration of using hands and arms, so that a reliable egocentric frame of reference is provided. Within "areas in which locomotion is required for exploration", the egocentric frame of reference becomes less reliable due to the body's need to continually change location while exploring (Ungar, 2000, p.2).

On the other hand, Ungar (2002) indicates that it is significant to clarify the distinction between those who are blind from birth or early childhood (i.e., early onset), and those who lose their sight later and with some visual experience before the onset of visual impairment (i.e., late onset). "Blind persons often come to know the spatial structure of a place they have explored by walking, without vision" (Haber and Haber, 1990; Hollyfield and Foulke, 1983; Klatzky, Loomis, Golledge, Fujita, and Oellegrino, 1990; Lockman, Rieser and Pick, 1981; Worchel, 1951 cited in Rieser et al., 1992, p.210). Nevertheless, the previous visual experience is believed to be beneficial for the development of such non-visual sensitivity and some studies also demonstrate deficits in the accuracy of spatial knowledge of people who are blind from birth or early childhood when compared to later-blinded people (Casey, 1978; Dodds, Howarth and Carter, 1982; Fletcher, 1980; Herman, Chatman and Roth, 1983; Rieser, Lockman and Pick, 1980; Rossano and Warren, 1989 cited in Rieser, 1992, p.210). It is indicated that the performance of spatial tasks of later-blinded people is generally more similar to sighted people than people who are early blinded (Ungar, 2000). Nevertheless, "visual experience facilitates the rate of development or the speed of learning but that it is not necessary to induce the capacity for learning" (Gottlieb, 1976 cited in Rieser, 1992, p.210). Although the necessary length of period of visual experience that is advantageous or spatial development is not clearly defined, studies are using broadly varying cut-off points, from a few months to three years of age, to distinguish between people who are early- and late-blinded (Ungar, 2000).

Another important distinction in spatial coding is the difference between "tasks that require participants to make a response based on a spatial relation that has been directly experienced" (i.e., memory tasks) and "tasks that require participants to infer a new relation based on their direct experience" (i.e., inferential tasks) (Ungar, 2000, p.3). The memory tasks simply involve some form of spatial coding, whereas in the inferential tasks, the coded information needs to be transformed. This distinction is usually used to examine the spatial coding especially in large-scale space; meanwhile, it is indicated that their performance in general appears to be more efficient and dependable when applying external coding in the inferential tasks, for example, "an integrated or map-like representation of a spatial layout" (Ungar, 2000, p.3).

2.5.2.2 Spatial relations in small-scale space

According to Ungar (2000), coding the location of an object could be either by "reference to one's own body and/or movements" or "relative to some external framework" (p.3). For example, the position of a cup on the table could be recognised either by its distance and direction from where someone is sitting through stretching out his or her arm in a specific direction corresponding to the body, or through relating the position of a cup to the layout on the table (e.g., between the teapot and sugar jar) (Ungar, 2000). In this case, coding the position of a cup may be more effective by adopting the former strategy through relating one's own body co-ordinates or by way of "a reliably reproducible series of arm movements"; yet people with vision may more naturally adopt the later strategy, and for those without vision, this strategy would also include "locating the reference objects by touch each time" (Ungar, 2000, p.3).

It is indicated that when people with little or no visual experience are in "areas that can be explored without changing the location of the body" (Ungar, 2000, p.3), they prefer to code the spatial relations through "reference their own body co-ordinates and/or their arm movements" (Ungar, 2000, p.3). This is due to early blinded people receiving a 'different type and reliability of spatial information' from those with vision, and these different qualities of experience usually spur them on to adopt different coding strategies from sighted people, which tends to arise from visual experience, to organise spatial information. (Millar, 1982 cited in Ungar, 2000, p.3).

Millar (1995, p.9) proposes two specific effects when there is no visual information. The first is that “there is little direct and reliable information about the relation between external surfaces which can provide spatial frame cues”. Another is “the loss in the redundancy of reference cues which the overlap of vision with other modalities provides”. “Cues from body-centred sources and from movements are more constant and reliable than external cues and therefore tend to predominate”, stated by Millar (1995, p.9).

Visual experience urges people, both who are late-blinded or blindfolded-sighted, to pay attention to external cues such as “the interrelationships between objects”, whereas it is demonstrated that people who are early-blinded have a tendency to ignore these cues and therefore use different strategies (Ungar, 2000, p.3). Research finds that relative to those who are late-blinded and sighted, early-blind participants generally achieve manipulatory spatial tasks well (Millar, 1994; Thinus-Blanc and Gaunet, 1997 cited in Ungar, 2000, p.4). It is demonstrated that body-centred and/or movement based coding strategies are less efficient in tasks that require “mental reorganisation, mental rotation or spatial inference, or when tasks are very complex” (Ungar, 2000, p.4). External frameworks are harder to access for blind people, indicated by Millar, (1988, 1994) as cited in Andreou and Mccall (2010, p.119), nevertheless, “visually impaired people have the potential to adopt tactile external coding strategies that might be different but functionally equivalent to those of the sighted”.

An example is found in the study of Andreou and McCall (2010, p.120). Through their research, they identified that a congenitally blind child tends to estimate the length of a room by “taking strides about the length of a metre”. They explained that initially the child appears to be coding the space by relying on "self-reference cues" (i.e., the paces) but not by the "external cues"; however, the child is actually equating the paces with the length of a metre which may "equally be taken to suggest that he is using an external frame of reference", stated by Andreou and McCall (2010, p.120).

2.5.2.3 Spatial relations in locomotor space

Cognitive mapping and wayfinding

Kitchin, Blades and Golledge (1997, p.235) state two main theories of how sighted individuals learn and develop cognitive map knowledge: i) a set of environmental cues develops and acts as the fundamental framework on which subsequent information, such as paths, is added; and ii) routes develop first, and landmarks are then placed in relation to them.

Nevertheless, the significance of landmarks is also demonstrated for the construction of initial framework for cognitive map knowledge. 'Anchor-point theory' has been proposed by Golledge (1978 cited in Kitchin, Blades and Golledge, 1997, p.235) and is explained as follows.

> "Different places have different salience to individuals and there fore become hierarchically structured. Primary nodes act as spatial primers which act as decision points. These cues are the anchors on which other information is 'hung', and they act as a spatial mnemonics, increasing the probability of recognising, or knowing the position of, an

> associated target cue. Other landmarks have lower levels of use and recognisability, each acting as minor anchors to the levels below. Secondary nodes identify place of decision-making, recreation and entertainment, such as major junctions, parks and cinemas. Tertiary nodes are usually places of minor decision-making (e.g., little-used junctions or little-known landmarks). Minor-order nodes are places that are specifically known, but which do not act as decision-making points, and these are often unique to the individual".

Couclelis, et al. (1987 cited in Kitchin, Blades and Golledge, 1997, p.235) further expanded Golledge's theory and suggested that "nodes within the hierarchy may not necessarily represent landmarks but may include any feature that acts as a cognitive map cue or anchor. For example, a stretch of main road may act as a cue".

Although the processes of how VIP learn new environments or update existing knowledge have not yet been fully understood, it is demonstrated that VIP learn new environments by relying heavily on haptic and verbal instruction (Hampson and Duffy, 1984 cited in Kitchin, Blades and Golledge, 1997, p.235). Hill, et al. (1993 cited in Kitchin, Blades and Golledge, 1997, p.236) have distinguished significant strategies that are used by both VIP and sighted/blindfolded groups which include: independent systematic exploration which varied according to the purposes under which such exploration took place; establishment of a significant and clearly defined anchor point as an origin; establishing the type of regularity found in the layout structure of the environment (e.g., regularities in the street system); establishing significant landmark cues which could be auditory, tactile, olfactory or locational; and as part of the preplanning process, choosing a path selection strategy such as minimising obstacles, minimising left turns or minimising effort or time.

It has been recognised that those with superior performance tended to use an anchor point (object-to-object) strategy, which is similar to that identified by Golledge (1978) and Counclelis, et al. (1987) in the “cognitive mapping and environmental learning processes”; meanwhile, individual variation in the use of spatial and wayfinding strategies is demonstrated (Hill, et al., 1993 cited in Kitchin, Blades and Golledge, 1997, p.236). The significance of considering this individual variation as well as the relationship between individual strategies and severity of VI are suggested; at the same time, “such factors need to be considered in the context of different environments and the type of mobility aids”, stressed by Kitchin, Blades and Golledge, 1997, p.236).

Orientation through the development of memory maps

> “In order to perform many tasks, blind persons must consult memory for information that seeing persons acquire by direct perception of the environments in which the tasks are performed while those tasks are in progress. If blind persons are to perform such tasks well, the information they need must be there when memory is consulted. Sometimes it is not there, for the reason that they did not remember to remember; that is, they did not remember that, in order to perform a particular task more skilfully the next time it must be performed, it will be necessary to commit certain information to memory”. (Foulke and

Hatlen,1992, p.47)

Allen, Milner and Price (2002) investigated how VI children develop memory maps while navigating within their home and neighbourhood environment. It is identified that VI children were able to use the environment where they are familiar with by developing a ‘cognitive orientation’, for example, counting steps, bus stops or learning where pavements are uneven. Through the development of a ‘sense orientation’ (e.g., by listening to the traffic sounds or by touching the tactile paving near pedestrian traffic lights), VI children were able to establish their location and improve their mobility. These two types of orientation were employed when the VI children needed to consider “what they were doing and where they were going, and therefore when they needed to make explicit use of a ‘memory map’” (Allen, Milner and Price, 2002, p.11).

“When the coordination of individuals’ memory maps and their actions becomes effortless, a ‘habitual orientation’ to the home and neighbourhood environment emerged” (Allen, Milner and Price, 2002, p.11). Habitual orientation emerged out of the routines, which were initially developed through continually repeating (e.g., on an everyday level) cognitive and sensory orientation practices. It is indicated, “once such routines were established, such cognitive and sensory orientation practices were dispensed with” (Allen, Miner and Price, 2002, p.11).

Cognitive, sense and habitual orientations concern a process of establishing and using a memory map of “particular built environments that were integral to the children’s lives, such as the home, the street, and the school”. Therefore, it is indicated that “cognitive and sense orientations constituted an explicit knowledge of these environments, while the habitual orientation constituted a tacit knowledge of these environments” (Allen, Miner and Price, 2002, p.11). On the other hand, when the VI children represented how they move around within built environments that they were less familiar with, transferable orientation was identified. Allen, Miner and Price (2002, p.11) explain that “this required them to use their familiarity with, for example, their own home or school and then transposing this ‘memory map’ onto the houses or schools that they were visiting”. By doing this, the VI children were able to orient themselves to move around within these unfamiliar environments.

2.6 Conclusion and implications for this study

This chapter provided a comprehensive literature review of VI and VIP. According to Welsh and Tuttle’s work, a different viewpoint of VI was furnished which assisted the present research to distinguish its complexity and variability (e.g., the age of onset, the length of time of impairment and the severity of VI) and understand how these variables influence VIP’s behaviour during the adaptation process and the development of coping skills. Welsh and Tuttle recognised VIP’s ability in adjusting adventitious VI in a positive way and considered one’s personality, behavioural characteristics, interests and abilities should be necessarily the same before and after the onset of VI, rather than the “loss” model (see more details in section 2.3.2.3) that were proposed by Cholden (1985) and Carroll (1961), as cited in Welsh and Tuttle (1997, p.69). This kind of thinking is similar to the asset-based approaches and deficit-based approaches that were discussed by the Glasgow Centre for Population Health (2012). A further discussion of asset- and deficit-based concepts will be provided in Chapter 3.4.

Other important findings emerged regarding VIP’s abilities of coping with the loss of vision such as superior skills in terms of using senses other than vision for tasks and superior performance in many memory-related situations were identified within those who grow up without vision input. Meanwhile, the research conducted by Boerner, et al. (2010) provided an insight into the use of a conceptual framework for a systematic assessment of VIP’s CSs. According to the research proposed by Lee and Brennan (2002), a rich array of CSs categorised under the three domains are identified which include: i) behavioural CSs (e.g., moving closer to see, relying on other senses to compensate); ii) psychological CSs (e.g., recognising others have similar problems, accepting limits imposed by vision loss); and iii) social CSs (e.g., activating formal help for services, talking over and explaining problems with others).

On the other hand, according to the review of VIP’s spatial navigational abilities, how individuals’ perceptual systems perceive spatial information was investigated. For example, making a useful estimation of an object’s distance and direction through the auditory system, and collecting spatial information through working the haptic, the kinaesthetic and the equilibratory systems together. Learning proper associations was suggested to be beneficial for VIP to understand their surroundings better. How VIP navigate in different kinds of spaces was also discussed. For example, in a manipulatory space, VIP may reference their own body and/or movement, or relative to other external frameworks to code an object’s location; when moving in a large-scale space, they may make use of landmarks to establish an initial framework for cognitive map knowledge; and with reference to the complexity of VIP, individual variation in the use of spatial and wayfinding strategies, is stressed again. The four orientation strategies proposed by Allen, Milner and Price (2002) (i.e., cognitive, sense, habitual and transferable orientation) are also significant for VIP's navigation. The discussion above summarises findings emerging from the review of VI and VIP, providing interesting and valuable insights for this study, and various aspects of these will be discussed in more detail in later sections.

3. Literature Review 2: Assisting Visual Impairment Through Design

3.1 Introduction

This chapter begins with a review of the development of models, which have evolved and are used quite widely in the Inclusive Design (ID) / Universal Design (UD) literature. An overview of design practice and research is also provided.

3.2 Models of health and inclusion

This section discusses models of health, disability and design inclusion which have relevance in this study.

3.2.1 Models of ageing / lifespan

It is useful to follow the development of models which have evolved and are used quite widely in the Inclusive Design (ID) / Universal Design (UD) literature and how these gave rise to approaches to ID/UD which may be problematic, i.e., using a 'deficit-based' model or approach.

While many sociologists and economists are discussing the connection between the ageing population and the change in people's thoughts and values, there are other experts trying to explain how people age. Sloane (1992, cited in Pirkl, 1994, pp31-32) proposes a useful "rule of thirds" for considering functional decline in older people, and in Figure 3.1 below it can be seen that 1/3 is due to disease, 1/3 to inactivity (disuse), and 1/3 is caused by the ageing process itself (senescence), which changes the stereotyped image from the ageing process being the only reason.

1/3	Disease
1/3	Inactivity (disuse)
1/3	Aging Process (senescence)

Figure 3. 1 The rule of thirds (Pirkl, 1994, p.32)

On the other hand, the figures below illustrate the changing relationship of the functional ability across life span. Figure 3.2 (Pirkl, 1994) describes that functional ability, which is often misconceived, increases gradually from birth until around the age of retirement and then starts to decrease when an individual becomes older.

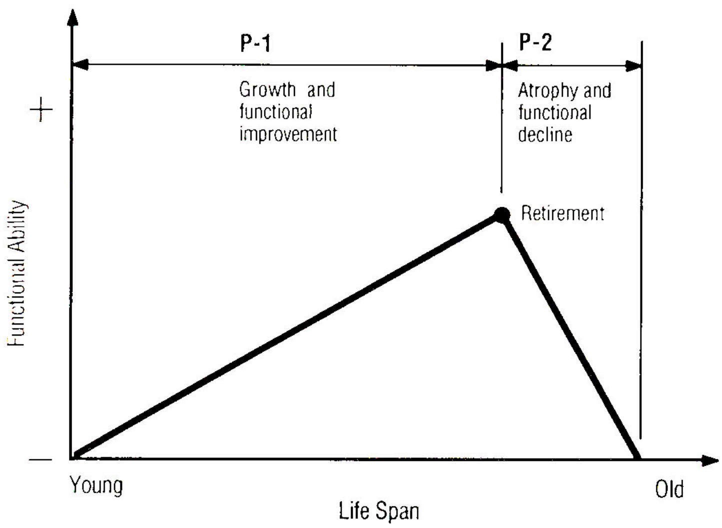


Figure 3. 2 Popular conception of life span (Pirkl, 1994, p.33)

A similar model is proposed as Figure 3.3 (Svanborg, 1985 cited in Pirkl, 1994, p.33) which shortened the first phase due to the various biomedical and environmental influences.

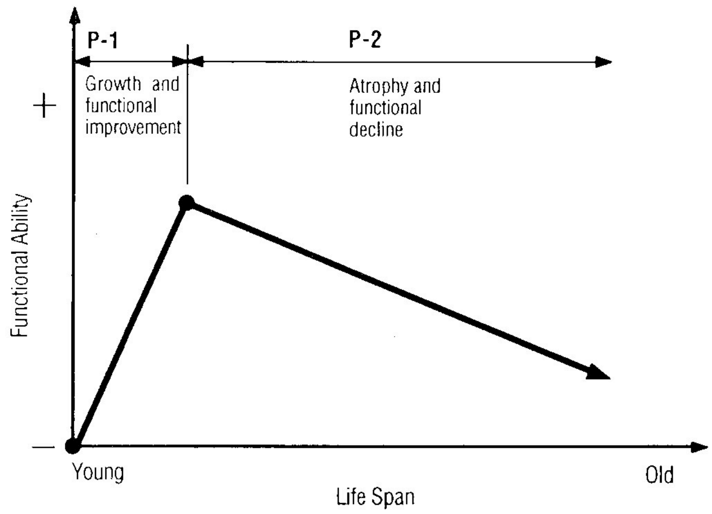


Figure 3. 3 Two-phase of life span model (Pirkl, 1994, p.33)

Weisgerber (1991, cited in Pirkl, 1994, p.34) further introduces a model (Figure 3.4) which divides the life span into four phases which are: i) growing and functional improvement; ii) a constant, nearly level period; iii) a period of functional decline; and iv) a rapid decline following the onset of ageing manifestations. Growing and functional improvement (i.e., phase one), which is illustrated by line A-B, is the period that functional ability strengthens rapidly. Both mind and body develop at this stage in older to prepare against the challenges in later life, and the period spans the years of the infancy, childhood, and formal education (Pirkl, 1994). When entering phase two, the functional ability maintains at the same level which can be seen as line B-C. Phase three, which is represented by line C-D, reveals a period of functional ability declining due to the mechanisms of biological ageing attacking our body’s physical and sensory health, and the restorative faculties fall gradually. Phase four, describing by line D-E, is the period when functional ability declines rapidly. It is suggested that the location of point D and E varies with each individual and happens within a wide range of ages and functional abilities. The body systems appear atrophied once the activity level drops, which accelerates the degeneration of the biological processes until an individual dies (Pirkl, 1994).

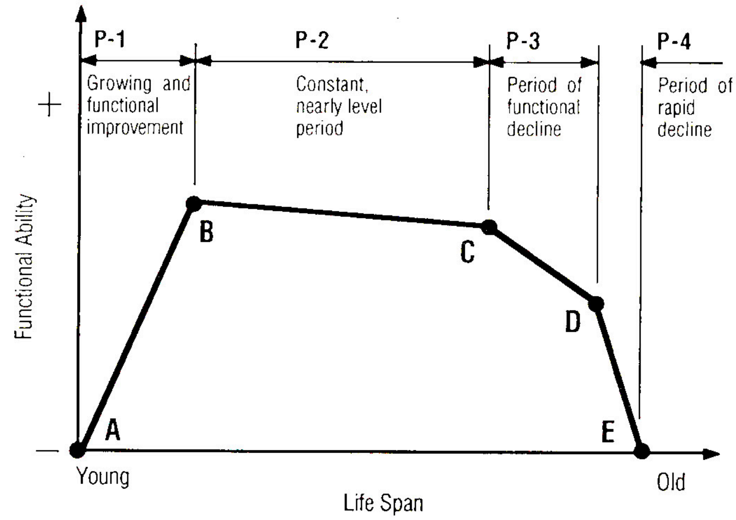


Figure 3. 4 Four-phase of life span model (Weisgerber, 1991 cited in Pirkl, 1994, p.34)

“Transgenerational design is the practice of making products and environments compatible with those physical and sensory impairments associated with human aging, which limit major life activities” (Pirkl, 1994 p.25). Figure 3.5 (Pirkl, 1994, p.36) illustrates how transgenerational design helps extending the range of functional ability to include older people and people with different abilities, as well as the young and able-bodied. As mentioned above, the line D-E includes a wide range of ages and functional abilities. Although many designs are proposed to address their physical needs, most products tend to exhibit prosthetic-like appearances which usually stigmatise their differences and cause “negative self-labelling” (Moss, Lemke and David, 1987). According to Parsons and Felton

(1990), this kind of design may not only expose an individual to the social stress as frustration but also trigger the body's defence mechanism, which aggravating one's condition and inducing the critical support point (CSP) to arrive earlier (see Figure 3.5). Transgenerational design focus more on the human performance and aid to improve one's confidence in later life. Meanwhile, such designed products can also extend the CSP, accordingly lengthening the period of one's independence and life (Pirkl, 1994).

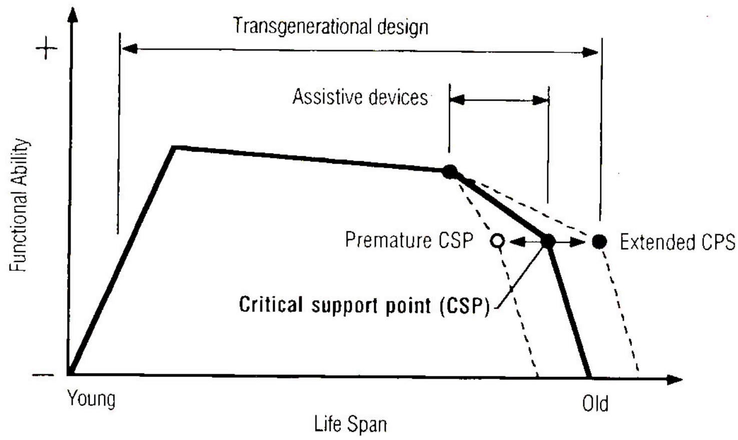


Figure 3. 5 Design support over the life span (Pirkl, 1994, p.36)

3.2.2 Benktzon's model of capability

Although ageing and disability are separate issues, if the factors overlap which can be the case in later life, then the result exaggerates the impact of both.

Benktzon (1993 cited in Keates and Clarkson, 2003, p.56) proposes the user pyramid model (Figure 3.6), which visually represents the full range of potential users and divided capabilities into three sections which are: severely disabled people, people with reduced strength and mobility, able-bodied people and those with minor disabilities.

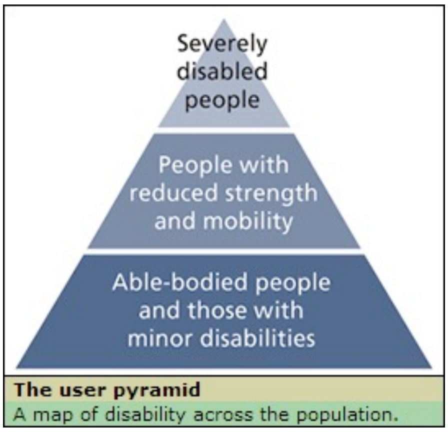


Figure 3. 6 Benktzon's user pyramid (Keates and Clarkson, 2003, p.56)

3.2.3 Keates and Clarkson's inclusive design cube

The model can be adopted as two approaches which are: top-down and bottom-up approaches. According to the Cambridge Engineering Design Centre (CEDC) (2005), top-down approaches (Figure 3.7) correspond to design approaches such as rehabilitation design and design for disability, and the designed products are usually categorised as assistive technology which provide remedial assistance to reinstate or replace a functionality capability. The top-down approach model is adopted to develop more inclusive products and guarantee the products are accessible by the least able users, and also to be used easily by able-bodied people and those with minor disabilities.

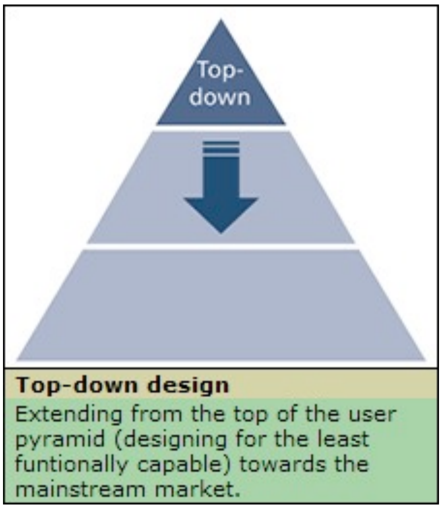


Figure 3. 7 Top-down design approaches (Keates and Clarkson, 2003, p.57)

On the contrary, bottom-up approaches (Figure 3.8) start at the bottom of the users, able-bodied people and those with minor disabilities. It expands upwards which means that more people are included by the product. It is said to have a great potential for identifying commercially successful products; nevertheless, when moving up each unit of the pyramid, the additional number of people included diminishes. Bottom-up approaches always need to be examined against top-down ones as they can only go a limited distance up the pyramid which may exclude some users from accessing or using the product easily and may require something radically different to be designed (CEDC, 2005).

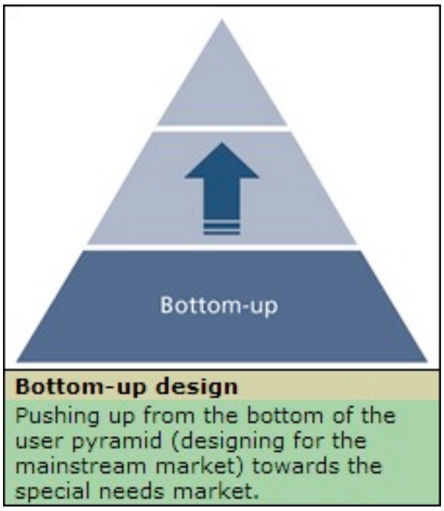


Figure 3. 8 Bottom-up design approaches (Keates and Clarkson, 2003, p.60)

Developing from the user pyramid concept, Keates and Clarkson (1999 cited in CEDC, 2005) offer an advanced model, the inclusive design cube (Figure 3.9), in order to approach the idea of designing for the whole population. According to CEDC (2005), the inclusive design cube is divided into three fundamental categories as show by the user pyramid:

- user-aware design: pushing the boundaries of 'mainstream' products to include as many people as possible;
- customisable/modular design: design to minimise the difficulties of adaptation to particular users;
- special purpose design: design for specific users with very particular needs.

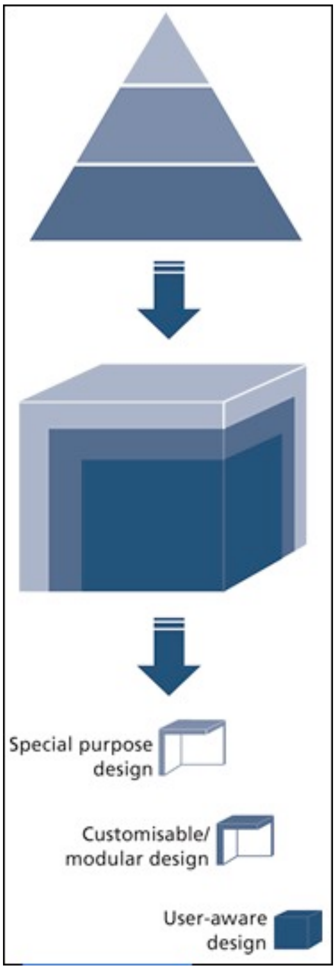


Figure 3. 9 The Inclusive Design Cube (Keates and Clarkson, 2003, p.62)

The inclusive design cube not only illustrates who is included by each design approach, but also who is excluded. It increases the awareness in designers to modify products by knowing how many users are excluded and why they are unable to use products (CEDC, 2005).

3.3 Design practice and research

From the review of practice and research, a number of research based organisations, centres and publications are identified and listed below.

- **The Foundation for Assistive Technology (FAST):** FAST is an organisation which is dedicated to the development of assistive technology (AT) for maximising disabled and older people's independence and improving their quality of life. Through working with specialists and the community, relevant research projects funded by the UK government are documented in FAST's Annual Parliamentary Report on Assistive Technology Research and Development.

- **Cambridge Workshop in Universal Access and Assistive Technology (CWUAAT):** CWUAAT is a series of workshops held biennially by the University of Cambridge since 2002. CWUAAT has a general focus on designing accessible technology and is devoted to raising awareness to support people with special needs, especially for those who are older.

- **Thomas Pocklington Trust:** Thomas Pocklington Trust is a registered charity and a major research and development body which aims to advance housing and care service provision for people with sight loss. A growing area of Pocklington's research is in the field of lighting and design in the housing environment, and they have produced a design guide which is intended to improve the design of visual environment in the home for everyone, especially for people with sight loss.

- **Design Research Centre and Design for Environments**: Professor Dalke is the director of the Design Research Centre and Design for Environments at Kingston University. She is a specialist in colour and lighting design and the focus of her research is in the field of accessibility, sensory design and healthcare sector.

- **Inclusive Urban Design: streets for life:** This book was produced from research by Burton and Mitchell in 2006. A series of design principles are introduced which addresses physical and cognitive requirements in environmental design for older people with dementia as well as for all users of urban space.

- **OPENspace:** OPENspace is a research centre for inclusive access to outdoor environments for everyone led by Catharine Ward Thompson. One of their well-known research projects, I'DGO (Inclusive Design for Getting Outdoors), was undertaken over ten years from 2003 to 2013 and focused on the design of gardens, streets, neighbourhoods and open spaces for improving older people's wellbeing and quality of life.

- **Murray and Dunlop Architects – Hazelwood School:** Hazelwood School was designed by architects Gordon Murray and Alan Dunlop, for pupils with multiple disabilities. One of their design features is assisting the pupils navigate and orientate around the building better and creating an environment that encourages greater independence within each child. A case study of Hazelwood School was developed by Scottish Matrix for Architectural Research and Knowledge (ScotMARK) and Gordon Murray + Alan Dunlop Architects (gm+ad), and published in 2007.

- **Sight Line: designing better streets for people with low vision**: Sight Line is a research project produced by Ross Atkin and published by The

Helen Hamlyn Centre for Design at the Royal College of Art in 2010. Through the observation of eight VIP navigating within their local neighbourhood, suggestions are provided for improving the design of urban environment.

3.4 Issues of relevance for this study arising from scoping review

3.4.1 Issues arising from the review of design models, practice and research

The discussion above selected three main models (the lifespan models from Pirkl 1994, Benktzon's 1993 User Pyramid, and Keates and Clarkson's 2003 Inclusive Design Cube), which are widely used in the ID/UD literature. These have influenced design approaches which highlight different levels of capabilities according to individuals' age or physical condition; therefore, practitioners are suggested to be more aware of their needs in order to make a product, a service, or an environment to be more accessible by as many people as possible.

The first issue arising from the design review is the types of models of 'disability/capability' used in the ID/UD community. These design approaches and models stress individuals' disability rather than capability and are similar to the traditional health care services which focus on "identifying the actual or potential health problems of individuals and providing interventions to solve, alleviate, or prevent those problems"; they are deficit-based which stress the problems, needs, and deficiencies (e.g., deprivation, illness, and health damaging behaviours) (Glasgow Centre for Population Health, 2011, p.5).

Nevertheless, deficit-based approaches can be problematic and with little focus on improving individuals' strengths and capabilities as well as not recognising their experiences, preferences, perspectives and knowledge (Rotegard, et al., 2010 cited in Glasgow Centre for Population Health, 2011, p.5). As a consequence, the feeling of disempowered may occur and individuals may become "passive recipients of services rather than active agents in their own lives" (Foot and Hopkins, 2010 cited in Glasgow Centre for Population Health, 2011, p.5).

On the contrary, asset-based approaches focus on individuals' positive capabilities, strengths and resources which are beneficial for assisting them to distinguish problems and solutions for health and wellbeing and therefore promote their self-esteem and coping abilities (Glasgow Centre for Population Health, 2011). The concept of asset-based approaches is similar to the present research in that the literature review of VI and VIP in Chapter 2 not only distinguished the variables of VI and how these may affect one's ability in developing coping skills, but also identified VIP's strengths and a set of strategies that they use to cope with everyday challenges.

Through reviewing the practice and research above, FAST and CWUAAT accommodate disabled and older people through innovational technology. This appears deficit-based by addressing their disability needs rather than focusing on the capabilities they possess.

The survey in section 3.3 also identified that in their daily lives VIP normally encounter different types of environment, with varying degrees of familiarity and predictability, from those which are very familiar, intimate and predictable to them such as the home or an immediate neighbourhood, to those which are largely unfamiliar and unpredictable, like an unknown environment or city.

Of interest here will be to explore what ‘assets’ VIP poses which may be potentially exploitable by professionals. A further discussion of how VIP’s needs are currently approached in current research and practice will be provided in section 4.3.2.2.

3.4.2 Gaps in ‘design’ knowledge and questions for the next stage of the study

The following questions arose as a result of the review of design models, practice and research.

- What are the processes and strategies that VIP use to deal with the built environment when navigating?
- Do they use different CS in different kinds of environment?
- To what extent do professionals of the built environment understand VIP’s CSs and to what extent does existing research take account of these?
- To what extent does existing research take account of these?

4. Research Methodology

4.1 Introduction

The literature review in Chapter 2 established that VIP were not a homogenous group, and that their conditions, personal experiences and individual strategies of dealing with VI, in the context of how they navigated different spaces and places, varied greatly. It also importantly revealed that VIP possess many capabilities which have tended to be unrecognised by design in the discussions of impairment and disability, and consequently are lacking in the approaches used by designers described in Chapter 3. As a consequence it will be important to recognise the different consequences of VI on different individuals and the different ways in which VIP develop strategies to cope with VI and, in the context of this study, the extent to which these strategies are commonly shared or individual in nature. My Chapter 2 review clearly revealed that these are people who are ‘differently abled’, who have various kinds of VI, and who from necessity or resourcefulness, have developed a set of alternative navigational strategies and it is this which I want to explore using a methodology appropriate to this enquiry. Chapter 3 allowed an opportunity to understand, more closely, the approaches to ‘inclusive’ design, the theoretical or conceptual models and practical approaches which the ID community had developed, and to look at in this chapter, in more depth through a case study approach, how professionals were approaching research and design in this field, with particular reference to the built environment, from the intimate home environment, to the public domain.

4.2 Theoretical and conceptual considerations

4.2.1 Epistemology

Crotty (1998, p.3) refers epistemology to "the theory of knowledge embedded in the theoretical perspective and thereby in the methodology"; it is described as "a way of understanding and explaining how we know what we know". According to Carter and Little (2007, p.1317), "methodology justifies method, which produces data and analyses"; knowledge is derived from the data and analyses, and "epistemology modifies methodology and justifies the knowledge produced".

4.2.2 Models and methods used by designers to approach an understanding of – and knowledge about – VI and VIP

A review of current approaches used in Design reveals different approaches to understanding VI and VIP. In these approaches commonly used by Design, there is a tension between approaches to capability and disability and how people are understood. While 'inclusive' approaches have achieved much they have their limitations and there is a lack of certain kinds of data about people themselves.

4.2.2.1 Conceptual frameworks

One approach from the Cambridge Engineering Design Centre (CEDC), as discussed earlier in Chapter 3, proposed the Inclusive Design Cube, a conceptual model where the user capabilities were divided into (on each of the three axes of the cube) a) sensory capability, which included vision and hearing capabilities; b) cognitive capability, which included thinking and communication capabilities; c) and motor capability, which included locomotion, reach and stretch, and dexterity capabilities (see figures 4.1 and 4.2). The Inclusive Design Cube conceptual model was intended to be helpful for designers to raise their awareness of the capabilities of the population, and not only exhibited people who are included by each design approach but also illustrated those who are excluded. CEDC (2005) practiced this approach through developing a framework which combined the statistics of user capabilities, obtained from a UK government-commissioned survey for supporting disabled people in 1996 to 1997 (Waller, Langdon and Clarkson 2010). The Inclusive Design Cube and the associated frameworks are perhaps best for illustrating large sets of statistical information relating to inclusion and exclusion. This kind of approach tends towards a positivist approach, generating ‘knowledge’ through quantification (i.e. from statistical information) with the researchers being at a distance from their subjects. In the Inclusive Design Cube, the ‘human model’ is diminished to three axes where only certain functions and capabilities are represented which are in decline from an ideal 100%. Also, a ‘social’ dimension is not included in this model, a problematic omission. Consequently these are inappropriate to this study which is concerned with people’s experiences, strategies and capabilities at an individual level.

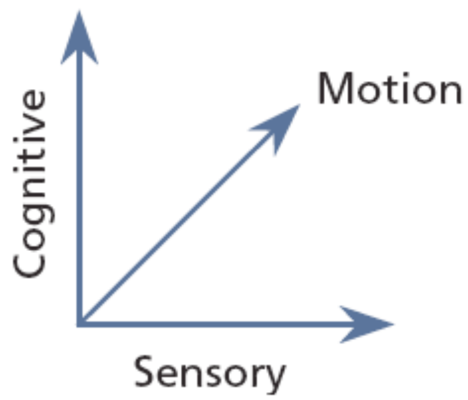


Figure 4. 1 The Inclusive Design Cube and user capabilities (Clarkson, Dong and Keates, 2003, p.433)

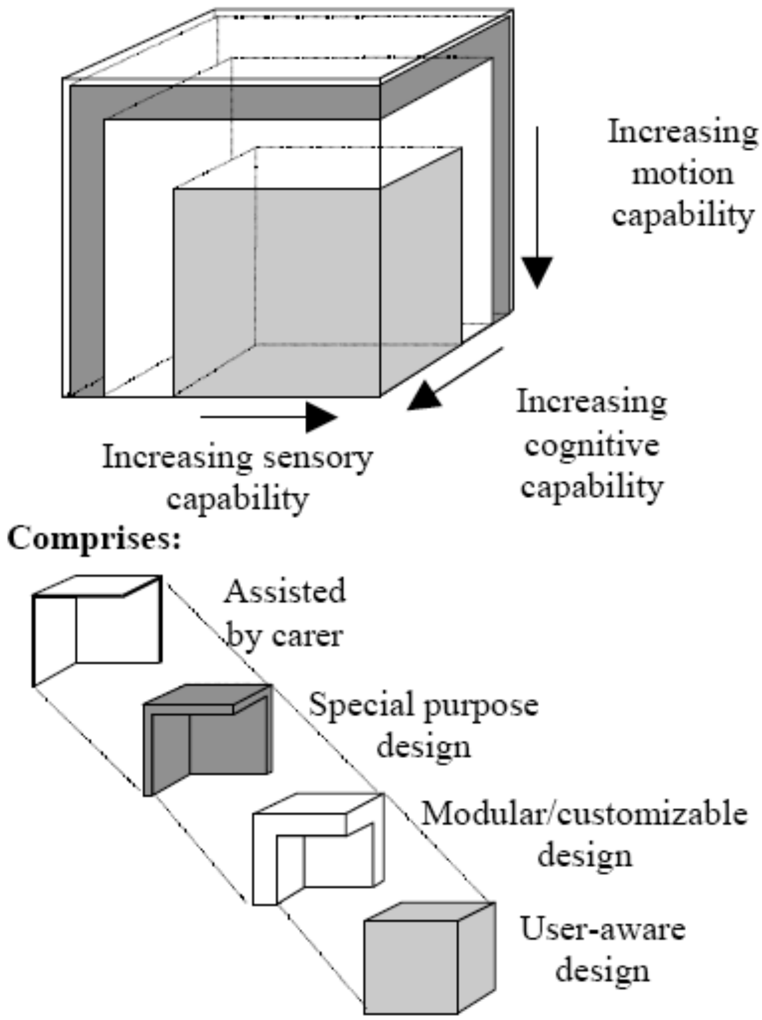


Figure 4. 2 The Inclusive Design Cube and design approaches (Keates and Clarkson, 2001)

4.2.2.2 Empathic tools

A more practical and experiential approach to gaining knowledge and understanding used by designers and researchers in inclusive design is in the use of empathic tools, which can be used to simulate certain conditions such as reduced mobility or reduced vision. The ‘Third Age Suit’ developed by Loughborough (2010) for designing more ‘inclusive’ car interiors for Ford is one example which was developed with more recent adaptations of the suit to simulate osteoarthritis. This approach created, e.g., the Ford Focus, a family car which was highly successful in Europe, appealing to a wide range of consumers. Part of this Third Age Suit included a visor which crudely simulated diminished vision. The Guide Dogs for the Blind Association’s (GDBA, 2002) ‘simulation specs’ and the CEDC (2007) also introduced a series of inclusive design tools. Among them, the Cambridge Simulation Glasses (CEDC, 2007) were designed to simulate a general loss of the ability to see fine detail which covered a range of VI from mild to severe sight loss. The effects are representative of an inability to achieve the correct focus, reduced sensitivity of retinal cells, and problems with internal parts of the eye becoming cloudy. These effects typically occur with ageing and the majority of eye conditions, as well as not wearing the most appropriate corrective glasses. These glasses enable quick identification of product features that do not have sufficient size or contrast. For example, these glasses are suitable for assessing the legibility of text and symbols, and the extent to which users will be able to see the different controls of a product. There are also researchers, for example, University of Reading (Banks and McCrindle, 2008), University of Strathclyde (Maver, Harrison and Grant, 2001) and University of Washington (Toufaili, Seibel and Mcintyre, 2004), devoting their research in developing tools and/or methods, which simulate the characteristics of a number of common visual impairments, in virtual reality environment. Although these kinds of tools might help a designer or researcher to begin to empathise with some of the issues associated with sight loss, the CEDC admits that “impairment simulation cannot convey what it is really like to live with capability loss on an everyday basis” (CEDC, 2013). This is true for all the empathic tools no matter how simple or sophisticated.

The empathic tools simulate, at a superficial level only, some aspects of impairment – but are perhaps more useful for sensitising the designer to some of the issues than for revealing the true experiences of what life is like for those with impairments, or the special skills and strategies that they develop over time to cope with particular situations. So, although empathic tools are designed more to assist the researcher or the designer, they would not provide the kinds of insights and data about the experiences of the subjects of this study themselves, i.e. VIP, with a range of VI, as revealed through my work in chapters 2 and 3.

4.2.2.3 Demographic charts

Some models of the lifespan cited in Pirkl (1994) have already been referred to in Chapter 3. Pirkl’s (1994) transgenerational design approach is the practice of making products and environments compatible with those physical and sensory impairments associated with human ageing, which limit major life activities. In 1988, Pirkl and Babic (cited in Hewer, et al., 1995) produced a series of ‘demographic charts’, derived from physiological data about the diminution, through ageing, of various facilities such as visual acuity, hearing, tactile sensitivity and motor control. For each of these the physical change, functional effect and the resulting problem were provided, as well as design guidelines and design strategies to enable the designer to accommodate these physical and physiological changes through the way they approached the design of products or environments. An example is provided, relating to the yellowing of the aqueous fluid in an ageing eye, in Figure 4.3.

impact of yellowing of fluid in an ageing eye

Example	Colour perception
Physical change	Yellowing of fluid in the eye
Functional effect	Fluid loses clarity causing shorter rays to be filtered out
Result (problem)	Inability to differentiate cool colours
Design guidelines	Maintain colour contrast
Design strategies	Use contrasting colours Use blue/violet/green combinations with care Avoid blue illuminants when sharp vision is necessary Use consistent colour-coding systems.

Figure 4. 3 Sample of demographic chart (Pirkl and Babic, 1988 cited in Hewer, et al., 1995)

As for the conceptual example of the Inclusive Design Cube, empathic tools simulate, at a superficial level only, some aspects of impairment. Again these are more useful for the designer in understanding how to compensate, through design, for disabilities than revealing the true experiences of, and strategies used by, individuals in daily life.

4.2.2.4 Co-design and EBD approaches

Kimbell (2011 cited in Macdonald 2013) discusses "the importance of putting end-users and stakeholders at the heart of design" which is relevant to the discussion of inclusive design and the question of with whom the privilege of designing is actually situated, i.e. "it becomes important to acknowledge the part that end users and other stakeholders play in constituting the effects of design through practice…end-users and stakeholders are co-designers as they engage with objects in their practices..." and regards design as "… a distributed social accomplishment", "not just as the work of design professionals but also of the … end-users and other stakeholders whose practices constitute design and its objects in different ways." However, although the process results in 'co-designs' it is difficult sometimes to separate out the contributions of designers from those with whom they are designing (e.g., end-users who may be appropriated into the 'design team'). More useful might be experience-based design methods as used by Bate and Robert (2007) and part of their methodological approach might be useful for understanding the experiences of VIP.

Similarly the work of Atkin (2010) attempts to understand 'how blind and partially sighted people navigate the public realm in order to embed an understanding of their needs into emerging street design practice'. The limitation of this approach is perhaps due to the lack of a methodological framework which can be used to give insights into the *existing experiences* and *strategies* of VIP.

4.3 Methodological approach adopted in this study

The above examples of commonly used ID theoretical and conceptual models and practical approaches which designers might use when designing products or environments reveal the limitations of both the approaches used and the data available for understanding the experiences of, and strategies used by, VIP, i.e., certain types of data acquired from VIP themselves. New data of the experiences of and strategies used by VIP might assist the designer in better understanding and recognising those capabilities (rather than disabilities) possessed by VIP as an evidence-base for designing.

The literature review in Chapter 2 provided the basis of a methodological framework which has been adapted and developed from the work of Lee and Brennan (2002) to allow the present research to fully identify and analyse the strategies, and their combinations used in different situation, e.g., the home, familiar environment and completely new environments..

Consequently, this study took an ethnographic approach with an emphasis on how people understand themselves and their environment. This would require a study of “people’s feelings, perceptions or experiences of what is going on” (Gillham 2000, p.7), which would require a qualitative methodology.

4.3.1 Methods

Marshall and Rossman (1999) regard qualitative inquiry as a cycle and propose the model ‘the cycle of inquiry’ (Figure 4.4), which illustrates the relationship between theory, practice, research questions, and personal experience. It is also suggested that a research project could be launched at any point in the cycle, in sequence, which guides researchers deliberating such issues as research questions, sites, and data collection strategies and shaping the focus of the study (Marshall and Rossman 1999).

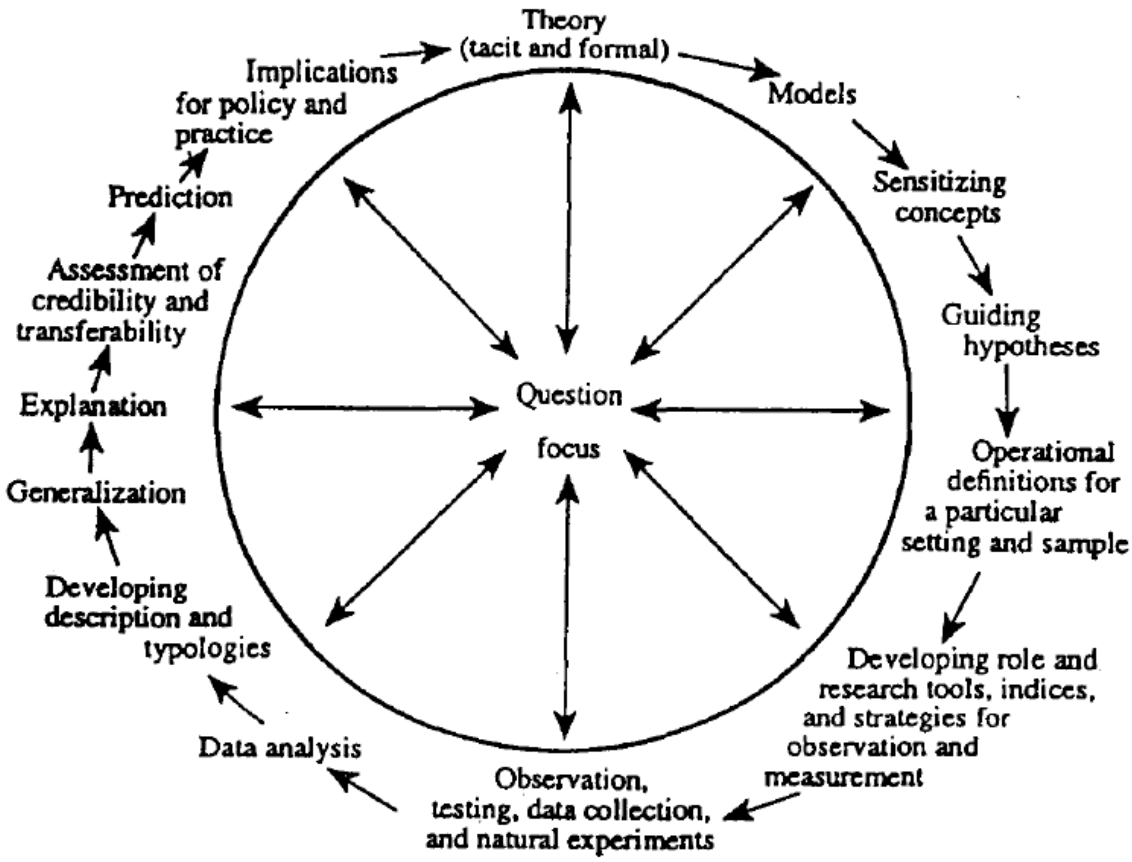


Figure 4. 4 The cycle of inquiry (Marshall and Rossman, 1999, p.26)

Triangulation is defined as “the use of more than one approach to the investigation of a research question” for strengthening dependability of the findings; it is also “one of the several rationales for multimethod research”, indicates by Bryman (2004, p.1142). Four types of triangulation are proposed by Denzin (1970 cited in Bryman, 2004, p.1142) which are:

1. Data triangulation, which entails gathering data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered.
2. Investigator triangulation, which refers to the use of more than one researcher in the field to gather and interpret data.
3. Theoretical triangulation, which refers to the use of more than one theoretical position in interpreting data.
4. Methodological triangulation, which refers to the use of more than one method for gathering data.

The present research adapted the cycle of inquiry as the methodology framework for this qualitative study. Meanwhile, data triangulation was used to approach the two groups of the participants, that is, the VIP and the professionals. Due to the considerably limited time for a doctorial study, this research did not undertake observation as one of the methods in the Marshall and Rossman model (a review of the work of Atkin (2010) also indicated the gap and the limitation of the VIP observation method); however, the semi-structured interviews with VIP gave sufficient information for testing the hypothesis. Although there is the opportunity for further work in future research (see more details in section 8.7).

4.3.1.1 Sensitising through empathic methods

Although the limitations of certain empathic methods have been discussed, when used as part of an overall methodology they would have a useful value in this context to initially sensitise myself to some of the issues faced by VIP when navigating, so these will be used prior to developing the questions and interviewing VIP.

As discussed in 4.2.2.2, as a means of sensitising myself only, and to gain a better understanding of the use of these kinds of tools, I made a journey around the city centre using the GDBA simulation specs (see Appendix I).

4.3.1.2 Personas

Although there are challenges and limitations to the creation and use of personas (Dotan, et al., 2009) a set of personas was developed together with the matrix of coping strategy (CS) categories derived from my analysis of the work of Lee and Brennan (2002) (see Figure 4.5) as discussed in section 2.4.2. The intention of using the personas technique in this study was to begin to understand VIP as individuals and to characterise different kinds of biographies and behaviour patterns among people with VI (i.e., everyone is an individual with different abilities, histories and who has developed their own ways of coping) and to give an insight into how CS are used by different VIP in these different categories.

People / Variable	Visually impaired from birth and early childhood	Visually impaired in mid-life	Visually impaired in old age
Variable 1: Age			
Variable 2			
Variable 3			
Variable 4			
Variable 5			
etc			

Figure 4. 5 Initial classification approach – variables in people

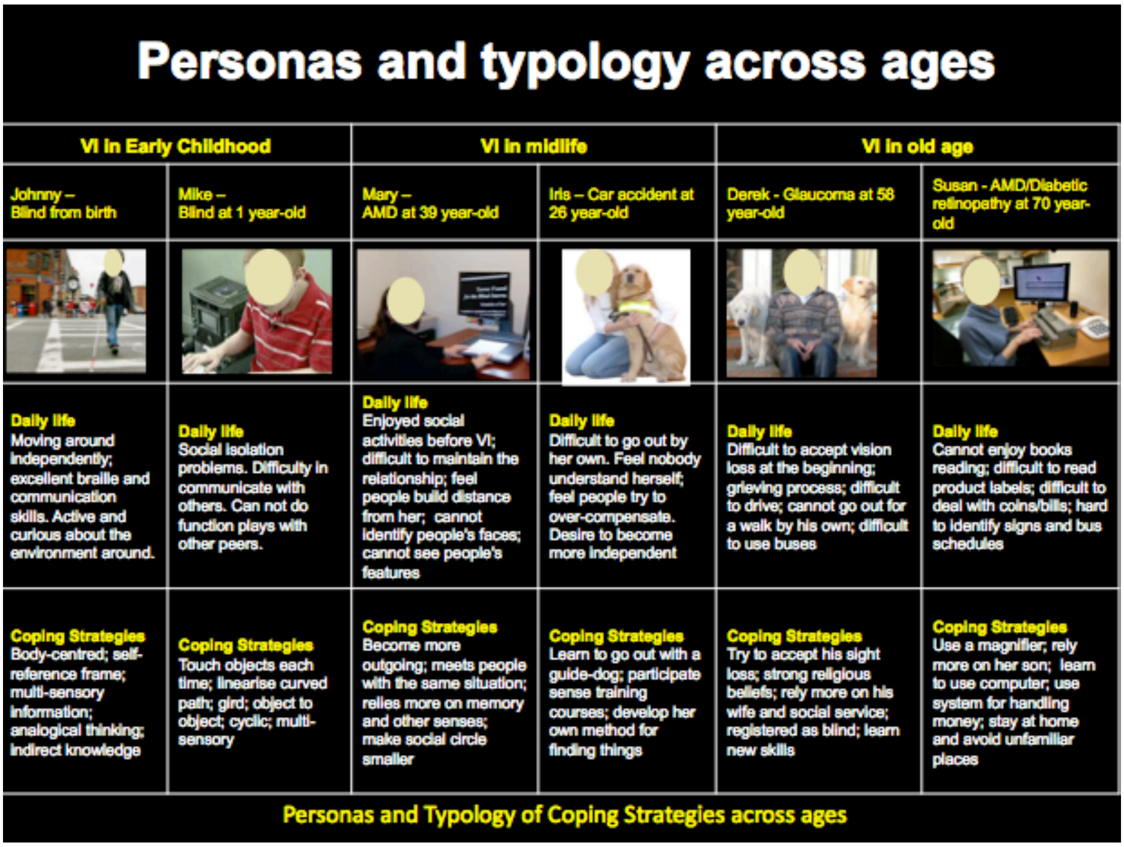


Figure 4. 6 Personas and typology across ages

Figure 4.6 provides an overview of how different people with different histories and conditions, and of different ages, might develop different coping and navigational strategies.

Figure 4. 7 Sample of personas No.7

Figure 4.7 provides a hypothetical interview case study and the kinds of data which would emerge from this.

Figure 4. 8 Case studies from interview data

Figure 4.8 provides the generic model for acquiring data from VIP.

4.3.2 Modelling and analytical concepts

4.3.2.1 Conceptual model for identifying and analysing navigational strategies

The review in Chapter 2 revealed previous models for categorising VIP's coping strategies (CSs) and Chapter 3 threw some light on the different kinds of environments that VIP are required to navigate within or around. Consequently, I would prefer to now name these specific attributes as navigational strategies (NSs) as the subset of CS (see section 2.4.2, Figures 2.5, 2.6, 2.7). I adapted CSs together with other strategies identified in section 2.5 and developed these into a model (see Table 4.1) derived primary from the work of Lee and Brennan (2002) (see section 2.4.2) and Allen, Milner and Price (2002) (see section 2.5.2.3) for the particular purposes of this study determined by the clear focus of identifying NS. The intention of this model was to enable me to codify and discuss data acquired from VIP's semi-structured interviews in a manner which would reveal NS used by different individuals in different environments. The intention was that this should also allow for easy comparison of data, raising further questions to explore and discuss. Using the same matrix should also allow me to map – in a separate but parallel set of interviews - the extent of professionals' knowledge of VIP's NS, derived from semi-structured interviews with professionals, and to separate and differentiate their knowledge of VIP's NS from their own design strategies for improving the environment. Therefore, this model of categorised NS could be used to codify which combinations of NS, as declared in interviews by different VIPs, were used in different kinds of environments.

Table 4. 1 Initial matrix of NS

Navigational Strategies (NSs)	
Main categories	**Sub categories**
Sense orientation	Relies on residual vision Relies on hearing Relies on touch Relies on smell Relies on kinaesthesia
Habitual orientation	Establishes routines
Cognitive orientation	Counts step Counts bus stops Learns where pavements stick up
Transferable orientation	Transposes familiar places onto unfamiliar places
Behavioural coping strategies	Acts like things are normal Acts more cautiously Eats Learns new skills Optimizes lighting for task Relies on memory to compensate Restricts geographic range of activity Seeks adaptive devices Seeks advice or help from doctor Seeks counselling or support Seeks information about eye condition Seeks information about services Seeks low vision exam Seeks medication/treatment Seeks optical devices Seeks service to learn new skills Stays at home or avoids unfamiliar places Takes meals out or reduces cooking Tries to maintain prior activities Uses adaptive device Uses optical device Uses system for crossing streets Uses system for finding things Uses system to identify clothes Uses system for medications Uses system for handling money Voluntarily reduced or stopped driving
Social coping strategies	Activates formal help in general Activates formal help for services for the disabled Activates information help in general Activates information help for emotional support Activates information help for low vision aids Activates information help for sighted guide Activates information help for visual information Attends counselling, support group or meeting Relies on children Relies on family but not friends Relies on friends but not family Relies on sister or brother Relies on spouse Seeks companionship or friendship Seeks companionship with sighted people Talks over and explains problems with others Talks or learns from others with vision loss Withdraws socially

Psychological coping strategies	Accepts limits imposed by vision loss Accepts vision loss with resignation Accepts vision loss in general Actively avoids negative feelings Actively tries to adjust Appreciates partial vision Believes in independence or self-reliance Believes in perseverance Believes vision loss caused by age Cries or weeps Distracts self or doesn't think about vision loss Expresses anger in general Expresses anger towards others Expresses anger towards self Expresses blame to towards God Expresses blame towards others Expresses self-blame Expresses self-pity Focuses on abilities Hope for cure for vision loss Hope for positive rehabilitation outcome Keeps problem to self or doesn't bother others Learns from past experience Plans for future regarding vision loss Other things worse than vision loss (experiential) Other things worse than vision loss (general) Recognises other have similar problems Relies on denial Relies on humour Relies on patience Relies on positive attitude or personality Relies on religious consolation

4.3.2.2 Conceptual model for distinguishing different kinds of environments

<u>Rational for case study methodology</u>

Case study is a common research method used in the social science disciplines such as psychology, sociology, business and community planning for investigation in different professional fields (e.g., social work, business and marketing, and public health). It is typically used to answer "how" or "why" questions, and is considered as a robust research method which allows the investigators to retain the holistic and meaningful characteristics of real-life events such as individual life cycles, small group behaviour, neighbourhood change, and school performance

(Yin, 2009).

As a result of the review of practice and research conducted for Chapter 3, four case studies have been identified and selected for the following reasons:

1. The Thomas Pocklington Trust provides access to examples of excellent research for design for VIP in and around the home, i.e. environments which are personal and intimate to VIP.
2. The Design Research Centre and Design for Environments at Kingston University conducts research into the public environment utilising design features which acknowledge VIP's residual vision and where VIP are navigating in the wider public, and often unfamiliar environments.
3. Burton and Mitchell provide an approach for structuring the environment to take account of a range of disabilities, including those associated with ageing and dementia. This case study will be useful as it will reveal issues relating to older VI people's navigation in neighbourhoods and public spaces.
4. The Hazelwood School designed by Gordon Murray + Alan Dunlop Architects provides a detailed example of a public space (school) designed specifically for children with a range of disabilities, including VI. This case study is useful as it reveals issues relating to younger VI disabled people in a space, which although not personal space in a sense, will become familiar to its users on a daily basis.

Further discussion and the analysis of the four case studies will be provided in Chapter 8.6.

The territory covered by the case studies

The Thomas Pocklington Trust and Hilary Dalke's research cover all people with sight loss, whilst Burton and Mitchell's emphasis is on people who are older (but who also have orientation and navigation issues due to age-related conditions such as dementia). Murray and Dunlop designed a specialist environment for children with VI and other sensory and physical disabilities from early childhood.

These four case studies, between them, cover approaches to the research and design of the environment for disabled, older people and/or VIP which consider a number of variables, including: i) age; ii) type of environment – across a spectrum which includes private and personal, public but familiar, and public and unfamiliar; and iii) type of design solution.

In terms of the type of environment, the Thomas Pocklington Trust is improving VIP's private and personal home environment as well as a public but familiar environment (i.e., local neighbourhood). Hilary Dalke's research focuses more on public spaces (e.g., hospital, transportation) which could be either largely familiar or unfamiliar. Burton and Mitchell emphasise the improvement of local neighbourhoods, which are public but largely familiar environments. Murray and Dunlop's design is about improving a public but familiar school environment, including internal and external areas, for children.

The Thomas Pocklington Trust, Hilary Dalke, Burton and Mitchell as well as Murray and Dunlop all acknowledge and utilise VIP and/or older people's residual vision and make use of design features such as colour and brightness contrasts and/or lighting to maximise their functional vision. The Thomas Pocklington Trust and Murray and Dunlop further make use of other senses to reinforce environmental features for VIP to identify where they are, for example, making use of textures and finishes as tactile clues. Hilary Dalke, Burton and Mitchell, and Murray and Dunlop also emphasise the coherence of the built environment to help people to find their way.

Conceptual model for distinguishing different kinds of environments

In order to understand which combinations of NS were used by which individuals in different kinds of environments, these were differentiated, for the purposes of this research, into:

E1: the intimate personal environments (e.g., home, where everything about the environment is familiar and largely predictable and which the VIP would have the most control over organizing the environment to suit their individual needs and preferences);

E2: the more public but still familiar environments (e.g., one's immediate neighbourhood where, e.g., routes are familiar and largely predictable but some things might be unpredictable due to, e.g., road works or parked cars);

E3: the unfamiliar and unpredictable environments (e.g., a new neighbourhood, or a journey to an unfamiliar part of the city or countryside where there are no familiar landmarks and everything would be unfamiliar and unpredictable).

Although there would be many further categories in between these three kinds of environments, these would provide sufficient distinction to understand if VIP required to use different strategies and/or combinations of NS for each.

4.4 Exploring the research questions

One hypothesis emerging from the review was that VIP use different NS in the three different types of environments (i.e., E1, E2 and E3). Rather than addressing their disabilities, the purpose of the present study is to develop a deeper understanding of VIP's innate capabilities and their use of NS in these three different kinds of environments and to establish the extent to which variables influence the use of these NS through the following questions:

1. What are the range of capabilities and NS that VIP use when navigating environments?
2. How do these capabilities and NS vary from individual to individual?
3. How can one categorise these capabilities and NS?
4. How do these NS depend on the degree of the VIP's familiarity with - and the kinds of - the environment to be navigated (i.e. from those which they know intimately to those which are completely unfamiliar to them, (i.e. models E1 to E3 above)?
5. Would this kind of knowledge be of value to professionals of the built environment?

These questions would be used as the basis for designing the semi-structured interviews (see Appendix E – interview questions for VIP participants) for the topic guide for the semi-structured interviews).

4.4.1 Semi-structured interviews

The methodological framework derived from the literature review in Chapter 2 has been designed for both i) identifying and analysing navigational strategies and ii) distinguishing different kinds of environments. To provide the relevant data, two separate groups will be interviewed: i) VIP and ii) professionals.

Ideally a large set of VIP (as described in Table 4.2) would be interviewed, but practically, within the timeframe and resources of this PhD, a group of 10 VIP were recruited, as the data emerging from these should be sufficiently ‘rich’ to be able to test my hypothesis for this qualitative study. All the participants were selected via a number of organisations for VIP. These organisations are given an interview information sheet for selecting VIP subjects. More details of the recruitment of participants will be explained in Chapter 5.1.3.

Table 4. 2 The list of categories of VIP

Age groups of VIP	Age of onset of VI
Early childhood	Blind in early childhood
	Partial sighted in early childhood
Late childhood	Blind in early childhood
	Partial sighted in early childhood
	Blind in late childhood
	Partial sighted in late childhood
Mid-life	Blind in early childhood
	Partial sighted in early childhood
	Blind in late childhood
	Partial sighted in late childhood
	Blind in mid-life
	Partial sighted in mid-life
Old age	Blind in early childhood
	Partial sighted in early childhood
	Blind in late childhood
	Partial sighted in late childhood
	Blind in mid-life
	Partial sighted in mid-life
	Blind in old age
	Partial sighted in old age

For professionals, those who had been involved in the design of environments and products for VIP might provide sufficiently revealing data. This should allow me to test my hypothesis that professionals – and perhaps access consultants – are generally not aware of the use of tacit NS used by VIP. Detailed discussion of the selection of professional participants will be described in section 5.4.2.

4.4.4.1 Data capture method

All the interviews were recorded by a digital audio recorder, and the audio data was then transcribed into written form through repeatedly listening and verifying (see more details in Chapter 5.4.1.4 and Chapter 6.2.4).

4.4.4.2 Data analysis method

The seven main categories of NS (i.e., sense orientation, habitual orientation, cognitive orientation, transferable orientation, behavioural coping strategies, social coping strategies, psychological coping strategies) identified from the literature review will be used as the model for coding and classifying the statements reported by VIP participants, and then a more comprehensive set of NS sub-categories within the framework was established. This NS framework was also used to code and categorise the statements reported by designer participants in order to see the extent of how designer participants understand VIP's NS and to compare what the differences or gaps were (see more details of the six main categories of NS identified from the literature review in Chapter 2.3; more details of the analysis method in Chapter 5 and 6).

Recruitment strategy

VIP: see Chapter 5.1.3

Professionals: see Chapter 5.4.2

<u>Ethics</u>

In order to adhere to the ethical policy of The Glasgow School of Art, an ethics approval form (Appendix A), a consent form for VIP participants (Appendix D), a consent form for designer participants (Appendix G), interview information sheets for subjects and recruiters of VIP subjects (Appendix B and C), E-mail content for designer interviews (Appendix F) and interview questions (Appendix E for VIP participants, Appendix H for designer participants) were provided. The ethics application contained the information of a list of organisations for the volunteer recruitment, and also clearly noted the issues of safety, for both participants and the researcher, consent, confidentially and balance. Ethical approval was given for the study. For more information on ethics, please see more details in Chapter 5.4.1.2.

4.5 Conclusions

Figure 4.9 below provides a diagrammatic overview of the methodology, with the main stages and methods used at each stage.

Figure 4. 9 An overview of the methodology

5. Interview set-up data capture and analysis

5.1 Introduction

This section describes, in detail, the design, set-up and analysis of interviews with VIP and professionals to acquire data helpful in: i) identifying and analysing navigational strategies in VIP and to determine if and how they use different kinds or combinations of NS in different kinds of environments; and ii) the extent of professionals' understanding of VIP's NS.

5.1.1 Main research question of the present study

As discussed in Chapter 2, visual impairment is complex and a number of variables influence the use of different NSs by each visually impaired person in their daily lives. Thus, it is hypothesised that VIP use different NSs in different types of environments. Drawing from the literature, and as explained in Chapter 4.4 above, for convenience these will be categorised into three sufficiently distinct environment types as follows: i) E1: the intimate personal environments (e.g., home, where everything about the environment is familiar and largely predictable); ii) E2: the more public but still familiar environments (e.g., one's immediate neighbourhood where routes are familiar but some things might be unpredictable such as road works or parked cars); and iii) E3: the unfamiliar and unpredictable environments (e.g., a new neighbourhood, or a journey to an unfamiliar part of the city or countryside). Rather than addressing their disabilities, the purpose of the present study is to develop a deeper understanding of VIP's use of innate capabilities and NSs in these different kinds of environments and to establish the extent to which variables influence these through the following questions:

1. What are the range of capabilities and NSs that VIP use when navigating environments?
2. How do these capabilities and NSs vary from individual to individual?
3. How can one categorise these capabilities and NSs?
4. How do these NSs depend on the degree of the VIP’s familiarity with - and the kinds of - the environment to be navigated (i.e. from those which they know intimately to those which are completely unfamiliar to them)?
5. Would this kind of knowledge be of value to professionals of the built environment?

5.1.2 Materials

In order to adhere to the ethical policy of The Glasgow School of Art, an ethics approval form (see Appendix A), an interview information sheet for recruiters of VIP subjects (see Appendix B), an information sheet for subjects (see Appendix C), a consent form (see Appendix D), and interview questions with prompts (see Appendix E) were provided. The ethics approval contained the information of a list of organisations for the volunteer recruitment, and also clearly noted the issues of safety, for both participants and the researcher, consent, confidentially and balance. The information sheets consisted of a research introduction, the purpose of the research, the process of interview, and researcher contact details. A set of inclusion and exclusion criteria for selecting VIP subjects was described in the information sheet for recruiters of subjects. The semi-structured research questions consisted of three main questions each with sub-questions and prompts. Due to the nature of some of the visual impairments of the participants, the consent forms were also available in the preferred format of interviewees. In the case of consent forms in a Braille format, the witness (care-giver/staff from the organisation) checked the consent form was the same as what was on the Braille form to agree signing. As an audio option, the consent forms were read by the researcher or their care-givers, and their consent was recorded by the recording device. The audio acceptance files were kept separately from the interview files to ensure anonymity and participants reassured that all data would be anonymised.

5.1.3 Participants and setting

In an ideal and appropriately financed study, the research would have intended to interview people who had experienced visual impairment at different stages of their life and who had had to adjust to visual impairment in different ways. In other words, those with a more recent onset of VI without a sufficient period of time to adjust and develop their strategies to cope with their impaired vision were excluded from this study. In addition, due to the requirements of Disclosure Scotland, the participants in this study were restricted to adults of 18 and over. The recruitment of participants started from October 2011 and a number of organisations for people with VI were contacted which included: Glasgow Shopmobility, SITE (Supported Integration, Training and Employment), Glasgow Access Panel, Centre for Sensory Impaired People (Glasgow), The Guide Dogs for the Blind Association, Royal National Institute of Blind People (RNIB), and Visibility (Glasgow).

Each of the organisations was given the interview information sheet for recruiters of VIP subjects which describing the research information and a set of inclusion and exclusion criteria for selecting VIP volunteers. Because of the nature of VI, conventional advertising was difficult, and the visually impaired communities tended to contact potential candidates through personal contacts. Therefore, the researcher’s contact details, which included school email address and working mobile number, were given by organisations who identified potential subjects for recruitment.

Participant information

All the participants were given an outline of the study, and the interview information sheet. A suitable time and location were arranged after participants had agreed to take part in the research. They were guided by the researcher from the meeting point, which they were familiar with, to the location of interview. Some of the interviews took place in a meeting room that was provided by Glasgow Shopmobility in Buchanan Galleries. Other interviews were carried out in a public but fairly quiet place, the café bar of the Glasgow Royal Concert Hall, adjacent to the Buchanan Galleries. No health and safety risks to participants were envisaged. A cup of coffee or tea was provided during the interview as an appreciation of their participation and contribution. All the interviews were conducted in daytime from December 2011 to February 2012.

Piloting the interviews

The first participant was recruited through the Festival of Opportunities for Disabled People event which was held by Ability Fest in October 2011. The contact details of the second participant were obtained from The Guide Dogs for the Blind Association. These two subjects participated in the pilot interviews which were conducted in December 2011. Both of these pilot semi-structured interviews were recorded by a digital audio recorder and were transcribed verbatim onto a word processor. After the initial analysis, one of the pilot trails proved greatly positive and the subject's data was included in the study as one of the formal semi-structured interviews. However, the data obtained from the other was discounted due to the participant being partially sighted as a result of brain injury, and who appeared to have more issues with regard to memory loss and was consequently removed from the interview record. The information sheet for recruiters of subjects was therefore modified and a more definitive set of inclusion/exclusion criteria was established, in that all the candidates had to be: i) had to adjusted to VI after a period of time; ii) were over 18; iii) were able to travel easily to interviews; and iv) were able to hear well (including those who are using assistive listening devices).

The participants were recruited via the organisations above who kindly helped to advertise the request for volunteers by publishing the information on their newsletter or informing their own members personally. In the meantime, with the permission from the organisations, the researcher attempted to take part in some of their activities such as raising funds for The Guide Dogs for the Blind Association at a railway station and visiting members of a yoga class of Visibility, which is an organisation that providing services (e.g., information, training and emotional support) for VIP, to make personal contact with potential candidates. In accordance with the inclusion and exclusion criteria for selecting potential VIP subjects, the volunteers were also recruited through asking people who had already been interviewed to identify other potential candidates they knew. Therefore, the recruitment took longer than anticipated and continued until February 2012. In total, ten VI participants (see Table 5.1. Participants' profiles) took part in this study. There were two males and eight females. The age range of participants was from 29 to 83, and the mean age was 56.5 years. All the participants were registered as blind or visually impaired. Table 5.1 provides the profiles of each of the individuals and also their means of navigation at the time of interview (i.e. guide dog, white cane, etc). The list of categories of individuals below, which would represent the full range of different subjects to be interviewed in an ideal study, was derived from the previous section (see section 4.4.4). The subjects for this study (see Table 5.1 for subjects' ID) are located against the following categories, which form sections of the larger matrix described previously in:

a) Visual impairment in mid-life

1. Mid-life – Blind in early childhood (S2, S5)
2. Mid-life – Partially sighted in early childhood
3. Mid-life – Blind in late childhood (S10)
4. Mid-life – Partially sighted in late childhood
5. Blind in mid-life (S3, S7, S11)
6. Partially sighted in mid-life (S6)

b) Visual impairment in old age

1. Old age – Blind in early childhood
2. Old age – Partially sighted in early childhood
3. Old age – Blind in late childhood (S8)
4. Old age – Partially sighted in late childhood
5. Old age – Blind in mid-life (S4)
6. Old age – Partially sighted in mid-life
7. Blind in old age (S9)
8. Partially sighted in old age

Table 5. 1 Profiles of VIP participants

No.	ID	Age	Gender	Age of onset	Age of sight loss	Age when registered as VI/blind		Type of VI	Navigational aid	Experience of other navigational aid	Other sensory/physical impairment
1	S2	48	Male	From birth	From birth	15	Blind	Glaucoma/ Cataract	Guide dog user from age 20	Used long cane before age 20	No
2	S3	59	Female	19	48	40	Blind	Glaucoma	Guide dog user from age 50	Used long cane for 6 months	No
3	S4	72	Male	(L) 60 (R) birth	(L) 60 (R) 19	60	Blind	(L)Accident (R)Lazy eye	Guide dog user from age 61	Used long cane for 1 year	Hearing impairment
4	S5	59	Female	From birth	From birth	5	Blind	Cataract	Guide dog user from age 36	Relied on others with symbol cane before age 36	No
5	S6	53	Female	30	N/A	33	VI	Retinitis pigmentosa	Guide dog user from age 36	No	Hearing impairment
6	S7	29	Female	From birth	19	24	Blind	Periventricular leuko-malacia	Guide dog user (first guide dog)	Used long cane from age 19	No
7	S8	74	Female	12	14	Unknown	Blind	Accident/Optic nerve damage	Symbol cane user	Mainly relied on others	No
8	S9	83	Female	73	73	73	Blind	Macular degeneration	Symbol cane user from age 73	No	No
9	S10	32	Female	From birth	9	16	Blind	Ectatic nerve/ Cataract	Long cane user from age 10	Used Guide dog for 1 year	No
10	S11	56	Female	40	41	44	Blind	Retinitis pigmentosa	Long cane user	No	No

5.1.4 Procedure

The average length of interview was approximately an hour and a quarter. Before the formal interview started, the purpose of the research and the interview questions were explained again to the participants. To adhere to the ethical policy, the content of the consent form was read out and recorded by the researcher, and all the participants were asked to sign two consent forms, which made clear to participants that their participation was voluntary and they could withdraw all or part of what they said during the research, being free to do so without giving any reasons. The researcher stored one of the consent forms securely, and participants kept the other. During the formal interview, the participants were asked to talk about their visual impairment history and describe their daily routine; i) at home; ii) during a typical journey that they made around their neighbourhood; and iii) during an unfamiliar journey that they had made before. To avoid influencing their answers and affecting the quality of data, the category of NSs identified from the previous chapter (i.e., 4.3.2.1) were not discussed with the participants. They were encouraged to talk about issues or problems arising from the three different types of journey and to describe strategies that they developed to cope with different kinds of situations. As with their consent, all the interviews were recorded by a Sony ICD-PX720 digital audio recorder. The audio data was transcribed verbatim into written form in order to make it easier to be examined later in detail and coded.

5.1.5 Coding and analysis of interview data

In the previous chapter, 4.3.2.1, NSs were categorised into seven main categories as follows:

1. Sense orientation
2. Habitual orientation
3. Cognitive orientation
4. Transferable orientation
5. Behavioural coping
6. Social coping
7. Psychological coping

The data obtained from the semi-structured interviews with VIP was initially transcribed verbatim onto a word processor. After repeatedly reading and verifying the transcriptions, the different strategies (NSs) discussed by each of the subjects were identified and then initially classified into the main categories in accordance with their definitions and/or sub categories (see Table 5.2); however, transferable orientation, which was indentified to be employed by VI children when they move around within unfamiliar environments (see Chapter 2.5.2.3), did not appeared to be indicated by any of the participants therefore it has been removed from the seven main categories of NSs. Strategies that were incongruent with the main categories were classified into 'Others'. After the initial coding, the strategies were compared and those with the same meaning but which were described in different ways were combined. Meanwhile, all the strategies identified in the statements of participants were further coded and simplified as the examples of the main categories, and then a more comprehensive set of category of NSs was established. This categorisation of NSs clarified strategies that were used by each subject in each of the three types of environments (see Table 5.3).

Table 5. 2 Examples of quotations coded in category of NSs

Category of NS	Example of comments
Sense orientation	I know that it's carpeted floor, partly because I'm walking on it but partly because the sound is quite dead (S10)
Habitual orientation	...you do learn a lot of…it's my repetition, you get to know your own area really well (S3)
Cognitive orientation	...that involved 5 road crossings, I think, so it's about 20 minutes walk (S7)
Behavioural coping	I say to the dog 'out', say to the dog 'find the path', and that's...she (guide dog) will find the lane (S5)
Social coping	I'd just wait and I got somebody to help me cross the road (S3)
Psychological coping	I think a blind person has to certain think and say I'm going to use my capabilities to the best my ability (S5)
Others	I'll visualise where the doors are, where the tables are (S2)

Table 5. 3 Example of subject variables – VIP participants

Subject ID				
Main categories of NS	Sub categories	E1	E2	E3
Sense orientation	Residual vision			
	Lights			
	Colour contrast			
	Uses bigger objects (building) as landmark			
	Observes people by their body language			
	Hearing			
	Echolocation			
	Judge where cars coming from			
	Judge different kind of cars			
	Traffic beeping sound			
	Uses different sounds as landmark			
	Uses audible announcement on train/subway			
	Touch			
	Label/tactile marker			
	Traffic light tactile pad			

	Tactile pavement			
	Tactile stairs on bus			
	Smell			
	Kinaesthesia			
Habitual orientation	Repetition			
	Keep things in the same place			
	Keeps furniture against to walls			
	Guided by others for couple times first			
Cognitive orientation	Counts step of stairs			
	Gets a roughly volume of time			
	Counts the number of crossings/corners			
	Remember where pavements stick up/different kind of kerbs, etc.			
	Counts kerbs to kerbs			
	Counts the number of lampposts by hearing			
	Counts stops when taking subway/bus			
	Counts the turns of the bus/car			
	Counts the ramp in the train station			
	Remember different size of roads			
	Remember where the entrance is			
Behavioural coping	Relies on memory to compensate			
	Uses adaptive device			
	Uses optical device			
	Uses system for finding things			
	Uses system to identify things			
	Reduces cooking			
	Acts more cautiously			
	Uses adaptive aid (guide dog/cane) to avoid obstacles			
	Guide dog knows routes			
	Guide dog finds kerbs/crossings			
	Guide dog judges if it's safe to cross roads			
	Uses system for crossing streets			
	Restricts geographic range of activity			
Social coping	Relies on others in general			
	Relies on others to find things			
	Relies on others to cross roads			
	Relies on others to take buses/trains/subway			
	Goes as far as possible then meet with others			
	Phones others when get lost			
	Asks different people to complete a journey			
	Go and ask people			
Psychological coping	Plans for future regarding vision loss			
	Believes in independence/self-reliance			
	Express anger in general			
	Accepts vision loss in general			
	Express anger towards self			
	Relies on positive attitude or personality			
	Actively tries to adjust			
	Focuses on abilities			

	Relies on patience			
Others	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Visualisation			
	Do things roughly			
	Indirect knowledge			
	Avoids to use echolocation by mouth outside			
	Avoids to use wood floor			
	Pre-plans journey			
	Walks along the edge of walls to get contact with objects by cane			
	Thinks socialise is more important than learns a route			
	Prepare to make mistake			
	Goes by car/taxi			
	Shows white cane to let people know			
	Analogical thinking			
	Walks in the middle of the road			
	Extend left hand to let people aware of			
	Arranges guide dog training for new routes			

5.3 Discussion: summary of findings from analysis of visually impaired people interviews

The findings from the analysis of the semi-structured interviews with visually impaired participants in this chapter were assembled into a matrix (Figure 5.1) which shows a composite of frequency of use of different types of NSs by all those interviewed. Its patterns illustrate that different combinations of NSs were being used by different individuals in the three kinds of categorised environments (i.e., E1: the intimate personal environments, E2: the more public but still familiar environments, and E3: the unfamiliar and unpredictable environments). Some NSs were also used across the different participants. These provisional and summary findings will be discussed in detail in Chapter 6.1.

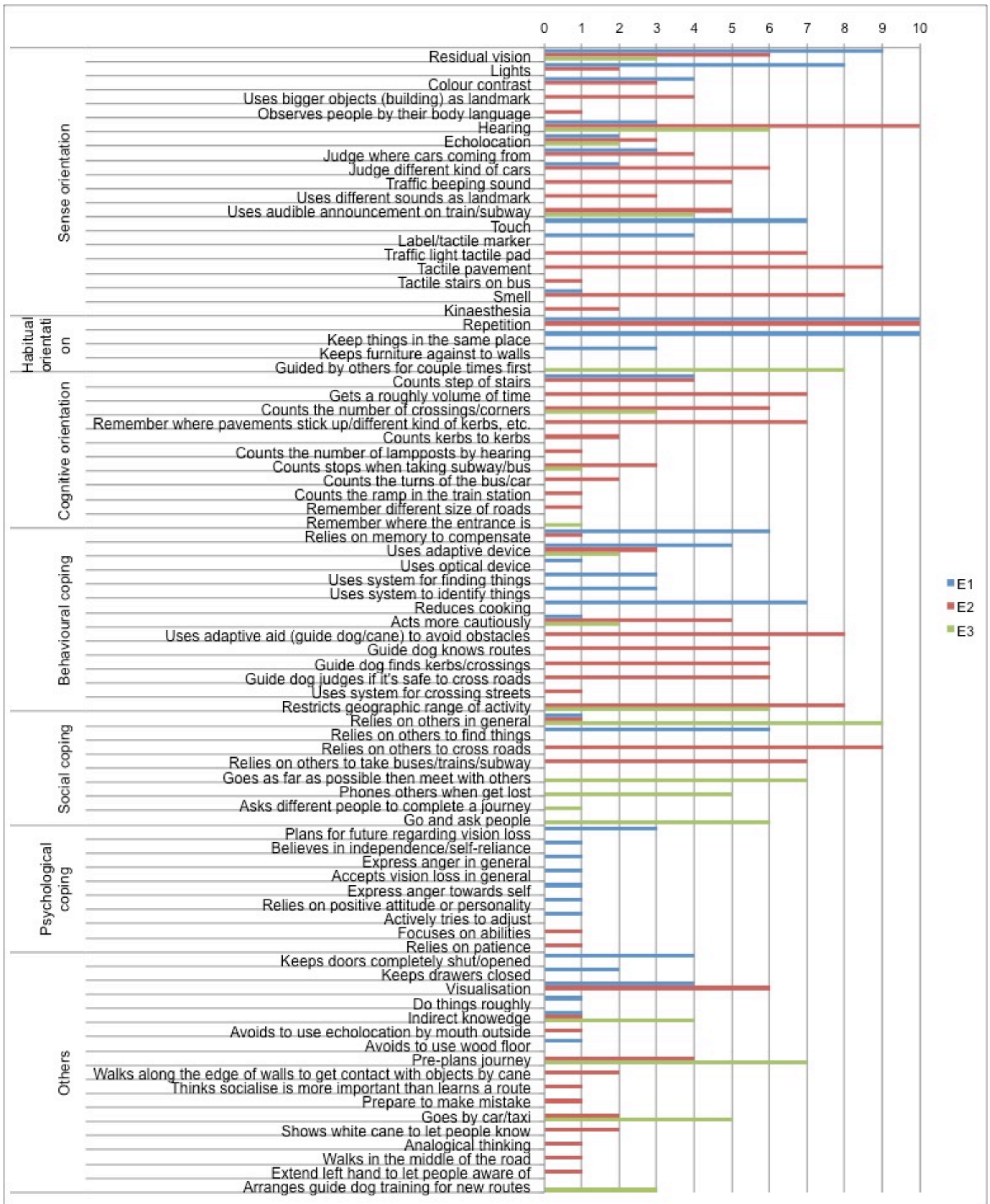


Figure 5. 1 Composite of NSs used by VIP in the three categorised environments

5.4 Semi-structured interviews of professionals

This section is also about establishing professionals' current approaches and practices in order to find out: i) if they understand the complex capabilities, in particular the NS, of VIP; ii) if they can understand and differentiate how VIP navigate in different kinds of environments; and iii) if they understand that the design of different kinds of environments (e.g., as typified by E1, E2, and E3 categories) might require different approaches to their design. This set of interviews and their analyses will provide data which allows a correlation between how VIP find their way around the three different categories of environments and the extent to which professionals know and understand these issues.

5.4.1 Method of present study

It is hypothesised that current building regulations, design guidelines, design methods and tools tend to address compensating for VIP's disabilities rather than exploiting VIP's capabilities. It appears there is currently insufficient information for professionals to understand the complexity of visual impairment issues, the importance of the multiple variables of VI and VIP, and the NSs that VIP have developed. Eight sets of semi-structured interviews were conducted in order to investigate how professionals approach VIP and how they comprehend VIP's capabilities in the context of how they find their way around the different environments encountered in their daily life. The main research questions used to guide the research at this stage were (see Appendix H – Interview questions for designer participants):

1. What is the professionals' design process?
2. What design references (e.g., building regulations/design guidelines/design methods/design tools/other) are professionals using?
3. How do professionals understand the capabilities of VIP and NSs used by

VIP?

4. How do professionals practice and apply their knowledge into their designs for VIP?
5. How do professionals provide design solutions for VIP?
6. Are professionals aware of the variables of VIP’s NSs and to what extent (e.g., the variables of ages, navigation aids, different types of environments)?
7. To what extent do professionals intentionally or accidentally provide design solutions for VIP’s capabilities?

5.4.2 Participants and setting

The research intended to interview people who were experienced in the different fields of ‘design for VIP’ in order to ensure that appropriate professionals were interviewed to cover the three different categories of environments. The recruitment of participants was through contacting their email or office number shown on their websites (see Appendix F – Email content for designer interviews). All the participants were given an introduction to the study and the purpose of the interview. After they decided to take part in the research, a suitable time and the location of the interview were then arranged. There were eight sets of semi-structured interviews conducted in the meeting rooms where the interviewees worked. Among these, one of the interviews, which was carried out in 2010 as the pilot study, was included in the research due to the data coinciding with the final research objective; the rest of the interviews were conducted between July and August in 2012. The participants were classified into three groups which included: i) practitioner; ii) academic researchers; and iii) access consultants (see Table 5.4

for designer participants' profile). In the group of practitioners, there were three architects (i.e., P1, P2, and P4) and one inclusive designer (i.e., P5). The group of academic researchers included a simulation tool designer (i.e., AR6) and a specialist environment designer (i.e., AR7). There were two access consultants with subject ID expertise: AC3 and AC8. The participants were chosen due to their work associated with inclusive design for VIP, which included school buildings and accommodation for visually impaired children, a leisure centre for visually impaired adults, phones for older people and VIP, a VI simulator and software, and lighting and colour design for older people and VIP. The two access consultants were also experienced in working with architects and designers for issues related to people with disabilities.

Table 5. 4 Profile of professional participants

No.	**ID**	**Types of expertise**	Design in types of environment	**Users**
1	P1	Practitioner - Architect	E2/E3	VI adults/VI older adults
2	P2	Practitioner - Architect	E2	VI children
3	AC3	Access Consultant	E1/E2/E3	Disabled people
4	P4	Practitioner - Architect	E1	VI children
5	P5	Practitioner - Product Designer	E1	Older adults
6	AR6	Academic Researcher	E1/E2/E3	Designers/business decision-makers
7	AR7	Academic Researcher	E2/E3	VI adults/VI older adults
8	AC8	Access Consultant	E1/E2/E3	Disabled people

5.4.3 Materials

The semi-structured research questions were divided into two sections. Each section consisted of seven to eight main questions (see Appendix H). All the participants signed the consent forms and with their consent, all the interviews were recorded using the digital recording device.

5.4.4 Procedure

The average length of the interviews was approximately an hour. The participants were asked to sign the consent form in order to make clear to participants that they could withdraw all or part of what they said during the research without giving any reasons, and the information from their interview responses would be kept confidential and would not identify them as the respondent. The semi-structured interviews were divided into two parts (See Appendix B: Interview questions for designer participants). The first part of the interview asked the participants to talk about their design process (two of the consultants, subject ID AC3 and AC8, were asked to describe what they thought the professionals' design process was), how they approached designing for VIP, and what design features that they provided for VIP. During the second part of the interview, they were asked to discuss how they thought about people who are visually impaired, to describe how they thought VIP found their way around the three categories of environments and difficulties that VIP might have during daily activities in the three kinds of environments. As with their consent, the interviews were recorded by the digital audio recorder and then fully transcribed into written form.

5.4.5 Coding and analysis of interview data

The data obtained from the semi-structured interviews with professionals was transcribed verbatim onto a word processor. In the analysis, the data for the first part of the interview was coded into each main category with its sub-categories (Figure 5.2). Based on their descriptions of design methods, the way that they approached VIP could be classified into: i) through primary research (e.g., consults with VIP, consults with organisations for blind and partial sighted people and references other designers' work); ii) through secondary research (e.g., references British standard, references Disability Discrimination Act (DDA) regulations, and/or other design examples); and iii) through design tools (e.g., simulation glasses, computer model, blindfold).

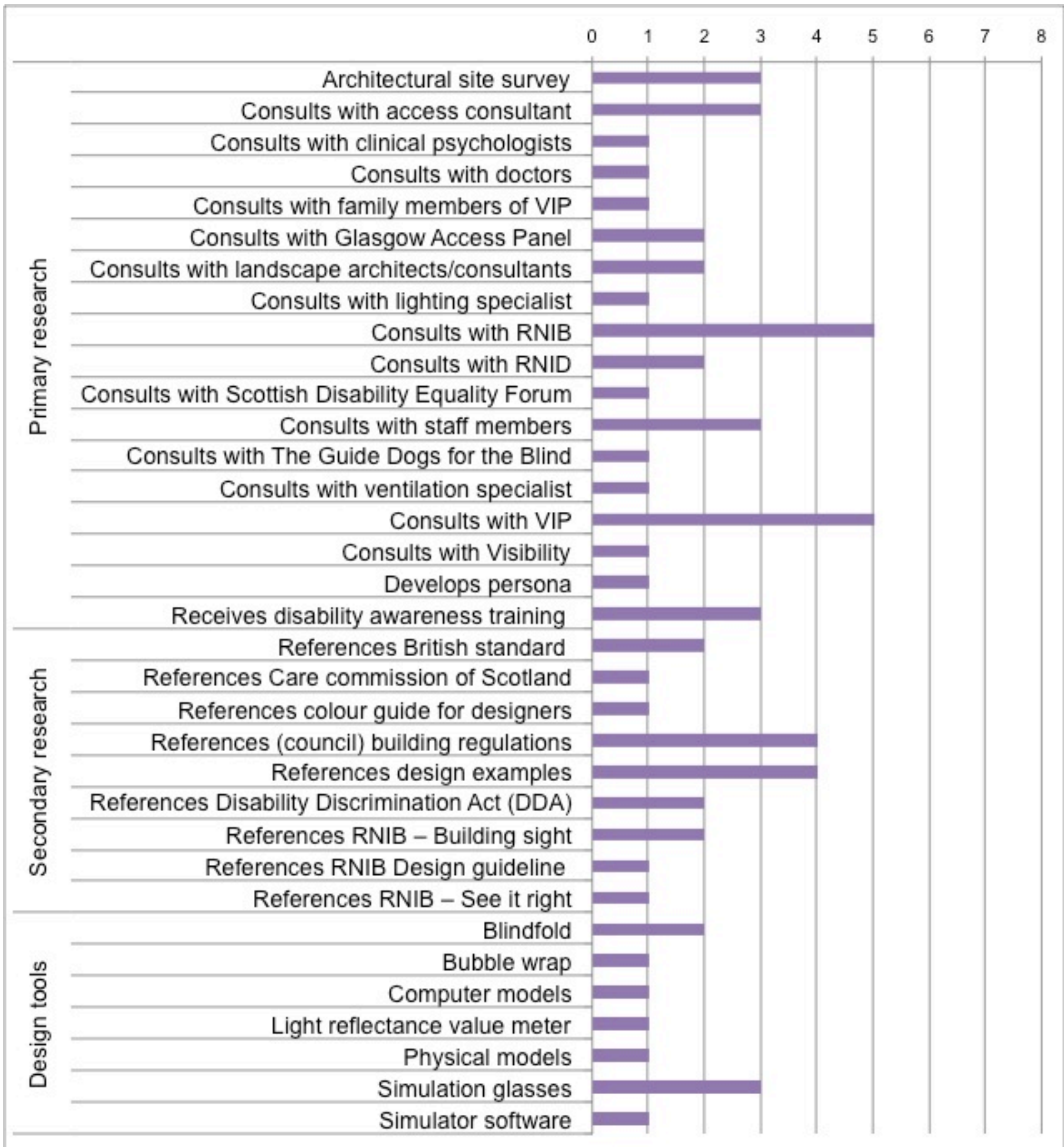


Figure 5. 2 Professionals' methods of research

According to the statements of the second part of the interview as well as the design solutions that they provided for VIP, strategies distinguished from the participants were equally coded into the main categories and sub categories of the NSs framework, which were identically to the VIP participants' (see Table 5.3), in order to make the data obtained from the two groups of the participants (i.e., participants of VIP and professionals) to be comparable. Although certain NSs were indicated when asking the participants to describe how they thought VIP navigated within the three categorised environments (i.e., E1: the intimate personal environments, E2: the he more public but still familiar environments, and E3: the unfamiliar and unpredictable environments), most of them did not appear to be able to clarify strategies used in the different types of environments as VIP participants did. Therefore, the three types of environments were not coded with the categories of NSs identified from the participants of professionals. Nevertheless, through their descriptions of the second part of the interview, the theme, variables of VIP, was derived and was used as one of the main categories with its sub categories (e.g., as age of onset, different types of VI, familiarity with the environment) to illustrate how participants understood the variability of VIP.

5.5 Discussion: summary of findings from analysis of professionals' interviews

The findings from the analysis of the semi-structured interviews with professionals interviewed in this chapter were assembled into a matrix (Figure 5.3) which shows a composite of frequency of their understanding of different types of NSs used by VIP. It is interesting to compare and contrast the patterns emerging between the tables for the VIP (Figure 5.1) and the professionals (Figure 5.3) which reveals the extent to which professionals are not aware of VIP's NS. These provisional and summary findings will be discussed in detail in Chapter 7.1.

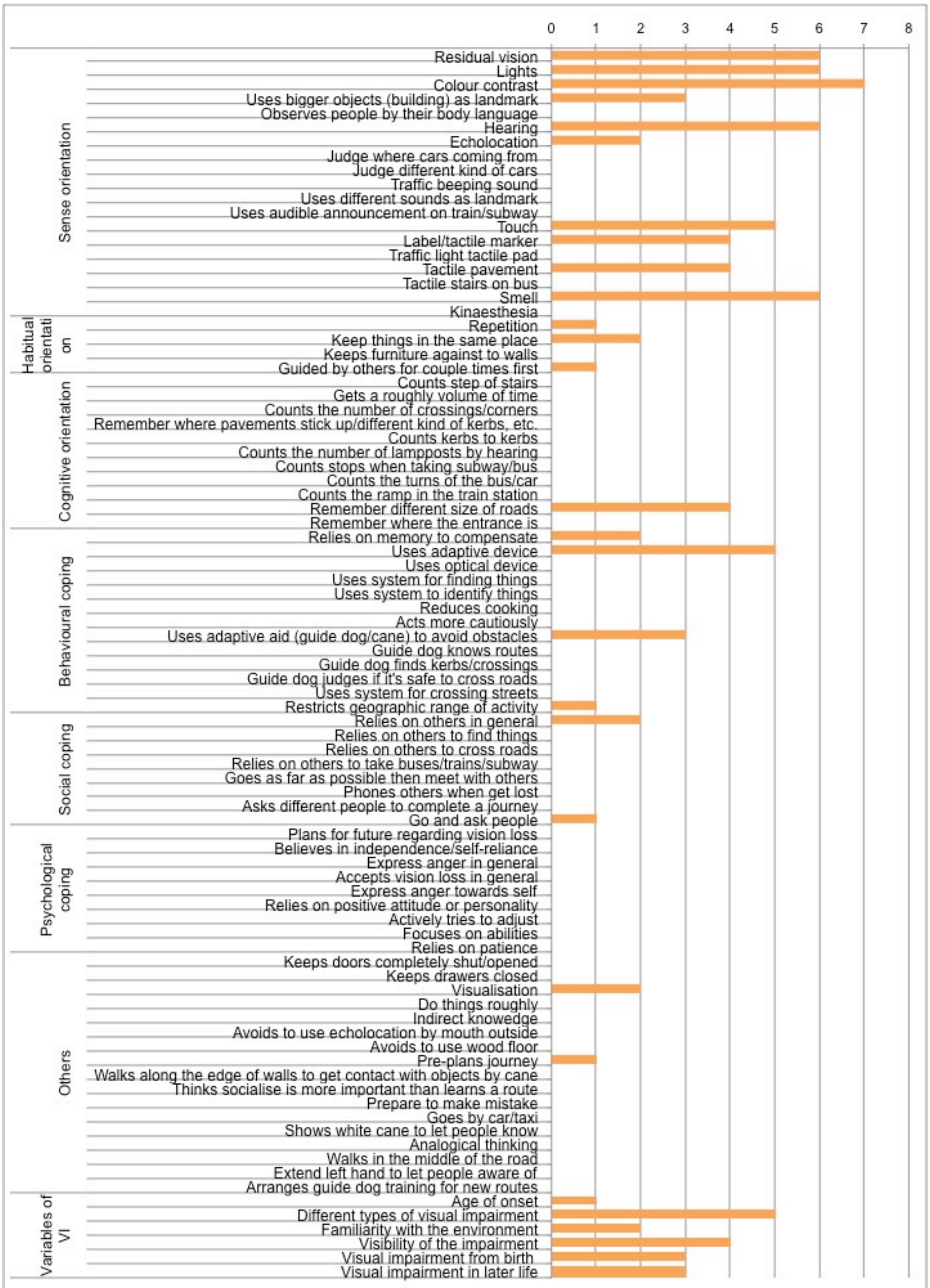


Figure 5. 3 NSs of VIP recognised by participants of professionals

6. Findings 1: VIP

6.1 Preliminary research findings and discussion

At this point, only an outline summary of the preliminary findings is provided and a fuller analysis and discussion is provided in Chapter 8. This chapter uses the NS framework that was derived from Chapter 4.3.2.1 as the basis for coding the transcriptions acquired through the semi-structured interviews with VIP discussed in Chapter 5, and the three types of environments discussed in Chapter 4.4. A summary of the findings in presented here. Although the data can be discussed from many perspectives, this chapter initially provides a discussion from the perspective of revealing and contrasting the different NSs used in each of the three categorised environments as explained in Chapter 4.4. These findings are presented in summary form through the graphic figures 6.1, 6.1, 6.3 and 6.4. Through presenting the data in this graphic form, it is immediately apparent that: i) different combinations of NSs are used in different types of environments; and ii) the different frequency, across all the VIP, of use of each of the NS. Extracts from the transcripts are provided to illustrate NSs used by VIP, and the frequency of usage of each of the NS is discussed below.

6.1.1 VIP’s NS in E1: the intimate and personal environments

According to the Figure 6.1, it can be seen that all the subjects used habitual orientation, through repetition and keeping things in the same place, as strategies to move around within their intimate and personal environments. Almost all of them used their residual vision to navigate at home; however, this strategy was dependent on the degree of their remaining vision and four of the subjects made use of colour contrast as strategies to see better. There were also eight of them who tended to put the lights on when they are home, although not all of them could really perceive the light.

More than half of the participants touched objects such as walls and floor with their hands or feet to help sense orientation to move around. In terms of behavioural coping, almost half of the subjects had a tendency to keep doors completely shut or opened as a strategy to avoid potential hazards such as colliding with these. Relying on memory to compensate for the loss of vision was the most frequently reported strategy in the behavioural domain. Social coping was less reported by the participants; nevertheless, more than half of them tended to ask others for help only when they could not find things. The subjects seldom used cognitive orientation when they are in the intimate and predictable environment. Six of them reported that they only used cognitive orientation at home when going up and down stairs through counting the number of steps in stairs, and four of the subjects indicated that they visualise the layout of their house so that they clearly knew their way around.

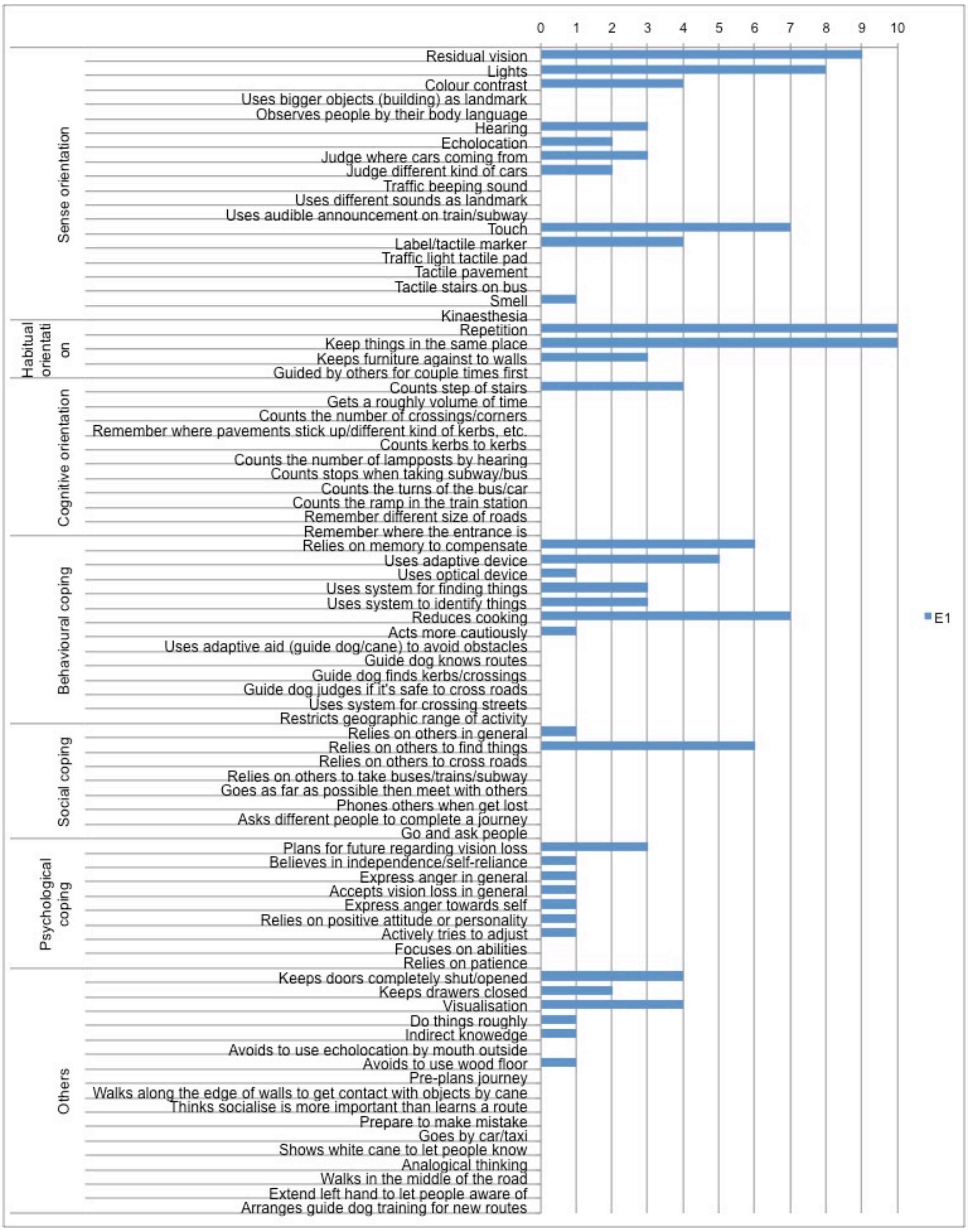


Figure 6. 1 VIP's NS in E1: the intimate and personal environments

6.1.2 VIP's NS in E2: the more public but still familiar environments

Using the sense of hearing was the most frequently used strategy by all the participants when they moved around within E2 the more public but still familiar environments (e.g., neighbourhood) (see Figure 6.2). Six of the subjects were able to judge different kinds of cars and four of the participants could judge where cars were coming from through hearing. In addition, five of the participants relied on the pedestrian traffic signal beeping sound to cross roads and audio announcements when they were on train or subway. Three of the subjects reported that they listened to echo sounds while navigating around, and they also utilised different kinds of sounds as ‘landmarks’ to help locate themselves.

The sense of touch was also frequently used among the subjects. Nine of the subjects sensed the tactile pavement by using their feet to find crossings and seven of them tended to cross roads though touching the traffic light tactile pad. Using the sense of smell to locate themselves (e.g., smelling a coffee shop) was also reported by eight of the subjects. Six of the participants utilised their residual vision. Four of them were able to orientate themselves through seeing bigger objects such as buildings and used them as landmarks; only a few of them used the contrast of colour and/or lights to identify where they were. Social coping was reported by nine of the participants, in that they always waited for someone to assist them to cross busy roads; in addition, more than half of the subjects relied on others to take public transport (e.g., bus, train). Two of the participants reported that they used kinaesthesia to orientate themselves. When moving around within E2 familiar and fairly predictable environments, it involved a lot of behavioural coping so that eight of the participants tended to restrict their geographic range of activity and also used adaptive aids (e.g., guide dog, cane) to avoid obstacles. Meanwhile, six of the participants tended to rely on their guide dogs to find routes, kerbs and crossings, and to judge if it was safe to cross roads.

Half of the subjects revealed that they used behavioural coping by acting more cautiously when they move around within a familiar environment. Cognitive orientation was also frequently used among the participants. Seven of the subjects demonstrated that they tended to memorise where pavements are uneven and/or to recognise different kind of kerbs, so that they could know where they are when they pass by next time. Besides, they also had a tendency to get a rough idea of time to calculate how far they have walked. Six of the participants revealed that they counted the number of crossings and/or corners in order to know where to go, and four of them counted the number of steps on stairs to avoid potential hazards such as falling over. A few of the participants would also count the number of stops and turns when they were on buses or other public transportations.

Visualising the surroundings to assist orientation was also reported by more than half of the participants. Meanwhile, some of the participants reported that they would plan the routes before they go out.

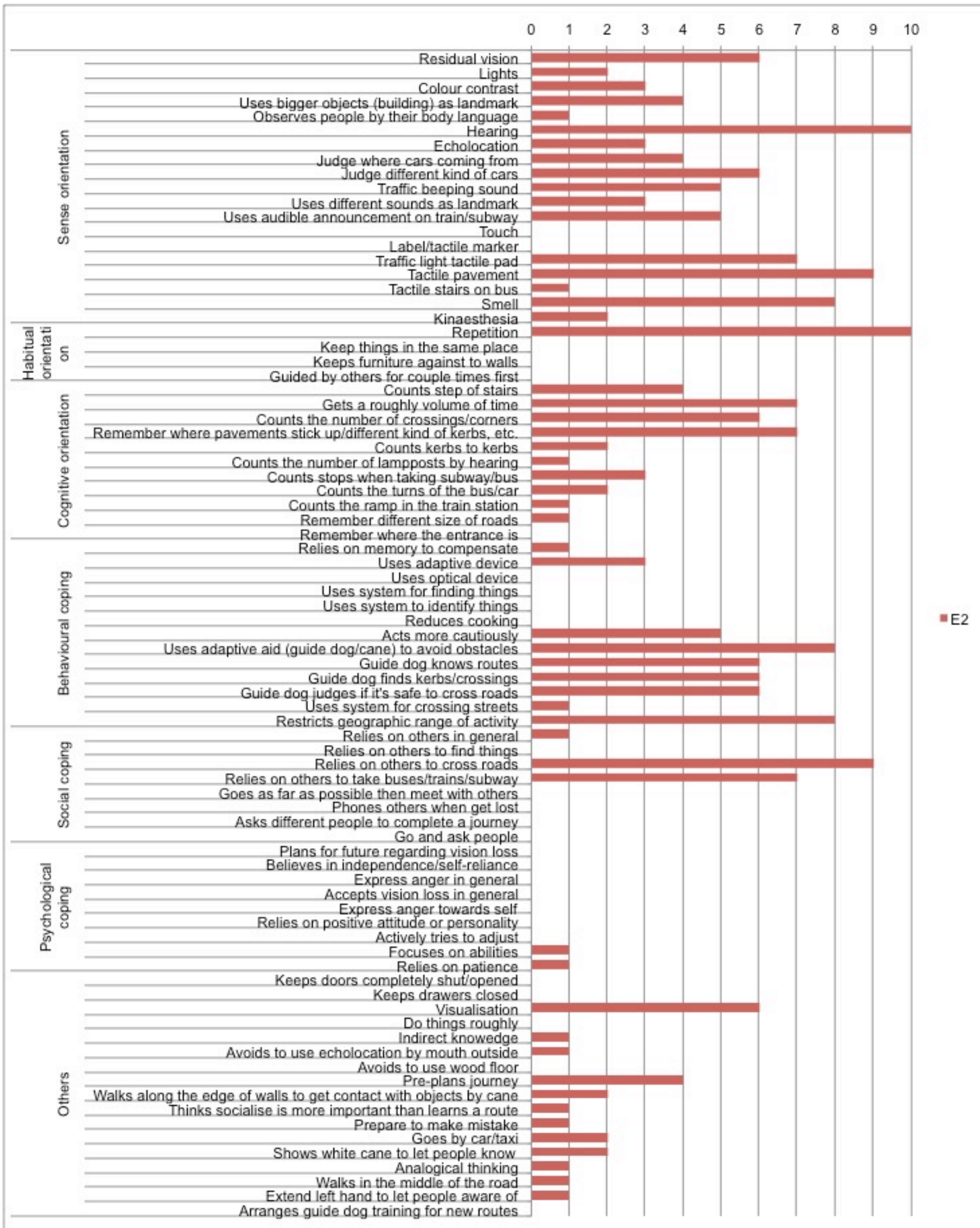


Figure 6. 2 VIP’s NS in E2: the more public but still familiar environments

6.1.3 VIP's NS in E3: the unfamiliar and unpredictable environments

Social coping was the most frequently reported among the participants (see Figure 6.3). Most of them tended to rely on others in general when they travel to a new place. Seven of the subjects tried to go as far as possible and then met with others to take them to the new place. When they lose their way, half of the participants tended to phone others to pick them up or ask others to describe the route. More than half of the participants also had a tendency to ask others randomly on the street for help and one of the participants asked different people to help complete a new journey. It was reported that eight of the subjects adopted the strategy of habitual orientation though guided by others for a couple of times first before they travel alone. Seven of the participants indicated that the key strategy is to pre-plan the journey and collect all the information they may need such as the address of the place beforehand. More than half of the subjects tended to rely on their sense of hearing to identify where they are and what is around them. It was reported that indirect knowledge such as asking others what is the best way to go was adopted as a strategy to go somewhere unfamiliar. In addition, half of the subjects reported that they preferred to go by taxi instead. Participants who are guide dog users also tended to arrange guide dog training for new routes. There were three subjects who used cognitive orientation through counting the number of crossings and/or corners. Nevertheless, more than half of the participants tended to adopt behavioural coping by restricting the geographic range of activity and to keep away from places they are not familiar with; few of them acted more cautiously and used adapted device.

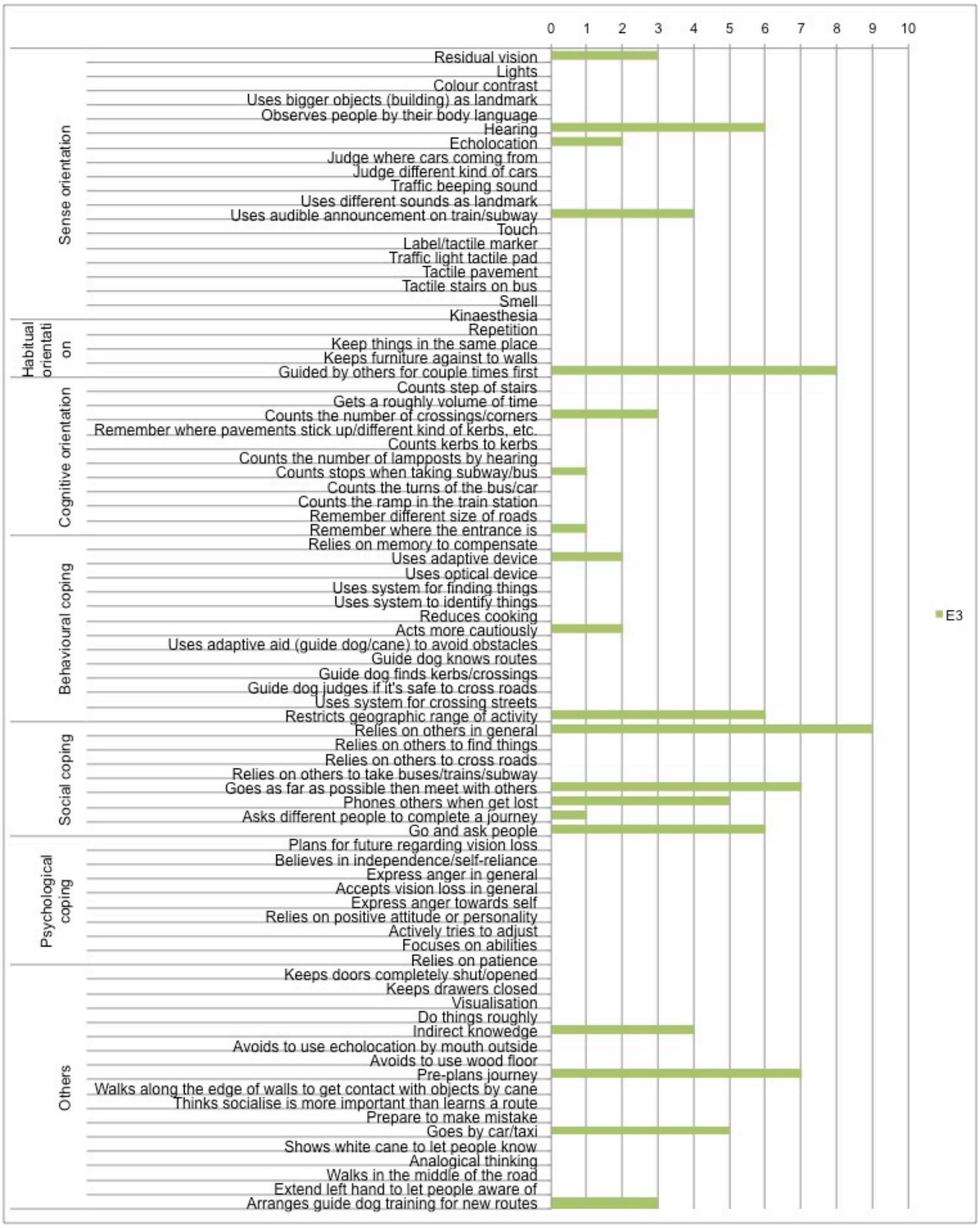


Figure 6. 3 VIP’s NS in E3: the unfamiliar and unpredictable environments

6.1.4 Discussion

According to Figure 5.1, as described in Chapter 5.3, it is obvious that the more public but still familiar environments (E2) involved the most NSs (see Figure 5.1). It can be identified that sense orientation NSs were the most frequently used when travelling within the more public but still familiar environments (E2), followed by the intimate personal environments (E1). Participants were less reliant on their senses to orientate when they were in unfamiliar and unpredictable environments (E3). Among all the senses, participants mostly relied on their residual vision and sense of touch when they moved around within intimate personal environments (E1). However, they appeared to depend much more on their sense of hearing than residual vision or sense of touch when in an environment that is fairly more public but still familiar (E2). Habitual orientation by repeatedly following the same routes or going to the same places seemed highly important to all the subjects, and once they are familiar with the environment, they could navigate themselves well. Participants also frequently used cognitive orientation when they were in the intimate personal environments (E1). Nevertheless, it is seldom used in the two other types of environments. On the other hand, social coping was the most frequently utilised strategy when participants were in an unfamiliar and unpredictable environment (E3). It appears that the more that participants are familiar with the environment the less they rely on others.

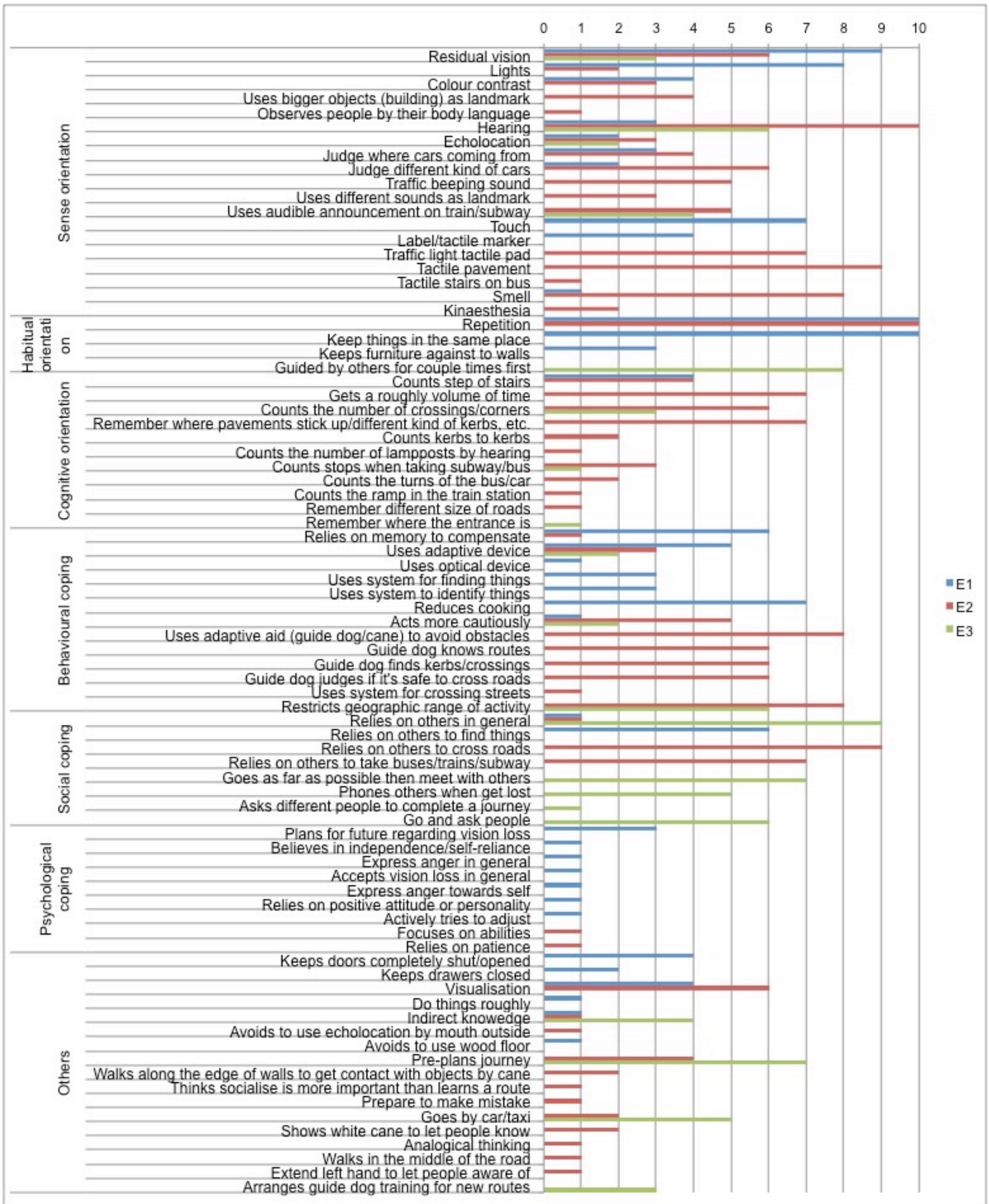


Figure 5.1 Composite of NSs used by VIP in the three categorised environments

6.2 Preliminary conclusion and implications for this study

The results from the coding and analysis of interview data suggest that the hypothesis, VIP use different NS in the three different types of environments (i.e., E1, E2 and E3), can be supported. The findings of the present qualitative analysis identified a range of NSs used by VIP who took part in this research when navigating different types of environments. The degree of the VIP’s familiarity with – and the kinds of – the environment did affect VIP’s use of different kinds of NSs. Understanding the patterns and combinations of NSs that VIP use may help professionals begin to look at VIP’s capabilities rather than solely their disabilities, and findings from this study may be able to contribute to developing a better understanding of the varied nature of VI and VIP’s navigational strategies, which may offer professionals more scope when they design the built environment. The next stage of the study will involve analysis of interviewings of different types of people (i.e., architects, designers, researcher, design consultants) who approach design for VIP in different ways in order to ascertain their knowledge about VIP’s needs and to understand their current approaches and the extent of their understanding of the NSs that VIP possess.

7. Findings 2: Professionals

7.1 Introduction

This chapter provides an outline summary of the preliminary findings, and a fuller analysis and discussion is provided in Chapter 8. The findings from the semi-structured interviews with professionals can be discussed by: i) professionals' design process; and ii) professionals' understanding of NSs used by VIP. As discussed in Chapter 5.4.5, the first part of the semi-structured interviews with professionals identified how the participants approach designing for VIP and their design process was described in Table 5.5. This chapter further coded Table 5.5 into a graphic figure (7.1) in order to visualise the data and make it easier to be understood. The second part of the discussion uses the NS framework (see Chapter 5.1.5) derived from the coding and analysis of semi-structured interviews with VIP as the basis for coding the transcriptions that were derived from the second part of the semi-structured interviews with professionals. The findings are presented in summary form and the participants' knowledge of VIP and the NSs they recognised are illustrated in Figure 5.2.

7.2 Preliminary research findings and discussion

7.2.1 Professionals' methods of research

This part of the discussion analysed the data obtained from the first part of the semi-structured interviews with professionals. These were categorised into three main themes including primary research, secondary research and design tools (Figure 5.2). In Figure 5.2, the main categories are illustrated with their sub categories, and the number from zero to eight presenting the numbers of participants reporting each aspect.

According to their statements, the present research found that nearly all of the participants relied on consulting with the Royal National Institute of Blind People (RNIB) and VIP as a primary research method to approach designing for people with VI. Three of the participants indicated primary research through architectural site surveys, consulting with access consultants, consulting with staff members and receiving disability awareness training. Consulting with the Glasgow Access Panel, landscape architects/consultants and the Royal National Institute for Deaf People (RNID) as a primary research method were indicated by one-quarter of the participants.

In terms of secondary research, half of the participants tended to reference (council) building regulations and design examples. One-quarter of the participants demonstrated referencing British Standards, Disability Discrimination Act (DDA) regulations and Building Sight, which was published by RNIB, as secondary research.

On the other hand, nearly half of the participants made use of simulation glasses as the design tool to help understand difficulties experienced by VIP as they move around within the built environment. Two of the participants relied on blindfolds to simulate impaired vision. Other design tools reported by the participants included bubble wrap, computer models, a light reflectance value meter, physical models and simulator software.

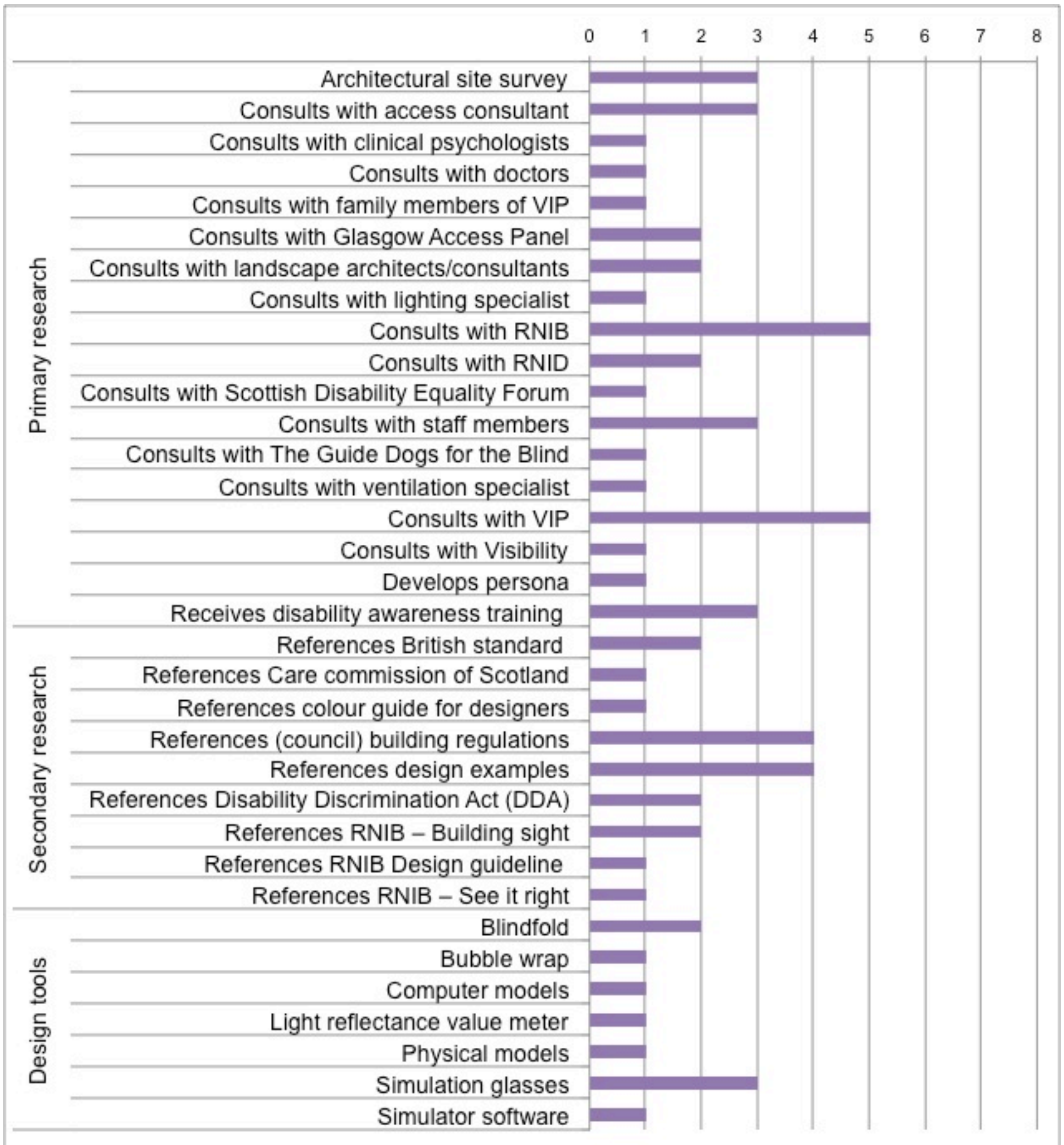


Figure 5.2 Professionals' methods of research

According to the semi-structured interviews with professionals, the research found that practitioners relied both on primary and secondary research to develop their knowledge of VIP. Speaking with VIP was the most frequently demonstrated primary research by the participants. There were half of them used primary research by speaking with VI related organisations and by visiting existing sites;

and nearly half of the participants tended to communicate with client and/or staff who had worked with VIP for a long time and to consult on issues with access consultant. In terms of the use of secondary research, there were half of the participants indicated the use of building regulations and/or design guidelines in general; meanwhile, they also tended to reference the Disability Discrimination Act (DDA) regulations. The use of building regulations was demonstrated by nearly half of the participants. When comparing the frequency of the use of these two types of research, it appeared that the participants relied more on the primary research for approaching VIP. The use of simulation tools was also indicated by the participants for developing knowledge of VIP and simulation glasses appeared to be the most common tool within the participants.

7.2.2 Professionals' understanding of navigational strategy

According to the second part of the semi-structured interviews with professionals, Figure 5.3 illustrated NSs identified from the statements of the participants. It can be seen that most of the NSs recognised by the participants were in the category of sensory orientation. Almost all the participants believed sense orientation, through the use of colour contrast to compensate, was helpful for VIP to navigate better. Meanwhile, more than half of the participants indicated VIP rely on sense orientation, through making use of lighting and residual vision in general, to navigate around. There were also six of the participants who believed VIP tended to rely on their sense of hearing and sense of smell in general for sense orientation. Sense orientation by using sense of touch in general was demonstrated by half of the participants. Meanwhile, there were nearly half of the participants who believed that through touching each time by hands or feet, label/tactile marker and tactile pavement are helpful for VIP to identify personal belongings and notice where they are. There were fewer participants who identified sense orientation through using bigger objects such as landmarks and using echoes to locate.

Other than sense orientation, behavioural coping through using adaptive device was the most reported NS that was recognised by half of the participants. There were three of the participants who indicated VIP rely on an adaptive aid (e.g., guide dog, long cane) to avoid obstacles as behavioural coping. Other behavioural coping NSs included relying on memory to compensate, which was recognised by two of the participants, and restricting geographic range of activity, which was recognised by one of the participants. Relying on memory to compensate and restricting geographic range of activity were two of the behavioural coping NSs that were demonstrated by a few participants. There were nearly half of the participants who believed VIP tend to remember different sizes of roads for cognitive orientation. Nevertheless, it was also the only NS that was recognised by the participants for cognitive orientation.

According to the Figure 5.3, it can be seen that the participants were less aware of other NSs. Habitual orientation, through keeping things in the same place, was indicated by two of the participants. There were two of the participants who believed that VIP tend to use social coping by relying on others in general. In terms of the category of others, visualisation was also recognised by two of the participants. Psychological coping was the only main category that was recognised by none of the participants. In terms of the variables of VIP, there were five of the participants who recognised different types of VI may influence VIP’s ability to navigate differently. Half of the participants indicated visibility was important factor when moving around. There were three of the participants who distinguished VIP by VI from birth and three of the participants distinguished VIP by VI in later life. Familiarity with the environment was recognised by two of the participants as an important factor for VIP's navigation. There was only one of the participants who clearly indicated the difference between VIP according to the age of onset.

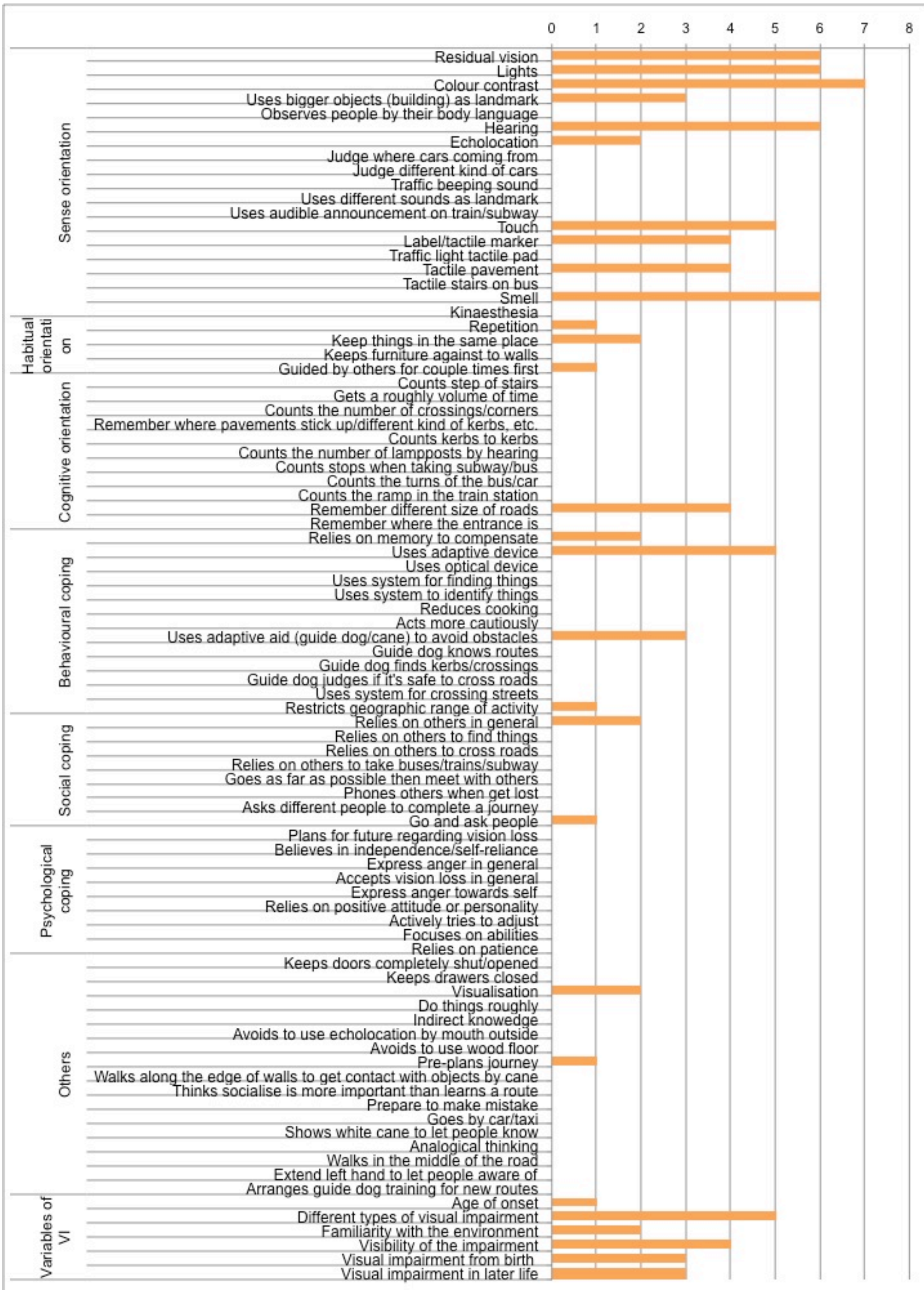


Figure 5.3 NSs of VIP recognised by participants of professionals

7.3 Conclusion and implications for this study

The findings discussed above showed that the participants had different levels of understanding of VIP. Although some of them recognised some of the variabilities of VI and VIP and identified some of the NSs used by VIP, their approaches to VIP, especially referencing current building regulations, design guidelines, and design tools, were fairly insufficient for participants to fully understand: i) the capabilities of VIP; and ii) how VIP move around different categories of environments. The results from the coding and analysis of interview data suggest that the hypothesis can be supported, i.e. there is currently insufficient information for professionals to understand the complexity of VI issues, the importance of the multiple variables of VI and VIP, and the NSs that VIP have developed. This finding supports a further and more detailed analysis in the next chapter in order to further discuss the differences between the findings from the VIP's interviews and the findings from the professionals' interviews.

8. Discussion

8.1 Introduction

In Chapter 5 and 6, data obtained from the semi-structured interviews with VIP was firstly and initially transcribed in order to immediately examine the research hypothesis and research questions. Through initially coding and analysing the transcriptions, an initial NS framework was developed and the preliminary findings have demonstrated that i) different combinations of NSs are used in different types of environments; and ii) the frequency, across all the VIP, of use of the NS.

This chapter intends to provide a more in-depth analysis of the data and to identify the extent to which NS are used by VIP and how they differ, by looking at the variables in the use of NS: i) within the three categorised environments; ii) amongst individuals with different types of VI; and iii) when different navigational aids are used to assist VIP. Meanwhile, it will also discuss the extent of professionals' knowledge and understanding of VI and VIP's capabilities and strategies for navigating in a number of types of environments and whether professionals tend to approach design for VIP through the use of asset-based models or deficit-based models.

To enable this, all the semi-structured interviews with VIP were carefully verbatim re-transcribed for establishing a more precise and robust set of data and research findings. The transcriptions were re-coded through repeatedly reading, a time-consuming process but important to ensure robustness of the data and its analysis. At the same time, through verifying with the literature in Chapter 2 again, some of the sub categories were re-organised and the main category, ‘Others’, was combined into other main categories. A more comprehensive NS framework was then established, and its sub categories were properly re-named and re-organised alphabetically (Figure 8.1). NSs identified from the semi-structured interviews with professionals were also re-coded into this new NS framework.

This chapter begins with a discussion of how the NS were used by individuals in different types of environments. At the end of this chapter, the four case studies that were identified from the current research and practice in the field of ID (see section 4.3.2.2) will also be reviewed and analysed (see section 8.6). Findings from this in-depth analysis of the two sets of semi-structured interviews (VIP and professionals) and the four selected case studies will be discussed in Chapter 9.

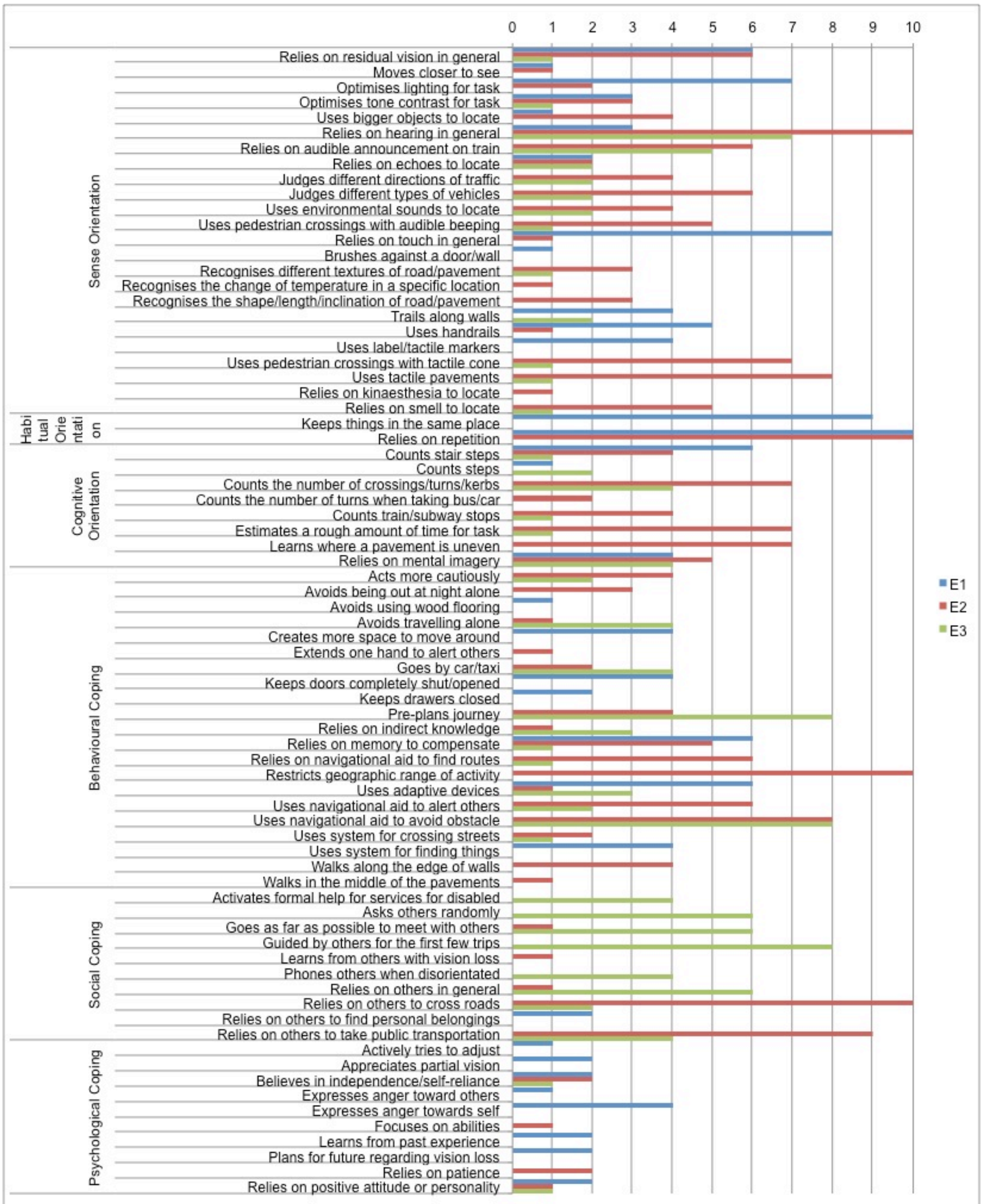


Figure 8. 1 Composite of NSs used by VIP in the three categorised environments (a recoded and re-analysed version of Figure 5.1)

8.2 NS used by each individual in the three types of environments

This section provides a discussion of how the NSs were used by individuals in different types of environments. Figures 8.2 to 8.4 illustrate subcategory total scores under each of the 6 main NS categories in the three types of environments. NSs used by each of the subjects in each of the environments are coded in Tables 8.1 to 8.20. Whereas the tables in section 8.1 showed the frequency of occurrence of reporting of NS across the sample in each of the three types of environments, the figures and tables in this section allow comparison between the individual VIP participant profiles. Figures 8.2 to 8.4 enable a different kind of comparison to be made between individuals, under their cumulative total scores in the 6 main categories and, through comparison between these figures and tables, the similarities and the differences among individuals can be identified and investigated.

When comparing the NSs used in the intimate and personal environments (i.e., Environment 1) (Figure 8.2), although subject 3 and subject 11 were both female and registered as blind in their 40s (see Table 8.4 and Table 8.20 for subjects' profile), subject 11 reported many more NSs than subject 3 did. According to Table 8.3 and Table 8.19, subject 11 tended to rely on residual vision, hearing and touch in general, whereas subject 3 only depended on residual vision and the sense of touch to move around. Behavioural coping strategies reported by subject 11 were two times more than of that reported by subject 3. It also shows that subject 11 relied a lot on psychological coping; nevertheless, no psychological coping was indicated by subject 3.

In terms of the NSs used in the more public but still familiar environments (i.e., Environment 2), subject 2 and subject 4 were both male guide dog users and with previous experience of using a long cane (see Table 8.2 and Table 8.6 for subjects' profile); however, they reported different combinations of NSs when moving around in Environment 2 (Figure 8.3). According to Table 8.1 and Table 8.5, subject 2 relied heavily on his sense of hearing and made use of his sense of smell to locate himself, whereas subject 4 tended to rely more on his residual vision. Although they both reported cognitive orientation through counting the number of crossings/turns/kerbs, subject 2 further indicated estimating a rough amount of time for the task, learning where a pavement is uneven, and relying on mental imagery for cognitive orientation.

Subject 8 and subject 9 were both female, aged more than 70, and used the same type of navigational aid (i.e., symbol cane) (see Table 8.14 and Table 8.16 for subjects' profile). However, NSs reported by subject 9 were generally more than that reported by subject 8. The differences are especially apparent in that subject 8 appeared to be much more mobile than subject 9 when navigating in the unfamiliar and unpredictable environments (i.e., Environment 3) (Figure 8.4). When looking at the biography of each, it can be seen that subject 8 was blind from age 14, whereas subject 9 was blind when aged 73. It is quite surprising because I would have expected an individual who had been blind for about 60 years should be more mobile and be able to report more NSs than one who had less time to adjust. This may be due to personality factors which is another variable to be considered in this work.

The presentation of the data in these formats allows the differences between in individuals to be understood as one of the variability factors that needs be considered in research of this nature.

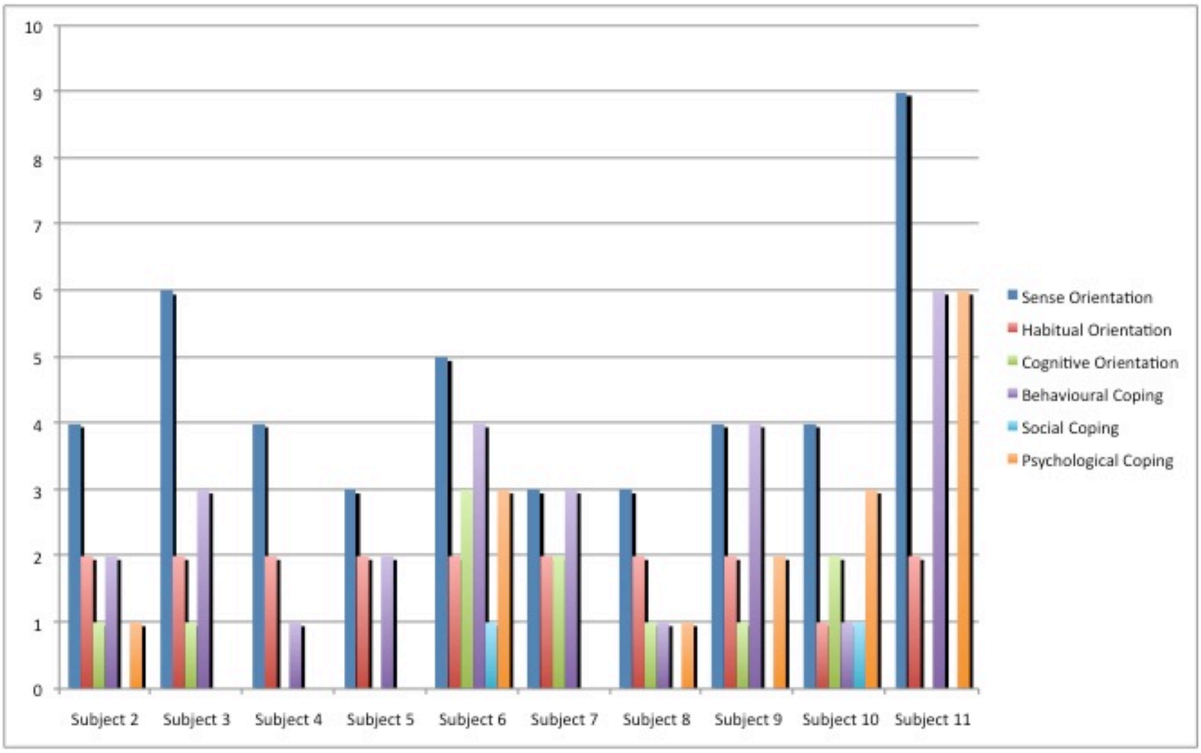


Figure 8. 2 Environment 1 – Subcategory total scores, per subject, under each of the 6 main NS categories

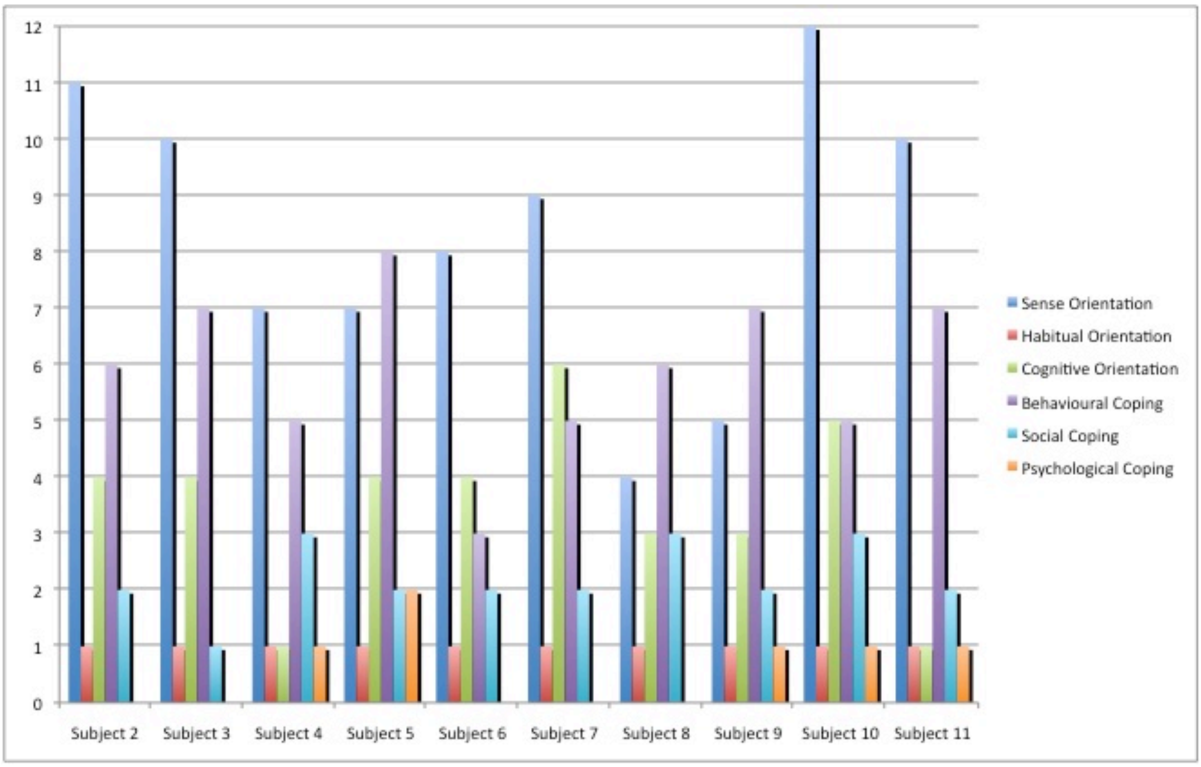


Figure 8. 3 Environment 2 – Subcategory total scores, per subject, under each of the 6 main NS categories

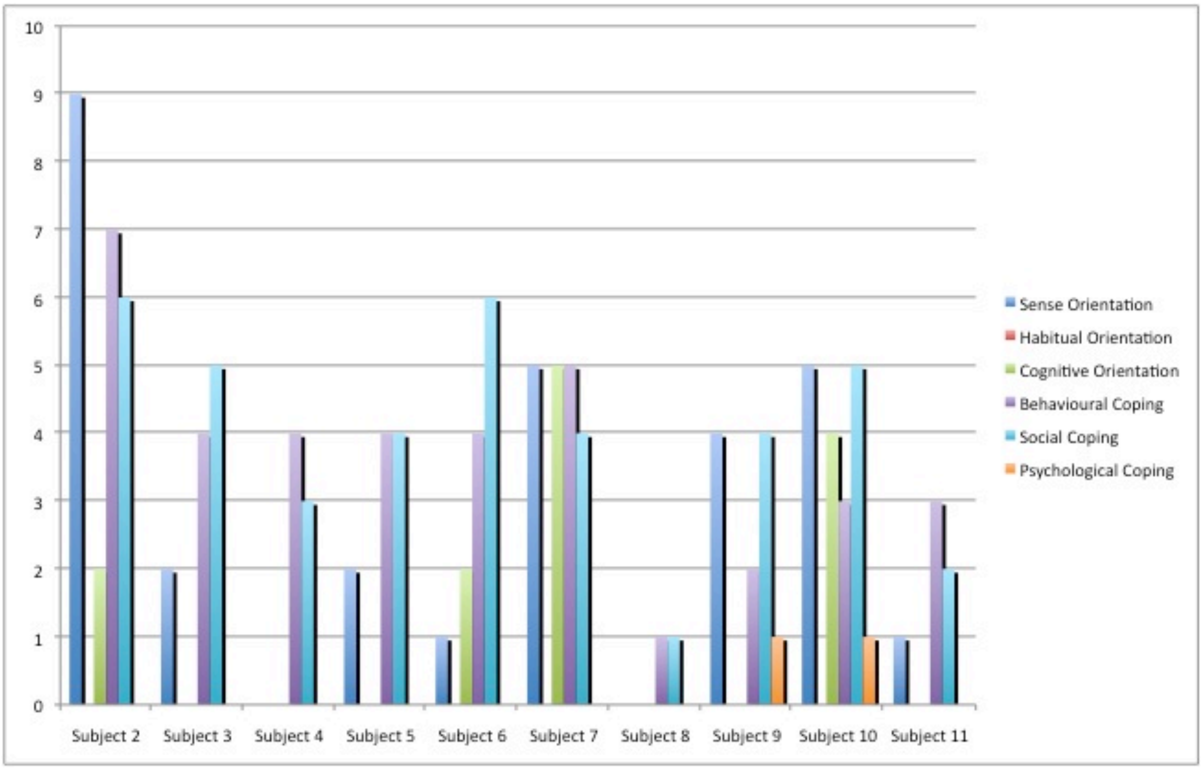


Figure 8. 4 Environment 3 – Subcategory total scores, per subject, under each of the 6 main NS categories

Table 8. 1 NS used by subject 2

Subject 2				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 2 Profile of subject 2

No.	1
ID	S2
Age	48
Gender	Male
Age of onset	From birth
Age of sight loss	From birth
Age when registered as VI/blind	15/blind
Type of VI	Glaucoma/cataract
Navigational aid	Guide dog user from age 20
Experience of other navigational aid	Used long cane before age 20
Other sensory/physical impairment	No

Table 8. 3 NS used by subject 3

Subject 3				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 4 Profile of subject 3

No.	2
ID	S3
Age	59
Gender	Female
Age of onset	19
Age of sight loss	48
Age when registered as VI/blind	40/blind
Type of VI	Glaucoma
Navigational aid	Guide dog user from age 50
Experience of other navigational aid	Used long cane for 6 months
Other sensory/physical impairment	No

Table 8. 5 NS used by subject 4

Subject 4				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 6 Profile of subject 4

No.	3
ID	S4
Age	72
Gender	Male
Age of onset	(L) 60 / (R) From birth
Age of sight loss	(L) 60 / (R) 19
Age when registered as VI/blind	60/blind
Type of VI	(L) Accodent / (R) Lazy eye
Navigational aid	Guide dog user from age 61
Experience of other navigational aid	Used long cane for 1 year
Other sensory/physical impairment	Hearing impairment

Table 8. 7 NS used by subject 5

Subject 5				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 8 Profile of subject 5

No.	4
ID	S5
Age	59
Gender	Female
Age of onset	From birth
Age of sight loss	From birth
Age when registered as VI/blind	5/blind
Type of VI	Cataract
Navigational aid	Guide dog user from age 36
Experience of other navigational aid	Relied on others with symbol cane before age 36
Other sensory/physical impairment	No

Table 8. 9 NS used by subject 6

Subject 6				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 10 Profile of subject 6

No.	5
ID	S6
Age	53
Gender	Female
Age of onset	30
Age of sight loss	N/A
Age when registered as VI/blind	33/VI
Type of VI	Retinitis pigmentosa
Navigational aid	Guide dog user from age 36
Experience of other navigational aid	No
Other sensory/physical impairment	Hearing impairment

Table 8. 11 NS used by subject 7

Subject 7				
		E1	**E2**	**E3**
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 12 Profile of subject 7

No.	6
ID	S7
Age	29
Gender	Female
Age of onset	From birth
Age of sight loss	19
Age when registered as VI/blind	24/blind
Type of VI	Leuko-malacia
Navigational aid	Guide dog user (first guide dog)
Experience of other navigational aid	Used long cane from age 19
Other sensory/physical impairment	No

Table 8. 13 NS used by subject 8

Subject 8				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 14 Profile of subject 8

No.	7
ID	S8
Age	74
Gender	Female
Age of onset	12
Age of sight loss	14
Age when registered as VI/blind	Unknown/blind
Type of VI	Accident/Optic nerve damage
Navigational aid	Symbol cane user
Experience of other navigational aid	Mainly relied on others
Other sensory/physical impairment	No

Table 8. 15 NS used by subject 9

Subject 9				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 16 Profile of subject 9

No.	8
ID	S9
Age	83
Gender	Female
Age of onset	73
Age of sight loss	73
Age when registered as VI/blind	73/blind
Type of VI	Macular degeneration
Navigational aid	Symbol cane user from age 73
Experience of other navigational aid	No
Other sensory/physical impairment	No

Table 8. 17 NS used by subject 10

Subject 10				
		E1	E2	E3
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 18 Profile of subject 10

No.	9
ID	S10
Age	32
Gender	Female
Age of onset	From birth
Age of sight loss	9
Age when registered as VI/blind	16/blind
Type of VI	Ectatic nerve/cataract
Navigational aid	Long cane user from age 10
Experience of other navigational aid	Used Guide dog for 1 year
Other sensory/physical impairment	No

Table 8. 19 NS used by subject 11

Subject 11				
		E1	**E2**	**E3**
Sense Orientation	**Relies on residual vision in general**			
	Moves closer to see			
	Optimises lighting for task			
	Optimises tone contrast for task			
	Uses bigger objects to locate			
	Relies on hearing in general			
	Relies on audible announcement on train			
	Relies on echoes to locate			
	Judges different directions of traffic			
	Judges different types of vehicles			
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping			
	Relies on touch in general			
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement			
	Trails along walls			
	Uses handrails			
	Uses label/tactile markers			
	Uses pedestrian crossings with tactile cone			
	Uses tactile pavements			
	Relies on kinaesthesia to locate			
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place			
	Relies on repetition			
Cognitive Orientation	Counts stair steps			
	Counts steps			
	Counts the number of crossings/turns/kerbs			
	Counts the number of turns when taking bus/car			
	Counts train/subway stops			
	Estimates a rough amount of time for task			
	Learns where a pavement is uneven			
	Relies on mental imagery			
Behavioural Coping	Acts more cautiously			
	Avoids being out at night alone			
	Avoids using wood flooring			
	Avoids travelling alone			
	Creates more space to move around			
	Extends one hand to alert others			
	Goes by car/taxi			
	Keeps doors completely shut/opened			
	Keeps drawers closed			
	Pre-plans journey			
	Relies on indirect knowledge			
	Relies on memory to compensate			
	Relies on navigational aid to find routes			
	Restricts geographic range of activity			
	Uses adaptive devices			
	Uses navigational aid to alert others			
	Uses navigational aid to avoid obstacle			
	Uses system for crossing streets			
	Uses system for finding things			
	Walks along the edge of walls			
	Walks in the middle of the pavements			
Social Coping	Activates formal help for services for disabled			
	Asks others randomly			
	Goes as far as possible to meet with others			
	Guided by others for the first few trips			

	Learns from others with vision loss			
	Phones others when disorientated			
	Relies on others in general			
	Relies on others to cross roads			
	Relies on others to find personal belongings			
	Relies on others to take public transportation			
Psychological Coping	Actively tries to adjust			
	Appreciates partial vision			
	Believes in independence/self-reliance			
	Expresses anger toward others			
	Expresses anger towards self			
	Focuses on abilities			
	Learns from past experience			
	Plans for future regarding vision loss			
	Relies on patience			
	Relies on positive attitude or personality			

Table 8. 20 Profile of subject 11

No.	10
ID	S11
Age	56
Gender	Female
Age of onset	40
Age of sight loss	41
Age when registered as VI/blind	44/blind
Type of VI	Retinitis pigmentosa
Navigational aid	Long cane user
Experience of other navigational aid	No
Other sensory/physical impairment	No

8.3 Variables in environments

8.3.1 VIP's NS in E1: the intimate personal environments

When asking the VIP participants to describe their daily routines in their intimate and predictable environments (i.e., E1) (Figure 8.5), all of them revealed that they had no problem to navigate themselves within their own houses, and none of them used navigational aids within Environment 1. Habitual orientation was the most frequently reported strategy by all the participants while moving within their intimate and predictable environments. Through their daily routines at home, repeatedly walking around (e.g., going from the bedroom to the kitchen for breakfast) enabled the participants to learn and familiarise the environment automatically. Keeping things in the same place, including every piece of furniture, was another strategy used by all of them which allowed the participants to find their way around without difficulties. This strategy also assisted the participants to find their personal belongings easily and to avoid potential hazards such as tripping over something unexpected on the floor.

> "S5: I just know where everything is, and my sister was in the house and her house next door, and she cleans for me but she makes sure she puts absolutely everything back exactly where it is." Interview 5 p.2

> "S6: When I decide where something go and that it, it doesn't get move, you know, I move it out to clean, and I put it straight back again, you know, so in my mind I know exactly where everything is in my house." Interview 6 p.2

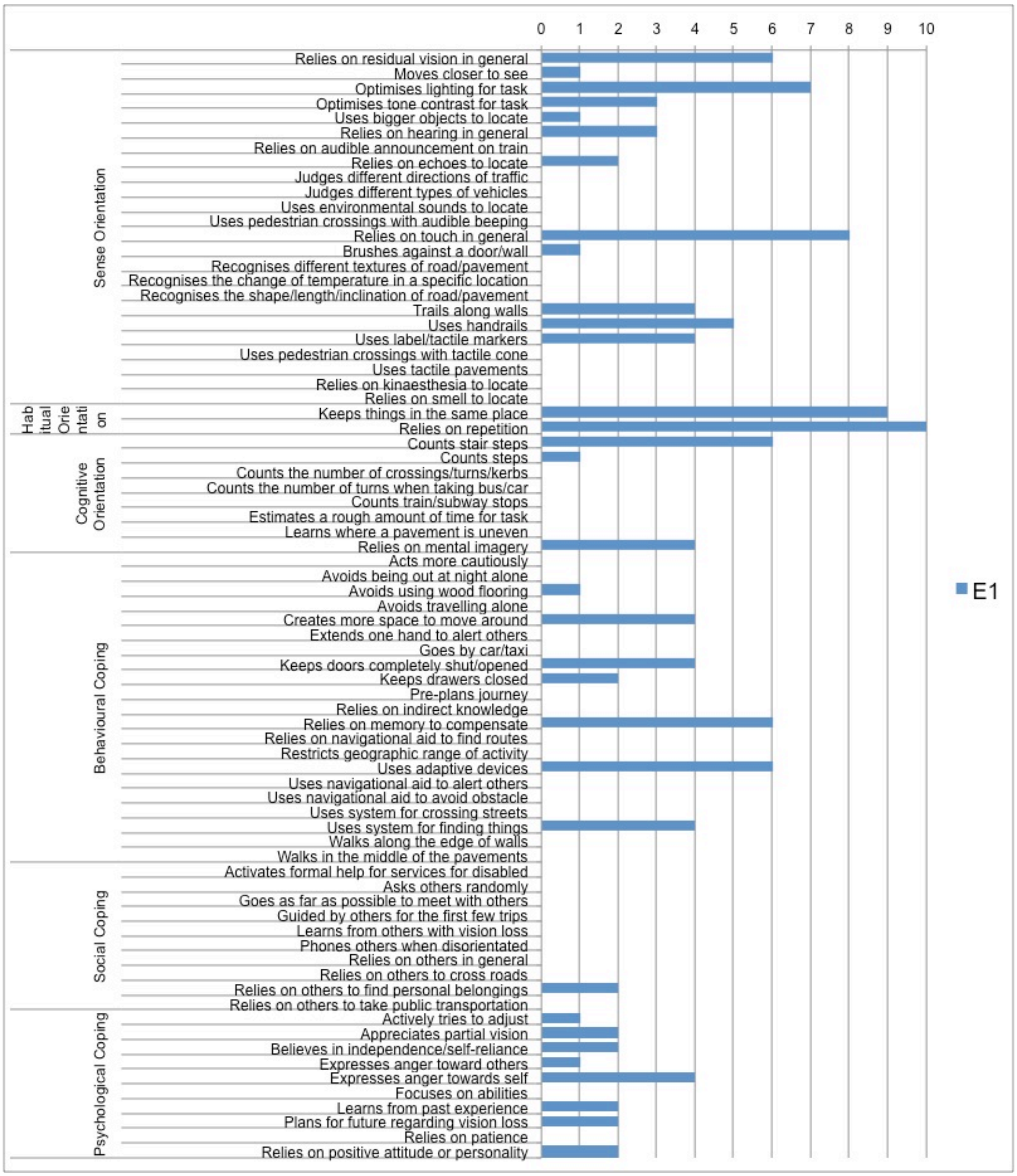


Figure 8. 5 VIP's NS in E1: the intimate personal environments (a recoded and re-analysed version of Figure 6.1)

The participants also relied on their senses to orientate themselves within Environment 1. Six of the participants made use of their residual vision to navigate around; nevertheless, the effectiveness of this strategy was dependent on the level of their residual vision. More than half of them tended to put the lights on during activities at home; however, not all of the participants were using their residual vision in a purely functional way.

> "S10: It's more of an aesthetic, emotional thing for, it's not a functional thing. Plus I have a child as well so having the light on is good for her so she can see. So I put the light on because I don't want her to be in the dark. Occasionally I'll forget to put it on. If it's really early in the morning I won't put it on. In general I put it on." Interview 9 p.8

Those who were able to distinguish colours also utilised tone contrast to navigate better.

> "S11: …Having said that there's probably isn't a month that goes by that I don't bump my knee on it, because I'm hashing about, but you know and again I did away with the carpets and got laminated flooring down, but I have scatter rugs down, secure scattered rugs so that gives me contrast." Interview 11 p.8

Eight of the participants demonstrated that they relied a lot on their sense of touch in general, for example, using their hands to identify different shapes of objects and search for their personal belongings. Five of them tended to hold the handrail while going up or down stairs. There were also four of the participants who reported that they would trail along walls with their hands while moving around, and one of the participants tended to quickly brush against doors or walls with elbow to help sense orientation.

“S6: …I tend to run my hands along the wall, and then when I come to the end of that wall I know I’m going to the living room, turn right and I’m going to my living room, or if I walk straight on then come to my kitchen, you do things without thinking but I do I feel all the time my hands” Interview 6 p.3

“S10: I might fleetingly with my elbow, brush it just to make sure. It's more about precision and accuracy because especially if you're tired, you can be inaccurate.” Interview 10 p.4

On the other hand, relying on memory to compensate for the loss of vision was one of the most frequently reported strategies in the behavioural domain. There were also six of them who made use of adaptive devices such as a talking clock and a talking microwave; among them, there was one who also used an adaptive device to identify different objects.

“S2: There’s an application, and the way you can do is to point it at something and you take a photograph, and then goes online, and it goes back and tell you what it is.” Interview 2 p.8

Using a systematic way for finding things was reported by four of the participants, and this behavioural coping also involved the use of other senses.

“S11: …If I drop things and I don’t see them I would use a brush or, or something to pull it all together, that’s what I would do…but if it's on the floor and it's, if it's something like…I don't know I dropped a…a coin for

> instance I would hear that, and then I would look for it, if I couldn’t see it, I would get a brush, or if I dropped a pill and then again if I couldn’t hear it or feel it I would pull it together with a, or go down on your knees and try and tactile, find it, you know.” Interview 11 p.13

In terms of cognitive orientation, there were more than half of the participants who tended to count the number of stair steps when going up or down stairs. Nearly half of them also revealed that they tended to visualise (i.e., mental imagery) their surroundings in order to help to learn or to remember the environment quicker.

> “S6: …And by the time your sight gone in your head you can picture your whole living, the bedroom, the kitchen in your head… To me, if I close my eyes I can see the whole living room, you know, I know exactly where everything is, like an image in your mind.” Interview 6 p.6

Psychological coping was also reported as used in Environment 1. Four of the participants revealed that they sometimes tended to express anger towards themselves when they could not find their personal belongings. Two of the participants tended to plan for the future regarding their vision loss, and there were also two who revealed that they believed in independence or self-reliance. Other psychological coping such as learning from past experience, appreciating partial vision, and relying on a positive attitude or personality were also reported by two participants.

> “S9: But if I put something, I mean for instance I lost a shoehorn for a week, and I was demented, I knew I had it in the house, I couldn't find

it…” Interview 9 p.3

“S11: …I try to eliminate the difficulties as I go along. I find that I try and get solutions to my personal problems…that’s the way I can answer that, so yes being visually limited, there are loads of difficulties, but you have to learn to adapt, to come to terms with it and to find substitutes, a way round it, or to give up, like driving.” Interview 11 p.13

Participants appeared less reliant on their sense of hearing while they moved around within Environment 1. There were only three of the participants who noted the use of their hearing in general, and two of these indicated that they tended to listen to echoes reflected from objects such as walls or floors to orientate.

“S2: When you walk to it, and you’ll know that. A smaller space is quite easy because you can use sound, and you can use surfaces, and you can use…if you walk around the room you know the room you know where the tables are… But I realised in a smaller room, there’s no echo…or different kind of echo. The different kind of reflected sound. [The echo from the wall?] Yes, or table, or floor.” Interview 2 p.6

On the other hand, although there were two of the participants who had a tendency to rely on others for finding personal belongings, strategies in the social domain were less reported in the home environment, which showed their autonomy and independence in Environment 1.

8.3.2 VIP's NS in E2: the more public but still familiar environments

Figure 8.6 illustrates NSs identified from the VIP participants when asking them to describe typical journeys that they made in the more public but still familiar environments (i.e., E2), all the participants discussed their daily routines within their neighbourhood, for example, from their own houses to a local supermarket, and/or journeys out of their local area, for example, from their neighbourhood to the city centre for work.

Before starting a journey, four of the participants tended to use behavioural coping by pre-planning a journey before they departed. They believed that preparing information such as timetables for public transport or reviewing potential routes in their head beforehand was important.

> "S3: …You have to kind of plan it from…my point of view is…what's the safest way...So you're always have to kind of plan." Interview 3 p.8

> "S11: … And I would have prepared my journey before I go anywhere, I would know where I was going, I would know which bus I was going to take…" Interview 11 p.15

> "S10: …I always plan my journey quite well so I always know…I estimate how long it's going to take me and then I add time on for any mistakes that I might make, or for getting lost. I don't normally get lost but there's always a possibility that I could go the wrong way, or I could forget what road it is." Interview 10 p.12

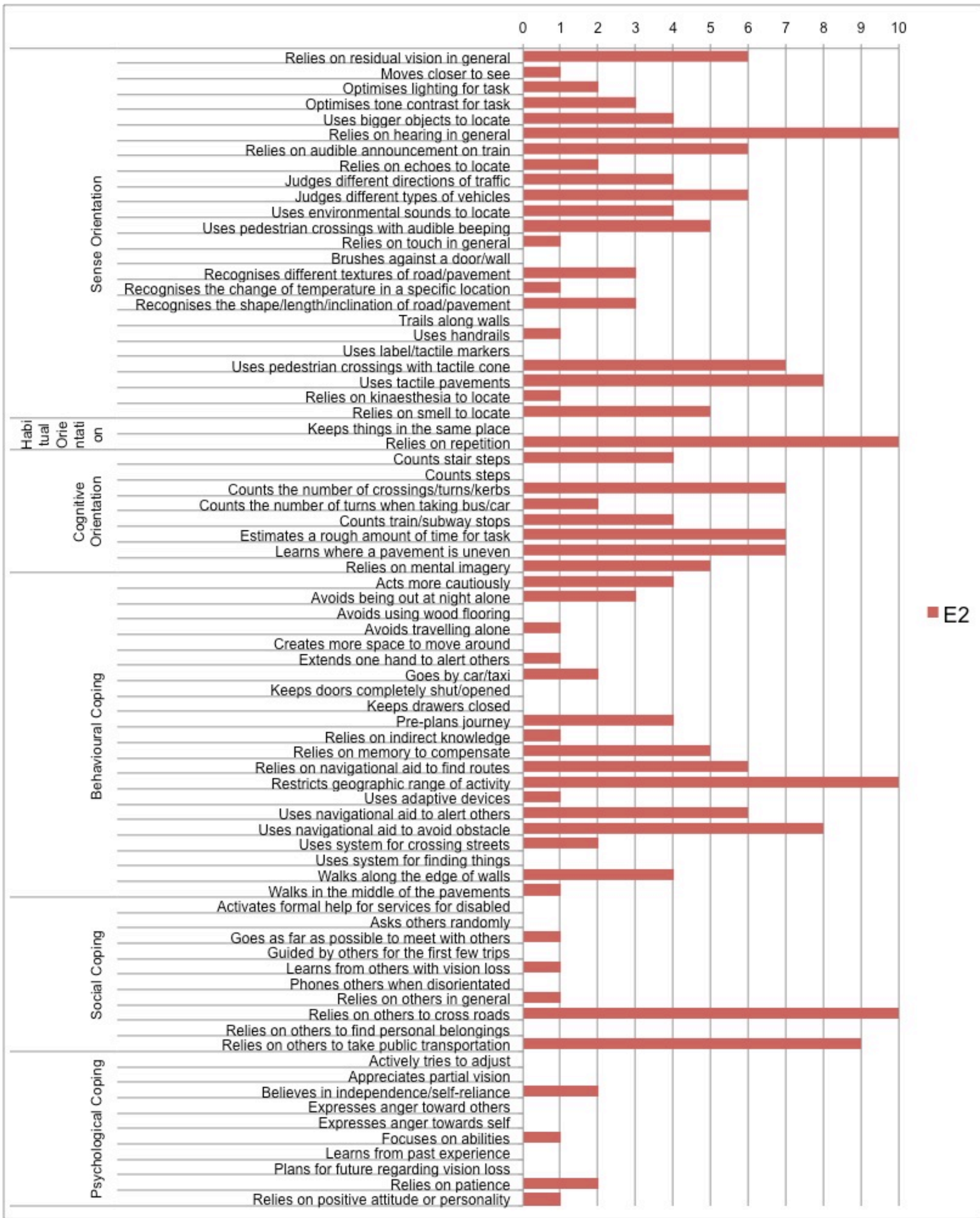


Figure 8. 6 VIP's NS in E2: the more public but still familiar environments (a recoded and re-analysed version of Figure 6.2)

When they were traveling within Environment 2, habitual orientation - through repeatedly following the same routes - was one of the NSs reported by all the participants.

"S2: …Some of these are subconscious and some of these are unconscious. Sometime you get a route all the time, you're not always thinking about it. It's kind of unconscious. It's kind of a…you do this often, it becomes a habit." Interview 2 p.14

"S3: …Because it's where I've lived since I was a child…So you do learn a lot of…it's my repetition, you get to know your own area really well…But most routes that you do as a visually impaired person locally, it's…by and large…it's the same route that you're doing all the time, with a few variations, so you get to know your own area and very well, you know." Interview 3 p.7-8

"S4: This is the same sort of routine everyday, no different things, I'm actually doing the same things everyday. This became a day routine…You get so familiar with things, they don't really bother me because I'm doing this…I keep repeat myself because you keep doing the same things everyday." Interview 4 p.11

Half of the participants demonstrated NS in the behavioural domain by relying on their memory to compensate for the loss of vision.

"S7: You need to remember huge amount, you need to have a very good memory definitely, and to remember how many (stairs) in each place." Interview 7 p.19

"S10: I work very much on a filter basis with my memory. I work out what I need to memorise and what I don't and I won't memorise things that I don't perceive as important. Maybe that's laziness, I don't know but maybe it's just using your brain for what you need to use it for." Interview 10 p.21

Restricting the geographic range of activity was another behavioural coping reported by all the participants. Some participants demonstrated that they always chose to go by the safest way to avoid potential hazards such as crossings without controlled pedestrian lights or uneven pavements, and some reported that they tended to keep away from places such as a busy street or a shopping centre because these places usually had many people and noises, which were not only disturbing but also disorientating.

"S3: …Sometimes you have to walk past the place that you're going…if it was on the other side of the road, because there's no crossing, so you'd have to walk out further to a crossing, cross over and then go back down the way…" Interview 3 p.8

"S10: I would often, if you're at a corner, I would try to avoid crossing at a corner in and indent so I know if a car turns I've got a little bit of time…Because it's safer. If I'm walking on a corner, I've got a tendency to veer the wrong way…So if you're on the road at the wrong point you could veer, or I could potentially be in danger of cars from multiple directions coming the same time. But if I indent, and I know that the cars are going to turn and I've got enough time to move back."

Interview 10 p.10-11

“S11: …I then walk from Central Station to Queen Street Station, but I do not go the route we came in today, I go up Hope Street and along so I'm avoiding a' the pedestrians, I'm going, I, I…I have a different map in my head, and so I would choose a different way, and the reason I do that is…even if it's further to walk, absolutely, because my safety is important.” Interview 11 p.17-18

“S7: …But I wouldn’t choose to come and walk in the city because I found it too stressful…and there aren’t the landmarks because there’s so many people moving around that you possibly can’t find them, so I just wouldn’t choose to do.” Interview 7 p.16

Most of the participants utilised strategy in behavioural domain, by relying on navigational aids (i.e., guide dog, long cane, simple cane) to navigate around obstacles (e.g., people, street furniture, bins on pavements). Some of them who were guide dog users had a tendency to rely on their guide dog to find the routes that they usually took. There were also more than half of them tended to use navigational aids as a symbol to alert others not to run into them and to ask for help when they needed assistance.

“S7: …There’s often loads of street furniture, so my dog guides me around the street furniture… And at the end of my street out, turn left and that goes passed a garden place, and the street where again is a lot of furniture outside, so she (guide dog) then has to guide me around that.” Interview 7 p.5-6

“S2: They (people) tend to get out of me, I got a big dog… They didn’t drive on you.” Interview 2 p.12

“S11: I have my stick there, I have my white stick there so they're aware that I have a vision problem, you know you have to help people, you can't just assume they're psychic.” Interview 11 p.21

As illustrating in Figure 8.6, the participants relied a lot on their senses to orientate while moving around within Environment 2. It was reported by all the participants that they relied a lot on their sense of hearing to identify their surroundings and to recognise where they were. Meanwhile, four of them made use of environmental sounds to help locate themselves.

“S2: I’ll tell (guide) dog to go left because I hear the traffic, I hear the main road. I know, I turn left, I’m still on the pavement, and I walk all way through the town, and to…I get to a crossing.” Interview 2 p.9

“S3: Because I walk past them all the time, and you hear they’re playing football, so you think “all right, okay, I’m at…near the leisure centre” because that’s the big fans there, and I hear the football hitting off, so you do go by a lot of things like that.” Interview 3 p.15

“S10: So you use traffic as a cue. So if the traffic is on your left, you know you're on a pavement with a main road with the traffic running behind you to in front of you. If the traffic is going from left to right, you know there's a main road in front of you.” Interview 10 p.10

Two of the participants also described how they used echoes to locate.

> “S10: …When I get off the train at central station, I know that in general, if I travel in the direction the train was just going I know that I'll get to the front of the platform and onto the concourse. When I get to the concourse, I can normally tell that by the echoes and by the amount of people there that are talking.” Interview 10 p.16

On the other hand, six of the participants made use of their residual vision to travel around. Among them, there were four used bigger objects to help locate themselves.

> “S6: If I’m walking down Buchanan Street, say I’m going right down to the Central Station, I use…you know the…it used to be Border Bookshop, now they’ve got sewing machines in the windows…then I know I’m turning right to go to Central Station, or I know I’m just a little bit lower to Argyle Street. Border’s always my focus point…I still use it as my focus point on Buchanan Street after the underground, underground’s just on the top half, and that would be the bottom half of Buchanan Street.” Interview 6 p.14

> “S11: …If I was coming in from the other way by bus into central station, I would, I knew it, I would know that’s where I was getting off, I

> would look for the clock at the end of the road and, u-uhh, that’s, that’s just in-built.” Interview 11 p.26

Through the use of residual vision, some of the participants also made use of lighting and/or tone contrast as cues.

> “S9: One place that’s very good is along Great Western Road at Kelvinbridge, and they have made the bollards mosaics, coloured mosaics. So that everybody sees it, and it's lovely… But even when it's, the, you know they, it's a night time and the light are on, you can make out these coloured ones, now that is a good point to make out, and another thing is when you're doing down steps, you can go upstairs because you see the difference in the rise and the tread, but going down there's nothing, but yellow, a wee bit of yellow on the side of each stair going down and you can make” Interview 9 p.5

It was also demonstrated by half of the participants that using their sense of smell was helpful to recognise where they were.

> “S5: …If you go along Sauchiehall Street you want to know where shop is, if you come along, I know when I…I can smell Lush, I know that I’m near the Savoy Centre, or I know that if I’m coming along, I can get to Thorntons, I might be gonna to buy some chocolates, and quite a lot of shops like that.” Interview 5 p.9

"S8: …Coffee shop, baker, butcher shop… There's smell coming from the butcher shop. Well, you're very aware with the smells. You know when you're passing Lush, you know you get coming to Lush." Interview 8 p.8

"S10: Chips. Chip shops. Pizza. Bookshop smells of paper, WH Smith's smells of paper. Clothes shops smell, you can smell the floor. Marks & Spencer smells has got quite a particular smell so has Debenhams. You can smell the perfume when you walk into Debenhams. Chemists always smell very similar and dentists smell quite similar as well." Interview 10 p.19

Navigating within Environment 2 also involved the use of touch. One of the participants reported feeling the air touching their face.

"S10: Sometimes you can find something like a railing or a bar or a door. You can feel the cold air coming towards you or something." Interview 10 p.24

Through using their sense of touch with their feet, some of the participants were able to recognise different textures of road or pavement, and some were able to distinguish the different shape, length, or inclination of a road or pavement.

"S3: If I turn to the right that will get me to the leisure centre, and then I can feel (touch) on when it's kind of cardboard, kind of ground, that's the area outside the leisure centre, so if I follow the cardboard a wee bit, I'd get to the doors for the leisure centre, so you're doing kind of things like that." Interview 3 p.15

"S10: …Then I turn right and walk across. I don't remember how many kerbs, but until I get to a small kerb. A road where there's a small distance between one kerb and the other. So I know that when I get to a smaller one I need to start looking on my right for the station ramp. There are two ramps. The first one is for the wrong platform that I don't need, but that's the one coming back. Then there's the one that I need to go. So it's the one on the right and I know that I'm there because I can feel railings and a ramp going down." Interview p.14

"S6: Another way I could do is not to cross over but to go straight down in this way, but there are quite a lot of really high kerbs, and some of it may be that high, you know…" Interview 6 p.13

Cognitive orientation was also demonstrated while navigating within the more public but still familiar environments. Together with the use of the sense of touch with their feet, there were more than half of the participants who tended to locate themselves by counting the number of crossings, turns, or kerbs.

"S2: Road junctions give you information, it gives you information about you're at a junction, you're at a different street, so by that you can count it, so you can say…somebody might say to me "to get to that restaurant, take your third street on your left", so I'll count three down kerbs, three down steps at each junction, so the first street with its down step, I can feel that with my toes, dog stops, that’s one, go to next street, when I down the kerb, I can feel that on my toes, second, get to the third one ‘ahuh, right’ I turn left here, so I’ll turn left to the dog, and walk down then...” Interview 2 p.19

“S6: When I come up to my second kerb to cross over…very bad ground, if I don’t go that way, I can’t go down, right down and going to Queen Street…” Interview 6 p.12

“S10: I know that to get to the bus I would come out of my house, turn left, turn left again and it's on the right. Then I know, but I would still use other cues like what's under my feet, fences, the sounds, to be 100% sure.” Interview 10 p.14

The participants also use cognitive orientation, through counting the stair steps, while they were going up and downstairs.

“S6: …Everywhere I go I count steps going down the way because I got tunnel vision…” Interview 6 p.2

While describing their journeys, more than half of the participants tended to use cognitive orientation by estimating a rough amount of time for the task.

“S2: …And then I cross the road, and I turn right, and I walk to another corner for about two minutes, and then I find out the zebra crossing.” Interview 2 p.9

"S7: …And that evolves…5 road crossings I think, so it's about 20 minutes walk, and straight line, until I get to the certain, again, non-audible, non-tactile crossing, which Tanzy (guide dog) would stop at, that's on my right hand side…" Interview 7 p.6

It was demonstrated by the participants that navigating within the more public but still familiar environments (E2) is not only achieved by referring to one single clue from the built environment but also requires a lot of additional information through the use of different NSs (e.g., relying on different senses and navigation aid to orientate) to help to develop mental imagery and build up a picture of the surroundings in their mind. One of the participants represented the way of reassessing the surroundings when noticing something was wrong.

"S2: You go and you stop, you find out what's changed here, it could be a car parked on the pavement, it could be a bin parked on the pavement, it could be road rocks… Then you stop, and you reassess it, and you looking for information, you'll listen to nearby traffic, you'll listen to sounds…a lot of sounds may be around you… I use a dog, you make a dog going and command to go on, and you forward the dog and see where it goes, so you're listening to all kinds of information… So when you walk down the road, and the music in the shop is not playing, and there's no traffic on the right and you can't smell anything, you'll hang on a minute, might gone the wrong way because all these things have changed, and it's unlikely that everything is gonna change, so you make suspicious that perhaps I've got the wrong way, or maybe the road has been closed, maybe something's happened, and you only aware of that."

Interview 2 p.14-15

When describing how they used strategies to cross roads, more than half of the participants believed touching tactile pavements with their feet was helpful for them to recognise where the pedestrian traffic lights were; five of the participants talked about pedestrian crossings with audible beeping, and seven of them made use of the rotating cone underneath the push button of signal-controlled pedestrian crossings by touch so that they knew when was safe to cross. Nevertheless, they indicated that not all the crossings were available with this equipment hence they had to always listen to the environmental sounds (i.e., traffic sounds) carefully and wait until the way was clear or traffic has stopped.

> "S2: …But I have to listen. I've got to listen carefully, you know. If I think it's going too fast, I'll just wait until it's clear. I'll listen to the car changes its gear." Interview 2 p.18

Through the use of sense of hearing, there were six of the participants were able to identify different types of vehicles, and four of them were able to judge different directions of traffic.

> "S7: I know which way the road, so they will be coming, and from my right, on one side, it's a double junction and left on the other." Interview 7 p.8

> "S10: …you can hear different directions of traffic. So you're taught when you're really little, or you learn yourself, to negotiate your area by traffic

noises." Interview 10 p.10

Kinaesthesia, the sense of bodily movement, was also reported when taking a bus.

"S6: When I'm coming home, the stop before my bus stop that I go off is a huge big bend, huge big corner, so it reminds me…sensing the bend and the dog do as well, then I jump up, I know I'm coming up to the bus stop because the bus goes around…there's a big corner." Interview 6 p.10

Participants who had residual vision had a tendency to rely on their vision to see the traffic lights; nevertheless, most of them were very light sensitive so the level of brightness of daylight was crucial. There were also participants who combined their use of residual vision together with their sense of hearing as a strategy to cross roads.

"S6: She [guide dog] will take me to the pole to press the button for the green man, and the green man comes on. Sometimes the light is okay, and I find pole and I can see the green man, but I don't always." Interview 6 p.11

"S9: …you're aware, if there's nobody there you hear the traffic stopping, and you can see a vague shape, so you know it's time to cross… You can, you see the fuzzy shape and you, you hear the brakes screeching, then they stop, and then you can see it, so you know where to cross."

Interview 9 p.16

Relying on others to help them cross road was another social coping demonstrated by all the VIP participants. In general, although they were capable of crossing roads by themselves, especially within their local environments, they tended to ask someone for help while they were at intersections without pedestrian crossings or busy main roads and junctions with vehicles coming from different directions. Heavy traffic sounds could be frightening and disorientating and consequently, in these situations, they lost their skills and confidence in crossing roads.

> "S3: …and there are a couple of shared street ones…which are…can be a bit of nightmare get across the road because cars are coming from…one, two, three, four directions when you're trying to cross… But people are fine…are quite kind, and are usually…kind of say to me, you know, "are you okay?" or "oh, you're okay now to cross", or if not, I'd just wait and I'm gonna have somebody to help me get across the road." Interview 3 p.7

> "S4: …Because sometimes you think how am I gonna cross the road. I had one experience. Charring Cross, which is a bad crossing anyway, I waited 10, 15 minutes before somebody came and do me to cross the road…there was a point of…a heavy traffic…motorway…" Interview 4 p.13

> “S4: …I was stuck in that jam cross, I couldn’t get across and I waited for ages before somebody came to assist me. Busy area…a lot of junctions.” Interview 4 p.14

The weather could also affect their ability to cross roads safely. Some of the participants reported bright sunlight and some indicated poor weather such as heavy rain or strong winds certainly hindered the use of their residual vision or sense of hearing.

> “S11: …But as I say a couple o' months, no a couple o' weeks ago the light was so strong I could not walk across the road myself, it was just too dangerous…It’s blinding, it’s completely blinding…You would just stand there and waiting for people to come.” Interview 11 p.19

> “S3: Sometimes if it’s heavy rain or wind does muffle the sound a lot, but I think what you have to do is you then walking slower and have to pay attention more because…pay attention of what’s around, a traffic or whatever, but sometimes you can be disorientated if it’s very heavy rain, and you can’t really see where you’re going, you know, but you really just have to pay more attention and kind of focus more when it’s like that.” Interview 3 p.16

> “S5: If it’s heavy rain or wind, I can’t carry an umbrella I have to wear on a hood, so my ears are more block off, so you wouldn’t hear things so clearly. You have to be much more careful crossing a road because you wouldn’t hear traffic.” Interview 5 p.13

While describing the use of public transportation, as illustrating in Figure 8.6 that social coping was the most frequently reported NS, through different levels of dependence on others to help them to travel by different kinds of public transportation.

In general, the participants relied on others to take buses through asking the bus drivers or passengers around the bus stop to know which number of bus was coming, and through asking the drivers to tell when to get off the bus.

> "S4: There's only 88 bus comes down that way, number 88. People getting know you. The driver will ask where you're going. Café place." Interview 4 p.12

> "S6: Usually that there are people at the bus stop, and I used to say what bus I'm waiting for to everybody when the bus is stopped." Interview 6 p.9

> "S9: And when I'm travelling about the town, I have my stick, and the bus stops and I say to them "what number is it please?" and they tell…"is it a number such and such?", and they tell me, I know where the buses are going." Interview 9 p.4

Nevertheless, it was reported that the bus drivers often forgot to notice them when approaching their stops thus most of the participants appeared reluctant to use buses. There were participants who relied on their residual vision to take a bus.

"S6: If there's nobody at the bus stop, I can make out while it's coming. I can't make out the numbers anymore. I'll stop the bus and say to the driver." Interview 6 p.9

"S11: I'm seeing, I'm also seeing, I'm looking intently for the bus stop with the, again I'm in familiar territory and I'm seeing the church, it's a big building so I'm seeing that." Interview 11 p.23

One of the participants described how she used cognitive orientation, by counting the number of turns, and behavioural coping, by using her adaptive aid, to take a bus.

"S10: I did ask the driver but they would forget sometimes. So I would both. Again, I'd do a mixture of three really: Learning the twists and turns in the road, asking the driver and using my GPS." Interview 10 p.14

In terms of the underground, the participants tended to rely on others through arranging assistance from staff, and they also tended to use cognitive orientation by counting the number of stops.

"S10: …You can get assistance on the underground if you go to the gate. They'll open it and they'll take you downstairs." Interview 10 p.13

"S7: Subway, not so much it's quite noisy and shakes, but you've got used to it to do that way, and again, the staff is very helpful… Because subway isn't audible and that's a bit of problem, so I find that from the staff beforehand how many stops is it to the certain station, and then I count them.” Interview 7 p.19

“S9: If you're on the Underground that’s different. You would count how many stops you were going.” Interview 9 p.9

Using social NS by activating formal help for services for disabled was also reported when taking a train. They would also rely on their sense of hearing to identify when to get off the train. The participants revealed the service of the railway stations was helpful.

“S2: I do train quite a lot. Staffs of the railway stations are very good and well trained. And more spaces on the trains, there’s announcement on the trains.” Interview 2 p.17

“S4: And I found another railway across a road here at Queen Street here, railway stations are very helpful, they come and assist you if you need any assistance. They’re very good.” Interview 4 p.4

8.3.3 VIP’s NS in E3: the unfamiliar and unpredictable environments

When the participants were asked to describe a journey that they made in the unfamiliar and unpredictable environments (i.e., E3) (Figure 8.7), not all of them had such an experience without being accompanied by someone, for example, a sighted person. Most of the participants appeared reluctant to visit places that they did not know well, and there were four of them who reported behavioural coping that they tended just to avoid travelling alone in Environment 3.

"S5: …If I go by a plane, I like having blind or someone sighted with me because even though people would give you help, it would be trying to find the person at initial stages when you into the airport…to make yourself phone to them, or if they didn't turn up you'd be in a very difficult situation, you know. So I try, if I'm going to fly somewhere then I'm trying to make sure that I have a sighted companion." Interview 5 p.12

"S5: There's no point and trying to go for an unfamiliar journey totally on your own, with you and your (guide) dog… You might give yourself for a lot of stress, and you certainly give your (guide) dog a terrible stress." Interview 5 p.16

"S11: But I wouldn't go to these places 'cause I'm, I would be too vulnerable, I would just, I would find ways of getting what I need, some, in other ways… I'm very reluctant to go into places that I don't know, it's too dangerous for me." Interview 11 p.33

More than half of the VIP participants reported social coping by relying on others in general to travel around Environment 3.

"S4: If I do a strange…all the area about…I'll ask for help or somebody takes me with the dog, and comes and collects me things like that." Interview 4 p.7

"S8: I rely on my husband and my daughter to take me around."

Interview 8 p.19

"S11: I don't think I've ever been to Braehead on my own, I'm either with my sister or my niece or with the Visibility Group or something, I don't think I've ever gone on my own." Interview 11 p.33

Six of the participants also relied on social coping by going as far as possible to meet others.

"S3: I wouldn't do an unfamiliar on my own… I'd always arrange for somebody to meet me at a meeting point and then take me. Because I couldn't cope, if I didn't know the area at all, I'm not able to make out landmarks." Interview 3 p.19

"S9: If I'm going to a place that I don't know, I'm usually meeting somebody." Interview 9 p.24

There were nearly half of the participants who also demonstrated NS in the behavioural domain that they tended to go by taxi.

"S2: I didn't…sometimes I didn't really know where I was going…if it's a long journey, I'll get the train to the nearest station, and then I'll get a taxi." Interview 2 p.18

"S5: If I'm going somewhere I don't know, then I'll get a taxi, or if I was going somewhere there's no bus I knew, then I'll get a taxi to take me because this then, they would take you right to the place.” Interview 5 p.12

Four of them reported social coping by activating formal help for services for disabled.

“S3: But as I said, when you get trained with a guide dog, they will always take you routes that you’re going to go, and again, they will show you, and it’s repetition… So they would take me and say “right, you go this way you go that way”, “oh, no no, that’s not a very good way because it’s not the safe crossing” and then we do a few times until you find a safe way to get there…I’d ask Guide Dogs to train me and my guide dog for a new journey.” Interview 3 p.18

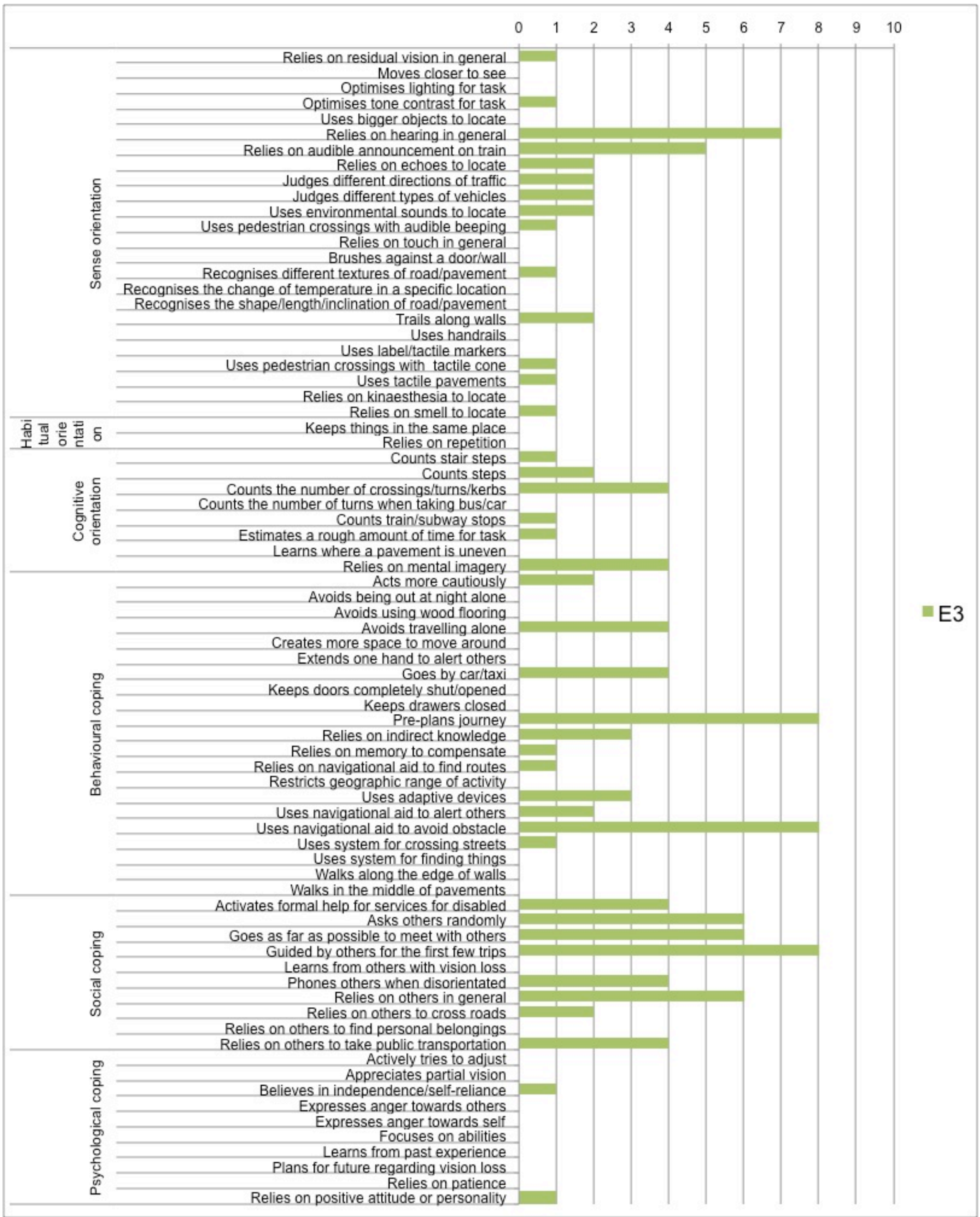


Figure 8. 7 VIP's NS in E3: the unfamiliar and unpredictable environments (a recoded and re-analysed version of Figure 6.2)

Even though some of the participants had a tendency to avoid unaccompanied journeys in Environment 3, a number of strategies were reported and are illustrated in Figure 8.7. There were eight of the participants who considered behavioural coping, by pre-planning journeys, as the most important strategy before travelling to unfamiliar and unpredictable environment. They tended to collect information such as timetables for trains or buses, the address of the destination, what was the best way to go, and if there would be someone to rendezvous with at a meeting point so that they could have a further understanding of where they were going and how to travel around Environment 3.

> “S2: …You need to know can I work it, can I get a train, can I get the underground, do I have to get a taxi, and then you work that out.” Interview 2 p.20

> “S11: I usually…I…if it was somewhere I wanted information I would find out about the buses, I would find, I would get, gather as much information as possible so I had the knowledge.” Interview 11 p.31

Social coping, through being guided by others for the first few trips, was the most frequently reported strategy for learning a new route.

> “S3: I would need somebody to take me around the Buchanan Galleries several times before I would be able to know the layout. Or I would have to come in the same entrance all the time to be able to know the layout.” Interview 3 p.16

> “S4: …the place that you never been before, I found the first thing you will do is get assistance, I’ll get somebody with you, so they can give you an idea. They will take you the first time, and you’ll see…there’s John

Lewis which is a big shop in the corner there and that's called John Lewis…" Interview 4 p.18

"S10: …If I'm walking a route and I want to learn it then I would normally use my cane and have someone behind me to show me once. Which is what my partner does. He shows me how to get somewhere by walking behind me and telling me where to go and then I would get a sense and then I would know." Interview 10 p.17

Four of the participants also presented NS in the social domain. They tended to phone others for help when they lost their way or when they did not know where they were going.

"S6: If I was really lost, I'll phone my husband to come and get me, or I'll get a taxi, I'll phone a taxi." Interview 6 p.22

"S7: …If I really get stuck, occasionally I'd alert mum and say "could you look up on the computer and find out where I am?" and then she would say "okay, did you cross two roads or three?" but if she isn't at home then that doesn't work." Interview 7 p.22

"S10: …I went to visit a friend in Edinburgh and she'd just moved but I phoned her and said "when I get off the bus will I be able to phone you and you can tell me which direction to go?" and she said "yes"… So I would phone her and then she could direct me over the phone… If somebody can't meet you then they can always direct." Interview 10 p.21

There were also participants who reported behavioural coping by making use of indirect knowledge to travel around Environment 3.

> “S6: I went to Partick Town Hall a few weeks ago, and I had no idea where to go, and I phoned my friend who lives in Partick and then said “how do I get there, I’m coming from Kelvinhall underground” and she said “you wouldn’t be coming from Kelvinhall underground, you’d go to Partick, and then you walk straight down to the kerb, turn left just a little bit, and you cross over the zebra crossing, and you turn right…” and I was like “okay okay, that’s fine”. So I did that I went to Partick station, I came out and I walked down and I crossed the road…” Interview 6 p.19

There was one of the participants described how she made use of behavioural coping, by relying on indirect knowledge and memory, together with cognitive orientation through counting the number of crossings to navigate around Environment 3.

> “S7: If I’m in a place I don’t know. If I have to go off to a conference or something, so hence I haven’t been there before, and I haven’t had a chance to ask somebody to take me there before, I’d look it up on the computer first, on a map, on Google Maps, and I…memorise the route, so I would know that and you would walk…okay, you don’t know how many paces but you know that, you then, you walk along the road, you have to cross two crossings you then turn right and then et cetera et cetera, and I do, I memorise that, I don’t know…maybe several times before I go, so then when I actually get there, I’ve got that picture in my

> mind of this map, it spoke on the computer, and I follow it that way." Interview 7 p.21-22

More than half of the participants also had a tendency to use NS in the social domain through asking others randomly during the journey when they need help.

> "S6: …I used three completely strangers to get from there to there, and then somebody else you know, and I did that all the way there." Interview 6 p.22

> "S9: It's very frightening if you come out at a wrong entrance, and you're an unfamil., it's quite frightening, but again I just ask." Interview 9 p.26

> "S10: The other day I had to walk to the St. Enoch centre. I know where that is but I had to walk in there to get my baby's milk and I didn't know where it was and I had to ask somebody how I get to Boots, and they took me. So I never really try to make an unfamiliar journey without asking somebody or without having some knowledge of the direction that I'm going in before I get there." Interview 10 p.20

Using adaptive devices such as the global positioning system (GPS) for behavioural coping was also reported by three of the participants, and this strategy also involved the use of their sense of hearing.

> "S4: …I will get a wee gadget, you clip it on there and it talks to you because soon you enter the bus station, it tells you "you're now entering

Buchanan Bus Station", or you can go to the café to your left, or you can go to the bus on your right, and things like that." Interview 4 p.14

"S2: …I got my GPS system, and I go "get me a route from Glasgow Central Station to Renfrew Street", and I put in the address, and I fold up, then I walk it offline…say, go from Glasgow Central Station, turn left, go up, Hope Street, turn left at Renfrew Street… You could speak to GPS, speak to it… So, all the GPS may tell me, they may say, your next junction on your left is Renfrew Street, ahuh, right, that's what I want, so you get to the down kerb, and you do the left turn, you turn left to meet Renfrew Street, then you're listening for the numbers…" Interview 2 p.19

"S10: If I am going to have an unfamiliar journey I would expect to have to ask people and if I think there's going to be nobody to ask then I would try and use a sat-nav." Interview 10 p.20

It can be seen in Figure 8.7 that most of the VIP participants demonstrated behavioural coping by using their navigational aid to avoid obstacle while moving around. There was one of the participants also described how she made use of the navigation aid when she lost her way.

"S7: …if I do get lost, and there isn't anybody around, I panic. You either have to try to retrace your steps, I'm with a (guide) dog, she would go back to where I started from and then you would need to start again…she can do an exactly and reverse. And then try and work out where I went wrong." Interview 7 p.22

In general, most of the participants used their sense of hearing while moving around in the unfamiliar and unpredictable environments; nevertheless, there were five of them who reported the use of audible announcement while taking trains. Two of the participants also tended to use echoes and environmental sounds to locate themselves.

> "S2: …So you'll listen to the sounds of traffic. You can hear, so you may use that information as well. Or you may say, turn left when you go on a bridge, you know when you under a bridge, you can hear the echo. Or you say, turn left and you'll get the bus stop, you may be walking along the bus shelter, and the echo may change, the sound may change "oh, there's a bus shelter there", the echo will change, then you turn left. So you're looking for all kinds of information all the time." Interview 2 p.21

8.4 Multi-variables in people

8.4.1 Variables in visual impairment

This section discusses the variables in VI – the severity of the impairment and how this influences their use of NS in each of the environments E1, E2 and E3. Figures 8.8, 8.9, 8.10 illustrate NSs used by the selected VIP participants in the three categorised environments. Eight of the participants were selected; among them, seven were registered as blind and one was registered as visually impaired. Those who indicated NSs which required the use of residual vision for helping navigation within the three categorised environments were classified into group 'V1' (subjects' ID: S3, S6, S9, S11) (see Table 5.1 for participants' profiles in Chapter 5). For example:

> "S3: …So I know the library is right to the very bottom and that is a huge, big building, so I can actually see the big mass of it." Interview 3 p.15

> "S11: If I'm out walking then I aim to go to the traffic lights and I have to train myself to wait and the green man flashing and that's very difficult, you have no idea how difficult that is if you've got a bit of sight and you're an active person, and you see that it's clear and, but you really have to train yourself to wait 'til the green man, when it's legally for you to cross the road." Interview 11 p.3-4

On the other hand, participants who demonstrated that they moved around within the three categorised environments without the use of vision or those who did not indicate NSs which required the use of residual vision, were categorised into group 'V2' (subjects' ID: S2, S5, S7, S10). For example:

> "S2: [Are you totally blind?] Yes, totally blind." Interview 2 p.1

> "S10: …Certainly in the daytime if it's too bright I can't really see anything, but I don't rely on my sight at all. I wouldn't rely on it for anything." Interview 10 p.2

Environment 1

Figure 8.8 illustrates the NSs that the two groups of the participants used in the intimate personal environments (i.e., E1).

Both of the two groups reported using sense orientation as a NS for navigating within Environment 1. All the participants in V1 group tended to rely on their residual vision in general. All of them indicated good lighting was helpful and half of them indicated the use of tone contrast for tasks at home. Most of the participants in group V1 also reported the use of touch. Three of them had a tendency to trail along walls with their hands to assist navigation, and they made use of a handrail when going up and down stairs. Using label or tactile marker for identifying things was reported by half of the participants in each group.

Although all the participants in group V2 demonstrated the use of their sense of touch in general, they did not appear to trail along walls with hands as V1 participants did. There was only one of them who tended to brush against a door or wall with their elbow quickly while moving around in Environment 1. In addition, half of them tended to locate themselves through listening to echoes.

Habitual orientation, through keepings things in the same place and relying on repetition, was demonstrated by all the participants in both groups. There were more participants in V1 who reported cognitive orientation by counting stairs steps to go up and downs stairs, whilst more participants in the group V2 reported cognitive orientation by relying on mental imagery.

In terms of NSs in the behavioural domain, all the participants in V1 indicated that they relied a lot on their memory to compensate for the loss of vision, and most of them also demonstrated creating more space to move around and the use of an adaptive device within Environment 1. Meanwhile, more than half of them also had a tendency to keep their doors completely shut or opened, and half of them tended to keep their drawers closed to prevent potential hazards (e.g., hitting their heads on the edge of door or drawer).

On the other hand, using a system for finding things was reported by half of the participants in each group. It appeared that participants in group V2 were less reliant on NSs in behavioural domain when compared to those who relied on residual vision. Similarly, participants in VI reported more psychological coping than those in group V2. The two groups were accordantly less reliant on social coping in the intimate personal environments.

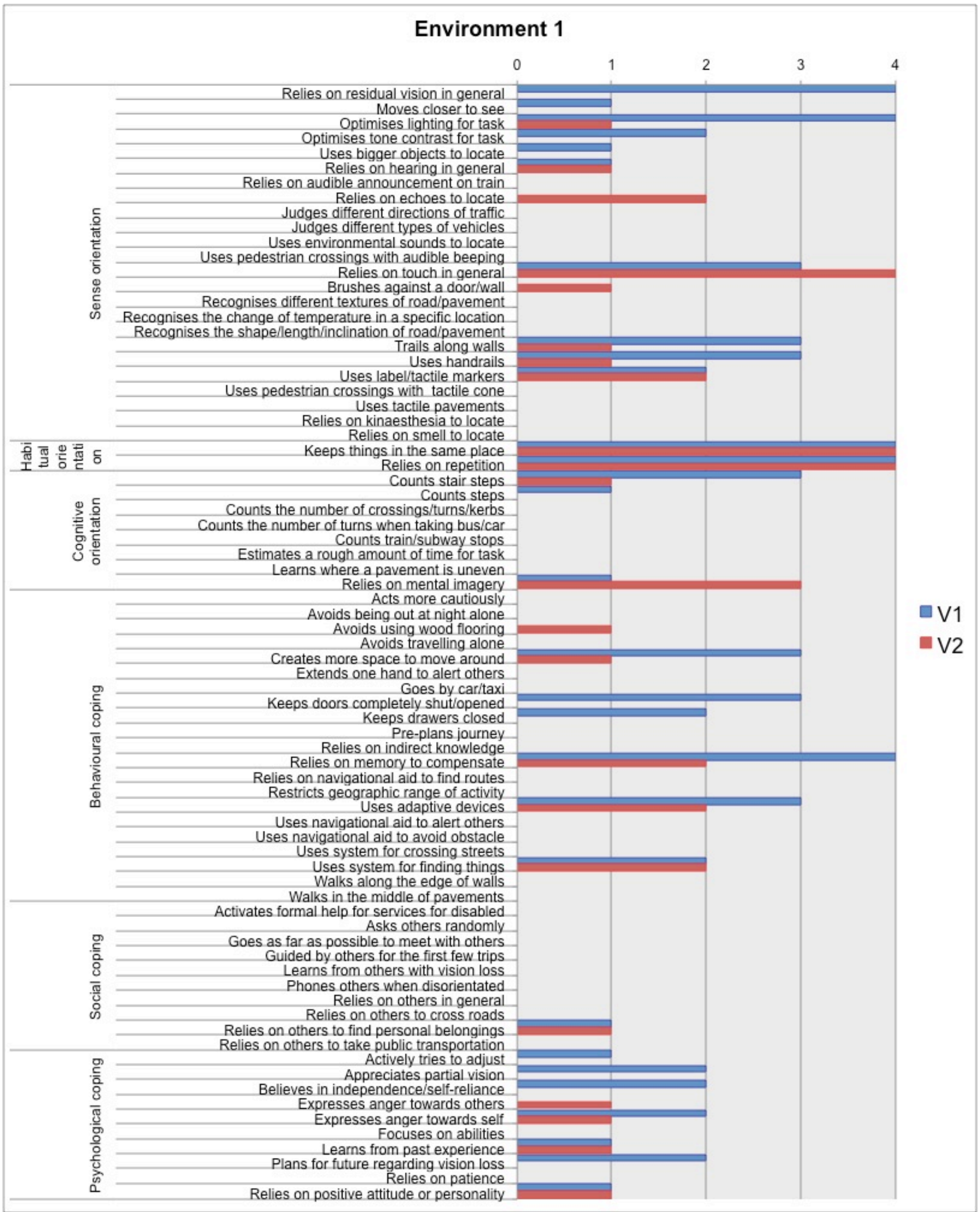


Figure 8. 8 The variables in VI – the severity of the impairment and influence on use of NS in Environment 1

Environment 2

When navigating around the more public but still familiar environments (i.e., E2) (Figure 8.9), participants in group V1 appeared to rely on their residual vision in general. Most of them made use of bigger objects to locate themselves, and half of them relied on tone contrast to help with their sense orientation. Half of the participants also revealed that an appropriate level of daylight was also helpful.

Although all the participants in the two groups reported the use of hearing while moving around within Environment 2, it appeared that the group V2 relied on their sense of hearing more than the participants in V1 did.

More than half of the participants in the V2 depended on audible announcements on train and made use of the audible beeping of a pedestrian crossing, whereas half of the participants in group V1 reported the use of these facilities.

Meanwhile, the participants in group V2 also had a tendency of being more sensitive to different kinds of environmental sounds. Almost all of them were able to judge different types of vehicles and different directions of traffic; three of them made use of environmental sounds for orientation; and half of the participants located themselves by echoes. Similarly, the participants in the group V2 relied on their sense of touch and sense of smell more than those in V1. None of participants in V1 reported using sense of smell to help orientation.

Habitual orientation, through relying on repetition, was indicated by all the participants in the two groups. In terms of cognitive orientation, most of the participants in group V1 demonstrated that they tended to estimate a rough amount of time for a task and to learn where a pavement was uneven. Half of participants tended to count stair steps, the number of crossings, turns, and/or kerbs, and to count train or subway stops, whereas there were fewer participants in V2 reporting strategies through counting stair steps and counting train or subway stops while moving around in E2 environments. Nevertheless, all of them navigated through counting the number of crossings, turns, and/or kerbs, and they also tended to estimate a rough amount of time for a task and learnt where a pavement was uneven while moving around. The greatest difference between the two groups was that all the participants in group V2 tended to rely on mental imagery to visualise their surroundings to help orientation whilst those in the group V1 did not.

In terms of behavioural NSs, restricting their geographic range of activity was demonstrated by all the participants in the two groups. Half of the participants in each group also reported that they tended to act more cautiously and relied a lot on their memory when they moved around within Environment 2. Most of the participants in group V1 relied on their navigational aids to avoid obstacle, and they tended to use navigational aids to alert others. In addition, more than half of them demonstrated that they always pre-planned their journeys before going out. Half of them also reported acting more cautiously, avoiding being out at night alone, relying on memory to compensate, and relying on a navigational aid to find their way as their behavioural coping. On the other hand, all the participants in the group V2 relied on navigational aids to avoid obstacles, and more than half of them tended to use navigational aids to find their routes.

Other behavioural coping reported by half of the participants in this group also included relying on a navigation aid to alert others, used a system for crossing streets, and walked along the edge of walls. The greatest difference between the two groups in behavioural coping was that participants in V2 group did not appear to pre-plan their journey before going out. NSs reported by the two groups in the social domain were significantly less different. All the participants in the two groups tended to rely on others to help them cross the road. Meanwhile, all the participants in V2 also demonstrated social NS by relying on others to help them take public transportation, which was more than those in V1.

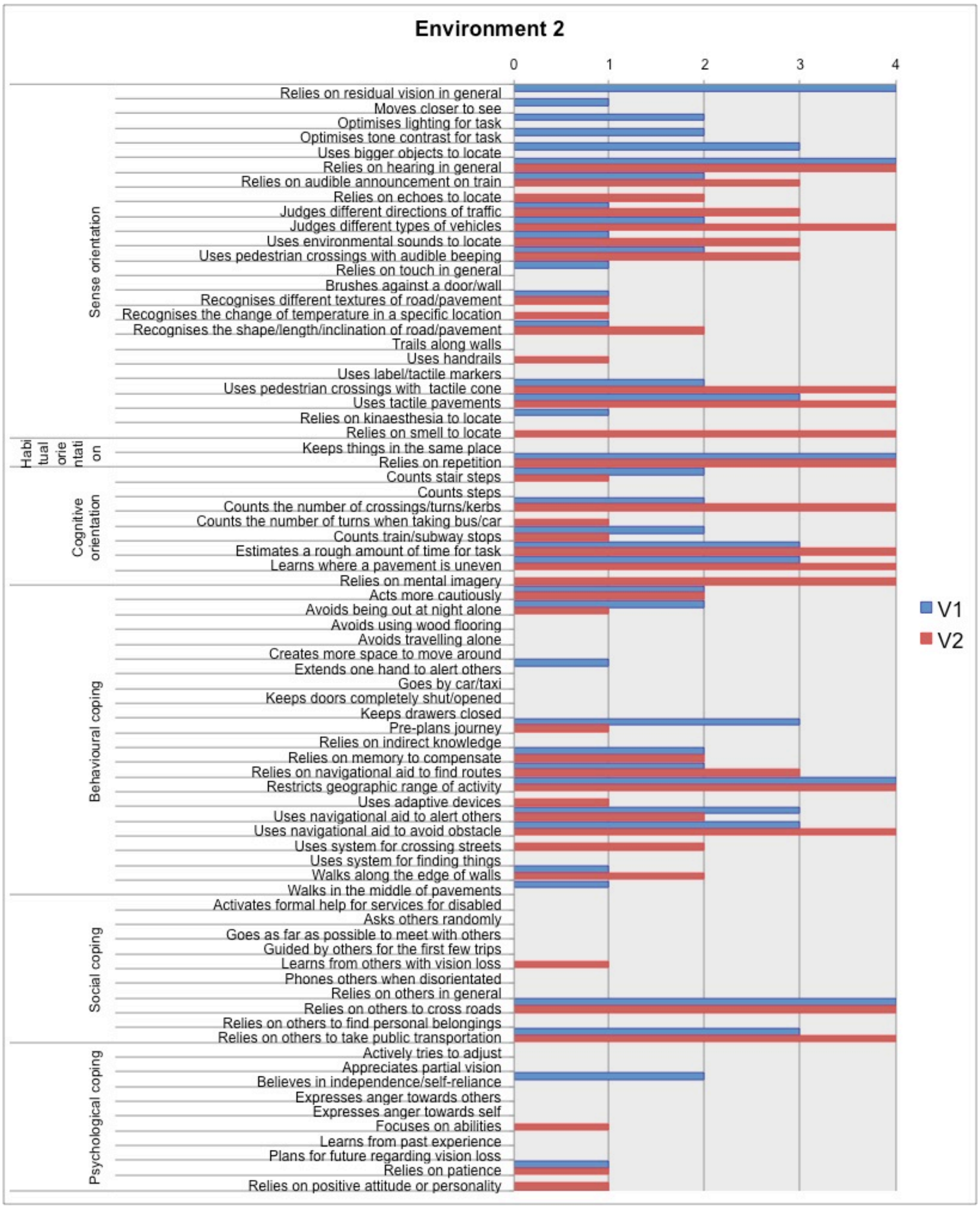


Figure 8. 9 The variables in VI – the severity of the impairment and influence on use of NS in Environment 2

Environment 3

Figure 8.10 described the NSs that the two groups of participants used when navigating in the unfamiliar and unpredictable environments (i.e., E3). Although the two groups both reported sense orientation while moving around within E3 environments, NSs which involved the use of different senses, demonstrated by the group V2 were considerably more than in the group V1.

Relying on hearing in general was the NS indicated by all the participants in V2, and it was also demonstrated by most of the participants in V1. Three of the participants in the group V2 and half of those in V1 relied on audible announcements on trains.

NSs reported by half of the participants in V2 included relying on echoes to locate, judging different directions of traffic, judging different types of vehicles, using environmental sounds to locate themselves, and using pedestrian crossings with audible beeping.

Most of the NSs reported by the two groups were focused on the use of the sense of hearing. Similarly, cognitive orientation was only reported by two of the participants in the group V1. Most of participants in the group V2 depended on counting the number of crossings, turns, and/or kerbs to help their orientation, and they tended to learn about E3 environments through relying on mental imagery. Counting steps was also reported by half of the participants in V2.

In terms of behavioural coping, both of the groups considered pre-planning their journey was an important strategy. There were more participants in the group V2 who relied on a navigation aid to avoid obstacles. Half of them also tended to travel by taxi, rely on indirect knowledge, and use adaptive devices.

There were more participants in the group V1 who tended to avoid travelling within Environment 3 alone. On the other hand, all the participants in VI reported using social NS by going as far as possible to meet others. Most of them also tended to rely on others in general, and half of them reported social coping by activating formal help for services for the disabled. When comparing this to those in the group V2, there were more participants who tended to ask others randomly and who were guided by others for the first few trip. Most of them also tended to phone others for help and rely on others to help them take public transportation when they travelled to Environment 3.

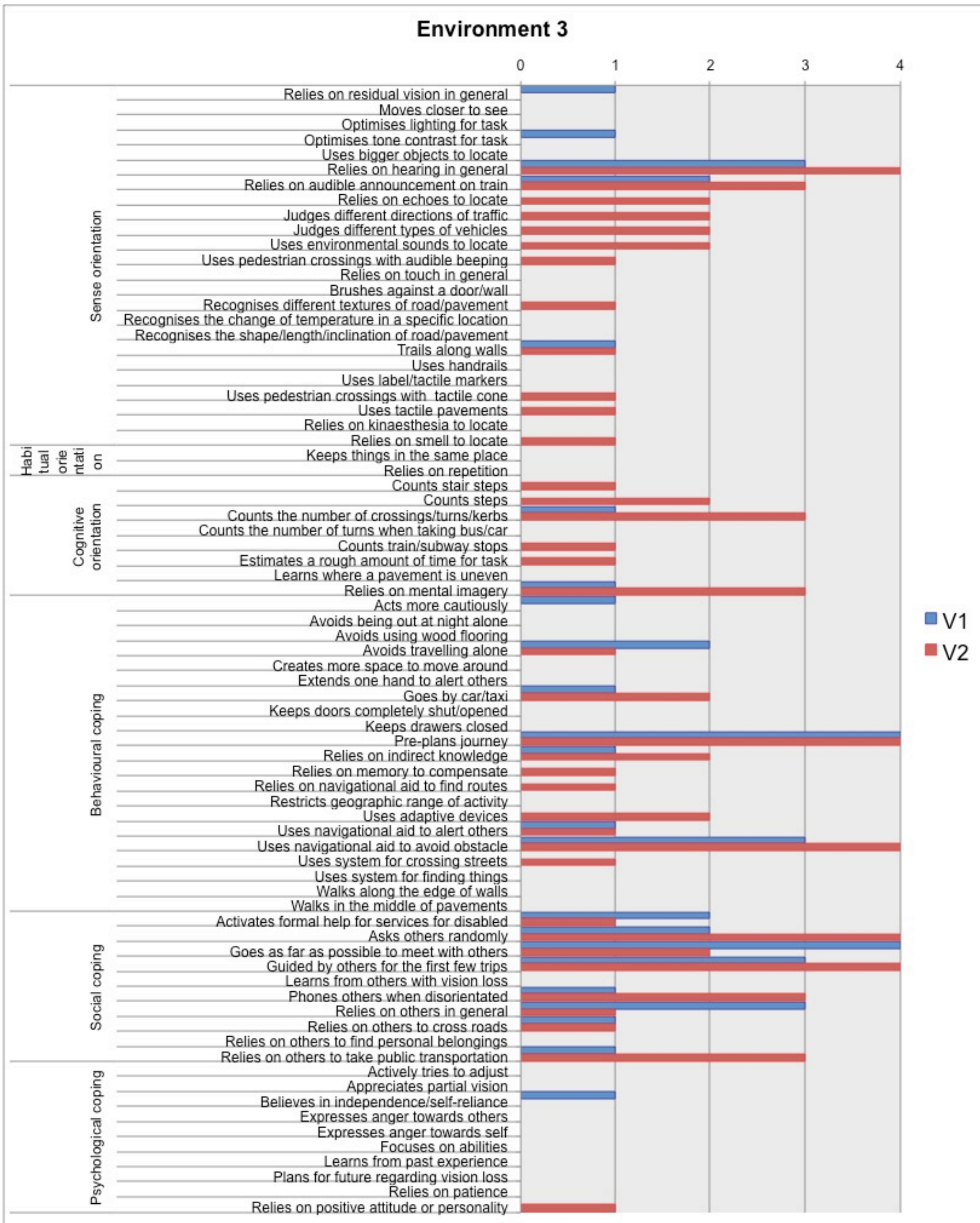


Figure 8. 10 The variables in VI – the severity of the impairment and influence on use of NS in Environment 3

8.4.2 Variables in navigational aids

8.4.2.1 The same navigational aid

This section discusses NSs used by individuals who used the same type of navigational aid.

There were six guide dog users in total (see Table 5.1 for participants' profiles in Chapter 5); among them, two participants (i.e., S2 and S7) had longer previous experiences of being long cane users. In order to investigate the correlation and differences, these two participants were separated from the others and were categorised into Group 2. The other guide dog users (i.e., S3, S4, S5 and S6) who had no or little previous experiences of using other types of navigational aid to move around independently were categorised into Group 1.

Environment 1

Figure 8.11 presents the NSs identified from the guide dog users when moving around E1 environments. It can be seen that all the guide dog users reported habitual orientation, through keeping things in the same place and relying on repetition, when moving within Environment 1. Most of them also tended to use their sense of touch in general. Sense orientation by optimising lighting for task was demonstrated by all the participants in Group 1. Most of them had a tendency of relying on residual vision in general and using a handrail to assist going up and down stairs. Participants in Group 2 reported NS by using labels and/or tactile markers through touch. They also relied on cognitive orientation, through relying on mental imagery, to assist orientation. Using a system for finding things was the behavioural coping demonstrated by Group 2.

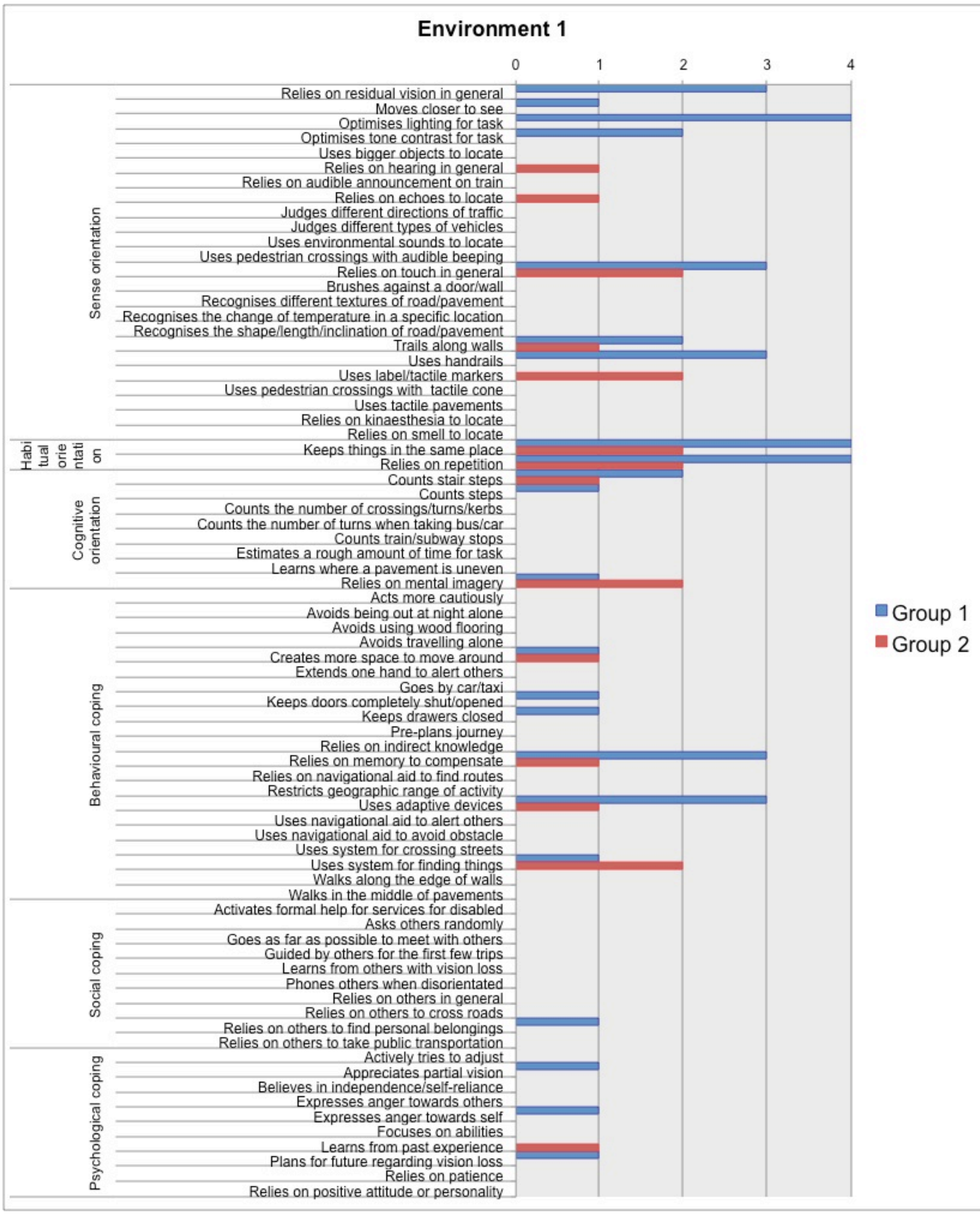


Figure 8. 11 NS used by Guide dog users in Environment 1

Environment 2

NSs identified from the six guide dog users when navigating in the more public but still familiar environments are illustrated in Figure 8.12. Sense orientation through relying on hearing in general was reported by all the guide dog users, and most of them also made use of audible announcements on trains. All of them also demonstrated NS by depending on pedestrian crossings with tactile cones. Through the use of the sense of touch, almost all the guide dog users believed that a tactile pavement was helpful. More than half of the participants in Group 1 tended to rely on their residual vision in general and use bigger objects to help locate themselves. Whereas participants in Group 2 appeared to rely heavily on their hearing, they also tended to use their sense of smell to help their orientation.

Habitual orientation, by relying on repetition, was demonstrated by all the guide dog users. They made use of cognitive orientation through counting the number of crossings, turns, and/or kerbs to help their navigation. Most of them tended to estimate a rough amount of time for a task and to learn where a pavement was uneven. When navigating within Environment 2, participants in Group 2 had a tendency of making use of cognitive orientation by relying on mental imagery.

NSs in the behavioural domain were more similar between the two groups. It was indicated by all the guide dog users that they relied a lot on their guide dogs to avoid obstacle and to find routes that they usually took. All of them inclined to restrict their geographic range of activity and depend on others to help them across roads. Meanwhile, most of the guide dog users also needed assistance to take public transportation.

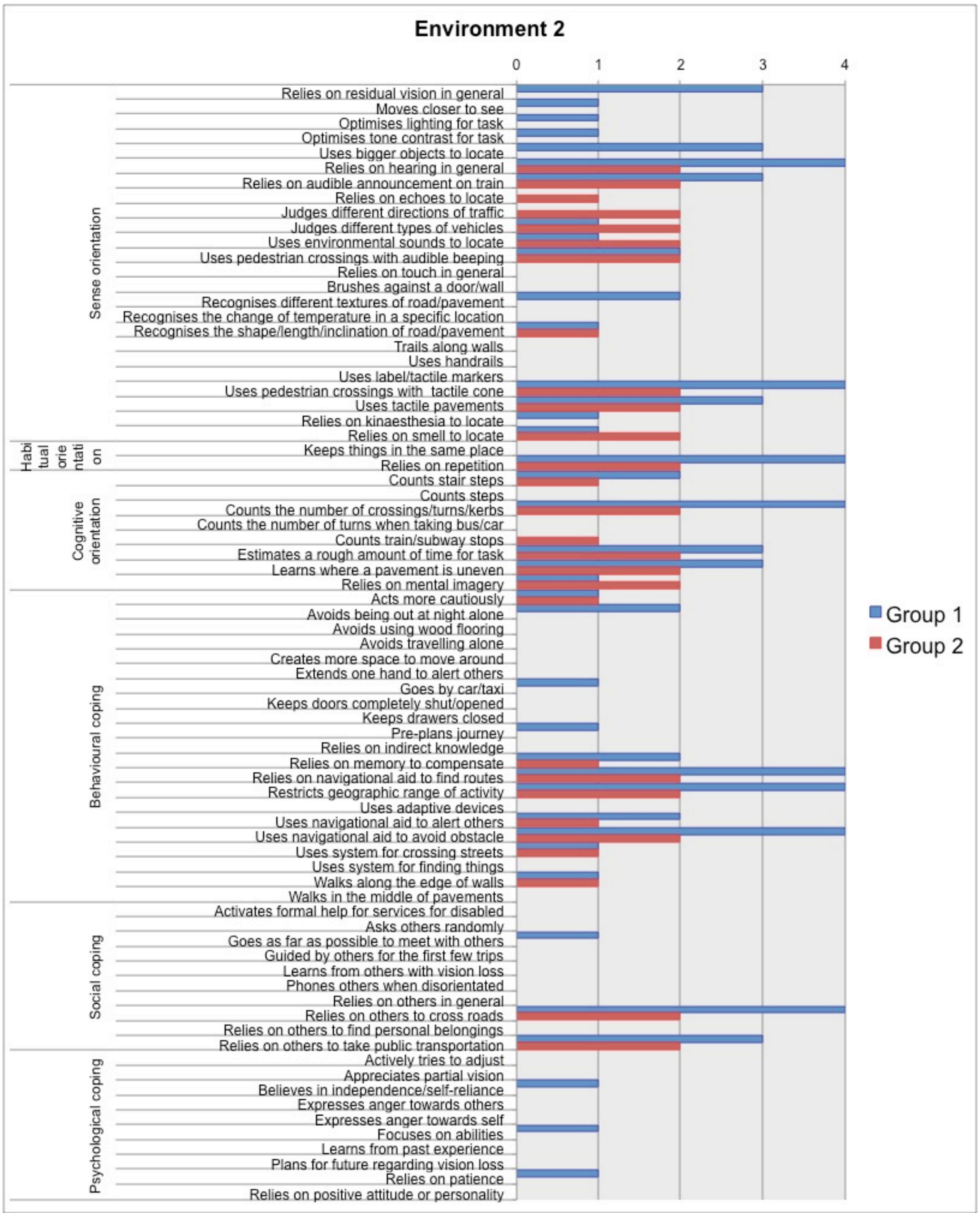


Figure 8. 12 NS used by Guide dog users in Environment 2

Environment 3

When travelling around the unfamiliar and unpredictable environments (Figure 8.13), most of the guide dog users reported the use of hearing in general.

Nevertheless, the participants in Group 2 appeared to rely on their sense of hearing more than those in Group 1 did. They also made use of cognitive orientation by counting the number of crossing, turns and/or kerbs, and relied on mental imagery to assist orientation. On the other hand, using their guide dog to avoid obstacle was the behavioural NS demonstrated by all the guide users. Most of them also revealed that pre-planning journey was important.

Participants in Group 2 appeared to rely on indirect knowledge more than those in Group 1, whereas there were more participants in Group 1 preferred to go by taxi or car when travelling to Environment 3. Being guided by others for the first few trips was the social coping demonstrated by all the guide dog users. Participants in Group 1 tended to rely on others for help in general and to activate formal help for services for disabled (i.e., guide dog training for a new route). Differently, Group 2 tended to use more social coping by asking others randomly, phoning others for help through their mobile, and relying on others to take public transportation during journeys in the unfamiliar and unpredictable environments.

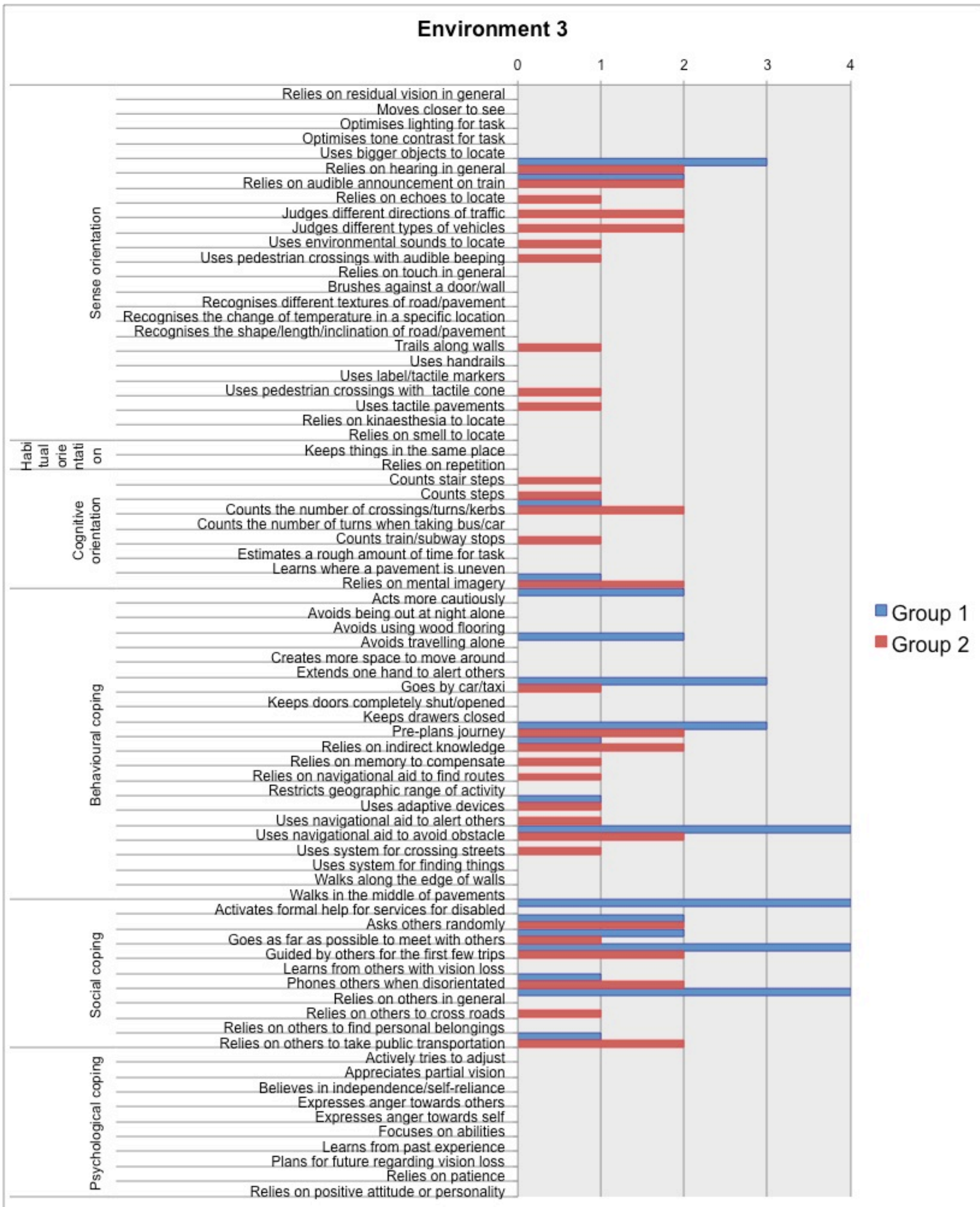


Figure 8. 13 NS used by Guide dog users in Environment 3

8.4.2.2 Different types of navigational aids

Although it is not possible to generalise from the single individuals in each of the three categories above, the purpose here is to illustrate that the data from a larger cohort of participants has the potential to be analysed by a number of variables. This section discusses NSs used by comparing groups of individuals who use different types of navigational aids. Three participants were selected: a guide dog user (i.e., S6); a long cane user (i.e., S9); a symbol cane user (i.e., S11) (see Table 5.1 for participants' profiles in Chapter 5).

The common ground of the three participants was that they were all reliant on their residual vision while navigating within the three categorised environments. In the same way, Table 8.21 illustrates NSs indicated by the three participants with their identification numbers, and the number before the identification numbers represented the amount of participants. NSs reported by all of them were coding in pink. In order to see the differences between the three participants, yellow was used to code NSs that were demonstrated by only one of them.

Table 8. 21 Different types of navigational aids

Different types of navigational aids				
		E 1	E 2	E 3
Sense Orientation	**Relies on residual vision in general**	(3) 6,9,11	(3) 6,9,11	(1)9
	Moves closer to see			
	Optimises lighting for task	(3) 6,9,11	(2) 6,11	
	Optimises tone contrast for task	(2) 6,11	(2) 9,11	(1) 11
	Uses bigger objects to locate	(1) 11	(2) 6,11	
	Relies on hearing in general	(1) 11	(3) 6,9,11	(2) 6,9
	Relies on audible announcement on train		(1) 9	(1) 9
	Relies on echoes to locate			
	Judges different directions of traffic		(1) 11	
	Judges different types of vehicles		(2) 9,11	
	Uses environmental sounds to locate			
	Uses pedestrian crossings with audible beeping		(1) 11	
	Relies on touch in general	(2) 6,11	(1) 11	
	Brushes against a door/wall			
	Recognises different textures of road/pavement			
	Recognises the change of temperature in a specific location			
	Recognises the shape/length/inclination of road/pavement		(1) 6	
	Trails along walls	(2) 6,11		(1) 9
	Uses handrails	(2) 9,11		
	Uses label/tactile markers	(2) 9,11		
	Uses pedestrian crossings with tactile cone		(1) 6	
	Uses tactile pavements		(2) 6,11	
	Relies on kinaesthesia to locate		(1) 6	
	Relies on smell to locate			
Habitual Orientation	Keeps things in the same place	(3) 6,9,11		
	Relies on repetition	(3) 6,9,11	(3) 6,9,11	
Cognitive Orientation	Counts stair steps	(2) 6,9	(1) 6	
	Counts steps	(1) 6		
	Counts the number of crossings/turns/kerbs		(1) 6	(1) 6
	Counts the number of turns when taking bus/car			
	Counts train/subway stops		(2) 9,11	
	Estimates a rough amount of time for task		(2) 6,9	
	Learns where a pavement is uneven		(2) 6,9	
	Relies on mental imagery	(1) 6		(1) 6
Behavioural Coping	Acts more cautiously		(2) 9,11	
	Avoids being out at night alone		(1) 9	
	Avoids using wood flooring			
	Avoids travelling alone			(1) 11
	Creates more space to move around	(3) 6,9,11		
	Extends one hand to alert others		(1) 11	
	Goes by car/taxi			(1) 6
	Keeps doors completely shut/opened	(3) 6,9,11		
	Keeps drawers closed	(2) 6,11		
	Pre-plans journey		(2) 9,11	(3) 6,9,11
	Relies on indirect knowledge			(1) 6
	Relies on memory to compensate	(3) 6,9,11	(1) 9	

	Relies on navigational aid to find routes		(1) 6	
	Restricts geographic range of activity		(3) 6,9,11	
	Uses adaptive devices	(2) 9,11		
	Uses navigational aid to alert others		(2) 9,11	(1) 9
	Uses navigational aid to avoid obstacle		(2) 6,11	(2) 6,11
	Uses system for crossing streets			
	Uses system for finding things	(1) 11		
	Walks along the edge of walls		(1) 11	
	Walks in the middle of the pavements		(1) 9	
Social Coping	Activates formal help for services for disabled			(1) 6
	Asks others randomly			(2) 6,9
	Goes as far as possible to meet with others			(3) 6,9,11
	Guided by others for the first few trips			(2) 6,9
	Learns from others with vision loss			
	Phones others when disorientated			(1) 6
	Relies on others in general			(2) 6,11
	Relies on others to cross roads		(3) 6,9,11	(1) 9
	Relies on others to find personal belongings	(1) 6		
	Relies on others to take public transportation		(3) 6,9,11	
Psychological Coping	Actively tries to adjust	(1) 11		
	Appreciates partial vision	(2) 6,11		
	Believes in independence/self-reliance	(2) 9,11	(1) 9	(1) 9
	Expresses anger towards others			
	Expresses anger towards self	(2) 6,9		
	Focuses on abilities			
	Learns from past experience	(1) 11		
	Plans for future regarding vision loss	(2) 6,11		
	Relies on patience		(1) 11	
	Relies on positive attitude or personality	(1) 11		

Environment 1

All the participants made use of residual vision in general and they optimised lighting for tasks in Environment 1. Habitual orientation was used through relying on repetition and keeping things in the same place. All of them tended to create more space to move around, keep doors completely shut or opened and relied on memory to compensate their impaired vision for behavioural coping. According to the analysis revealed in this figure, the guide dog user (S6) and the long cane user (S11) had a lot in common. Both of them made use of tone contrast for tasks and relied on touch in general. They also tended to trail along walls with their hands while moving around. Keeping drawers closed was the behavioural coping used by both of them. Meanwhile, they both reported psychological coping by appreciating partial vision and planning for future regarding vision loss. On the other hand, some of the same NSs were indicated by the symbol cane user (S9) and the long cane user (S11). Through sense of touch, both of them made use of label and/or tactile marker and relied on handrail to go up and down stairs. The symbol cane user (S9) and the long cane user (S11) demonstrated the use of adaptive devices for behavioural coping, and believed in independence or self/reliance for psychological coping. The guide dog user (S6) and the symbol cane user (S3) had less common in Environment 1. Cognitive orientation through counting stair steps was reported by both of them. They tended to use behavioural coping, by keeping furniture against the wall, to make more space to move around in Environment 1. Psychological coping, through expressing anger toward oneself, was also indicated by both of them.

On the other hand, the guide dog user (S6) tended to rely on cognitive orientation more than the others and was the only participant who reported social coping in Environment 1. The long cane user (S11) indicated many NSs that were different from others. The participant made use of bigger objects to help them to locate themselves and relied on hearing in general for sense orientation. Creating more space to move around and using system for finding things were behavioural NSs demonstrated by the long cane user (S11). The participants also tended to adjust to the loss of vision actively, learning from past experience, and relied on a positive attitude or their own personality for psychological coping.

Environment 2

There were some NSs reported by all the participants while navigating within Environment 2. All of them depended on their residual vision and sense of hearing in general. Habitual orientation, through relying on repetition, and behavioural NSs, through restricting geographic range of activity, were indicated by all three of them (i.e., S6, S9, S11). Meanwhile, they also tended to rely on others for crossing roads and taking public transportation as social coping.

The symbol cane user (S9) and the long cane user (S11) presented a lot in common. Both of them made use of tone contrast through the use of residual vision. Through the sense of hearing, they were able to judge different types of vehicles. When taking a train or subway, both of them used cognitive orientation by counting stops. Behavioural NSs were also demonstrated as they tended to pre-plan journeys before going out; meanwhile, they also acted more cautiously and used their navigational aids to alert others while moving around within Environment 2.

On the other hand, some NSs were indicated by both of the guide dog user (S6) and the long cane user (S11). Through the use of residual vision, they tended to look for bigger objects to assist orientation. Both of them revealed that appropriate levels of daylight and tactile pavements were helpful. Meanwhile, they also relied on behavioural coping through using their navigational aids to avoid obstacles. Cognitive orientation, through estimating a rough amount of time for task and learning where a pavement was uneven, was the only NS reported by both of the guide dog user (S6) and the symbol cane user (S9).

The guide dog user (S6) relied on his sense of touch more than others did, and the participant was also the only one who made use of kinaesthesia to help locate themselves. Cognitive orientation demonstrated by the guide dog user (S6) included counting stair steps and counting the number of crossings, turns, and kerbs. Meanwhile, the guide dog user (S6) also tended to use behavioural coping by relying on his guide dog to find routes. On the other hand, the symbol cane user (S9) made use of audible announcements on trains through the sense of hearing. The participant did not report any NS that required the use of sense of touch, smell, or kinaesthesia to help orientation. The participant tended to avoid going out at night alone and walking in the middle of pavements as behavioural coping. Believing in independence or self-reliance was the psychological NS reported by the symbol cane user (S9). The long cane user (S11) relied more on his sense of hearing than the others did. The participant also reported the use of touch in general. Behavioural NSs reported by the long cane user (S11) included extending one hand to alert others and walking along the edge of walls. The participant also relied on patience as a form of psychological coping.

Environment 3

NSs reported by the three participants in Environment 3 were less in common. Behavioural coping, by pre-planning journey, and social coping, by going as far as possible to meet others, were the only two NSs demonstrated by all three of them.

Both of the guide dog user (S6) and the symbol cane user (S9) relied on hearing in general. They also tended to ask others randomly and to be guided by others for the first few trips as social NSs when travelling in Environment 3. There were two

NSs used by both guide dog user (S6) and the long cane user (S11). Behavioural coping, by using navigational aid to avoid obstacle, was indicated by two of them. They also reported social coping by relying on others in general to travel within Environment 3. The symbol cane user (S9) and the long cane user (S11) did not report the same NS at all when navigating in Environment 3.

The guide dog user (S6) was the only participant who relied on cognitive orientation. The participant tended to rely on mental imagery and to count the number of crossings, turns, and/or kerbs. Behavioural coping, through going by taxi or car and relying on indirect knowledge, was demonstrated. The participant also activated formal help for services for disabled and phoned others for help when disorientated as social coping. On the other hand, the symbol cane user (S9) tended to rely on residual vision in general when travelling around Environment 3. Making use of audible announcements on trains through hearing and trailing along walls by touch were demonstrated by the symbol cane user (S9). The participant had a tendency of using his symbol cane to alert others as a form of behavioural coping. NS in social domain, by relying on others to cross the road, and psychological coping, by believing in independence or self-reliance, were demonstrated by the symbol cane user (S9). Although the long cane user (S11) indicated that an appropriate level of daylight was helpful for navigation, the participant tended to avoid travelling alone in Environment 3.

8.5 Further discussion of interviews with professionals

8.5.1 Professionals’ current approaches and practices

The semi-structured interviews were conducted with four practitioners (i.e., P1, P2, P4, and P5), two access consultants (i.e., AC3 and AC8), and two academic researchers (i.e., AR6, and AR7) (see Table 5.4 for Professionals’ profiles in Chapter 5.4.2)

The practitioner participants reported using many more primary research methods when compared to the access consultant and academic researcher participants, and it appeared that they mainly relied on primary research to approach design for VIP rather than secondary research (Figure 8.14).

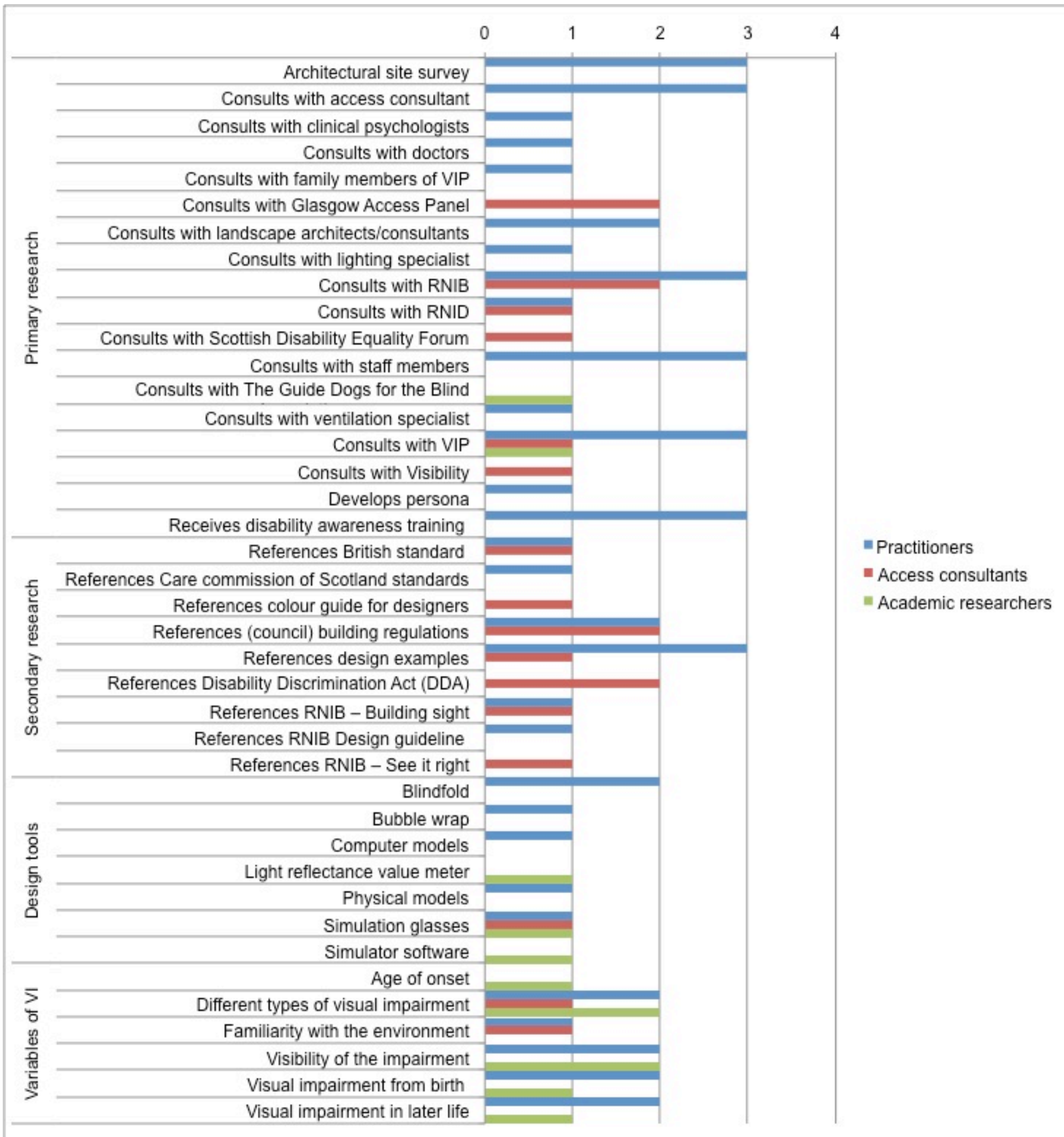


Figure 8. 14 Professionals' methods of research (a recoded and re-analysed version of Figure 5.2)

Access consultant participants possessed knowledge of different VI-related organisations and they tended to suggest that designers make contact with them for disability awareness training and visually impaired focus group recruiting if designers required. Whereas consulting with VIP was the only primary research reported by one of academic researcher participants (i.e., AR7).

In terms of the practitioner participants, it was demonstrated by three of them that they tended to develop design briefs through constantly consulting and communicating with their clients, which included staff members (i.e., staff members of the VI-related organisations) and those with VI as the building or product users. Through working with VIP over a long period, it was indicated that the staff members were much more experienced and were more aware of the nature of VIP than the practitioner participants; thus, it appeared that the staff members directed the design to a certain extent and the practitioner participants relied heavily on the information that was given.

> "P1: The client, Royal Blind, is supposed to work with people with visual impairments for a long time, and they are good clients as well who used to work with us. They had experience in working with the visual impairers so they had a lots pointers and tips for us. They were quite involved with the designs in terms of keeping us right and in terms of what is to avoid and what is to include." Interview 1 p.3

Three of the practitioner participants also indicated that they worked closely with VIP in order to have a better understanding of their needs.

> "P4: So we had a number of initial workshops with the staff just to get a handle on the brief and following that we had a number of workshops with the pupils to get what they felt they wanted in a residential block." Interview 4 p.1

“P5: Before we do the experience map we do a lot of customer research. We would send the products to a selection of 10 or 20 people in our target market and they would keep the product for two to four weeks and then we come back and interview them regarding their experience of the current product and how we can improve it…Our designers go out and get those insights through interviews.” Interview 5 p.2

Consulting with the Royal National Institute of Blind People (RNIB) was another means that the practitioner participants used to approach design for VIP. It was also demonstrated that access consultants were involved in the design team; nevertheless, three of the practitioner participants indicated that an access consultant was someone who acted as a ‘checking tool’ for ensuring the design of the building was accessible for disabled people in general rather than for VIP specifically.

“P1: To be honest I don’t think they were geared up to visual impairment. I don’t think it was one of their specialties. They had a general understanding, but I don’t think they added that much more to what the client had already advised us.” Interview 1, p.10

“P2: I think that access consultants basically, in a case like that, are just there to ensure that you haven't missed anything. So they're a follow-up, they're a checking tool.” Interview 2 p.9

“P4: To be honest it was more like they were performing a check on us to make sure everything complied with regulations. They weren't involved in any of the briefing workshops for example… Because the client runs a number of facilities, it was the client that took the lead on that.” Interview 4 p.10

An architectural site survey was reported by three of the practitioner participants. Among them, one of the practitioner participants not only visited the existing site but also reflected other designers' design concepts by visiting other buildings that were designed for VIP.

“P1: We had a tour around by their centre manager… We did speak to them. I think it was actually the head teacher at the time we spoke to at Hazelwood School, and they gave us some tips about issues they've encountered. Things to avoid and things that were working well for them, so that was quite useful.” Interview 1 p.6-7

Nevertheless, the practitioner participants did not appear to be aware of people who acquired VI at different age stages (i.e., from birth versus old age) and that they may have different needs and may develop different NSs.

On the other hand, most of the practitioner participants were advised to receive disability awareness training by their clients or RNIB. They used simulation aids such as blindfolds, bubble wrap, or VI simulation glasses to simulate VI and to experience different textures of surfaces with their feet or hands. Some of them also used these as a design tool to examine the visibility of the tone contrast within the built environment. The practitioner participants indicated it was helpful for them to have a better understanding of VI and to experience what VI was like, and one of them also tended to use simulation tools to examine the design during the final stage of the project.

> "P2: …In order to try and understand this whole idea about if you're partially sighted, what is it that you're actually seeing… Because there is a perception. We used colour only to different between, bright red in the younger school and a dark red in the senior school. So it went in the colour spectrum of red through the classrooms but it wasn't because the children could read that better. We found, when using the (simulation) glasses that children weren't particularly aware of strong colours. They were aware of tones of colours but not necessarily of colour and so it changed your perception." Interview 2 p.7

> "P4: My assistant went on a day course with the Royal Blind and the staff showed them what it would be like if they were visually impaired. They basically spent a day with a blindfold on picking up things like changes in level. What change on level does it have to be before it becomes a trip hazard for example; even surface materials… I think it was very helpful because unless you do have a visual impairment, you automatically take things for granted" Interview 4 p.5-6

> "P5: …We have goggles with different lenses that we can put into them to simulate different visual impairments… I think they're good and it gets designers thinking more. It makes it fun and it gives the designers more empathy because it's difficult to imagine what impairment is like, but more effective if they can experience what it's like… I think you get

> insights from speaking to people and that's where the ideas come from. They come from real user experiences of the product or service and then we use that to design will resolve that problem. We then use the toolkit to test whether the designs we come up with work." Interview 5 p.4-5

One of them also used computer and physical models as tools to communicate with and present design concepts to their clients. On the other hand, one of the access consultant participants also provided VI simulation glasses for designers for VI awareness training. One of the academic researcher participants indicated that the simulator software was helpful for raising the awareness and assisting people to have a better understanding of VI; whereas the simulation glasses were used to assess visual acuity contrast which helped designers to assess whether an actual object has enough contrast for people with VI.

Nevertheless, as demonstrated in Chapter 2, VI and VIP issues are complex, and it appears there are gaps in what is available for practitioners to approach designing for VIP. Another academic researcher (i.e., AR7) argued that simulation glasses were not suitable for assessing the contrast due to the fact that each VI person has a completely different set of vision problems: the light reflectance value meter was proposed for measuring the light reflectance off a surface, which would be more accurate for assessing the contrast and predicting visibility of objects for VIP. It was suggested that the simulation tools would not assist people to understand NSs used by VIP.

> "AR6: So even if your situation was absolutely perfect, it still wouldn't capture things like coping strategies, living with it on a everyday basis,

how the person learns to cope with different things. So that lot would never be simulated even if you had a completely perfect simulator.” Interview 6 p.6

In terms of secondary research, most of the participants indicated the insufficiency of current regulations and design guidelines in terms of designing for VIP, and that the needs from each client might be different. This implies the lack of useful research methods and data for practitioners approaching designing for VIP.

“P1: Obviously that sort of standard building regulations and always have to refer to the council regulations, but in terms of the specific regulations for the visually impaired, there wasn’t really…” Interview 1 p.7

“P2: …You could get design of a classroom for blind children, but you couldn't get it specifically related to the current building regulation in Scotland or the current thinking… The legislation and the governmental regulations relating to it are quite amorphous. There's a lot of medical textbooks on it but not in terms of how it relates to architecture.” Interview 2 p.5-6

“P4: The British Standard is just a generalisation. Something were finding more and more with projects is that we're designing things like accessible or disabled toilets to the British Standards, but clients are asking for oversized facilities because it depends on the type of disability a person has and the type of wheelchair.” Interview 4 p.4

"P5: It's difficult. Per product or per service it's very different. You can't have guidelines that give you a good toolkit for specifics. You have some basic guidelines which give you basic advice on font size for example but for more specific information I think you have to talk to the end user." Interview 5 p.6

There were five of the participants who recognised the variables of VI in terms of the types of the impairment.

"P1: …and it could vary across a whole range of different visual impairments." Interview 1 p.3

"P4: I think it's clearly dependent on the types of visually impairment they've got and you get the feeling that they can adapt to pretty much anything…." Interview 4 p.11

"AR7: …I haven't tested one visually impaired person that has the same visual impairments as another. Every single person has a completely different set of vision problems…" Interview 7 p.7

The variability in the visibility of the impairment was indicated by four of the participants.

"P5: You have different levels of visual impairment so it's hard to label them. They go from fully blind to just bad eye sight." Interview 5 p.8

> “AR6: What matters is what level of vision have they got and what level of vision do they need to do the task.” Interview 6 p.10

Nearly half of the participants distinguished people with VI from birth and with VI later in their life.

> “P2: …children who are born with sensory impairment and then there are the people who develop it later in life and that’s an interesting difference I think. The point being, how mature adults with sensory impairment navigate their environment is totally different from children.” Interview 2 p.10

> “P4: Most of them had issues with their eyesight from birth and a lot of them were getting progressively worse as they got older as it was congenitive. There was one guy that could see a little bit when we started the process, but by the time we’d finished the process he was completely blind” Interview 4 p.2

> “AR6: I think it would make more sense to take across different spectrums of severity of visual impairment. So rather than just talking about how visually impaired people do this thing, you’ve got to consider how people who are blind since birth do this thing, you’ve got how people whose vision has gotten progressively worse over the life course of their life do this thing, you’ve got people who are just starting to lose their vision. Then you have three completely different perspectives on those things.” Interview 6 p.11

8.5.2 Navigational strategy identified by professionals in more detailed

Through the description of how the designer participants think about how VIP navigate within the three categorised environments and/or the design solutions that they proposed for VIP, sense orientation was the most frequently reported NS by the participants (See Figure 8.15). Seven of the participants believed that optimising tone contrast was helpful to assist VIP to help themselves find their way better. Nevertheless, they exhibited different levels of understanding when they described the use of tone contrast for VIP. Among them, the two academic researcher participants (i.e., AR6 and AR7) and one of the practitioner participants (i.e., P2) indicated the importance of the use of tone contrast for VIP rather than colour contrast.

> "P2: Contrast and tone. Not colour contrast. Contrast between grey and black or a grey and a dark grey or a white and a black. So it was about tonality in contrast rather than about colour. So rather than having black and yellow or black and red it was black and grey. So it was totally different. So we chose to make them different more because it would identify different areas of the school for different people." Interview 2 p.13

> "AR7: It'd nothing to do with colour. Colour can be useful, but it's not useful at all for people with visual impairment. The thing that's mostly important is the tonal contrast." Interview 7 p.4

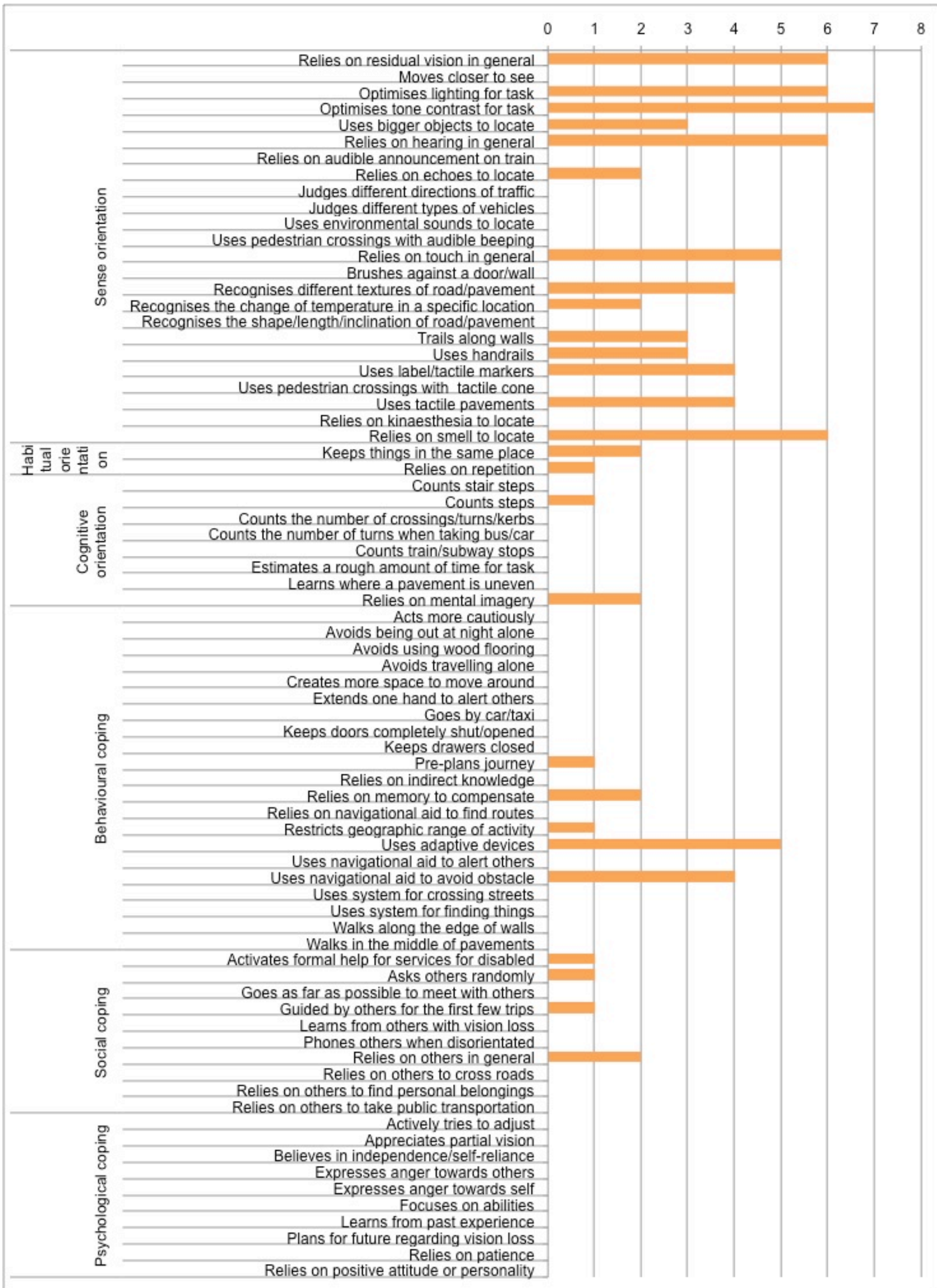


Figure 8. 15 NSs of VIP recognised by participants of professionals (a recoded and re-analysed version of Figure 5.3)

Whereas other participants did not appear to be aware of the differences between the two and use the term ‘colour contrast’ when describing this strategies.

> “P1: I think it’s just to see that when you don’t have that sharp focus to see down to two pieces of colours next to one of another.” Interview 1 p.3

> “P5: They have some basic guidelines concerning screen contrast, backlight color, graphic color and contrast. That's pretty much what we get from them and then everything else is down to speaking to people.” Interview 5 p.4

> “AC8: …You can use visual contrast and between the different floors, walls, to have visual contrast. You can use edges or you can even have like different colours edges…and streets I think it’s obviously already have…bubble pathways…the head of foot on the stairs…different colours…” Interview 8 p.10

Some of them also made use of different colours to signify different spaces; nevertheless, one of the practitioner participants revealed that VIP failed to remember the meanings of different colours.

> “P1: …In terms of signifying which space, we basically had different colours in each one of these cottages. We’ve got green here, blue here, or red at the end, but everybody forgets what the green room is… Basically we had set green for the gym and blue for the IT, but people

> aren't making that connection, so it's not working in that sense as well as it should've." Interview 1 p.4

In addition, the participant appeared to recognise that younger and older VIP might have different levels of capability in terms of memory.

> "P1: [So the colour coding worked better with younger VIP than those who were older?] I don't know actually. That's an interesting question which might be something to ask the client actually." Interview 1 p.5

Six of the participants indicated NSs through the use of residual vision in general. Meanwhile, optimising lighting for tasks was also demonstrated by six of the participants.

> "P4: They wanted it to be as light as possible, so we had floor to ceiling windows in all the bedrooms that we normally wouldn't have in residential properties." Interview 4 p.7

> "AC3: …And there are other British Standards on lighting as well because that's very important for visually impaired people – how to get the lighting right" Interview 3 p.18

> "AR6: …My focus is more around helping people with mild degrees of visual impairment navigate. For which you'd be looking at things like the visibility of the fire escapes and the extent to which the lighting and the contrast guides you towards fire escapes and that sort of thing…"

Interview 6 p.13

Using bigger objects to locate was indicated by half of the participants.

> "P1: I think, again, just the sort of big gestures at the openings just to highlight where the changes in direction are and the sort oversized slots to signify it."

> "AR6: …Comparatively something like an audio description or Braille or any of these other kind of things are very much more at the minority end. So we normally talk about setting a sensible target. You can always go with bigger… So if it's currently very small and you make it a little bit bigger, you'll get a lot more people back."

Six of the participants indicated that VIP relied a lot on their sense of hearing while navigating around; nevertheless, they appeared to just have a general idea and most of them did not specifically describe how VIP actually made use of sounds.

> "P2: …So we had perforated ceilings, we had insulated ceilings, we had no opening windows, we had no mechanical parts in the ventilation because that meant there was no hum coming from ventilation. So that if blind people were blind and navigating by hearing, then there was nothing interrupting their navigation." Interview 2 p.3

> "P4: There's the play garden at the front, a courtyard garden with a water feature and seat and there's a play garden that is a sensory garden… So

from a sound and smell point of view there's lots of stimulus for children." Interview 4 p.8

"AR6: …So someone who has been blind since birth has probably developed a fantastic sense of smell and hearing." Interview 6 p.11

When asking the participants to describe how did they think VIP found their way around, there were two of them who indicated the use of echoes. One of the academic researcher participants described how a blind person made use of echoes.

"AR7: Sound is used a lot. We had a woman who was totally blind and couldn't see anything. No light coming through a window at all. But if she went into a room, she could tell you how big the room was and how many people were in there by the way in which her voice spread around the space, reverberated or didn't. So she would know exactly what she was in, by sound." Interview 7 p.12

Another practitioner participant described the design of different ceiling heights and space sizes, which characterised the changes in acoustic quality within the building, which VIP used for echolocation.

"P1: One idea we tried to carry through was the fact that the acoustic quality change through the building because of the junction and you sort of see at this point of the roof is quite high up but over here is quite low. These spaces are quite different internally you see… Both the light and the sound as well…like you can add a response to this when you are in the space. It’s kind of hard to explain without actually being at the building. Like at the entrance here, floor to ceiling high is maybe only about 2.4 metres so you can feel that sort of sound by turning off the ceiling. I think you can sort of appreciate that’s a tighter space or a smaller space where further down this end of the building, the ceiling is about 4 metres high, so you can sense a somewhat more open space. I think that changes the acoustic feel… There are rooms in the workshop where the ceiling is high, and there's more space but sort of back product of that was that these spaces had a sort of different acoustic quality to them (VIP) and were quite different.” Interview 1 p.12

Nevertheless, through the description by the practitioner participant, it did not appear a full understanding of how echolocation actually worked with VIP.

Six of the participants indicated the use of smell and most of them added plants with different smells in the garden for VIP.

“P1: Basically down here, there’s an area that actually we were…as sort of the colour varied area for the members to plant and to do a bit of gardening. There’s a greenhouse here as well. Basically the idea was to plant the seeds…which was just a whole variant and sort of species across that different smells and things…they ended up planting lots of lavenders so that’s all you can smell.” Interview 1 p.11

"P2: We looked at a sensory garden so there was spices and herbs and lots of perfumed plants so they could experience olfactory senses." Interview 2 p.11

"AC3: …But obviously the main thing is having plants that smell, you can touch, like Lavender and things." Interview 3 p.17

"P4: The sensory garden had lots of smelly plants like lavender so the kids could feel them…" Interview 4 p.8

"AC8: …Sense of smell, and particularly an external environment you can use plants, and other different senses." Interview 8 p.10

However, the way that the participants made use of the sense of smell appeared to be more like a therapeutic function rather than a navigation function.

On the other hand, five of the participants indicated the use of touch in general.

"P1: I think a lot of touches obviously or your other senses are hidden or to have to be hidden. They have to use them so I think yeah touching and sound to certain extent as well." Interview 1 p.12

"P4: Touching, hearing, colors potentially, but again that depends on the level of impairment. Sound definitely and feeling, not just through their hands but also through their feet." Interview 4 p.14

Through the use of sense of touch, four of the participants indicated that making use of different textures of road/pavement was helpful for VIP to help locate themselves better.

> "P4: Like going from a smooth material to a more textured surface. If they were walking along, we had to change the surface texture again near the entrance so the kids would know they were at the entrance." Interview 4 p.6

> "P5: That, I imagine, is how someone who is blind would find their way around, by things they step on or things they touch." Interview 5 p.8

One of the academic researcher participants also described how VIP made use of their sense of touch and hearing to navigate around.

> "AR7: The most important thing for many of them is the quality of the surface they're walking on and the sound it makes. So if they're walking along a pathway and suddenly they hear the sound of gravel under foot, they know that they may have gone over the edge of the path, so it helps them walk straight because that can often be a problem." Interview 7 p.12

Half of the participants demonstrated the use of label and/or tactile markers and some of them also applied this concept to the design.

> "P1: Follows the full length of the north side of the building and each of these locations, there's a stud underneath the handrail to signify that

there’s a door to the left.” Interview 1 p.4

“P4: Things they can follow, plus identification marks outside rooms. So every bedroom was going to have a particular emblem on it so people knew whose room it was without having to read Braille with their fingers.” Interview 4 p.12

“P5: We notice that some visually impaired people actually stick stickers on to phones because the contrast on telephones isn't very high so they have to stick bright colored stickers on to indicate which key is which. So we thought instead of people doing that we could just put some identifiers on.” Interview 5 p.3

Half of them also believed that tactile pavements were helpful for VIP.

“AC3: The other thing they use of course is the bubble you see on pavements–tactile paving. That's something which has now come in a lot more than it used to be. The tactile paving you need to be able to actually feel with your feet. So that's another thing they will use.” Interview 3 p.19

“P5: …And also that there are tactile clues like the bumps on the pavement when you get to a road crossing.” Interview 5 p.8

Three of the practitioner participants reported trailing along walls with their hands or feet as one of the NSs used by VIP.

“P1: Again there's touch to locate themselves in the wall and touch their way around, trail them along, and they will get to the door. That’s when they know they are into the space, and I think the touch is sort of the key one for walking their way in the corridor.” Interview 1 p.14

“P2: In some instances it is that they would trail their arm along a wall. So we developed what we call the ‘Sensory Wall’ which had shapes on it and different surface textures and stuff like that. So it was almost like a memory board. So if they felt a certain pattern, like Braille almost, like a big huge Braille kit. If they felt a particular pattern they knew where they were in the school.” Interview 2 p.11-12

Two of the practitioner participants and one of the academic researcher participants revealed the importance of handrails for VIP.

“P1: I think the idea was that they use the handrail to sort of trail along… to locate themselves and find their way along…there’s touch to location themselves in the wall and touch their way around, trail them along and they will get to the door. That’s when they know they are into the space, and I think the touch is sort of the key one for walking their way in the corridor.” Interview 1 p.14

“AR7: What they do want is some very basic things, done well and simply. Things like handrails being visible, stair nosing on stairs. People have tremendous accidents on stairs. Falling over, tripping over, tripping up, tripping down. They always want a handrail. The moment there's any change in level from the ground, they need a hand rail." Interview 7 p.11

Recognising the change of temperature in a specific location was identified by two of the participants.

One of the practitioner participants explained the change of temperature not only assisted VI children to locate themselves but also provided a sense of joy through the sense of touch.

> "P2: …My point is that those children experience joy for example through feeling heat coming off a surface. One of the reasons that the current wall for example is clad in roofing slates is so that it warms up at a different rate to the timber. So a child walking by it gets two experiences. One, they can feel the heat on a summer's day emanating from the slate; and two, the lichen and texture of the slate is a reference point for them so they can touch it and know exactly where they are and know there's a covered wall that will take me round to the other side of the school." Interview 2 p.4

Behavioural NSs were reported less frequently by five of the participants. Five of the participants demonstrated the use of an adaptive devices such as a talking machine or GPS. Meanwhile, using a navigation aid to avoid obstacles was also indicated by half of the participants. Relying on memory to compensate for the loss of vision was a behavioural NS understood by both of the academic researcher participants.

“AR6: That would probably depend on how good your memory was. If your memory is brilliant you might navigate just by knowing where you last pit something. So if you wanted to know where the phone was, you would remember where you last put your phone, so that would help you. But if your memory was also problematic, then you might need a carer because you're not capable of doing it anymore. Interview 6 p.11

“AR7: No, just people with very low vision or totally blind and the moment that happens, it's very difficult to navigate in the outside world. So their own home, they would know really well as it's all in their memory so they can move around and operate quite happily in their own environment.” Interview 7 p.8

One of the access consultant participants identified behavioural coping by pre-planning a journey was important for VIP when travelling to an unfamiliar environment.

“AC3: New environments are particularly difficult. What some of them will do in advance is go onto the website if there is one, and try to get a map in advance.” Interview 3 p.20

Understanding of behavioural NS through restricting geographic range of activity was reported by one of the practitioner participants.

“P5: I guess if they're by themselves they could only go where they've been shown… If I was blind I would feel quite restricted as to where I

> could go. I know the shops, my friend’s house and maybe the park, but that's it and that's your world.” Interview 5 p.10

In terms of habitual orientation, the importance of keeping things in the same place was indicated by one of the access consultant participants and one of the practitioner participants.

> “AC3: They get to know where things are. The danger is when they've got visitors who move things. Their families will know very quickly. Please don't move the chairs, leave them where they should be. Where I know they are. The danger is when someone else moves something and they don't realise that.” Interview 3 p.19

> “P5: They might create a mental map of the environment in their head so it might be quite disturbing for them if you move furniture around. So I think it's important that things don't move.” Interview 5 p.8

One of the academic researcher participants also recognised the need for habitual orientation, by VIP relying on repetition.

> “AR7: Like one of my visually impaired volunteers, whenever she goes to a building that she has to repeatedly go to, she will spend a full day before she needs, to know about how to go around this building, just feeling her way around this building.” Interview 7 p.9

One of the practitioner participants and one of the academic researcher participants talked about how they think VIP use mental imagery.

> “P1: I think the key to this has been sort of clarity of circulation. Really just a simple circulation diagram and be able to form a mental picture of the space and being able to follow your way around easily and not having sort of complex maze or corridors things like that.” Interview 1 p.13

> “AR7: …She's literally mapping the 3D environment and once it's in her head, she knows the distances too. So she's developed this highly skilled way of putting maps of places into her head. So when she goes again it's like a satnav in her head and she knows exactly where to go to do things. So people develop the most amazing skills.” Interview 7 p.9

One of the access consultant participants also indicated cognitive orientation by counting steps.

> “AC3: I think in their own home most visually impaired people get to know the layout quite quickly and they know where the furniture is, how many steps it is from one room to the next.” Interview 3 p.19

On the other hand, one of the access consultant participants reported social NSs by activating formal help for services for disabled and asking others randomly. The participant also indicated that VIP tended to rely on others in general as social NS when they travelling to an unfamiliar environment.

> “AC3: I think some of them if they’re going to a new environment will ask for assistance will take a friend with them. Although that's not always possible and it shouldn't be necessary, but they will quite often. That would be a strategy to take a friend or a family member with them to a new place.” Interview 3 p.21

Whereas one of the academic researcher participants reported relying on others in general when asking to describe how VIP navigate around within a familiar environment such as a neighbourhood.

> “AR6: Off the top of my head, guide dogs and canes and assistance, people helping them walk around.” Interview 6 p.12

Guided by others for the first few trips was the social NS reported by one of the practitioner participants when asked to describe how VIP move around within their neighbourhood; in addition, the participant also believed that blind people tended to stay at home without going out.

> “P5: If they were going to the shop for example. They would probably use a walking stick and have to learn. They might have to be shown a few times and learn it that way. I imagine it's very difficult though, unless they're very confident, if they're blind they might stay in the house a lot.” Interview 5 p.9

8.6 Discussion of the data from the case studies

The previous sections above have discussed design practitioners' understanding of NSs that are used by VIP as revealed through the analysis of the interviews with them. This section intends to identify how existing design in research takes account of VIP's NS through the discussion and analysis of the four case studies that were selected from the current research and practice in the field of ID in section 4.3.2.2. Each of the case studies is reviewed, coded and then mapped onto the NS framework with the three categorised environments in order to distinguish the areas that are being covered.

8.6.1 Case study 1: Thomas Pocklington Trust – Lighting in the home

8.6.1.1 Research review and NS coding

<u>Percival and Hanson's research for Thomas Pocklington Trust</u>

Percival and Hanson's (2007) research, which was funded by the Housing Corporation and Thomas Pocklington Trust, stresses the lack of attention on people who have VI in the working age between 18 and 55, and addresses the issues of housing and support needs and priorities of VIP. According to Percival and Hanson (2007), four main issues of the housing requirements and preferences are recognised which include: i) space; ii) location; iii) safety and security; and iv) modifications and maintenance. It is demonstrated that VIP in working age actively deal with their domestic surroundings as any other occupants do. The difference may be that VIP usually need flexible and additional use of space to balance competing needs for entertainment, support, hobbies and assistive technology (E1: behavioural coping, creates more space to move around); meanwhile, the environment is expected to be free from impediments and hazards. Percival and Hanson (2007) stress four important issues for space requirements and preferences which are i) space for equipment and storage; ii) space to be free from harm; iii) garden space including guide dog needs; and iv) space to socialise as well as accommodate carers or guests. On the other hand, the position of housing is expected to be in proximity to amenities, people and transport links. Contrary, living in an isolated, out-of-the-way location may make VIP feel unhappy and the lack of connection with the outside world may make them feel bored and frustrated or ill. Through these points, people with sight loss are "strategically active" within the built environment of home and neighbourhood (Allen et al., 2002 cited in Percival and Hanson, 2007, p.64).

Improving outside lighting (E2: sense orientation, optimises lighting for task) can reinforce safety and security, especially for the orientation and safety (Hanson, 2005; Rees and Lewis, 2003 cited in Percival and Hanson, 2007, p.64), dependable door entry systems, community alarm systems, and robust front doors with adequate locks. According to Percival and Hanson (2007), such provision may provide VIP a greater sense of safety and security. Some other certain features for improving safety around the home are suggested such as brightly coloured plugs and variable textures on approaches from the road to the front door (E2: sense orientation, optimises tone contrast for task) (E2: sense orientation, recognises different textures of road/pavement).

According to Cooper, et al. (1995 cited in Percival and Hanson, 2007, p.64), modifications and maintenance may present challenges to those with VI and Allen, et al. (2002 cited in Percival and Hanson, 2007, p.64) suggest that this may be partly due to building regulations and guidelines do not accommodate issues of sensory accessibility sufficiently. Setting artificial light in appropriate positions may make up for poor levels of natural light, for example, in the kitchen or bathroom where with potential hazards (E1: sense orientation, optimises lighting for task). According to the participants, this kind of improvements for lighting, as well as making use of colour for maximising light and colour contrast, greatly advance their safety and enjoyment within home environment (E1: sense orientation, optimises tone contrast for task).

Housing for people with sight loss: A Thomas Pocklington Trust design guide

Thomas Pocklington Trust and Habinteg Housing Association (2008) introduced a new design guide which fully incorporates inclusive design principles throughout. The design guide is largely based on the research projects commissioned by Pocklington which mainly focus on the needs, experiences, expectations and choices for VIP within their housing environment. The design guide is developed to provide advice and guidance for architects, designers, builders and others who are involved in building and developing inclusive domestic environments paying attention to the needs of VIP.

A background to sight loss is provided within the design guide and the prevalence of VI which is increasing with age in the UK is discussed. An overview of the five most common eye conditions are also provided which including: macular degeneration (MD), cataract, glaucoma, retinitis pigmentosa, and diabetic retinopathy. The design guide stresses that only few people who are VI are classified as being totally blind and most of them have residual vision; therefore, proper design could be helpful for maximising their functional vision (E1/E2: sense orientation, relies on residual vision in general).

On the other hand, thirteen general design principles are proposed which include: i) inclusivity; ii) site location; iii) site layout; iv) mix and form of dwellings; v) space standards; vi) simplicity; vii) consistency; viii) preventing barriers and trip hazards; ix) providing contrasts; x) textures and finishes; xi) wayfinding assistance; xii) lighting; and xiii) security. These design principles place emphases on maximising functional vision and minimising barriers and risk when designing housing environment. Following these design recommendations can not only improve the visual environment in home for everyone but also be of special benefit to people with VI (E1/E2: sense orientation, relies on residual vision in general).

<u>Housing design for better sight: solutions for living with sight loss</u>

Research funded by Thomas Pocklington Trust (Slater, 2008) provides a further discussion of the thirteen design principles and focuses on lighting design in order to improve the housing environment for VIP (E1/E2, sense orientation, optimises lighting for task). It is indicated that most of the existing housing is problematic and failed to accommodate the needs of people with sight loss. Although there is no ‘one size fits all’ approach to provide suitable accommodation for VIP, a well-considered design may not only address many basic problems of living with impaired vision but also enhance their independence and quality of life. Slater (2008) indicates the government guidelines for Lifetime Homes have concentrated on people with physical disabilities (e.g., wheelchair users) but largely neglected those with sensory disabilities (e.g., VIP).

People with different types and levels of VI may need different levels of lighting (E1/E2: sense orientation, optimises lighting for task). Some may prefer brighter light whilst some may be sensitive to light and even modest levels can be painful. Meanwhile, the levels of lighting is critical according to the types of tasks such as go up and down stairs, prepare food, deal with paper work and choose appropriate clothes to wear. Therefore, the flexibility of lighting is significant and is stressed as one of the main principles in the Design Guide (Slater, 2008). According to Slater (2008, p.10), lighting should consider: i) shield users from glare; ii) avoid potential hazards; iii) provide even levels of light across a room; iv) put light into dark places; v) be flexible; and vi) improve vision (E1/E2: sense orientation, relies on residual vision in general).

The research is also based on the inclusive design principle that “the developments which are designed to meet the needs of all occupants regardless of age, gender or disability” (Slater, 2008, p.11). The flexibility of lighting described above is one of the fundamental principles and all the thirteen design principles are covering internal and external environment of housing areas which can be discussed as follows.

Space standards are significant for the internal housing environment due to the capacity of accommodating friends or family as guests in home is indicated to be beneficial for improving the feelings of inclusion and well-being (E1: behavioural coping, creates more space to move around). Simplicity and consistency throughout the house are stressed as important principles for assisting VIP to locate and operate the basics, for example, always setting hot taps on the same side and locating light-switches and electrical points at a standard height (E1: habitual orientation, keeps things in the same place). In order to prevent barriers and trip hazards, it is suggested to avoid using carpets with strong weaves or pile, and bathrooms are suggested with non-slip flooring and transitions of flooring between rooms and smooth and flush are also important (E1: sense orientation, recognises different textures of road/pavement). On the other hand, providing contrasts in colour or brightness are helpful for locating objects (E1: sense orientation, optimises lighting for task, optimises tone contrast for task). Textures and finishes can also give tactile clues (e.g., operating taps and heating controls) (E1: sense orientation, relies on touch in general); however, it is stressed that shiny walls and surfaces should be avoided in order to diminish glare for VIP (Slater, 2008).

In terms of external housing environment, people with sight loss may rely on mental mapping to distinguish where they are and find their ways through environmental clues (E2: cognitive orientation, relies on mental imagery); therefore, location and site layout and the mix and form of dwellings are especially important. These factors affect their independence directly. Slater (2008) indicates that the flexibility of lighting is particularly important due to people with different types of visual conditions may need different levels of illumination (E1/E2: sense orientation, optimises lighting for task). The six principles of lighting are provided which including: shield users from glare, avoid potential hazards, provide even levels of light, put light into dark places, be flexible and improve vision.

8.6.1.2 Where and how Thomas Pocklington Trust’s work maps onto my own work

According to the Case study 1, NS being recognised and addressed through research at the Thomas Pocklington Trust are showed in Figure 8.16. Most of the NSs identified from the Case study 1 are within the categorisation of sense orientation. None of the NS is distinguished for VIP navigating within the unfamiliar and unpredictable environment (i.e., E3).

In the intimate personal environments (i.e., E1) and the more public but still familiar environments (i.e., E2), navigation through the use of residual vision in general is indicated.

> “The design guide stresses that only few people who are VI are classified as being totally blind and most of them have residual vision; therefore, proper design could be helpful for maximising their functional vision”. (Case study 1, p.285)

> “These design principles place emphases on maximising functional vision and minimising barriers and risk when designing housing environment”. (Case study 1, p.285)

Sense orientation through optimising lighting for task is emphasised as an important strategy for VIP navigating within E1 and E2.

> “Setting artificial light in appropriate positions may make up for poor levels of natural light, for example, in the kitchen or bathroom where with potential hazards”. (Case study 1, p.284)

> “The flexibility of lighting is particularly important due to people with different types of visual conditions may need different levels of illumination”. (Case study 1, p.287)

Optimising tone contrast for task is suggested for sense orientation in the intimate personal environment and the more public but still familiar environment.

> “Some other certain features for improving safety around the home are suggested such as brightly coloured plugs…”. (Case study 1, p.283)

> “Providing contrasts in colour or brightness are helpful for locating objects”. (Case study 1, p.287)

Sense orientation by recognising different textures of road is also suggested within E1 and E2.

> “Bathrooms are suggested with non-slip flooring and transitions of flooring between rooms and smooth and flush are also important”. (Case study 1, p.287)

> “Some other certain features for improving safety around the home are suggested such as bright coloured plugs and variable textures on

> approaches from the road to the front door". (Case study 1, p.283)

Sense orientation by relying on touch in general is demonstrated as one of the strategies for VIP navigating within the intimate personal environment.

> "Textures and finishes can also give tactile clues (e.g., operating taps and heating controls)". (Case study 1, p.287)

The consistency of the home environments is identified in Case study 1 and is mapped onto habitual orientation, through keeping things in the same place for habitual orientation within E1.

> "Simplicity and consistency throughout the house are stressed as important principles for assisting VIP to locate and operate the basics, for example, always setting hot taps on the same side and locating light-switches and electrical points at a standard height". (Case study 1, p.287)

Creating more space to move around within the intimate personal environment is the only behavioural coping identified from Case study 1.

> "Space standards are significant for the internal housing environment due to the capacity of accommodating friends or family as guests in the home is indicated to be beneficial for improving the feelings of inclusion and well-being". (Case study 1, p.286)

Relying on mental imagery for cognitive orientation within the more public but still familiar environment is indentified.

> “In terms of external housing environment, people with sight loss may rely on mental mapping to distinguish where they are and find their ways through environmental clues”. (Case study 1, p.287)

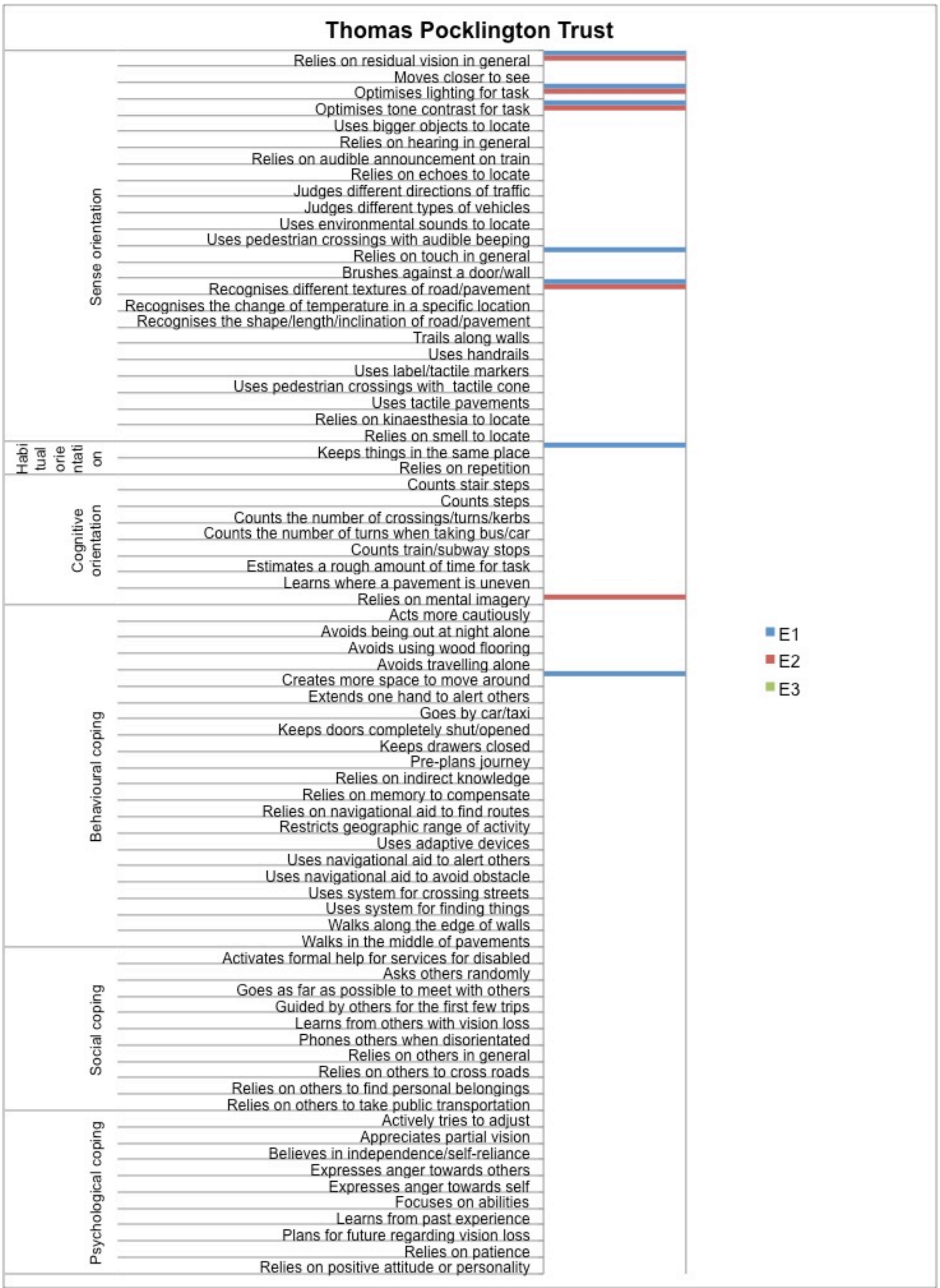


Figure 8. 16 NS being recognised and addressed through research at the Thomas Pocklington Trust

8.6.2 Case study 2: Hilary Dalke – Lighting and colour design in public spaces

8.6.2.1 Research review and NS coding

Dalke, et al. (2010) also introduces five key factors which affect visual acuity for assessing the visibility of designs in a real world context are as a) colour contrast (E1/E2/E3: sense orientation, optimises tone contrast for task); b) lighting (E1/E2/E3: sense orientation, optimises lighting for task); c) visual ability of the target group (E1/E2/E3: sense orientation, relies on residual vision in general); d) the dimension of the object text or element (E1/E2/E3: sense orientation, uses bigger objects to locate); e) and its distance from the observer (E1/E2/E3: sense orientation, moves closer to see).

Between 2001 and 2003, Dalke, et al. (2004) conducted the EPSRC/ DfT LINK funded project, "Inclusive Transport Environments: Colour Design, Lighting and Visual Impairment", which address issues regarding future multi-modal public transport environments for VIP and elderly users. Dalke, et al. (2004) indicate that there are merely 6% of people who are registered visually impaired are totally blind, in other words, most of VIP still have residual vision so that "colour, contrast and lighting can empower and make visible an otherwise incomprehensible environment" (E1/E2/E3: sense orientation, relies on residual vision in general, optimises lighting for task, optimises tone contrast for task). In terms of mobility, it is believed that visual field, colour and contrast sensitivity are more important than visual acuity. Through inclusive design, people with low residual vision can be empowered even just by improving the chance of light perception (Dalke, et al., 2004). However, within architectural design, there is a tendency of using specific materials either for the robustness or for the aesthetic appeal which is influential on the accessibility of transport environments. For example, the massive use of “monochromatic colour schemes and large reflective surfaces, such as glass and steel” are problems that have identified for those who are visually impaired, indicated by Dalke, et al. (2004).

Dalke, et al. (2004) state seven key factors for the successful visibility of objects are as:

1. Distance – Between an inter-model ‘decision point to object’ on wayfinding route were important, combined with high Lux Levels.
2. Overall Size – Dimensions are obviously critical to a sign or object being noticed before being approached to be ‘read’. It was found that in many case signs were never actually expected to be ‘read’ (E2/E3: sense orientation, relies on bigger objects to locate, moves closer to see).
3. Repetition – Infrastructure details such as columns, tiled surfaces and patterns were revealed as being of great use to visually impaired people if repeated through a site (E2/E3: habitual orientation, relies on repetition).
4. Movement – Most backlit and moving signage scored highly with the visually impaired people. One exception was ‘Countdown’ displays, which were not liked at all due to the inability to scan text at speed (E2/E3: sense orientation, relies on residual vision in general).
5. Colour Design – Colour space polar opposites, such as Red & Green or Blue & Yellow, when used together were very good at attracting attention even if not enough contrast was evident (E2/E3: sense orientation,

optimises tone contrast).

6. Diagonal Lines – Diagonal reflections on steel handrails in an otherwise vertical and horizontal world were seen to be useful.
7. Consistency – Certainly on of the most important aspects of the environment is the consistency with which any feature is presented to the public. Visually impaired people report confusion when information is not where expected (E2/E3: habitual orientation, keeps things in the same place).

When navigating around and distinguishing features of an environment within a building, there are only a few people who look further ahead than two metres (K. Bright, et al., 1997 cited in Dalke, et al., 2004). Colour coding is believed to be important for people who are visually impaired due to most of them tending to “undertake scanning to identify, primarily, colour and luminance contrast difference between features”, stated by Dalke, et al. (2004) (E2/E3: sense orientation, optimises tone contrast and optimises lighting for task); meanwhile, it is recognised that many VIP find it difficult to deal with monochromaticity, and the floor finishes are suggested to be light matt so that people who are using the space can see the contrast between their feet and floor clearly (E2/E3: sense orientation, optimises tone contrast for task). Moreover, staff uniforms within the multi-modal public transport environments should be clear and recognisable, and the colours are suggested to be juxtaposed, such as red-blue against yellow (Dalke, et al., 2004) (E2/E3: sense orientation, optimises tone contrast for task). It is found that signage which is backlit is useful for people with visual impairment, and signage within transport environments is proposed to be matt in order to avoid glare from reflections. Meanwhile, positioning signage at an appropriate visual angle is significant for wayfinding; rather than vertical visual angle, placing signage at an appropriate horizontal visual angle is more effective to provide optimum recognition (Dalke, et al., 2004).

According to Dalke, et al. (2004), it is useful to utilise lighting to draw people's attention to central areas (e.g., concourse information points); nevertheless, the result of surrounding lighting such as glare and shadowing should be avoided since it may result in people who are visually impaired having a sense of fear of darkness. "Seeing the signs in the first place, is the most important task of good lighting", addressed by Dalke, et al. (2004) (E2/E3: sense orientation, optimises lighting for task). There is also a need to be aware of diffused lighting due to it softening shadows which can lead to a consequence of mistaking steps or changes in level. Meanwhile, all coloured light sources and bright daylight are recognised as problematic for people who are visually impaired. Many VIP find it difficult to access ticket booths or machines when getting travel information or ticket due to their variations in lighting; good transition lighting is essential because it is painful for some types of VI going from bright to dimly lit areas, it is recognised as further disabling, indicated by Dalke, et al. (2004) (E2/E3: sense orientation, optimises lighting for task).

On the other hand, according to the research into the use of colour design and lighting in hospital, Dalke, et al. (2006) propose useful principles in an aspect of colour design in order to enhance the visual environment for patients, staff and visitors within the hospital environment. "Colour and appropriate lighting are powerful tools for coding, navigation and wayfinding; colour can also promote a sense of well-being and independence", stated by Dalke, et al. (2006, p.344). The quality of visual environment, including daylight and electric light, is influential which can not only affect hospital staff's moral but also their productivity. It is also recognised that a well improved visual environment such as "the use of appropriate colour in interior design, display of certain types of art work and the provision of sunlight and attractive views out", can boost the recovery rates by as much as 10% (Ulrich, 1984 cited in Dalke, et al., 2006, p.344) (E2/E3: sense orientation, optimises tone contrast and optimises lighting for task).

Dalke, et al. (2006) conducted the research in 20 hospitals intending to develop NHS principles for designing attractive visual environments through establishing appropriate colour specifications and meeting issues such as accessibility and navigation. It is recognised that the application of colour and lighting are especially significant for those who are older or visually impaired due to their needing clear cues and they may also need longer time to comprehend visual information around them; therefore, signposting should be as clear as possible to assist this group of people to have more confidence to use the environments (Dalke, et al., 2006) (E2/E3; sense orientation, relies on residual vision in general). Although colour strategies are helpful for defining the architectural environment, lighting also plays as an important role to enhance and affect the colour of materials. For example, the installation of colour glass designs in panels or windows in entrances, waiting areas or corridors not only gives people a good visual interest during daylight and a welcome distraction, but also provides good tactial assistance for orientation and wayfinding (Dalke, et al., 2006) (E2/E3: sense orientation, optimises tone contrast and optimises lighting for task).

On the other hand, colour and coding should be apparent and effortless for all visitors to understand and use in any situation; nevertheless, it is identified that many colour coding schemes fail to be recognised by hospital visitors, indicated by Dalke, et al. (2006) (E2/E3: sense orientation, optimises tone contrast for task). “Colour requires knowledgeable implementation and should be used for simple zoning of no more than four spaces of a building (e.g., quadrants)”, stated by Dalke, et al. (2006, p.349). It is also found that using colour coding as wayfinding boundaries on the floor is not only helpful for those who are older or visually impaired but also beneficial for preventing wall damage by alerting hospital porters steering trolleys with a distance from walls; colour coding should avoid using colours that are confusing (e.g., turquoise), in other words, colours that are unique in their descriptive words such as red, yellow, blue and green are recommended (Dalke, et al., 2006).

According to Dalke, et al. (2006), applying colour design in the built environment is beneficial for people with VI and contrast can provide accessible cues which can maximise the use of their residual vision (E2/E3: sense orientation, optimises tone contrast for task and relies on residual vision in general). All the potential barriers or facilities (e.g., external seats of hospitals) should have contrasting colours for safety issues. In terms of surface textures, they can give profitable tonal details; however, all the materials should be carefully examined with issues such as reflections and glare otherwise they will be confusing and aggravate people’s impairment (Dalke, et al., 2006) (E2/E3: sense orientation, optimises tone contrast for task). Colour and contrast are essential factors within spaces which provide tone detail for people to reference as cues to distinguish the shape of spaces (e.g., corridors), yet this detail will be withdraw if the lighting is insufficient. Bright, Cook and Harris, (1997) as cited in Dalke, et al. (2006, p.351), also recognised that Victorian architecture and interiors are advantageous to those with VI for wayfinding because of the shadow detail on mouldings can assist people to discriminate the shape of spaces (E2/E3: sense orientation, optimises tone contrast for task); it is vital for architects and designers nowadays to practice this knowledge and increase the incidence of shadow detail within modern buildings so that people with VI can understand their immediate surroundings better (Dalke, et al., 2006).

Places without sufficient lighting to assist the transfer, for example, corridors changing from dark to extremely bright sunlight, are frightening for those who are older or visually impaired due to this group of people often having problems of light adaptation. Meanwhile, the interior appearance within buildings can be entirely different along with the transformation of illumination from daylight to nighttime; possessing the levels of illumination for a cheerful atmosphere within hospital environments is crucial yet it is often slighted (Dalke, et al., 2006).

8.6.2.2 Where and how Kingston's work maps onto my own work

Figure 8.17 illustrates NSs that are recognised from the research in the work of Hilary Dalke and colleagues at the Design Research Centre and Design for Environments of Kingston University. It can be seen that the NSs distinguished from the Case study 2 are within the categorisations of sense orientation and habitual orientation.

Sense orientation through relying on residual vision in general, optimising lighting for task, optimising tone contrast for task are repeatedly emphasised for the navigation within the three categorised environments (i.e., E1, E2 and E3). Moving closer to see and using bigger objects to locate are also sense orientation identified from Case study 2.

> "Five key factors which affect visual acuity for assessing the visibility of designs in a real world context are as a) colour contrast; b) lighting; c) visual ability of the target group; d) the dimension of the object text or element; e) and its distance from the observer". (Case study 2, p.293)

> "There are merely 6% of people who are registered visually impaired are totally blind, in other words, most of VIP still have residual vision so that colour, contrast and lighting can empower and make visible an otherwise incomprehensible environment". (Case study 2, p.293)

> "Overall Size – Dimensions are obviously critical to a sign or object being noticed before being approached to be 'read'. It was found that in many case signs were never actually expected to be 'read'". (Case study 2, p.294)

The use of colour and lighting in Case study 2 is not only suggested for improving VIP's independence but also for promoting a sense of well-being as well as for coding different spaces.

“Colour and appropriate lighting are powerful tools for coding, navigation and wayfinding; colour can also promote a sense of well-being and independence”. (Case study 2, p.296)

“It is also found that using colour coding as wayfinding boundaries on the floor is not only helpful for those who are older or visually impaired but also beneficial for preventing wall damage by alerting hospital porters steering trolleys with a distance from walls”. (Case study 2, p.298)

The consistency of the public environments is proposed in Case study 2 is mapped onto habitual orientation, through keeping things in the same place. Habitual orientation by relying on repetition is also recognised for the navigation within the more public but still familiar environments and the unfamiliar and unpredictable environments.

> “Consistency – Certainly on of the most important aspects of the environment is the consistency with which any feature is presented to the public. Visually impaired people report confusion when information is not where expected”. (Case study 2, p.295)

> “Repetition – Infrastructure details such as columns, tiled surfaces and patterns were revealed as being of great use to visually impaired people if repeated through a site”. (Case study 2, p.294)

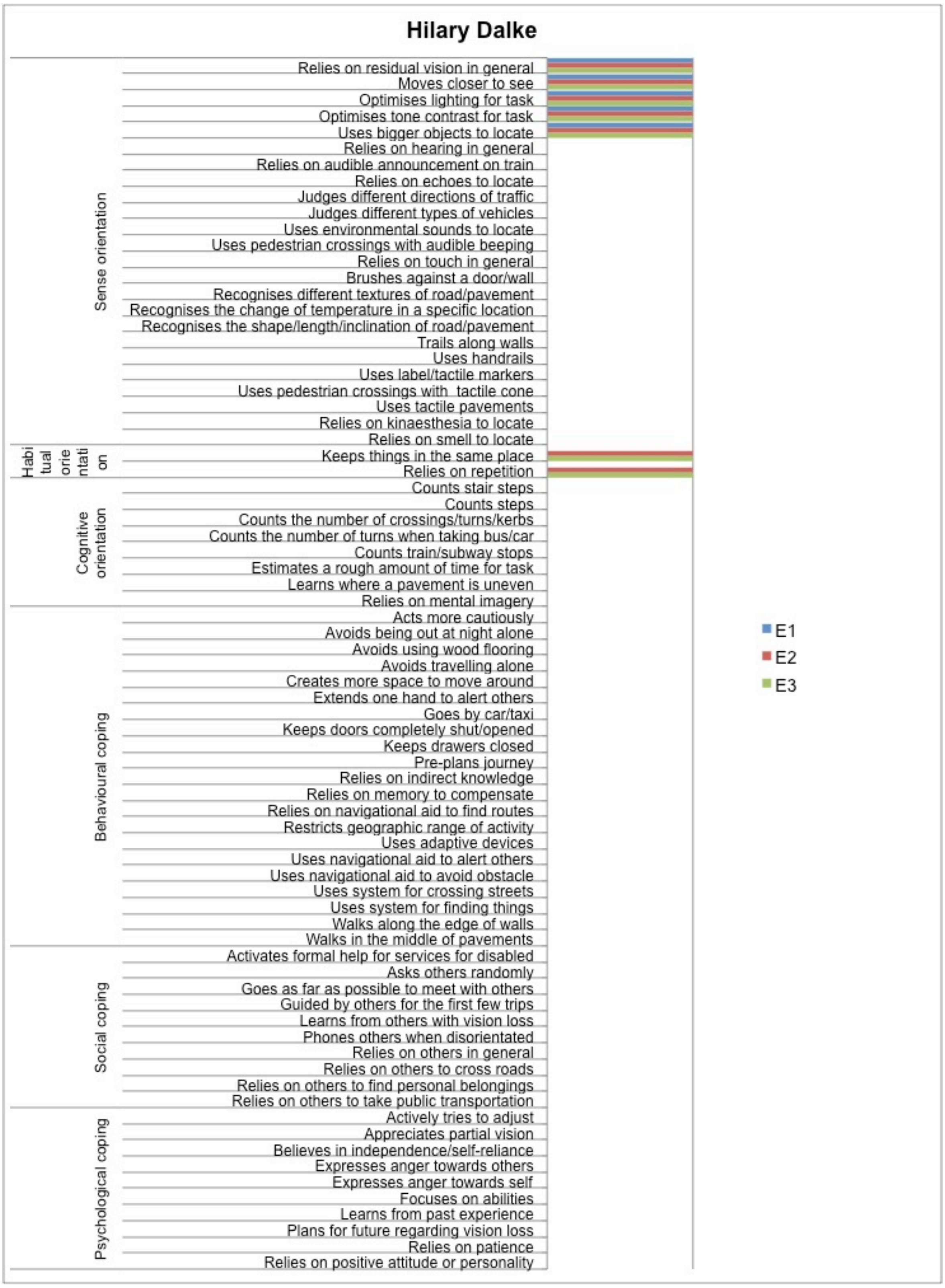


Figure 8. 17 NS being recoginsed and addressed through research in the work of Hilary Dalke and colleagues at the Design Research Centre and Design for Environments of Kingston University

8.6.3 Case study 3: Burton and Mitchell – Orientating in neighbourhood

8.6.3.1 Research review and NS coding

According to Burton and Mitchell's (2006) dementia research project on older people's general experiences of their local neighbourhood streets, their work, Inclusive Urban Design: Streets for life (Burton and Mitchell, 2006), addresses issues that they identify from older people, 20 with dementia and 25 without. Although this research is focusing on older people with and without dementia, it is useful as it reveals issues relating to older VI people's orientation in neighbourhood environment.

It is significant to provide people who are older an accessible outdoor environment where they are able to use and enjoy. Home is an important environment that meets older people's needs; therefore, a good quality of neighbourhood is also essential for their daily living. Burton and Mitchell (2006, p.39-43) state that most of older people go out regularly for their own purpose. No matter those who are with or without dementia, older people do enjoy the time when being out. A number of benefits of using local streets are, briefly:

1) Freedom and autonomy: deciding where to go and managing trips from start to the end makes older people feel they are really in charge of their own life after losing many abilities due to the ageing process.

2) Dignity and sense of worth: ageing processes can lead people to lose their sense of value, and people who are older find it important to do something useful

even if it is just a small task such as posting a letter or buying newspaper; going out and using local streets to complete simple tasks can assist older people to rebuild their sense of worth.

3) Fresh air and exercise (physical health): rather than achieve specific tasks, older people tend to go out for their own reasons, and fresh air and exercise not only advantage their physical health but also mental wellbeing.

4) Psychological wellbeing and enjoyment (mental health): going out and walking the local streets can simply delight older people which benefits their general happiness and wellbeing; older people tend to appreciate planting, building and architectures and use them as landmarks for wayfinding.

5) Social interaction: going out creates many opportunities for older people to contact with others which could be intentional trips such as visiting friends or family or accidental interactions with neighbours on streets or people in parks and other open spaces; social interaction not only contributes to mental health but also general wellbeing, it is considered as important part of our quality of life.

However, it is recognised that older people also feel anxious and fearful, which are two of the most common negative feelings, when they are using local streets. For example, some older people think of being out after dark (E2: behavioural coping, avoids going out at night alone) or being places where they are unfamiliar is dangerous and threatening (E3: restricts geographic range of activity). Many of them are also terrified of going out due to their physical problems such as unsteadiness or poor eyesight. In addition, they dread to fall over or being knocked over by cyclists or people barging into them. Social and psychological difficulties such as poor bus services, closure of shops, scared of being attacked or getting lost (Burton and Mitchell, 2006). In order to improve older people's quality of life and make the outdoor environment more accessible, Burton and Mitchell (2006) suggest familiar, legible, distinctive, accessible, comfortable and safe as the six principles and the key design factors for streets for life.

Burton and Mitchell (2006, p.51) state the definition of familiarity as "the extent to which streets are recognisable to older people and easily understood by them" and familiar streets are "hierarchical and long established with forms, open spaces, buildings and features in designs familiar to older people". Following these expectations, a neighbourhood is then establishing a familiar, predictable and understandable environment, which is helpful for older people to recognise where they are and what is expected within that setting.

In general, when people live in the same place longer, they become more and more familiar with their neighbourhoods and can remember all its individual components such as the layout of streets, the choice of different routes to the same destination, the locations of local services, facilities, pedestrian crossings, street furniture and so on (Burton and Mitchell, 2006) (E2: habitual orientation, relies on repetition). Nevertheless, it is found that those who are experiencing short-term memory problems need to continually walk the same routes and passing by the same features of buildings and environments on a regular basis to strengthen their abilities of recognising and remembering their local environment (E2: habitual orientation, relies on repetition). Meanwhile, people with dementia are found to be less aware of the changes of their surroundings when compared to those without dementia; it is indicated that they often become confused or lose their way when they do note a change (Burton and Mitchell, 2006). On the other hand, it is identified that some people with and without dementia have difficulty to recognise modern designs of street furniture (e.g., telephone kiosk, bus shelters, public benches) and the majority of them still prefer it to be in traditional styles because of its long-term familiarity.

"People with dementia are less likely or able to try to make sense of the unfamiliar so that features such as symbols must be clear and unambiguous and in styles familiar to older people to be of any practical use" (Burton and Mitchell, 2006, p.60). It is also suggested that maintaining long-established streets is significant, and for any change necessary to be small-scale and incremental. New developments should use local forms, styles and materials so that people who are older could be more familiar with their new neighbourhood. Street types should be maintained or designed hierarchically from high streets and side streets to lanes and footpaths in order to present a clear overall image of an area.

In terms of legibility, Burton and Mitchell (2006, p.64) state the definition as "the extent to which streets help older people to understand where they are and to identify which way they need to go. Legible streets have an easy to understand network of routes and junctions with simple, explicit signs and visible, unambiguous features" (E2: sense orientation, relies on residual vision in general). In spite of people tending to achieve successful wayfinding though restricting their activities within local neighbourhood (E2: behavioural coping, restricts geographic range of activity), it is found that most of older people, with and without dementia, are using some form of wayfinding technique even though this is usually a subconscious activity. Maps become relatively more difficult to understand and follow while people are growing older and many of them unable to locate their home which causes a sense of anxiety. Some may try to ask for directions (E2: social coping, asks others randomly); nevertheless, older people either distrust or misunderstand the information they are given or worry that they cannot remember or follow the directions (Burton and Mitchell, 2006). On the other hand, it is recognised that some older people tend to visualise routes in their mind (E2: cognitive orientation, relies on mental imagery). They also have a tendency of repeatedly following the same route (E2: behavioural coping, restricts geographic range of activity), and some of them even plan their route before they go out (E2: behavioural coping, pre-plans journey); nevertheless, it is found that those who use techniques of mental mapping or route planning also mentioned that they get lost sometimes (Burton and Mitchell, 2006).

It is found that most older people locate themselves by searching for both distant and nearby landmarks as well as other features of the built environment in order to know which way to go, although they are not always aware of doing so. Many of them also reveal it is helpful to see the end of a short street. Meanwhile, rather than long and straight streets, many of them prefer streets that are mildly winding which is helpful for maintaining concentration and escape from becoming disoriented or confused. At the same time, "relatively narrow streets also help people to concentrate due to the closer proximity of environmental cues as well as feeling 'cosier' and less threatening than wide streets" (Burton and Mitchell, 2006, p.70).

Burton and Mitchell (2006, p.65) state that "a legible neighbourhood would mean that less conscious effort is required to prevent them from losing the way and that they would be less fearful of getting lost". The shape and the size of streets are suggested to be short and fairly narrow in order to support older people keeping concentration, otherwise longer streets should be gently winding with bends and turners which greater than 90 degree to break down the length. On the other hand, it is demonstrated that public spaces and buildings should present certain appearances of what they are for and make the entrances clear. In addition, placing buildings facing street can also assist older people to distinguish if they are public or private spaces (E2: sense orientation, relies on residual vision in general). "Signs give directions should preferably be on posts and single pointers and positioned at important wayfinding decision points, such as road junctions and crossings"; meanwhile, signs should with "large, realistic graphics and symbols in clear colour contrast to the background, generally with dark lettering on a light background" (Burton and Mitchell, 2006, p.77) (E2: sense orientation, optimises tone contrast for task). On the other hand, it is identified that some older people tend to visualise routes in their mind (E2: cognitive orientation, relies on mental imagery). They also have a tendency of repeatedly following the same route (E2: behavioural coping, restricts geographic range of activity), and some of them even plan their route before they go out (E2: behavioural coping, pre-plans journey); nevertheless, it is found that those who use techniques of mental mapping or route planning also mentioned that they get lost sometimes (Burton and Mitchell, 2006)

Burton and Mitchell (2006, p.78) state that "distinctiveness relates to the extent to which streets give a clear image of where they are, what their uses are and where they lead"; meanwhile, "distinctive streets reflect the local character of the area and have a variety of uses, built form, features, colours and materials that give the streets and buildings their own identity within the overall character of the neighbourhood”. Each neighbourhood has its own characteristic, and the feature of local streets helps older people recognising where they are and feeling secure like at home in their surroundings. Therefore, it is important to reflect the local character and existing built form when regenerating an existing place so that the area can maintain its distinctive local identity (Burton and Mitchell, 2006).

Llewelyn-Davies, (2000) as cited in Burton and Mitchell (2006, p.79), suggests that people, no matter whose ages are younger or older, are not just approaching their destination by simply picking up the most obvious route, they are also influenced by whether the route is attractive or not. It is stressed that rather than formal surroundings (e.g., botanical or historic garden), people with dementia favour to visiting smaller, informal, or nature green open spaces (e.g., wooded area). Nonetheless, older people without dementia appear appreciative of both of these two environments. Those with dementia also prefer to visit parks with many different activity areas (e.g., children’s play areas, tennis courts) and urban squares with different shops and cafés as well as those helpful, interesting and pleasant features, such as seating, public art and greenery. Places where are more active and mixed use relatively provide more interests and simulation for those who need to retain concentration in order to prevent themselves losing their way.

Meanwhile, “mixed used streets, and places with buildings and architectural features in a variety of local styles, sizes, shapes, materials and colours not only make a neighbourhood more interesting to walk around but also help people with dementia to maintain concentration", (Burton and Mitchell, 2006, p.79). In addition, the five key landmarks, which are most used by those older people when finding their way, are stated by the authors due to their distinctive features which are:

1. Historic buildings, such as churches, and historic structures, such as memorials and monuments.

2. Civic buildings, including town halls, hospitals, churches, village halls, libraries.

3. Distinctive structures, including high-rise buildings, bridges, spires, steeples and towers (E2: sense orientation, relies on bigger objects to locate).

4. Places of interest and activity, including parks, commons, playing fields, tennis courts, nature reserves, allotments, play areas and recreation grounds.

5. Unusual places, buildings or usages that have a distinctive local identity.

Besides, aesthetic features (e.g., water pumps, fountains, ponds, attractive front gardens) and practical features (e.g., street furniture) are classified as two main environmental features that make streets more distinctive.

In terms of accessibility, it is defined as "the extent to which streets enable older people to reach, enter, use and walk around places they need or wish to visit, regardless of any physical, sensory or mental impairment". It is also suggested that "accessible streets have local services and facilities, are connected to each other, have wide, flat footways and ground level signal-controlled pedestrian crossings" (Burton and Mitchell, 2006, p.92). Older people go out alone and have a tendency of using their local facilities within walking distance of their home (Peace, 1982 cited in Burton and Mitchell, 2006, p.94). Nevertheless, most of the built environment features are designed for those who are younger and healthier; older people, especially those who are aged 75 and over, find it really difficult to access local services when compared to those who are younger (Department of the Environment, Transport and the Regions (DETR) and Department of Health (DoH), 2001 cited in Burton and Mitchell, 2006, p.94). Streets with barriers (e.g., uneven pavements, steep footways, inaccessible public transport stops, insufficient public toilets) are extremely unfriendly with older people and often compel them to stop visiting these places. It is indicated that "these unfriendly streets force older people experiencing temporary or permanent incapacity to either stay at home or to restrict their activities to local services and facilities, regardless of their quality or suitability" (Peace, 1982 cited in Burton and Mitchell, 2006, p.95).

According to Burton and Mitchell (2006), older people should live where there is a telephone and post box within a distance of 125m. Essential facilities (e.g., food store, post office, bank, health centre, etc.) should no further than 500m from their houses, and secondary services, for example, park, leisure facilities, library, should be best located within 500m and no further than 800m. On the other hand, footways are suggested to be flat and with a minimum width of 2m so that people with dementia and people with mobility problems and wheelchair users could have extra spaces to avoid oncoming pedestrians (E2: behavioural coping, creates more space to move around). In terms of changes in level, gentle slopes are more ideal than small steps as they are easier to see and negotiate, especially for those who are older. However, it is noted that level changes where unavoidable should be marked clearly with well illumination (E2: sense orientation, optimises lighting for task), handrails on both sides as well as non-slip and non-glare surfaces should also be provided (E2: sense orientation, uses handrail). Public toilets should be located at ground level, and the weight of gates and doors should be less than 2kg so that people with weak or stiff hands can open these less strenuously.

Burton and Mitchell (2006, p.104) refer to comfort as “the extent to which streets enable people to visit places of their choice without physical or mental discomposure and to enjoy being out of the house”. It is also suggested that “comfortable streets are calm, welcoming and pedestrian-friendly with the services and facilities required by older people and people experiencing temporary or permanent incapacity”. Older people, especially those with dementia, found it stressful to cope with unfamiliar environment, and they tend to confine themselves in places where they are familiar (E3: behavioural coping, restricts geographic range of activity). Recognising where they are, where they can find services and facilities that they need and how local features work provide a sense of comfort which not only helps older people enjoying outdoor journeys but also sustain their independence and self-esteem. Although it is demonstrated that older people, especially those with dementia, prefer to visit active and mixed use open spaces and appreciate interesting urban architecture, many of them found it uncomfortable and difficult to cope with urban traffic and crowds because loud noises are startling which cause confusion and disorientation, and pedestrians are usually blocking the pavement (Burton and Mitchell, 2006).

The research suggests that open spaces should be fairly small and well defined so that older people do not feel it too scared to enter. Active areas, for example, cafés and playgrounds, not only make those with dementia feel they are welcome and fine to be there but also attract other users to come to share the space hence it is more used and not isolated. Nonetheless, it is necessary to provide an area with suitable lighting (E2: sense orientation, optimises lighting for task) and seats away from busy streets and crowds, but not out of sight, for those who are older so that they can take a rest and enjoy the quiet for a while. Quiet streets are also significant for people who are older. Meanwhile, acoustic barriers like planting and fencing are also recommended as they help pedestrians keep a distance from traffic and also lower background noises (Burton and Mitchell, 2006).

In terms of safety, it is referred to “the extent to which streets enable people to use, enjoy and move around the outside environment without fear of tripping or falling, being run-over or being attacked. Safe streets have buildings facing onto them, separate bicycle lanes and wide, well-lit, plain, smooth footways”, (Burton and Mitchell, 2006, p.115). It is stressed that potential hazards such as uneven pavement and bicycles on footways are not only dangerous for any user but also lead to even more serious consequence for people who are experiencing memory or orientation problems because they are less aware of these problems. It is found that older people dread being attacked while they are out, for example, walking in empty places or streets. They also avoid to go out unaccompanied after dark (E2: behavioural coping, avoids being out at night alone) and tend to keep away from streets or alleyways that are unable to be overlooked (e.g., toilets below ground, underpasses) since they cannot see what is down there. Nevertheless, quiet alleyway or footpath would be friendlier and more welcoming if it is short and straight connected between two busy streets, in addition, both of ends should be apparent (Burton and Mitchell, 2006).

The research demonstrates that older people prefer signal-controlled pedestrian crossings due to these having been establishing for a long time so that people are familiar with and feel more confident to cross roads. It is also suggested that audible cues with lower pitch and visual signals should be provided on both sides of the road (E2: sense orientation, uses pedestrian crossings with audible beeping). In addition, non-controlled traffic islands are stressed as useful and alternative for wider but less busy roads since they allow people to cross roads in two stages so that people who are older are able to stop and take a break in the middle of the traffic (E2: behavioural coping, uses system for crossing streets). Footways are significant for those with dementia due to they tend to walk slower and with unsteady shuffling gait. Therefore, footways should be plain, smooth, level, non-slip and non-reflective. According to Burton and Mitchell (2006), tarmac is the most ideal paving material for people who are older.

8.6.3.2 Where and how Burton and Mitchell's work maps onto my own work

According to the Case study 3, NSs being recognised and stressed in the research of Burton and Mitchell are show in Figure 8.18. It can be seen that nearly all the NSs identified from the Case study 3 are categorised within the more public but still familiar environments (i.e., E2).

Sense orientation through the use of vision, optimising lighting for task, optimising tone contrast for task and using bigger objects to locate are distinguished.

> “Legible streets have an easy to understand network of routes and junctions with simple, explicit signs and visible, unambiguous features”. (Case study 3, p.306)

> “It is necessary to provide an area with suitable lighting”. (Case study 3, p.313)

> “Distinctive structures, including high-rise buildings, bridges, spires, steeples and towers”. (Case study 3, p.310)

Using pedestrian crossings with audible beeping and using handrail are also distinguished for sense orientation.

> “Older people prefer signal-controlled pedestrian crossings due to these having been establishing for a long time so that people are familiar with and feel more confident to cross roads. It is also suggested that audible cues with lower pitch and visual signals should be provided on both sides of the road”. (Case study 3, p.314)

> “It is noted that level changes where unavoidable should be marked clearly with well illumination, handrails on both sides as well as non-slip and non-glare surfaces should also be provided”. (Case study 3, p.312)

Habitual orientation by relying on repetition is demonstrated.

> "When people live in the same place longer, they become more and more familiar with their neighbourhoods and can remember all its individual components such as the layout of streets, the choice of different routes to the same destination, the locations of local services, facilities, pedestrian crossings, street furniture and so on". (Case study 3, p.305)

Cognitive orientation is identified through relying on mental imagery.

> "It is identified that some older people tend to visualise routes in their mind". (Case study 3, p.308)

In terms of behavioural coping, avoiding being out at night alone, creating more space to move around, pre-planning journey and using system for crossing street are demonstrated.

> "Older people dread being attacked while they are out, for example, walking in empty places or streets. They also avoid to go out unaccompanied after dark". (Case study 3, p.313)

> "…footways are suggested to be flat and with a minimum width of 2m so that people with dementia and people with mobility problems and wheelchair users could have extra spaces to avoid oncoming pedestrians". (Case study 3, p.311)

> “Some of them [older people] even plan their route before they go out”. (Case study 3, p.307)

> “Non-controlled traffic islands are stressed as useful and alternative for wider but less busy roads since they allow people to cross roads in two stages so that people who are older are able to stop and take a break in the middle of the traffic”. (Case study 3, p.314)

Restricting geographic range of activity for behavioural coping is indicated and is distinguished in both E1 and E2.

> “Older people, especially those with dementia, found it stressful to cope with unfamiliar environment, and they tend to confine themselves in places where they are familiar”. (Case study 3, p.312)

Asking other randomly is the only social coping identified from the Case study 3.

> “Maps become relatively more difficult to understand and follow while people are growing older and many of them unable to locate their home which causes a sense of anxiety. Some may try to ask for directions; nevertheless, older people either distrust or misunderstand the information they are given or worry that they cannot remember or follow the directions…”. (Case study 3, p.307)

Figure 8. 18 NS being recognised and addressed in the 'Streets for Life' research of Burton and Mitchell

8.6.4 Case study 4: Gordon Murray + Alan Dunlop Architects – Hazelwood School

8.6.4.1 Research review and NS coding

Hazelwood is a purpose built school specially designed for pupils with multiple disabilities and caters for a maximum of 60 children or young people with an age rage from 2 to 19 years. Each pupil who attends Hazelwood has a combination of two or more impairments: visual impairment, hearing impairment, mobility or cognitive impairment. A case study of Hazelwood School was developed thereafter by Scottish Matrix for Architectural Research and Knowledge (ScotMARK) and Gordon Murray + Alan Dunlop Architects (gm+ad), and it was published in 2007.

During the initial brief development and commission process, gm+ad realised that there was only a little literature on this kind of buildings which were directly programmatic or of design relevance. Although there were examples for buildings that were designed for visually impaired users, a design for children who are visually and hearing impaired, with a combination of other physical disabilities and/or cognitive problems as the main users made the type of building unique. Hazelwood School was regarded as the first project with this particular function for both the client and architects.

Series of activities were carried out in order to have a further understanding of the attitude of staff toward to other similar buildings and of children in other types of environments. After these activities and a further consultation with staff, significant conclusions were developed and were reflected in the design development process. For example, while visiting one of the parks, the design team identified that the children think of a more complex environment was more challenging than a plain accessible wheelchair-type route. Meanwhile, they also noticed the importance of smells (E2: sense orientation, relies on smell to locate), and the relationship between vibration and the nature of different kinds of materials, as a consequence, the value of considering the sense of hearing was addressed (E2: sense orientation, relies on hearing in general). It was found that existing schools visiting and close contact with both children and staff provided insight into preferences of staff toward the buildings, which was significant for the design process (Jenkins, et al., 2007). Detailed design features could be discussed as follows.

Due to the nature of the location of the site, the amount of circulation space was limited after excluding the built area, which was one of the issues that design encountered. The circulation areas had to be utilised as a portion of the learning experience since the corridors cannot function as the only circulation. This issue was reflected on the initial interior ‘street’ development as well as the connection of the area to the classroom spaces. Meanwhile, gm+ad developed a storage wall and trail rail within the circulation area as one of the initial design innovations which not only met the needs of specific storage but also developed a navigation device to aid pupils moving around within the building more autonomously (Jenkins, et al., 2007). (E2: sense orientation, trails along walls) (E2: behavioural coping, uses navigational aids to find routes)

The location of the site was near a major traffic junction which made it especially challenging due to the noise which could lead to a significant effect on the main teaching areas. Children who are visually impaired dependent on their hearing a lot so the design was vital in terms of acoustics (E2: sense orientation, relies on hearing in general). In order to deal with this issue, most of the classrooms spaces were positioned on the quiet edge along the north; contrary, spaces with more transient were positioned to the south. At the same time, the north and the south areas were connected by the “street” and curved the building around the existing trees. The curved shape separated the whole building, both internally and externally, into a series of space groupings which not only made the spaces easier to control and navigate, but also lowered the hazard of visual confusion (Jenkins, et al., 2007) (E2: sense orientation, recognises the shape/length/inclination of road/pavement).

All the classrooms facing to the north were designed with massive areas of clerestory glazing in order to maximise daylight piercing through and to provide an even allotment of illumination within the spaces, which was considered as one of the key design factors for those who are visually impaired (E2: sense orientation, optimises lighting for task). Meanwhile, for the sake of avoiding the noise from outside and accomplishing the acoustic needs for children with VI, all the teaching spaces were without opening windows. Instead, the design team developed the storage boxes placed in the back of each classroom, and contained a long and thin acoustic fresh air plenum through the use of their depth. In addition, the acoustic ceilings in all the teaching spaces were carefully designed to diminish the reverberation of higher sound volumes. On the other hand, the roof of the building provided quiet and protected external environments, which were significant for children to explore and engage in sensory activities (e.g., hear the wind generated from trees, feel the rain) (Jenkins, et al., 2007) (E2: sense orientation, relies on hearing in general) (E2: sense orientation, relies on touch in general).

In terms of the “street”, it functioned as circulation as well as teaching space, and was also considered as the focal point that connected all the key elements. The roof above the street was combined with the same clerestory glazing as the classrooms did. As a consequence, the area was supplied with sufficient natural light which responded to children who were able to distinguish between natural and artificially lit environments. The threshold spaces decreased in height along the roof steps created a totally different volume within the building, which could be used as a navigation cue for children who are able to hear (E2: sense orientation, relies on echoes to locate). In addition, tactile flooring and colour contrast were also applied to identify the entrance (E2: sense orientation, recognises different textures of road/pavement) (E2: sense orientation, optimises tone contrast for task). When considering those who are visually impaired during the design process, the design team found it challenging but also important to utilise colour and contrast (e.g., differentiating between walls and floor surfaces and circumscribing doors within walls). “Incorporating this within the building was imperative to ensure an entirely legible solution, however, controlling the palette of colours was also important to minimise visual confusion” (Jenkins, et al., 2007, p.13). Not only the children but also the teaching staff were considered as the main users of the building. gm+ad developed a neutral colour scheme and used blocks of strong vivid colours to distinguish threshold spaces and storage walls, consequently, “colour changes or contrast to the neutral background act as signifiers to the children but also contributed to a bright environment for the staff to work in", stated by Jenkins, et al. (2007, p13) (E2: sense orientation, optimises tone contrast for task).

Through their observations in the existing schools, the design team identified that children were taught to guide themselves by trailing walls, surfaces or handrails (E2: sense orientation, trails along walls) (E2: sense orientation, uses handrails). Therefore, gm+ad designed the storage wall, which was covered with cork to provide a warmth and tactile quality, in a combination of messages along the length of the building. It was considered as the principal navigation device to guide the children around the school, and the messages assisted them to know where they are (E2: sense orientation, uses label/tactile marker). The wall was intentionally curved which not only increased the storage spaces but also added interest to the route for the children. On the other hand, a series of rails were developed throughout the building, and the diversity of their heights was designed to respond the children in different ages. "The transom for trailing and the sill doubles as a kerb which particular children will use to guide canes or the side of their feet (E2: behavioural coping, uses navigational aids to find routes) (E2: sense orientation, recognises the shape/length/inclination of road/pavement). All navigational devices, be it trail rails, window transoms or signage on doors, are set at a consistent height (E2: habitual orientation, keeps things in the same place) throughout the building so that they can be quickly located by the children" (Jenkins, et al. 2007, p.13).

The east end of the street, where the senior classrooms were located, was divided from the major spine of the building by a glazed roof area, which formed a contrast of lighting in different levels. Due to the fact that the area was also the exit to the playground spaces and the Life Skills House, a number of visual and tactile clues were applied to the flooring and the wall finishes which intended to alert the user of this area (E2: sense orientation, uses label/tactile marker). Meanwhile, carrying the external wall materials (e.g., zinc and slate cladding) into the street space also gave a tactile indication of a change. Young people were guided into the senior classrooms by the cork wall, however, at this point, the roof geometry altered and the glazing was removed which formed an internalised environment with very different qualities to the rest of the street (Jenkins, et al., 2007).

Outside environment was regarded as an external classroom and the structure and cladding were carefully considered, focusing on sensory stimulation. Textured materials, for example, naturally weathering larch boarding, were selected which not only to provide tactile characteristics for children to trail but also stimulate their sense of smell (E2: sense orientation, trails along walls) (E2: sense orientation, relies on smell to locate). Roofing slates, utilised to clarify some specific external areas due to their surfaces, were also beneficial for children to track; together with a glulam timber frame within the building, a clear contrast was formed which could assist children to locate themselves. Another advantage of the slate was that it could be used as a strong heat source so that children were able to sense and reference it for the orientation (E2: sense orientation, recognises the change of temperature in a specific location). On the other hand, sound was also considered as an important medium to interpret the external surfaces. The paths around the school and the gardens were built of different materials from bound gravel, which crunches under foot, to recycled bound rubber and timber decking (E2: sense orientation, recognises different textures of road/pavement). Each area was characterised by distinct finishes so that it feels and sound different when children step on it (Jenkins, et al., 2007) (E2: sense orientation, relies on hearing in general).

8.6.4.2 Where and how Murray and Dunlop Architects' work maps onto my own work

Through Case study 4, Figure 8.19 illustrates NS being recognised and addressed in the research of Murray and Dunlop Architects. All the NSs are categorised within the more public but still familiar environment (i.e., E2) and most of the NSs are under the categorisation of sense orientation.

Sense orientation by optimising lighting for task and optimising tone contrast for task are distinguished as two of the design features.

> "All the classrooms facing to the north were designed with massive areas of clerestory glazing in order to maximise daylight piercing through and to provide an even allotment of illumination within the spaces, which was considered as one of the key design factors for those who are visually impaired". (Case study 4, p.321)

Sense orientation through relying on hearing in general and relying on echoes to locate are identified.

> "Children who are visually impaired dependent on their hearing a lot so the design was vital in terms of acoustics". (Case study 4, p.321)

> “For the sake of avoiding the noise from outside and accomplishing the acoustic needs for children with VI, all the teaching spaces were without opening windows”. (Case study 4, p.321)

> “The threshold spaces decreased in height along the roof steps created a totally different volume within the building, which could be used as a navigation cue for children who are able to hear”. (Case study 4, p.322)

Several design features through the use of touch are recognised which including: relying on touch in general, recognising different textures of road and/or pavement, recognising the change of temperature in a specific location, recognising the shape, length and/or inclination of road and/or pavement, trailing along walls, using handrail and using label/tactile marker.

> “gm+ad developed a storage wall and trail rail within the circulation area as one of the initial design innovations which not only met the needs of specific storage but also developed a navigation device to aid pupils moving around within the building more autonomous”. (Case study 4, p.320)

> “The curved shape separated the whole building, both internally and externally, into a series of space groupings which not only made the spaces easier to control and navigate but also lowered the hazard of visual confusion”. (Case study 4, p.321)

> “Tactile flooring and colour contrast were also applied to identify the entrance”. (Case study 4, p.322)

> “Through their observations in the existing schools, the design team identified that children were taught to guide themselves by trailing walls, surfaces or handrails. Therefore, gm+ad designed the storage wall, which was covered with cork to provide a warmth and tactile quality, in a combination of messages along the length of the building. It was considered as the principal navigation device to guide the children around the school, and the messages assisted them to know where they are”. (Case study 4, p.323)

> “Another advantage of the slate was that it could be used as a strong heat source so that children were able to sense and reference it for the orientation”. (Case study 4, p.324)

> “The paths around the school and the gardens were built of different materials from bound gravel, which crunches under foot, to recycled bound rubber and timber decking”. (Case study 4, p.324)

Sense orientation by relying on smell to locate is identified.

> “Textured materials, for example, naturally weathering larch boarding, were selected which not only to provide tactile characteristics for children to trail but also stimulated their sense of smell”. (Case study 4, p.324)

Other NSs distinguished from the Case study 4 are habitual orientation through keeping things in the same place and behavioural coping through relying on navigational aid to find routes.

> "All navigational devices, be it trail rails, window transoms or signage on doors, are set at a consistent height throughout the building so that they can be quickly located by the children". (Case study 4, p.323)

> "The transom for trailing and the sill doubles as a kerb which particular children will use to guide canes or the side of their feet". (Case study 4, p.323)

Figure 8. 19 NS being recognised and addressed in the research of Murray and Dunlop Architects in their Hazelwood School

8.7 Conclusion

This chapter has provided a detailed discussion of the findings from an analysis of the data, using the framework derived from the literature review of VIP, from i) VIP's interviews; ii) professionals' interviews; and iii) case studies of research practice for the design of the built environment. This has demonstrated a gap in knowledge and understanding, from the professionals' perspective, of the extent of VIP's use of NS in relation to the built environment. The implications of this finding in relation to the hypothesis explored in this study, and for future research in this area, will now be discussed further in Chapter 9.

9. Conclusions

9.1 Strengths and limitations of study

As mentioned in section 4.4.4, a much greater range of possible participants (see Table 4.2) was conceived as a framework from whom to acquire data for analysis, representing a greater range of variables such as the age of onset, type of VI, the length of time of impairment, and the severity of the impairment.

Due to the limited timeframe, resources and purposes of this PhD, a limited number of VIP participants were able to be recruited. For example, participants from the early and late childhood categories would have to be supervised by the parents during interview and children in these age categories would not have been able to act autonomously in the same way as adults in navigating the environments independently without adult supervision. Although no children were recruited into the study, the value of Hazelwood case study was what it told me about the level of professionals' understanding of VIP's NS.

In Table 4.2, one can see, within the mid-life and old-age categories, a number of sub-categories across which one could sample exhaustively, given the luxury of sufficient time and funding. However, sampling for the present study was assisted by vision rehabilitation organisations according to a set of inclusion and exclusion criteria (see more details in section 5.1.3), which was established and used as the basis for identifying potential VIP participants who were able to travel autonomously and therefore to investigate how they used different combinations of

NS in the different types of environments.

This may lead a risk of bias in that the data was only obtained from users of those services and excluded those who were more reluctant to seek help. However, the results may only be different when using a different set of criteria, that is, to include those who are newly blind and have not been able to adapt to their impaired vision and to develop their own strategies. With these specific criteria, sufficient data would not be provided due to their being less able, or unable, to describe the NS that they use in the different types of environments. Therefore, it could be assumed that even if those non-service users were included, it may still produce similar results: VIP use different combinations of NSs in the different types of environments.

On the other hand, although the samples were purposively selected according to the inclusion and exclusion criteria, the ten subjects recruited from the vision rehabilitation organisations still provided randomness to an extent, in that there are variations, for example, in their personal background, biography, personalities, age, the severity of the impairment and use of navigational aids, etc. (see more details in Table 5.1 Profiles of VIP participants). The discussion in 8.2 reveals the random element that individuals' personalities can bring into the data emerging from the sample.

Although the sample size of the present study is limited, the VIP participants were identified not only by the researcher but also allotted by the vision rehabilitation organisations, according to the inclusion and exclusion criteria for selecting subjects. In addition, the use of the methodological framework derived from the review of literature in Chapter 2.4.2 as both a generative and an analytical tool has already provided sufficiently rich data from the range of ten VI subjects to reveal and illustrate very clearly the different combinations of NS used by different VIP in different environments.

Again, using the same framework, the analysis of the data derived from the small representative sample of professional participants and from the case studies, has revealed that professionals, in their endeavours to specify or design environments for VIP, appear to have only a fragmented view of some of the NS employed by VIP and that their 'inclusive' models perhaps do not fully accommodate VIP's assets in using the rich combinations of NS they appear to possess. The professionals included in this study were selected for their specialist expertise and/or experience in accessibility and inclusive design. Even with such a small sample of professionals, the limited extent of their knowledge of VIP's NS became apparent. I would have expected that professionals without the degree of expertise represented in this small sample would have had even less awareness of VIP's NS, and so my proposition about professionals' knowledge was able to be supported by the evidence from this small sample without the need to recruit a larger sample of professionals some of whom would not have had this specialist expertise or experience. In this sense, the two sets of samples were representative enough of the two communities (i.e., VIP and professionals) to confirm my proposition.

A discussion of the main findings is now provided together with a discussion of utilising an asset-based approach, the contribution to knowledge and implications for further research.

9.2 Main findings

9.2.1 Findings from the analysis of VIP

The analysis of the interviews with ten VI subjects revealed how and how well VIP use their innate – or tacit – and sometimes more conscious abilities to navigate around different kinds of environments using a number of NS.

Based on Lee and Brennan's (2002) coping strategy (CS) model (see more details in Chapter 2), NSs that were reported by the VIP participants were reflected in the NS matrix, which was developed and used to analyse the interview data.

The detailed analysis of the VIP interviews in sections 8.3 and 8.4 illustrated the consistency of some of the NS over the ten VI subjects, and it also presented how the combinations of NS change in different types of environments.

It was clear that the VIP participants did make use of their abilities through a number of strategies while navigating around the built environment. They used different combinations of NS in different types of environment.

The combinations of NS reported by the participants varied depending on their degree of visual impairment and also on their use and type of navigation aids (e.g., canes or guide dogs).

These findings not only indicate some of the complex variables associated with a population of VIP but also presented some of their strengths and abilities.

9.2.2 Findings from the analysis of professionals' data

The detailed analysis of professionals' interviews in section 8.5 demonstrated that the designer participants had only a limited understanding of VIP's NS: they neither fully understood how VIP navigated around the built environment nor were they fully aware of the complex variables of each individual VIP.

The findings showed that there are gaps between what VIP participants demonstrated they were able to do (either tacitly, or more consciously) and what the designer participants considered VIP were both able and unable to do, which clearly showed the limitations of the designer participants' understanding of the complexities of VI, and the NS used by VIP.

Meanwhile, the approaches (i.e., revealed through primary and secondary research) used by the designer participants to design for VIP appeared to be based on a 'deficit-based' approach or model (see more discussions in sections 3.3 and 3.4), which concentrated on designing for the disabilities or limitations resulting from VI (e.g., using DDA regulations, British Standards) and through the kinds of design strategies they used (e.g., simulating different forms of VI through simulation tools). Although some responses indicated that they understood VIP's abilities with regards to residual vision, they are not helpful for professionals to understand the more resourceful 'assets' and strategies that VIP may already have developed (e.g., habitual orientation through relying on repetition, cognitive orientation through counting steps, behavioural coping through relying on indirect knowledge).

With regards to the discussion of the case studies in section 8.6, although some of the design research already recognises that VIP have certain assets (e.g., residual vision) and provides very useful design guides and/or design solutions for strengthening VIP's abilities, there appears to be no literature available for the design community at present that has fully developed an overview of the 'compensatory' strategies that VIP use, their complexity, and how these strategies are used in different combinations in different kinds of environments when navigating.

9.3. Implications of the findings (The relationship between findings and existing research)

I argue there is a need for a much more comprehensive understanding by professionals, of VI, of VIP and of their NSs (i.e., their assets) when considering the design of environments which can better accommodate VIP.

Through revealing and discussing the complexity of and use – by VIP's – of their NS, the results of my research, presented in an accessible format to professionals, may allow professionals to understand the complexities of not only VI but also to begin to understand VIP's compensatory strategies, that is, a view of the world from the VIP's perspective and to consider a more asset-based approach to designing for VIP. This may also be of value for application in other areas of Inclusive Design and not limited to VI.

9.4 Contribution to knowledge

The main contributions to knowledge in the present research have been, in summary, to:

- develop and use a methodological framework, derived from a literature and case study review, and tested in a sample of VIP to reveal the range and complexity – and the inter-relatedness – of different strategies and variables used by VIP, and also how their use differs in different kinds of environments;
- use this framework to reveal, by contrast, this with the limited and fragmented understanding that professionals, who are interested in and committed to specifying and designing for VI, have about VIP's strategies and innate abilities;
- use the findings to strengthen the case for a more asset-based approach to researching and designing for VIP (and by implication for other forms of disability) and to develop asset-based models in contrast to the predominantly deficit-based models and approaches currently used in design.

9.5 Implications for future research

The research presented here has demonstrated an overall understanding of VIP's strengths and abilities in navigation through the use of the NS framework. There is potential for future research to explore the larger VIP sample as described in

Table 4.2.

Although the current research into designing or specifying environments for VIP provides valuable and useful design guides and/or design solutions, it appears fragmented and focusses only on a narrow range of area(s) as the figures illustrate in section 9.2.2.

After the submission of this thesis, a discussion with the Director of RNIB was conducted. The feedback from him of the evidence I obtained using the NS framework was positive, as it clearly and robustly presents simply the six main navigation categories (three orientation and three coping) but with more complex sub-categories. This discussion led to an invitation to present my research at a national RNIB-organised conference which has the possibility to generate further interest from this work.

This NS framework is potentially a bridge between the VI and design communities. The next stage would be to have a conversation with both communities about how best to take these findings and the use of the NS framework forward. The future research may have a lot of possibilities but will be very dependent on the nature of the discussions between VIP and professionals. I see my current NS framework as a useful tool facilitating these discussions. Professionals have had a particular approach to the simulation of the impairment, which determines their design approaches. However, I believe that when VIP see the limitations of what professionals are aware of, they might be able to suggest to professionals what they could start to look at. Meanwhile, presenting the NS framework to VIP may also change the VIP’s own awareness of their capabilities (perhaps these NSs are used tacitly rather than consciously) and, in turn, the way that they speak to professionals.

Therefore, I see my first task will be to open up that discussion between the VI and design communities about my findings and to see where would that work takes me. A further research publication plan is envisioned for the near future through publishing a series of journal papers as well as briefing papers summarising findings for the design and VIP communities, based on the work in this thesis, which include the following:

Journal/academic papers

- A review paper discussing existing research in the field, its significance, controversies and problems with regard to the research question under consideration;
- A methodological paper which focusses on how the methodological framework was developed;
- A findings paper which discusses the analysis and synthesis of the data, and findings from the use of the methodological approach.

Summary briefing / findings papers

- A briefing / findings paper for the design community
- A briefing / findings paper for the VIP community

Appendix A: Ethics Approval Form

APPENDIX A ETHICS APPROVAL FORM

THE GLASGOW SCHOOL OFT ART

ETHICS COMMITTEE

APPLICATION FORM FOR ETHICAL APPROVAL

This application form should be submitted to the School Research Developer EITHER in hard copy through the internal mail OR as a Word attachment.

All questions must be answered.

1. Name(s) of person(s) submitting research proposal:

   Ji Wei Wu

2. Position(s) held (e.g. Lecturer, Doctoral Student etc.):

   Doctoral Student

3. School:

   School of Design

4. Project title:

   Improving the understanding of the innate abilities and coping strategies of visually impaired people (VIP): an analysis and modelling of their spatial navigational abilities for designers of the built environment

5. Have all investigators read, understood and accepted the GSA Ethical Policy, a statement of which is available on the GSA website? Please circle or highlight:

   YES NO

6. Does your proposal involve human subjects, materials or data not in the public domain? Please circle or highlight:

   YES NO

7. If you answered YES to Question 6, please append a copy of your research proposal to this document.

See the attached document.

8. What, if any, in your opinion are the ethical considerations involved in this proposal? You should consult the ethical policy statements of the AHRC and/or ESRC, and you may also wish to consider some or all of the following issues:

-- issues of safety, including the experience of the investigators (subjects, investigators)
-- issues of consent (are the subjects students, or others in a dependent relationship? Does the research include children or people with special needs? Will payment or any other incentive be

Appendix A: Ethics Approval Form

made to any research subject? How is consent to be obtained? It is expected that consent will be given in writing.)
-- issues of confidentiality (Can subjects be identified from information held by another party? Who will have access to the data and what measures will be adopted to maintain the confidentiality of research subjects and to comply with data protection requirements, e.g. will data be anonymised?)
-- issues of balance (Are there any cultural, social or gender-based characteristics of the research subjects which have affected the design of the project or which may affect its conduct?)

Please continue on a separate sheet if necessary. If Question 8 is non-applicable, simply insert "N/A" below.

Recruitment and Interviewing of Participants
The subjects will be volunteer visually impaired people who are aged 18 or above. The interviewees will be recruited through:

- Glasgow Shopmobility, a registered Scottish charity aiming to assist people who have physical or sensory impairment to access city centre shops and services more freely < http://www.glasgowshopmobility.org.uk/>,
- Supported Integration, Training and Employment, SITE < http://www.sitescotland.org/>,
- Glasgow Access Panel, a registered charity aiming to improve the accessibility of services, facilities and buildings across Glasgow for all disabled people < http://www.glasgowaccesspanel.org.uk/ >,
- Centre for Sensory Impaired People, a Glasgow City Council centre for assessment and training for sensory impaired people < http://www.glasgow.gov.uk/en/Residents/Care_Support/SensoryServices/>,
- The Guide Dogs for the Blind Association, a registered charity supporting blind and partially sighted people to enjoy the same freedom of movement as everyone else, < http://www.guidedogs.org.uk/>.

Due to the condition of visual impairment, conventional advertising is difficult, and the visually impaired communities tend to contact potential candidates by personal contact. Therefore, my contact details (school email address and working mobile number) will be given by organisations and recruited subjects to potential candidates as a means of further recruitment.

Safety
Subjects:
Some of the interviews will take place in rooms that are provided in the premises of the organisations above. Other interviews will be carried out in a meeting room in Buchanan Galleries, which is next to the entrance of John Lewis on ground floor, and is provided by Glasgow Shopmobility (220 Buchanan Street, Glasgow, G1 2FF). No health and safety risks to participants are envisaged. Interviews will be conducted in daytime between November (2011) and February (2012).
Researcher:
The mobile phone number given in the information sheets was purchased for the research used only. For all interviews, all subjects' names and contact details, interview schedules, and interview locations will be provided in advance, to my Director of Studies, Prof Macdonald, and there is also an agreement to text my Director of Studies as soon as I safely finish each interview.

Consent
Participants will be given an outline of the study (interview information sheet for subjects – attached as a separate document) that they keep. The information sheet will be available in the preferred format (in large print, audio, or Braille) of interviewees.
Written consent will be obtained from participants. Participants will also be asked to sign two consent forms (attached as a separate document), that will make clear to participants that their participation is voluntary and they can withdraw all or part of what they say during the research, being free to do so without giving any reasons. One will be stored by the researcher securely, and another will be kept by participants.

Appendix A: Ethics Approval Form

Due to the nature of some of the visual impairments of the subjects, the consent form will be also available in the preferred format of interviewees. In case of Braille format, the witness (care-giver/staff from the organization) will check the consent form is the same as what is on the Braille form to agree signing. In terms of audio, the consent form will be read by myself or their care-givers, and their consent will be recorded by the recording device. The audio acceptance files would be kept separately from the interview files to ensure anonymity.

Confidentiality
Data will be stored securely in locked/password protected files. Data and transcripts will be coded to protect participants' identities. Only the researcher will have access to individual's identities and this information will be destroyed at the end of the research project.
When published all participants will be given pseudonyms.
All the interviews will be recorded by the recording device, for later transcription and the data will be kept securely and anonymised so that subjects cannot be identified.

Balance
The study does not require balancing its outcomes on race, social class or cultural issues however gender and age will be monitored in the cross section of individual recruited for interviews and the workshop.

9. Date of submission of form: 10 October 2011

10. Signature of person making the proposal:

Ji Wei Wu

Thank you for filling in this form. You should receive confirmation of ethical approval within three weeks of submitting it. IMPORTANT: lead times for applications must take into account this timescale for approval.

For office use:

DECISION: APPROVED.

Initials of scrutineers (if applicable): TC/AH/AD

Signature of Convenor GSA Research Ethics Group: 14 Dec 2011

Date of decision (copy of this form to be returned to proposer)

Form updated: March 2005

Appendix B: Interview Information Sheet for Recruiters of VIP Subjects

Title of research

Improving the understanding of innate abilities and coping strategies of visually impaired people (VIP): an analysis and modelling of their spatial navigational abilities for designers of the built environment

Subjects who have visual impairment will be invited to take part in the research study: Improving the understanding of innate abilities and coping strategies of visually impaired people (VIP): an analysis and modelling of their spatial navigational abilities for designers of the built environment. For this studies, I am interested in candidates who are i) over 18; ii) can travel easily to interviews; iii) can hear well (including those who are using assistive listening devices). Before they decide it is important for them to understand why the research is being done and what it will involve.

1. What is the purpose of the study?

I am a PhD student at The Glasgow School of Art, supervised by Professor Alastair Macdonald and Sally Stewart. This research aims to develop a deeper understanding of the varied nature of the visual impairment and how different people use different tactics or strategies while they make journeys which are both familiar and unfamiliar to them.

2. What kinds of people will I need to recruit for my study?

I aim to interview adults who have experienced visual impairment at different stages of their life and who will have had to adjust to visual impairment in different ways. I am looking for your help in recruiting approximately 3 visually impaired people for my pilot interviews, and 10 people for my formal interviews. However, due to issues with Disclosure Scotland requirements, I am restricting my interviews to adults of 18 and over at present. All the candidates have to be able to travel easily to interviews and be able to hear well (including those who are using assistive listening devices).

3. What will happen to people if they take part?

Their involvement in the study would be to take part in an interview where we discuss: their daily routine at home; a typical journey that they make around their neighbourhood (e.g., supermarket, transport stations, workplace); an unfamiliar journey that they make (e.g., city centre/suburbs, shopping mall, family/friend visiting, unfamiliar transport station). The interview is expected to last around one hour. I will record the interviews with their permission. If some interviewees are accompanied by their care givers, they are welcome to make comments along with the interviewees as another source of data giving a different insight.

If they (and their care-givers) decide to take part they will be given an information sheet to keep, and the information sheet will be available in the preferred format (in large print, audio, or Braille) of interviewees. They (and their care-givers) will also be asked to sign a consent form and provided with a copy of this. If they decide to take part, they are still free to withdraw from the study at any time and without a given reason.

The interview will take place in the rooms that are premises of your organisation if possible. In this case, I will provide the named contact and details of the contact in the organization and a schedule and location of interviews in advance, to my Director of Studies, Prof Macdonald. If not, the interview will be carried out in a meeting room in Buchanan Galleries, which is next to the entrance of John Lewis on ground floor, and is provided by Glasgow Shopmobility (220 Buchanan Street, Glasgow, G1 2FF). No health and safety risks to participants are envisaged. Interviews will be conducted in daytime between November (2011) and February (2012).

4. What will happen to me if they take part?

If they decide they want to take part in this study, they can contact me, Ji-Wei Wu by text or phone on 07411 752318 or by email on J.Wu2@student.gsa.ac.uk.

I will explain what the research is about, what will be involved in the interview process and can also answer any questions they might have. They can then decide if they want to go ahead with the interview and we can arrange a suitable time and location.

5. Will my taking part in this study be kept confidential?

Research will be carried out in accordance with the Glasgow School of Art’s Ethical Policy. All information that is collected about subjects will be kept strictly confidential. The only contact information required will be either a mobile/landline telephone number or email address. Their name or any contact details will not be recorded on the interview transcripts. In addition, any details which potentially could identify them will also be removed or changed.

6. What will happen after the interview?

After the interview, our conversation will be fully transcribed. All of the interviews will be analysed, a report written up and the results of the study will be used in my PhD thesis. Findings from this study will contribute to developing a better understanding of the varied nature of the visual impairment and coping strategies, which may offer designers more scope when they design the built environment. Subjects can receive a summary of my research findings on request after the completion of my research.

7. Contact for further information

Ji-Wei Wu (PhD Candidate)
School of Design
The Glasgow School of Art
Tel: 07411 752318
Email: J.Wu2@student.gsa.ac.uk

Academic Supervisors

Director of Study: Professor Alastair Macdonald
(Senior Researcher, School of Design)
Tel: 0141-353-4715
Email: a.macdonald@gsa.ac.uk

Co-Supervisor: Sally Stewart
(Mackintosh School of Architecture)
Email: s.stewart@gsa.ac.uk

Appendix C: Interview Information Sheet for VIP Subjects

Title of research

Improving the understanding of innate abilities and coping strategies of visually impaired people (VIP): an analysis and modelling of their spatial navigational abilities for designers of the built environment

You are invited to take part in a research study which is concerned with improving the understanding of how visually impaired people find their way in familiar and unfamiliar locations. Before you decide to participate it is important for you to understand what it will involve.

1. What is the purpose of the study?

I am a PhD student at The Glasgow School of Art, supervised by Professor Alastair Macdonald and Sally Stewart. This research aims to develop a deeper understanding of the varied nature of visual impairment and how different people use different tactics or strategies while they make journeys which are both familiar and unfamiliar to them. For example, a child who was blind from birth may tend to develop mental maps to recognise the layout of his/her neighbourhood; an individual who was visually impaired during working life may cope with the loss of vision by relying more on other senses, and being more caution when he/she is moving around in the city centre; an individual with visual impairment in old age may prefer to make use of his/her residual vision by using large print labels with strong colour contrast to find where things are in his/her house. Describing and categorising of these diverse abilities may offer designers more scope when they design the built environment.

2. Why have I been chosen?

I wish to interview a range of adults who have experienced visual impairment at different stages of their lives and who will have had to adjust to visual impairment in different ways. Your name has was suggested by __________________ (the name of the organisation)

3. What will happen to me if I take part?

Your involvement in the study would be to take part in an interview where we discuss: your daily routine at home; a typical journey that you make around your neighbourhood (e.g., supermarket, transport stations, workplace); an unfamiliar journey that you make (e.g., city centre/suburbs, shopping mall, family/friend visiting, unfamiliar transport station). The interview is expected to last around one hour. With your permission, I would like to record the interviews. Your care-giver is also welcome to participate in the interview with you.

You do not have to give your real name. If you decide to take part you (and your care-giver) will be given this information sheet to keep. You (and your care-giver) will also be asked to sign a consent form and be provided with a copy of this. If you decide to take part, you are free to withdraw from the study at any time and without a given reason.

4. What will happen if I take part?

If you decide you want to take part in this study, you can contact me, Ji-Wei Wu. You can contact me by text or phone on 07411 752318 or by email on J.Wu2@student.gsa.ac.uk.

I will explain more about the research, what will be involved in the interview process and can also answer any questions you might have. If you then decide to go ahead with the interview, I will contact you to arrange a suitable time when you travel to the city centre. The location will take place in rooms that are provided in the premises of the organization, or at a meeting room in Buchanan Galleries, which is next to the entrance of John Lewis on ground floor, and is provided by Glasgow Shopmobility (220 Buchanan Street, Glasgow, G1 2FF). Interviews will be conducted in daytime between November (2011) and February (2012).

5. Will my taking part in this study be kept confidential?

All information that is collected about you will be kept strictly confidential. The only contact information required will be either a mobile/landline telephone number or email address. Your name or any contact details will not be recorded on the interview transcripts. In addition, any details which potentially could identify you will also be removed or changed.

6. What will happen after the interview?

After the interview, our conversation will be fully transcribed. All of the interviews will be analysed, a report written, and the results of the study will be used in my PhD thesis. Findings from this study will contribute to developing a better understanding of the varied nature of visual impairment and how different people use different tactics or strategies. This is important in offering designers more scope when they design the built environment. If requested, I can provide a short summary of my research to you at the end of my study.

7. Contact for further information

Ji-Wei Wu (PhD Candidate)
School of Design
The Glasgow School of Art
Tel: 07411 752318
Email: J.Wu2@student.gsa.ac.uk

Academic Supervisors

Director of Study: Professor Alastair Macdonald
(Senior Researcher, School of Design)
Tel: 0141-353-4715
Email: a.macdonald@gsa.ac.uk

Co-Supervisor: Sally Stewart
(Mackintosh School of Architecture)
Email: s.stewart@gsa.ac.uk

Appendix D: Consent form for VIP participants

Research into issues and problems encountered by experiences of sight loss or visual impairment

Ji-Wei Wu (PhD Candidate)
School of Design
The Glasgow School of Art
Date commenced PhD: September 2009
Supervisor: Prof Alastair Macdonald
Co-Supervisor: Sally Stewart

I want to thank you for taking the time to meet with me today. My name is Ji-Wei Wu and I would like to talk to you about some issues and problems encountered by your experience of sight loss or visual impairment.

This will help in my research which is being supervised by Professor Alastair Macdonald, Senior Researcher in the School of Design at The Glasgow School of Art and which will adhere to our Ethical Code of Practice.

The interview should take approximately an hour. With your consent, I will be tape-recording the session because I do not want to miss any of your comments. Because we are on tape, would you mind speaking up so that I do not miss your comments.

All responses will be kept confidential. This means that any information from your interview responses which I include in my research will not identify you as the respondent. Remember, you do not have to talk about anything you do not want to and you may end the interview at any time. I may wish to follow-up some points from this interview, and may wish to contact you again. This will be optional and there is no obligation to participate.

Are there any questions about what I have just explained?

Are you willing to participate in this interview?

Research into issues and problems encountered by experiences of sight loss or visual impairment

PhD candidate: Ji-Wei Wu
Supervisor: Prof Alastair Macdonald, Senior Researcher School of Design, The Glasgow School of Art

Statement of Consent

I understand that the study involves interview/s and possible follow-up session/s which will be tape-recorded. I understand that taking part in the research is entirely voluntary and that I can stop taking part in the study at any time and without giving any reason.

I understand that anything I tell the researchers in the study will be confidential.

I understand that no real names will be used in the research report and that all the names will be fictitious to conceal my identity.

I have read / heard and understand this information and I agree to take part in the research.

I ___________________________ agree to take part in the above research.

Date: ________________________

Appendix E: Interview questions for VIP participants

Environments – Navigation under 3 headings

1. The intimate personal environment (e.g., at home):
Living room, bedroom, bathroom/toilet, stairs, hallway, kitchen, entrance, backyard/front courtyard

2. The more public but still familiar environment (e.g., the neighbourhood around the home and familiar journeys):
Supermarket, post office, restaurant/bar/coffee shop, shopping mall, cinema, park, transportations (bus, underground, train), workplace, school, church, hospital

3. The unfamiliar and unpredictable environment (e.g., complex new environment and unfamiliar journeys):
City centre/suburbs, shopping mall, hospital, family/friend visiting, unfamiliar transport station, travelling place

Research question

6. What are the range of capabilities and NS that VIP use when navigating environments?
7. How do these capabilities and NS vary from individual to individual?
8. How can one categorise these capabilities and NS?
9. How do these NS depend on the degree of the VIP's familiarity with - and the kinds of - the environment to be navigated (i.e. from those which they know intimately to those which are completely unfamiliar to them, (i.e. models E1 to E3 above)?
10. Would this kind of knowledge be of value to designers of the built environment?

Interview Questions

1. Could you please tell me your age and your visual impairment history?
   - Name: ________________________
   - Gender: ________________________
   - Age: ________________________
   - Age when visual impairment onset: ________________________
   - Type(s)/Cause of visual impairment: ________________________
   - Type of navigation aid: ________________________
   - Registered as a visually impaired person (when?): _________________
   - Other sensory impairments/physical disease:
     ____

2. Could you please describe your daily routine at home (e.g., living room, bedroom, bathroom/toilet, stairs, hallway, kitchen, entrance, backyard/front courtyard)?

- Navigation
- Tasks
- Perception of the surroundings
- Environmental features
- Mental mapping
- Challenging tasks
- Strategies

3. Could you please describe a typical journey that you make around your neighbourhood (e.g., supermarket, post office, restaurant/bar/coffee shop, shopping mall, cinema, park, bus station, underground station, train station, workplace, school, church)?

1. Daily routines
2. Description of routes for tasks
3. Perception of the surroundings
4. Significant environmental features
5. Mental mapping
6. Challenges
7. Strategies

4. Could you please describe an unfamiliar journey that you make (e.g., City centre/suburbs, shopping mall, hospital, family/friend visiting, unfamiliar transport station, travelling place)

1. Description of routes for tasks
2. Experience of learning a new route
3. Perception of the surroundings
4. Significant environmental features
5. Challenges
6. Strategies

Appendix F: E-mail content for professional interviews

Dear Sir/Madam

I am Ji-Wei Wu, a PhD student of The Glasgow School of Art. My director of studies is Professor Alastair Macdonald, Senior Researcher in the School of Design.

My PhD research is concerned with developing a better understanding of how visually impaired people's (VIPs') find their way around the built environment.

As part of my research, I am now keen to interview a number of architects and designers, who are experienced in the design of the built environment, in order to assist my study and to develop a deeper understanding of the design processes they use.

I am writing to ask if you would be interested in - and would agree to - being interviewed by myself for this purpose. I am happy to arrange a mutually suitable time and date for a visit. I expect the interview would take approximately 30 minutes.

I would be really grateful if you could share your knowledge with me.

I am looking forward to hearing from you.

Kind regards,

Ji-Wei Wu

Appendix G: Consent form for professional participants

Research into design processes encountered by experiences of sight loss or visual impairment

Ji-Wei Wu (PhD Candidate)
School of Design
The Glasgow School of Art
Date commenced PhD: September 2009
Supervisor: Prof Alastair Macdonald
Co-Supervisor: Sally Stewart

I want to thank you for taking the time to meet with me today. My name is Ji-Wei Wu and I would like to talk to you about your experience in designing the built environment for visually impaired people.

This will help in my research which is being supervised by Professor Alastair Macdonald, Senior Researcher in the School of Design at The Glasgow School of Art and which will adhere to our Ethical Code of Practice.

The interview should take approximately 30 minutes. With your consent, I will be tape-recording the session because I do not want to miss any of your comments. Because we are on tape, would you mind speaking up so that I do not miss your comments.

All responses will be kept confidential. This means that any information from your interview responses which I include in my research will not identify you as the respondent. Remember, you do not have to talk about anything you do not want to and you may end the interview at any time. I may wish to follow-up some points from this interview, and may wish to contact you again. This will be optional and there is no obligation to participate.

Are there any questions about what I have just explained?

Are you willing to participate in this interview?

Research into issues and problems encountered by experiences of sight loss or visual impairment

PhD candidate: Ji-Wei Wu
Supervisor: Prof Alastair Macdonald, Senior Researcher School of Design The Glasgow School of Art

Statement of Consent

I understand that the study involves interview/s and possible follow-up session/s which will be tape-recorded. I understand that taking part in the research is entirely voluntary and that I can stop taking part in the study at any time and without giving any reason.

I understand that anything I tell the researchers in the study will be confidential.

I understand that no real names will be used in the research report and that all the names will be fictitious to conceal my identity.

I have read / heard and understand this information and I agree to take part in the research.

I ______________________________ agree to take part in the above research.

Date: __________________________

Appendix H: Interview questions for professional participants

Introduction
I am researching how designers think about VIPs, how they approach design for VIP, and how they understand VIP's capabilities when navigating in different environments

Section 1

This section is about establishing designers' current approach and practice. For example, how they currently think about VIP, how they currently approach designing for VIP, and what tools, guidelines, regulations, etc they use.

1. How do you think about VIP? How do you define VIP?

2. a) Do you do any kind of designing for VIP and b) do you design any kind(s) of environments for VIP?

3a. If yes, what do you design (for VIP)? How do you approach designing for VIP?
3b. If no, how would you design an environment for VIP? How would you approach designing for VIP?

4. What regulations/design guidelines/design strategies do you reference (if any)?

5. What do you think of current building regulations/design guidelines/design methods/tools? Are they helpful for you to understand VIP's issues better?

6. If yes, how do you usually apply the knowledge into the way you design the environment for them? Do you go further than the building regulations/design guidelines/design methods/tools?

7. If not, what do you think would be helpful to improve the knowledge about VIP?

Section 2

This section is concerned with asking designers more probing questions about VIPs. For example, how do designers understand VIP's capabilities when navigating in the environments, how do designers solve problems for VIPs, and if designers are using different design guidelines/design methods/tools to approach VIP in different environments.

8. How do you think VIP find their way around the environments encountered in their daily life?

9. What difficulties do you think VIP might have when they move around in different environments (e.g., during activities at home, going to the supermarket, to visit friends/family, to hospital/related organisations, or a new location)?

10. What strategy/strategies do you think VIP use to deal with these difficulties and for finding their way around?

11. Do you think there is a best or ideal strategy for them?

12. Do you think design can help solve their problems? If so, how?

13. What do you think are important features that should be incorporated in the design of the environment for VIP? Why do you think these features are important?

14. What do you think of the current standard of design of environments? Do you think they assist VIP?

15. Can you think of any what you consider to be examples of: a) good well-designed environments for VIP; b) poor, badly-designed environments for VIPs. Give reasons to support your choice.

Appendix I: Sensitising through empathic method

A journey with visual impairments

Introduction

To sensitise myself to some of the issues encountered by VIP, I made a journey through different spaces and places in the centre of Glasgow using the GDBA simulation specs which simulated: i) cataracts; ii) macular degeneration; iii) diabetic retinopathy and iv) glaucoma. This is record of that journey made in June 2010

1. Vision Impairment with Cataracts

Accommodation

When wearing the cataract simulation glasses, most of the level buttons were too dark to identify, and the numbers were difficulty to see. Only the one with green circle can be seen at first sight.

The button with the red light can be identified more easily. The audio sound of “the door is open/close” was helpful to know whether the door is closed or not.

The graphics on the vending machine can be identified, however, the visibility would be improved when graphics with lights.

Street

The yellow part of pedestrian crossing interface is easily noticed, however, the black part can be hard to identify, and the “wait” sign was also difficult to see. It took some time to know whether the crossing signal was processing or not.

In this view, the red traffic light opposite was the most obvious object to be noticed.

It was confusing to identify if it was stairs or just a shadow on the ground.

The two traffic lights were two of the most noticeable objects through the cataract simulation glasses.

Supermarket

The words on the signboard were extremely difficult to identify and the colours were also too dark to be seen. The clearest colour was red, the next was white, and it was hard to identify the blue colour.

When selecting the food in the refrigerator, I can only see the food with a vivid colour, e.g. yellow, red, etc.

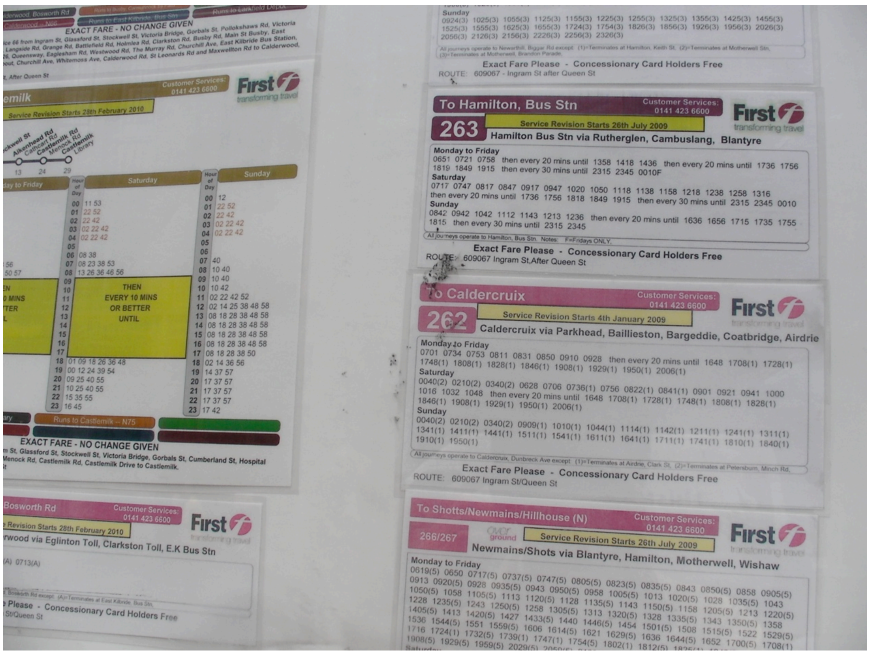
The black words on the yellow background discount cards were easier to read than those on the white card.

When using the self check out machine, the “start” button with green light cannot be found, and the screen on the card payment machine cannot be seen at all.

2: Vision Impairment with Macular Degeneration

Bus station

The numbers on the board can only be identified when standing very close, and the size of the numbers was slightly laborious to read.



The bus numbers were too small to read.

The bus number was big enough to identify; however, the street name cannot be seen. It was easier to read the information with yellow lights than that with green lights.

Street

The black obstacles cannot be noticed when wearing the macular degeneration glasses.

It was much more difficult to notice the stairs when using the macular degeneration simulation glasses than with the cataract simulation glasses.

When using the macular degeneration simulation glasses, all the pedestrians were totally blurry; however, the street cleaner who was wearing the fluorescent green uniform can be identified more easily.

The pillar on the street was extremely difficult to be noticed and was very easy to collide with.

Shopping mall

When wearing the glasses of macular degeneration, the signboards with lights can be seen easier. However, most of the words on the signboards were too small to read, only the bigger words can be identified.

The words on the rectangular floor guide board were too small to read, and the words on the higher position of the board cannot be identified at all. The floor guide board was covered by glass which made it more difficult to read due to the reflection.

3: Vision Impairment with Diabetic Retinopathy

Street

It was confusing to identify which way to pass through.

The city guide board was like a dark object and difficult to understand what it was.

It was hard to identify the name of the streets.

When wearing the glasses of diabetic retinopathy, the vision was too blurry to distinguish pedestrians' faces. The most visible objects were still the traffic signals.

The road name on the street nameplate cannot be identified at all.

The downward stairs were not clear enough to identify and the black lines on the ground were confusing.

The upward stairs with contrasting shadow made it clear enough to be noticed.

When wearing the glasses of diabetic retinopathy, the sense of distance with pedestrians was confusing and was easy to collide with others.

4. Vision Impairment with Glaucoma

Street

When wearing the glasses of glaucoma, the vision was not too difficult to see objects in the front, however, when crossing the road, the running vehicles coming from both left and right sides are less easy to be noticed. Meanwhile, the person who was standing next to me cannot be seen either. The vision was too narrow to see either side.

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