

Measuring what Matters:
*Comparing the Lived Experience
to Objective Measures of
Accessibility*

A thesis presented for the degree of Doctor of Philosophy at the
University of Aberdeen

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2013

Declaration

I declare that this thesis has been composed by myself. The work has been done by me and it has not been accepted in any previous application for a degree. All quotations have been distinguished by quotation marks and the sources of information specifically acknowledged

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02 April 2013

Abstract

Accessibility is an enduring concept in Transport Planning, historically relating to the performance of the transport system and more recently to the understanding of social aspects of transport planning and practice. Accessibility Planning, set in the context of addressing social exclusion, is one example of an applied approach to accessibility which seeks to reflect user perspectives. However, translating the concept into practice is problematic. Measurement is dominated by time and distance and separation of people from destinations, rather than reflecting individuals' perceptions. The core aims of this thesis are to critically appraise dominant approaches to Accessibility Planning and to understand how objective measures relate to perceptions of accessibility.

The thesis is structured into two main empirical stages. Firstly a review of current approaches is undertaken through engagement with accessibility practitioners in England and a comparative analysis of accessibility measures in the English Core Accessibility Indicators and National Travel Survey. Secondly a mixed methods case study, utilising household survey and mental mapping interviews in Greater Nottingham, is presented. Statistical analyses are used to compare objective and self-reported measures of accessibility and to explore factors contributing to perceptions of accessibility. Perceived accessibility is more strongly related to self-reported measures than to objective measures. Demographic characteristics and attitudes are also important in explaining variation in perceptions. For example, while an elderly person may perceive accessibility to be worse because of physical mobility issues, car users may perceive inaccessibility due to lack of awareness of alternatives, leading to different policy approaches. A grounded theory analysis of interview data highlights that affective and symbolic factors are useful in understanding perceptions of accessibility, in addition to the instrumental factors more usually studied.

Recommendations include a need to incorporate subjective measurement alongside more traditional accessibility measures, in line with wider policy discourses such as the recent development of subjective wellbeing measures by the Office for National Statistics.

Acknowledgements

Five years ago I had never been to Scotland and I had never thought about doing a PhD. A lot has changed since then, I have a lot of people to thank helping me get here, but most importantly I've made lots of great friends.

I am indebted to my supervisors, John Nelson and Jillian Anable, for your constant support, encouragement, patience and belief in me. Especially Jillian; for supporting me emotionally as much as academically, putting up with all the tears and dragging me out of several holes. I hope I haven't been too tortuous a first student for you. I am also grateful also to Derek Halden for his insights and feedback at earlier stages.

Without the input from survey respondents and interview participants I could not have done this research and I am thankful to them for giving up their time. Anke, Ilse, Geertje, Laura, Rob, Mike, Izzy&Yvonne – thanks for the hours spent envelope stuffing.

To everyone in St. Mary's and the map room, there are far too many to mention but you've all made it a fun few years. Particular thanks to Alison for making my maps look nice and Lorna for listening, and fellow phd-ers, Caroline, Marie, Agu & Richard. Laura - I enjoyed our games of squash and Friday morning coffee chats (er... I mean writing sessions), glad we've both finally made it. Also, everyone in CTR – Paulus, TaoTao, Craig, and Kate; for making me realise I could do it and for TGRG and Geovation fun! Rob for all hours of coffee rants. Geertje –what can I say? I wouldn't be here without you. I can never thank you enough for your constant support, be it getting stuck in the snow, drinking coffee, stats lessons, offering Dutch translations of my survey or endless hours in the Machar....and to the rest of the Machar gang for all those quick ones after work.

Kelly and Laura, you were a great inspiration for me; thanks for giving me the opportunity to be involved in exciting projects which gave me the passion to start this thesis. Laura thanks for always being there whatever crisis I might be having and being such a great friend (and co-holiday planner!).

I have been lucky to been involved in two exciting research projects over the last year - thanks to Catharine, Peter and everyone at OPENspace for giving me a great opportunity to work with you, my thesis has improved because of this experience. Lynette and Eva, thanks for all the support and encouragement over the last few months.

To those that had to live with me: Helen thanks for all the laughs, dragging me to circuits and making me run; Yvonne for wine Wednesdays (and Thursdays, Fridays, Saturdays...); Alex and Andrew – I promise to leave the cupboard and be a more exciting flatmate; and especially Izzy for living with me through the whole for three(+) years and making it all so much fun. I couldn't have asked for a better flatmate when I ventured to Aberdeen (well maybe not a brummy!) and you've become one of my best friends. Thanks for putting up with all my return visits this year. I promise to move out properly now.

Thanks girlies for all the weekend escapes and Jenna (not forgetting monkey & teddy) for all the motivation, silliness and curlywurlys. Emily, thanks for all the dinners and dragging me away from my desk to explore Edinburgh. Derek, you've made the past year so much more fun, thanks for not holding me to my promises of "it's almost over" and for scrupulously proof-reading it all.

Last but not least: Mom, Dad, Leanne & Richard for always being there for me and supporting me despite not having a clue why or what it's all about. It's because of you that I have the (usually well-hidden) self-confidence and determination to have achieved this. Thanks Dad for being the best printer ever and going out of your way to print my surveys so brilliantly, I couldn't have done it otherwise (sorry I was busy in my viva when you wanted Springsteen tickets!). Just don't ask me where I'll be in five years time....

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List of Abbreviations

CAI	Core Accessibility Indicators
COA	Census Output Area
DCLG	Department for Communities and Local Government
DfT	Department for Transport
ER	Electoral Roll
GIS	Geographical Information System
GPS	Global Positioning System
JT	Journey Time
LA	Local Authority
LSOA	Lower Super Output Area
LTA	Local Transport Authority
LTP	Local Transport Plan
NATA	New Approach to Appraisal
NEET	Not in Education, Employment or Training
NTS	National Travel Survey
ONS	Office for National Statistics
PAF	Postcode Address File
PT	Public Transport
S(IMD)	(Scottish) Indices of Multiple Deprivation
SEU	Social Exclusion Unit
STAG	Scottish Transport Appraisal Guidance
TTW	Travel to Work

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Use of Lower Super Output Area (LSOA) boundaries is covered by both of the statements above.

Part I: Introduction

1. Introduction

1.1 Introduction

Despite the recognised importance of accessibility in Transport Planning, it is an elusive concept, meaning different things to different people and as a result can be poorly defined and poorly applied in practice.

“accessibility....is a slippery notion... one of those terms which everyone uses until faced with the problem of defining and measuring it” (Gould 1969, p.64)

Accessibility is an enduring concept in transport planning and improving accessibility has long been an aim of transport planners (Holst, 1979; Metz, 2008). It is usually defined as the ease of access to destinations (Social Exclusion Unit (SEU) 2003), but translating the concept into practice can be problematic. This thesis investigates approaches to measuring accessibility, how such measures translate (or not) into achieving wider outcomes of transport planning and policy, and the relationship between objective measures and individuals' perceptions of accessibility. Measures of accessibility are usually objective, and while there are attempts to understand perceptions, these are not compared with the objective condition. This research therefore explores the relationship between objective and subjective measures of accessibility.

Accessibility to goods and services is an important aspect of an individual's quality of life. Poor accessibility may be a result of physical location or transport disadvantage. An inability to access basic levels of services such as employment, education and healthcare can perpetuate deprivation and social exclusion in society.

Furthermore, if services are located in places which are difficult to access using public transport, walking or cycling, then car use can become a necessity, meaning that those who do not have a car are excluded. The resulting increased car use by the majority facilitates development in even more disparate locations. Accessibility, as a concept in transport planning is therefore inextricably linked to sustainable travel and transport deprivation although these two policy goals may be at odds with each other.

Accessibility Planning is a policy mechanism designed to improve the ability of people to access opportunities (Halden, 2011) which allow them to participate in society. This has become popular in the UK, specifically England following a report by the Social Exclusion Unit, “Making the Connections” (SEU 2003). The

development of a range of measures known as the Core Accessibility Indicators (DfT, 2009a), measuring spatial accessibility to destinations, is associated with the development of Accessibility Planning Policy. These indicators form a core part of this thesis and are critiqued in depth in Chapter 4.

1.2 Background

This thesis addresses how the concept of “accessibility” has been applied in transport studies and transport planning and policy internationally, and questions whether current approaches allow the desired benefits of improving accessibility to be achieved. The research explores the relationship between objective and subjective measures of accessibility and overall accessibility perceptions. The impetus for this research is the author’s experience of the process of Accessibility Planning in England¹, related to the Local Transport Plan (LTP) requirements for Accessibility Strategies. This experience developed a critical perspective, both of the process (Lucas, 2006; Preston and Rajé, 2007), and of the way accessibility is currently measured and a perceived gulf between measures of accessibility and the perceptions of the individuals (Morris et al., 1979; Pacione, 1982), whom the process seeks to help.

A detailed discussion of definitions of accessibility is included in Chapter 2. However it is important to adopt a working definition from the outset, and clarify for the purposes of this study what accessibility does and does not include, in order to set bounds of this research.

The Oxford English Dictionary defines accessibility as:

“The quality or condition of being accessible”; and accessible is defined as 1a) “Capable of being entered or approached; ease of access; readily reached or got hold of b) of a person: readily and willingly available to others. Also (without construction): approachable; friendly; c) Able to be received, acquired, or made use of; open or available; d) Able to be (readily) understood or appreciated) Open to the influence of; capable of accepting; willing to receive; 2a) Capable of being used as an access; affording entrance or a means of approach. Also in figurative contexts; b) Capable of being conveniently used or accessed by people with disabilities; of or designating

¹ This thesis focuses specifically on the English context. England is a constituent nation of the United Kingdom (UK). Transport is a devolved power meaning that the process of Accessibility Planning, as applied through Local Transport Plans is unique to England, although Accessibility Planning is also applied in other parts of the UK, and internationally (as discussed in Chapter 5). The Department for Transport (DfT) is a UK government department, but its local transport planning jurisdiction only covers England. UK and England are therefore used at various points in this thesis depending on whether it is DfT policy (UK) or the specific way in which this has been administered through local transport planning (England).

goods, services, or facilities designed to meet the needs of the disabled.”
(Oxford English Dictionary, 2012)

It is clear that accessibility is a broad concept, dependent upon the situation to which it is applied. The working definition of accessibility at this stage of the research is the ability of people to access destinations or the ease with which a destination can be reached by a population, based on the SEU (2003) definition and used in Accessibility Planning, which sets the context for this research. Accessibility is usually measured by the physical separation (e.g. time, distance or cost) of people from those destinations and is not a new idea in transport planning. Numerous studies have attempted to develop robust quantitative measures of these objective aspects of accessibility. Accessibility in the context of social exclusion can be traced back to the work of Moseley et al. (1977) on rural transport and more recently has been formalised in UK policy through the introduction of Accessibility Planning as a mechanism to reduce transport related social exclusion (SEU, 2003), alongside a social shift in transport studies more generally.

Mobility and accessibility are often used interchangeably (Ross, 2000) yet they are two distinct concepts. Mobility is the ability to move whereas accessibility is the ease with which something is reached. In the absence of virtual mobility (Kenyon et al., 2002), mobility is necessary but not sufficient for accessibility. It is possible to be highly mobile yet have poor accessibility, as accessibility also depends upon the location of destinations and services. It is possible to imagine areas or individuals with high and low mobility and high and low accessibility. In terms of sustainable travel the ideal scenario is high accessibility and low mobility, whereas policy aimed at reducing transport related social exclusion would aim to ensure accessibility to services, even if this is met through providing car-based mobility. Transport policy often focuses on improving mobility, for example through relieving congestion without considering the accessibility that this affords. Accessibility Planning is a policy approach intended to rectify this by concentrating on providing access to goods and services, particularly for vulnerable population groups.

The approach advocated by the Social Exclusion Unit (SEU, 2003) and Department for Transport (DfT, 2004) recognises factors other than spatial separation as being important, and places emphasis on barriers such as information, cost, and safety and security, as well as provision of services and journey times. In doing so it also recognises that accessibility is not just about transport but also the provision of

services, and therefore advocates cross-sector working to achieve social inclusion objectives such as reduction of unemployment, missed appointments or those not in education, employment or training.

Despite this recognition, accessibility measures used in planning are dominated by “easily” quantifiable time/distance measures, and therefore do not necessarily reflect the complex interactions, perceptions and behaviours of individuals which influence travel and ultimately the ability of people to access destinations. In addition, indicators are aggregate, and GIS analysis is undertaken at the zonal level, assuming homogeneity of accessibility among geographical zones or socio-demographic groups, which may serve to obscure more scattered instances of inaccessibility, which are likely to be experienced by those most at risk from exclusion (Hine & Grieco 2003). Handy & Niemeier (1997) highlight the need for a high level aggregate analysis as well as local community planning;

“an accessibility measure is only appropriate as a performance measure if it is consistent with how residents perceive and evaluate their community. In other words, a practical definition of accessibility must come from the residents themselves, rather than from researchers, and reflect those elements that matter most to residents” (Handy & Niemeier 1997, p1176).

Targets set by local authorities are usually time based threshold accessibility measures, such as ensuring that “% of people over 60 are within 15 and 30 minutes of a GP surgery by public transport, walk and cycle” (Derbyshire County Council, 2005). However, it is difficult to see how such targets will lead to the kind of improvement advocated by Accessibility Planning, such as a reduction in the number of missed appointments. If 80% of the population already has access within 33 minutes, a three minute journey time reduction for a minority of the population may not be an appropriate policy goal. In the context of social exclusion it might be more appropriate to concentrate on the 5%, for example, who may never be able to use public transport, regardless of the journey time.

It is important to understand local level, household and individual accessibilities in addition to the aggregate, national or regional picture if we are to properly understand the relationship between accessibility and associated outcomes, and therefore target interventions appropriately.

Measurement of accessibility can be seen as one, of many, social indicators, monitored in order to ultimately improve the human condition through improved wellbeing. In social indicators research, an objective indicator relates to a

government indicator or measure designed to reflect the 'real' situation, and a subjective indicator is used to understand an individual perception or experience of that reality; as explained by Pacione (1982) objective indicators are "*hard measures, describing the indicators within which people live and work (p.498)*" whereas subjective indicators "*describe the way people perceive and evaluate conditions around them*" (p.498).

In the context of accessibility measurement, traditional accessibility measures based on time and distance are objective measures which seek to represent the reality of accessibility provided by the transport and land-use system, whereas subjective measures relate to the perceptions and self-reported accessibility of individuals, in other words: the "lived experience".

Social surveys are expensive and it is difficult to obtain representative samples so there is a tendency in public policy to model phenomena based on data that are cheaper and more straightforward to collect. Time is a concept that is easier to understand and can be measured. This leads to measures of potential accessibility based on the transport infrastructure, but such measures may bear little resemblance to realised or experienced accessibility which is more closely related to travel behaviour. However, understanding perceptions is important if the kinds of outcomes anticipated by changes in accessibility are to be possible.

Core Accessibility Indicators (CAI) (DfT, 2009b) are used in this thesis as an objective measure of accessibility and compared to subjective measures and perceptions of accessibility collected through primary research in the form of a detailed case study. The CAI have been developed as part of Accessibility Planning in England and calculate accessibility to seven destination types by car, public transport and cycling at the zonal level. A detailed description and critique of the CAI forms part of Chapter 4.

1.3 Research Gap

Many have noted the need for a greater understanding of subjective accessibility or mobility in relation to objective measures (e.g. Jones 2011; Ziegler & Schwanen 2011; van Acker et al. 2010; Morris et al. 1979). Ziegler & Schwanen (2011) suggest a need for a much greater understanding of perceived mobility to help in understanding mobility in relation to the objective physical environment (or equally

accessibility). They suggest that subjective factors are a better predictor of wellbeing, and that a combination of qualitative and quantitative approaches is useful. Relying on subjective or satisfaction studies alone can result in a satisfaction paradox whereby there is a reported high level of satisfaction despite seemingly unfavourable conditions (Diener et al., 1993), as measured by an objective measure.

While there is a considerable body of work attempting to develop objective measures of accessibility and equally those seeking to understand people's perceptions and experiences of travel, there is limited work directly comparing the two approaches to understanding accessibility for the same people or places. If more can be done to understand the difference between perceived and policy measured accessibility, then improvements in perceived and therefore realised accessibility, may be achieved, alongside improvements in how accessibility is measured and assessed by practitioners. Recently, Jones (2011) has suggested that "*The relative importance of, and interrelationships between, subjective and objective constraints*" (p.40) warrants further in depth empirical investigation.

1.4 Aims and Objectives of Thesis

The aims of this thesis are to understand how accessibility is currently measured and to explore how such measures of accessibility relate to individuals' perceptions of accessibility. The research is set in the context of Accessibility Planning in England and transport geography as an academic discipline which increasingly considers the social dimensions of transport. The aims are addressed through the following objectives:

Objective 1: To critically review the literature relating to measuring accessibility

Objective 2: To critically assess the current approach to Accessibility Planning in the UK, and specifically England

Objective 3: To develop understanding of the relationship between objective and subjective measures of accessibility

Objective 4: To understand which factors influence perceptions of accessibility

Objective 5: To provide recommendations for enhancing current accessibility measurement techniques

Research Questions specific to each part of the research are introduced in the chapter in which they are addressed.

1.5 Structure of Thesis

The objectives are addressed in two main stages (Figure 1.5.1). Firstly a review of current approaches to Accessibility Planning and secondly a detailed case study approach to understanding how perceptions of accessibility relate to objective measures.

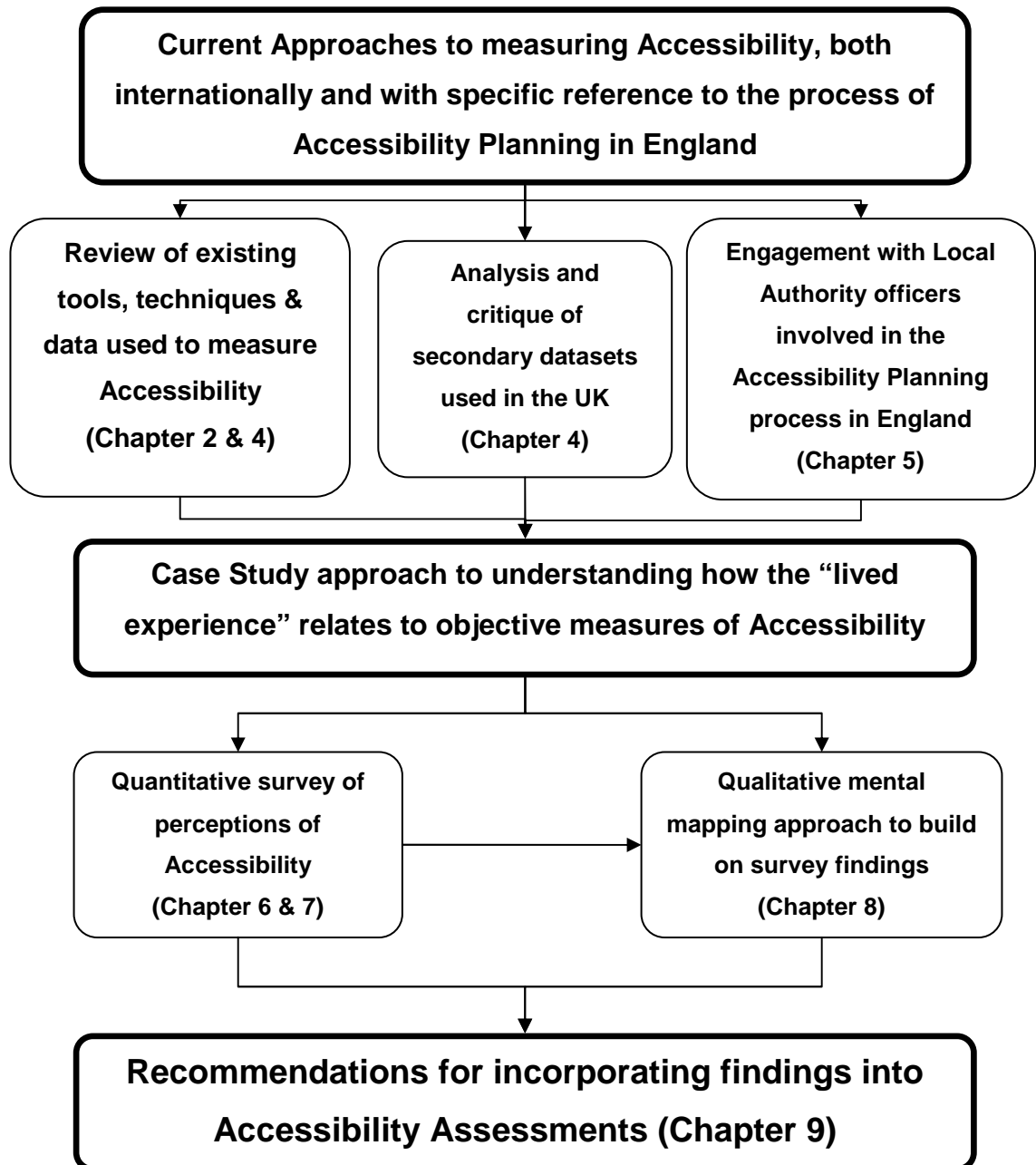


Figure 1.5.1 – Structure of Thesis

A review of the literature relating to measurement of accessibility and subjective and objective measures is presented in Chapter 2.

Chapter 3 details the overall methodological approach to the research.

The first empirical stage of the research comprises an analysis of current approaches to measuring accessibility and is addressed through Chapter 4; a review of existing datasets and a comprehensive analysis of Core Accessibility Indicator Data (CAI) and National Travel Survey (NTS) data. Chapter 5 reviews current approaches to measuring and applying accessibility through semi-structured interviews with officers from Local Authorities in England who have been involved in applying Accessibility Planning in practice.

These chapters feed into and inform the second main stage of the research which is a case study approach to understanding the lived experience of accessibility as compared to objective measures.

This is achieved through a detailed household survey to measure perceptions of accessibility in Greater Nottingham. The survey sampling and questionnaire development is presented in Chapter 6. Chapter 7 contains detailed survey analysis, comparing objective (CAI) and subjective (household survey) measures of accessibility. Chapter 8 is a more in-depth exploration of factors influencing perceptions of accessibility.

Finally, Chapter 9 draws together the material from all stages of the research and presents overall conclusions and recommendations.

2. Accessibility: A Review of the Literature¹

¹ An earlier version of the first part of this chapter was presented as a written paper and oral presentation at the Universities Transport Studies Group (UTSG) Conference in Plymouth, January. 2010. (Appendix B)

2.1 Introduction

This chapter sets the context and background for this research and outlines the direction of this research, through a review of the current literature. The review is split into two main sections: firstly, accessibility, as a concept in transport planning and its measurement and application, are reviewed temporally and spatially. A gap is identified relating to the measurement of perceived accessibility and the use of subjective measurement from individuals' perspectives. The second section therefore draws on a wider field of literature to review the relationships between objective and subjective measures in transport studies more broadly. Finally the review highlights gaps in research to set the context for the following chapters.

2.2 Accessibility in Transport: Definitions, Concepts and Measurement

This section discusses varying definitions and approaches to measuring accessibility presented in the literature.

2.2.1 Defining Accessibility

Accessibility has a long history in transport planning. However, this does not mean its definition is easy (Gould, 1969). Gould highlights the difficulties in defining and measuring a term so frequently used as accessibility. Accessibility can be, and has been, defined in numerous ways, dependent upon the context in which the term is being employed, who is defining it and for what purpose.

As highlighted by Gould (1969) and others (Geurs & van Wee 2004; Pirie 1979), accessibility is an elusive concept that can easily be misunderstood and poor understanding can mean that the concept is difficult to apply in practice (Straatemeier, 2008).

In the context of Transport Planning, accessibility is usually understood as the extent to which something is "*get-at-able*" (Moseley 1979, p.56). Geurs & van Eck (2001) consider accessibility to be the way in which the land-use and transport system allows individuals or destinations to interact using a range of transport modes. Whilst recognising individuals, this definition focuses on the ability of the land-use and transport system to provide accessibility to destinations.

Taking a people focused approach, the Dictionary of Human Geography defines accessibility as *“the ease with which people can reach desired activity sites, such as those offering employment, shopping, medical care or recreation”* (Gregory et al. 2009, p2). Their definition goes further, suggesting that accessibility is often used as an indicator of quality of life and explaining that accessibility is *“affected by land-use patterns, mobility and mobility substitutes in the form of telecommunications”*(Gregory et al. 2009, p2). This definition suggests that mobility is an important aspect of accessibility but also emphasises the importance of infrastructure. The terms accessibility and mobility are often used interchangeably (Ross, 2000) and consequently measures of accessibility focus on the transport system, however these two concepts are different; a discussion of the differences between accessibility and mobility was included in Chapter 1.

Social impacts and issues of transport exclusion and disadvantage, rather than system focused definitions of accessibility have gained prominence in the last decade, particularly following recommendations by the Social Exclusion Unit (SEU, 2003). The concept of accessibility in Transport Planning in the UK has developed a more social aspect (Lucas et al., 2001; Lyons, 2003), with a clear link between issues of social inclusion and deprivation. Internationally too there is an increase in the number of studies using accessibility to understand the transport needs of diverse population groups, with a particular focus on those at risk of exclusion (Church et al., 2000; Casas, 2007; FIA Foundation, 2007; Currie et al., 2009; Stanley and Lucas, 2009; Bukhari et al., 2010).

The SEU defines accessibility as the ease with which people can access goods and services, asking *“can people get to key services at reasonable cost, in reasonable time and with reasonable ease?”* (SEU, 2003, p1). Defining accessibility in this way makes it more difficult to measure, as ‘ease’ and ‘reasonable’ will be interpreted differently depending upon the individual context. Within this definition the SEU emphasises the need for consideration of the physical availability of transport, journey time, cost, information, safety and security and travel horizons.

There is a conceptual link between accessibility and social exclusion, evident in the work of Moseley et al. (1977) who explored issues of rural inaccessibility. It is postulated that poor levels of accessibility to essential services can lead to and

exacerbate social exclusion. Accessibility issues among groups at risk of exclusion have been well researched (Dibben, 2003; Casas, 2007; Titheridge et al., 2007; Ureta, 2008).

Social exclusion is defined as a multidimensional and dynamic concept meaning that individuals may be excluded or at risk of exclusion at different times and may move in and out of exclusion. It is also a relative concept rather than an absolute concept such as poverty, as highlighted in the definition of exclusion as not being able to participate in activities normal to the society in which someone lives (Burchardt et al., 1999). Social exclusion and deprivation are often used synonymously and transport deprivation is often associated with social exclusion, although there are differences between the two concepts. Deprivation may be seen as a more static state from which an individual struggles to move whereas exclusion is more the process by which someone becomes deprived. There is an increasing number of studies focusing on transport and social exclusion and in some cases inaccessibility is seen as synonymous with social exclusion (e.g. Scottish Transport Appraisal Guidance, (Transport Scotland, 2008)), although this is not necessarily the case. It is possible to live in an inaccessible area and not be excluded from participating in society, if one has the means to do so virtually or to travel. Equally, an individual could live in an accessible location yet be unable to participate in activities due to non-geographical barriers. Section 2.2.3 discusses the potential outcomes of changes in accessibility and how these are achieved.

Accessibility is increasingly used in transport, and other fields, in relation to disability, and ensuring equality of access for all groups in society (Homer, 2003). Such uses are linked by a more people focused use of the term and the inclusionary connotations of accessibility. Accessibility is often contiguous with inclusivity and equality, both within and outside of transport studies. For example 'accessible transport' is often provided for those with mobility difficulties and many websites have 'accessibility' statements relating to the policies they adopt to ensure inclusive access to all members of society¹. The scale of this 'accessibility' is often much more micro, for example in relation to step free access on public transport. Historically, in transport planning accessibility has been used to describe the physical separation of

¹ See for example: <http://www.eastcoast.co.uk/-general-links-/accessibility/> (accessed 18/6.2012)

people from goods and services but the emphasis on social inclusion is more recent. Although academically social aspects of accessibility have been discussed for some time (Moseley, 1979), the practical application is more recent (SEU, 2003).

This section has discussed varying definitions of accessibility. Definitions can be place-based or people-based (Weber, 2006) and may consider individuals or system constraints. Increasingly the focus is on accessibility of individuals rather than systems. Scale plays an important role; accessibility can mean anything from the presence of a wheelchair ramp to a regional macro-economic measure of performance. Clarity regarding which “accessibility” is being discussed and measured is important in any study. The focus in this thesis is neither on macro-economic measures nor micro level accessibility but the local level of accessibility to destinations in transport planning.

Differing understandings of accessibility will lead to the concept being applied in different ways. In order to develop practical applications of accessibility there is a need to develop appropriate and meaningful measures of accessibility which measure variation both spatially and temporally and can be utilised in planning and policy decision making. As outlined above, emphasis can be placed on the accessibility of a place or a person, and on individual capabilities or system provision. Vandenbulcke et al. (2009) suggest that accessibility is determined by four interdependent components: A *transport* component (transport system); A *land-use* component (the magnitude, quality and characteristics of activities found at each destination); A *temporal* component (availability of activities); An *individual* component (needs, abilities and opportunities of individuals). The extent to which each of these components is represented in accessibility measures differs depending upon the definition of accessibility adopted. This is a useful categorisation for understanding the components of traditional accessibility measures, which measure objective accessibility, but does not incorporate whether this accessibility is related to the realised accessibility of individuals through their travel behaviour. The following section discusses approaches to measurement.

2.2.2 Measuring Accessibility

Measures of accessibility are almost as numerous as its definitions. This section summarises a review of empirical papers that apply measures of accessibility based

ona more detailed review conducted at an earlier stage of the research (Curl, 2010) and is included in Appendix B. This was built around a typology of tools, techniques and data. Following the early review it was found that any application of the concept of accessibility to a real-world situation requires a) a *technique* (or measure), based on some theoretical understanding; b) a *tool* such as a spreadsheet, database or transport model (which is often bespoke to the specific application) in order to operationalise the technique; and c) *data* such as the road network, location of activities or travel behaviour data. This section focuses on the techniques used to measure accessibility. A discussion of tools and data specific to the UK context is included Chapters 4 and 5.

Classical approaches to measuring accessibility include Hansen (1959) and the time-space geography of Hägerstrand (1970). Hansen developed a measurement of accessibility to be used in development control and town planning, based on a definition of accessibility as the “*potential opportunities for interaction*”. His formula was based on:

“accessibility at point 1 to a particular type of activity at area 2 (say employment) is directly proportional to the size of the activity at area 2 (number of jobs) and inversely proportional to some function of the distance separating point 1 from area 2. The total accessibility to employment at point 1 is the summation of the accessibility to each of the individual areas around point 1. Therefore as more and more jobs are created nearer to point 1 the accessibility to employment at point 1 will increase” (Hansen, 1959, p.73).

This definition is the focus of many macroeconomic studies where travel time accessibility is used as a measure of the efficiency of the transport system and is commonplace in regional science approaches (e.g. Bertolini et al., 2005; Geurs, 2006; Vandenbulcke et al., 2009; Gutiérrez et al., 2010).

Taking a more person-centred approach Hägerstrand (1970) introduced the concept of time-geography and space-time, which is based on individual travel spaces and taking into account daily scheduling. Hägerstrand (1970) critiqued aggregate and regional approaches to addressing complex individual issues such as accessibility to services and emphasised the need to focus on individuals’ constraints. While recognising that there cannot be a focus on each and every individual, he suggested a focus on a “twilight zone” between aggregate statistics and biographical approaches. Hägerstrand (1970) conceived individual time-space prisms

representing a daily or life path, which is related to a potential path area (PPA) for each individual's accessibility based on their individual and system constraints.

This approach has been applied extensively in academic studies, particularly utilising travel diary data in the United States (Weber and Kwan, 2003). Such an approach provides a much greater insight into the individual constraints and difficulties faced in day to day travel. However, there is limited evidence of this approach being applied in practice, perhaps due to the data requirements and the difficulty of developing policy to address individuals' issues. More recently, this approach has been somewhat revived with advances in GIS technology and processor capabilities which mean that much more data can be processed (Kwan and Weber, 2003). Using a combination of time-space measures and multilevel modelling Weber & Kwan (2003) investigate the influence of various individual and environmental variables in explaining accessibility. Their accessibility measures are individual time-space accessibility measures calculated using travel diary data and the transport and land-use infrastructure. The study concluded that individual factors are more important than urban form characteristics in explaining *car based* accessibility (Weber and Kwan, 2003). However, their dependent variable is based on objective measures of what level of accessibility is possible given individual constraints, but does not account for whether an individual is satisfied or not with their level of accessibility. This shows that despite accounting for individual constraints, time-space studies are usually calculated using objective datasets of the transport system and there is an assumption that a larger potential path area is desirable, meaning greater accessibility. However, it is possible that an individual travels further as a result of the disparate location of activities. The relationship between such measures of accessibility and behavioural outcomes is therefore unclear.

These two approaches can be seen to represent a places or people focus of accessibility measures, with Hansen's measure an engineering and macroeconomic based modelling approach and Hägerstrand's theoretical time-geography approach focusing on individuals (Shaw 2012).

There are however, a plethora of intermediate approaches to measuring accessibility in the literature and various attempts have been made to categorise these.

Vandenbulcke et al. (2009) categorise approaches to measuring accessibility into

four main types: *infrastructure* based measures; *activity* based measures; *person* based measures; and *utility* based measures. Handy & Niemeier (1997) also classified measures into categories as follows: *cumulative* measures; *gravity* based measures; and *random utility* theory. Geurs & van Eck (2001) provide a detailed overview of accessibility measures, classifying these into *infrastructure* based, *utility* based, and *activity* based. Geurs & van Wee (2004) identify four types of measure: *infrastructure* based; *location* based; *person* based; and *utility* based. Baradaran & Ramjerdi (2001) use a slightly different categorisation, splitting measures into: travel-cost; gravity; constraints-based; utility-based and; composite. In a review of accessibility measuring techniques Halden et al. (2000) categorised measures into: *simple* measures; *opportunity* measures; and *value based* measures. Liu & Zhu (2004) suggest accessibility measures may include seven aspects: definition of a spatial unit for analysis; definition of socio-economic groups; type of opportunities; mode of travel; definition of origins and destinations; measurement of attractiveness; and travel impedance. It is evident that not only are there many different approaches to measuring accessibility, but also that these have been categorised and defined in numerous ways. Table 2.2.1 summaries the main types of measures based included in the categorisations above and gives an example measure in each case.

The majority of studies reviewed here were based on cumulative opportunity, potential and gravity measures following (Hansen, 1959), or focus on individual time-space measures of accessibility following the time-space geography of Hägerstrand, (1970). The choice of measure utilised relates to the aims and objectives of the study, with strategic, destination based studies using cumulative or contour measures, origin based studies of accessibility using potential or gravity based measures, and individual level studies using activity based measures.

Table 2.2.1 – Categorisation of Accessibility Measures

Measure	Description	Example Measure
<p>Infrastructure based measures</p> <p>(e.g. Church et al., 2000)</p>	<p>Relate to the performance of the network and therefore might include measures used in transport modelling such as capacity, or in terms of public transport frequency or reliability.</p>	<ul style="list-style-type: none"> • Travel times to development site • Frequency of bus services passing an origin point • Congestion across a local authority area
<p>Cumulative measures</p> <ul style="list-style-type: none"> - Contour measures - Threshold Measures <p>(e.g. Nettleton et al. 2007; Casas 2007; Escalona-Orcao & Díez-Cornago 2007)</p>	<p>Represent the accessibility at a location (origin) to another (destination) or set of destinations and are the most easily understood measures. These are often also described as contour measures, due to the contour maps produced.</p>	<ul style="list-style-type: none"> • Proportion of the population within a reasonable (e.g. 30 minute) walking time threshold of a doctors surgery • Number of schools within a 20 minute drive of a postcode sector (origin)
<p>Gravity based measures</p> <ul style="list-style-type: none"> - Hansen measures - Opportunity measures - Potential measures <p>(e.g. Bertolini et al. 2005; Geertman & Van Eck 1995; Knox 1981; Hansen 1959)</p>	<p>An extension of cumulative measures, but opportunities are weighted by an impedance factor and the attractiveness of the destination, and may also be called opportunity or potential measures. The resulting measure does not mean anything on its own but is a relative measure of accessibility at one point relative to others within the study area.</p>	<ul style="list-style-type: none"> • Accessibility of the defined population (e.g. within a local authority area) to employment (where accessibility is calculated using a function of travel time and number of jobs available at each employment site). • Accessibility of schools to the population (where accessibility is calculated using a function of travel time and number of children of school age).
<p>Utility based measures</p> <p>(e.g. Bohnet & Gertz 2008; Niemeier 1997)</p>	<p>Considers travel behaviour in terms of selecting the location based on economic principles of diminishing return; the likelihood of an individual making a certain choice is based on the attractiveness of that choice in relation to all options.</p>	<ul style="list-style-type: none"> • Monetary value of a change in accessibility for a defined population • Accessibility, in terms of attractiveness, of a destination based on the expected utility an individual will gain
<p>Activity based measures</p> <ul style="list-style-type: none"> - Time-space measures - Potential Path areas <p>(e.g. Buliung & Kanaroglou 2006; Casas 2007; Farber & Páez 2009)</p>	<p>Relate to individuals' level of access to spatially distributed activities, considers location of activities, travel through the network and incorporates a behavioural element, usually captured via travel diary data.</p>	<ul style="list-style-type: none"> • Potential Path Area The area that can be visited by an individual taking into account location of destinations, the transport network and the individual's scheduling constraints • Household Activity Space Extension of the Potential Path Area to account for the activities and constraints of all members of the household

However, many studies of accessibility do not use these ‘traditional’ types of accessibility measure but instead use a range of methods to understand accessibility issues, be this people or place-based. A typology of techniques, tools and data used to measure and assess accessibility was developed as part of this review.

Figure 2.2.1 summaries the relationship between techniques, tools and data requirements, showing the different types of tools and data that were found applied to each different technique.

One of the most commonly used tools is some form of Geographical Information System (GIS), and the majority of studies covered by this review utilised GIS to implement accessibility techniques. A range of GIS based tools developed specifically for measuring accessibility were identified, including ACCMAP (Hillman and Pool, 1997), ACCESS (Liu and Zhu, 2004), ACCALC¹, Accession² (Jones 2011; Nettleton et al. 2007), PTAL³ (Wu & Hine 2003), PTATT⁴ and CAPITAL (Church et al., 2000). Tools are also developed for specific purposes such as accessibility to food⁵ or healthcare⁶. In contrast to the previous examples, both of these tools were developed from a non-transport perspective. Similarly the Cycling Health Economic Assessment Tool⁷ was developed from a health perspective to quantify the benefits of improved cycling accessibility.

Transport Models can be used to provide an understanding of the level of accessibility provided by the transport system, and therefore are most likely to be used to calculate infrastructure measures such as congestion levels or network distances. The coarse scale of analysis of such models means they are more likely to be used to assess high level strategic accessibility rather than to understand an individual’s accessibility problems, and therefore have less relevance for more disaggregate measures as shown in the diagram.

¹ http://www.dhc1.co.uk/features/accessibility_planning.html

² www.citilabs.com/accession

³ Public Transport Accessibility Levels (PTAL)

⁴ Public Transport Accessibility and Travel Times (PTATT) (www.caci.co.uk/pttt)

⁵ Food Mapping Toolkit (<http://www.foodvision.gov.uk/pages/food-mapping>)

⁶ Health Services Travel Analysis Toolkit (HSTAT) (<http://www.london.nhs.uk/what-we-do/improving-your-services/performance-and-development/redesigning-services/transport-and-accessibility>)

⁷ Cycling HEAT (http://www.euro.who.int/transport/policy/20070503_1)

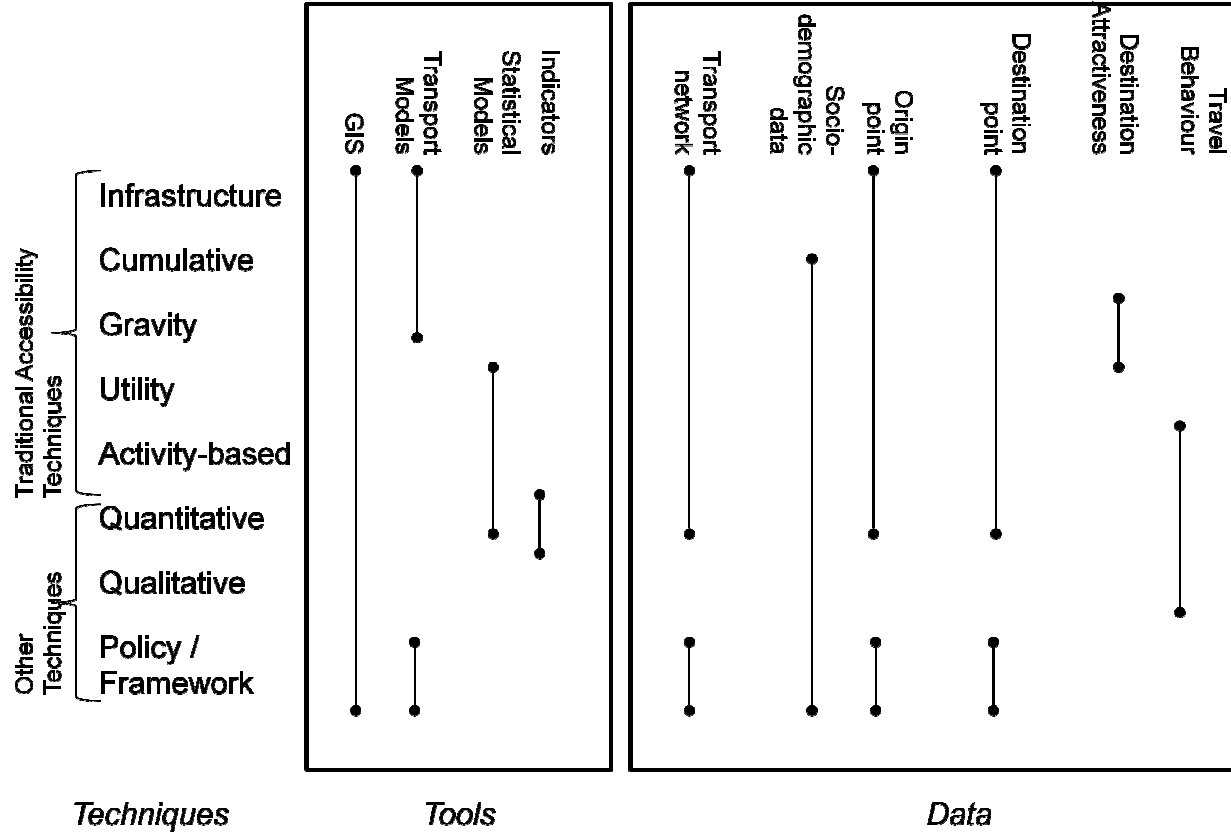


Figure 2.2.1 – Summary of Review of Accessibility Studies and Typology of Tools, Techniques and Data

Likewise statistical models based on individual level data and techniques such as multilevel modelling are used more frequently in quantitative studies and more complex measures such as activity utility-based measures.

Quantitative approaches based on social indicators, such as the Indices of Multiple Deprivation (IMD) or quality of life are often used to assess accessibility. The Accessibility domain of IMD includes geographical measures of accessibility. These are usually based on objective datasets but may also utilise perception data for example from household survey data. However, on the whole household surveys are used to collect travel behaviour data rather than an individual's satisfaction with or perceptions of their accessibility. The Core Accessibility Indicators (CAI) calculated by the Department for Transport (DfT) may collectively be seen as an indicator tool, but are also based on infrastructure and cumulative accessibility measures and calculated using a GIS-based tool, highlighting that this categorisation of tools, techniques and data is not mutually exclusive, but nevertheless provides a useful framework to understand the various inputs to an accessibility assessment. A detailed discussion of the CAI is in Chapter 4.

Qualitative assessments of accessibility include those based upon interviews (Lotfi and Koohsari, 2009), focus groups (McCray, 2009) or workshops (Jones 2011). Such qualitative approaches are more common when the issues being explored are related to individuals' perceptions (Rajé, 2007a) and also when studies incorporate a focus on social exclusion.

Individual level data and subjective measures have been incorporated into existing accessibility measures in a number of ways and the extent to which individual accessibility is considered by existing approaches varies as illustrated by Table 2.2.1 and Figure 2.2.1. Gravity models incorporate destination attractiveness or deterrence functions which may be based on individuals' travel behaviour. For example the Core Accessibility Indicators calculated for England currently use existing travel demand based on National Travel Survey data to determine the deterrence function for continuous accessibility measures. However, such an approach is problematic given that existing travel patterns do not necessarily reflect desired travel behaviour and therefore may be as much a function of accessibility provided by the transport system and therefore not an appropriate input to an accessibility measure.

Utility measures such as logsum measures (Geurs et al, 2010) are designed to incorporate individual accessibility (dis)benefit into transport appraisals, rather than

just aggregated travel time savings. Activity based measures are more focussed on individual behaviour and are calculated using individual travel patterns, often utilising travel diary data (e.g. Farber and Paez, 2009), and taking into account constraints such as individual mobility. Such measures utilise objective measures of the transport and land use system and therefore do not account for whether an individual is satisfied with their current levels of accessibility within the system. Furthermore, although activity based measures can calculate the potential path area within which an individual can access services, given their individual constraints, there is no account of whether they fulfil or are aware of this potential. Discrepancies may still occur between how an individual may perceive their local accessibility and that measured by planners or researchers.

Survey based approaches and qualitative studies go much further than traditional accessibility measures in understanding and measuring individual accessibility. However, those based only on subjective or self-reported data generally do not compare these with an objective measure.

The types of data used vary in terms of their level of detail, availability, coverage and recentness. It is evident that the type of data required is dictated by the type of measures being applied and the tools used, but also that the reverse is often true, whereby the data availability drives the decision regarding the tools and techniques to be employed. If this is the case, it is vital to ensure that the data that is being used is appropriate to the research questions and desired outcomes, otherwise there is potential for inappropriate conclusions based on limited available data.

There are a number of national data sets which are periodically updated and provide data useful for analysing accessibility (e.g. National Travel Surveys and Censuses). However, given that such datasets are rarely designed for this specific purpose and are reported at quite coarse scales they are not always appropriate, and data is often used as proxies for required information (e.g. car ownership used for low income and poor accessibility). The advantage of these datasets is their ease of availability and low cost to the researcher. On the other hand, data sets such as the 1994 Portland Household Activity and Travel Behaviour Survey (e.g. Farber & Páez 2009; Buliung & Kanaroglou 2006) or the German Mobility Survey (Bohnet and Gertz, 2008) have been the basis of detailed studies into accessibility, with the disadvantage that they are expensive to conduct and as a result not regularly updated, so the data is often quite old when it is used. Use of GPS in conjunction with GIS offers the potential for

collection of such data to become more commonplace and there have been some studies using such data (Schönfelder & Axhausen 2003). Accessibility studies also include data as wide ranging as physical activity levels (Cerin et al., 2007; Aytur et al., 2008; Badland et al., 2008) and house transaction prices (Andersson et al., 2010).

In any measure of accessibility, it is important to consider the appropriateness of the data sets being used, both to the type of technique and also the desired outcomes of a study. Time-space measures are the most data intensive, requiring detailed travel diary data, whereas infrastructure and cumulative measures are the least data intensive and can often be calculated using existing datasets such as GIS layers of road networks and destination types.

Many studies utilise a combination of techniques in developing an understanding of accessibility, as, broadly speaking, quantitative approaches provide an aggregate level of understanding, often enriched by qualitative work addressing individual level issues. As suggested by Handy & Clifton (2001), the best approach is often a combination of techniques with an initial accessibility assessment, which is enriched by local case studies. Qualitative methods may be best placed to understand detailed accessibility requirements, but the tools for implementation are less developed in a practical sense. Framework and policy approaches include those that incorporate more than one technique, for example combining accessibility measures and quantitative statistical analysis to form policy decisions.

One such policy approach is the process of Accessibility Planning introduced in England following the recommendations of the Social Exclusion Unit in 2003 which is a core focus of this research and is reviewed in Chapter 5. The transport appraisal guidance provided by the UK (NATA¹) and Scottish (STAG²) governments also include an accessibility element which is discussed in more detail in Chapter 5. The Accessibility Policy Assessment Tool (APAT) developed by Bristow et al. (2009) is an example of a tool designed to assess accessibility related policies.

The scale of measurement is important in any study of accessibility and can affect the outcomes significantly. The studies covered in this review vary in scale from the individual household level, through neighbourhood, census zones to the whole city/region scale. A popular scale of analysis is the census zone or traffic model zone

¹ New Approach to Appraisal

² Scottish Transport Appraisal Guidance

due to the relatively easy availability of secondary data at these scales, particularly in the USA and UK where many of the studies are undertaken. Activity based and qualitative approaches are able to consider the individual level of accessibility, but are more difficult to transform into policy applications than more aggregate measures based on quantitative techniques or cumulative measures.

Where analysis is undertaken for sub-sections of society, the focus is on groups seen as being at risk of experiencing poor accessibility or exclusion from accessing facilities. Analysis has been undertaken for socio-demographic groups based on criteria such as ethnicity (Comber et al. 2008), income (Lau and Chiu, 2003; McCray, 2009), disability (Casas, 2007), employment (Lucas et al., 2001), age, (particularly elderly and young adults), (Lucas et al., 2001; Ziegler and Schwanen, 2011), gender (Kawase, 1999; Bostock, 2001; McCray, 2009) and no-car households (Wixey et al., 2005; McCray, 2009). However, it is important to note that there may not be noticeable differences in spatially measured accessibility of different socio-demographic groups, particularly if they are not geographically concentrated (Hine & Grieco 2003) and also that not all people within a certain group will experience the same levels of accessibility. For example, older people may be identified as being at risk of exclusion if they live in a geographically concentrated area which is spatially inaccessible, but isolated individuals living in areas with good spatial accessibility would not be identified by current approaches. Despite work undertaken to understand how attitudes and perceptions affect transport behaviour (Anable, 2005; Rajé, 2007b) limited evidence has been found of such an approach to understanding people's perceived levels of access to destinations. Accessibility analyses tend to be based on objective measures and analysing pre-determined social groupings (Wixey et al., 2003).

There are examples of accessibility studies focused on a wide range of destination types including: employment (Willigers et al., 2007; Fernandez, 2008); city centres; green space (Comber et al. 2008); healthcare (doctor, pharmacy, hospital, primary care) (Yang et al., 2006; Nettleton et al., 2007) social activities (Axhausen 2008); retail and food (Lee and Lim, 2009); and post offices (Comber et al. 2009). Many applied examples focus on specific facilities, such as healthcare, education or employment (Atkins and CRSP, 2008). However, it must be recognised that an individual's perceived accessibility and daily travel patterns are not likely to be influenced by the levels of access to one particular type of facility, but of all the

facilities they need to access as well as the diversity and choice of destinations within each type (Ferguson, 2010). Activity based accessibility measures based on time-space geography account for daily activity patterns, trip chaining and potential path areas. However, such measures are much more difficult to operationalise into a practical measure useful in planning applications due to the heavy and costly data demands, as well as the difficulty of translating understanding of individual accessibility needs into strategic planning decisions.

Studies focus on a range of travel modes, usually investigating accessibility by car, public transport or walking in isolation from other modes. US based studies are heavily car-centric, with public transport based accessibility only being considered in the case of studies focusing on groups with low car availability. More advanced GIS techniques mean that there are techniques which allow assessment of multi-modal accessibility (Kwan and Weber, 2003) although on the whole it is deemed more appropriate to consider car and public transport separately due to the differing nature of mobility and accessibility provided by the two modes. Likewise, walking is usually only considered in small scale local studies or as part of a public transport journey.

In summary, time-space measures and utility measures are more able to reflect individual behaviour than more aggregate economic measures of accessibility. They are arguably more appropriate for analysing accessibility problems faced by individuals but are less used in practical application, possibly because the tools do not exist to implement them and the data requirements are too heavy. On the other hand, cumulative, gravity and infrastructure measures are much easier to apply yet the extent to which they are able to measure progress toward solving accessibility problems is questionable. Following the criteria outlined by Vandebulcke et al. (2009) most measures used include a transport component and a land-use component, but fewer include a temporal component and even fewer an individual component. This highlights the tension between developing a theoretically robust measure and one which can be applied in practice.

Throughout the literature various applications of accessibility assessments and measures have been found. These are predominantly in transport appraisal, land-use planning/allocation, understanding travel behaviour, policy evaluation and as social indicators. The research question and type of application often defines and drives the decision regarding the type of measure to be used, the scale of analysis and the data inputs. However, it is also true that often the data and tools available dictate the way

in which accessibility is understood and applied. It is therefore necessary to understand the ways in which these interactions work and identify gaps in data availability and ways of measuring, and therefore how outcomes can be improved.

2.2.3 Relating measures to outcomes and critique of current approaches

This section critiques the types of accessibility measures outlined above in terms of the outcomes that are sought through changes in levels of accessibility. This section therefore begins with a discussion of what outcomes accessibility, or specifically improvements to accessibility, aim to achieve.

Accessibility has traditionally been measured in a number of ways, however, with a trend towards consideration of the social impacts of transport and accessibility there is a need to understand accessibility from the point of view of the individual rather than just presenting the objective reality. This is recognised by the process of Accessibility Planning in the UK which sought to address multiple barriers to accessibility but this recognition has not translated into measures of accessibility (Handy and Niemeier, 1997).

Morris et al. (1979) outlined three potential uses of accessibility indicators: system evaluation; travel demand models; and urban development models. Since then it seems the uses (and perhaps abuses e.g. Halden 2011) of measures of accessibility have multiplied. What were once used solely used within models of travel and land-use have now extended into much broader fields within transport, including social inclusion, health and wider agendas.

Improved accessibility is generally seen as a normative policy goal within transport planning (Ross 2000; Farrington & Farrington 2005) as improved accessibility is seen to reduce travel times and improve the efficiency of the transport system. Transport appraisal is heavily based around value of time with a focus on reducing travel times and new transport infrastructure is assessed on its ability to achieve this. This approach is widely critiqued and it is not the intention to explore this in depth here. However the main relevant criticisms question the benefit of aggregate time savings to individuals (Metz, 2008; Delbosc, 2012) and the lack of integration with the planning system which means that locations of activities are not planned in coordination with transport provision. Accessibility Planning can be seen as a response to critiques of the current system, focusing on the accessibility of goods

and services to the population, rather than simply on mobility. As outlined in Chapter 1 mobility is just one aspect of accessibility. Mobility is necessary but not sufficient for accessibility. However, all too often the terms are used interchangeably (Ross, 2000) and accessibility is deemed to be improved through mobility rather than land-use changes.

Morris et al. (1979) discussed the potential of behavioural accessibility measures based on trip rates, and other studies have used trip rates or trip length as an indicator of realised accessibility (Mercado and Páez, 2009; Scheiner, 2010). However this can be problematic as it is unclear whether a larger number of trips or longer trips indicate better or worse accessibility. Some studies (e.g. Kamruzzaman et al., 2011) have been based on the assumption that more trips or greater distance travelled result from or result in better levels of accessibility, and from a social exclusion perspective this could also be true as better accessibility may result in more trips among a less mobile population and people being more engaged in society. However, from a sustainability perspective this is not necessarily the case as greater accessibility might result in having to undertake fewer trips to access goods and services essential to needs. Equally, travelling further could either be seen as poor accessibility necessitating travelling further, or better accessibility allowing greater distances (and opportunities) to be reached. There is a need to understand whether expressed accessibility (i.e. travel behaviour) is equal to desired accessibility. Outcomes will not be uniform across the population; so what might be positive for one group is not necessarily positive for another. It is therefore important to ensure that the outcome measure in any study is appropriate to the aim of the research or policy (Delbosc, 2012).

Blind pursuit of improved accessibility may not lead to desirable outcomes in terms of an improved standard of living, the ultimate aim of any policy. Improving accessibility for rural populations could have unintended consequences such as urbanisation, or could contradict other agendas such as sustainability. It must therefore be questioned whether constant improvements in accessibility to destinations are achievable or indeed desirable.

Attempts to improve accessibility through mobility have resulted in faster transport networks and as a result more disparate destinations, leading to what Knowles (2006) has called a differential collapse in time-space, whereby accessibility is

unevenly spread leading to exclusionary processes in which those who do not have access to the transport network can access fewer destinations. This is the basis for the move towards consideration of social issues in transport and the positioning of accessibility within a social exclusion framework, in the UK in particular through Accessibility Planning.

Accessibility Planning is a policy approach to planning accessibility to destinations which is adopted to represent user perspectives. It is one example of a policy approach to operationalising the concept of accessibility. In England this is generally seen to have gained prominence following the 'Making the Connections' report by the Social Exclusion Unit (SEU) in 2003 which highlighted the link between transport and social exclusion, multiple barriers to accessibility and the need for cross-sector working to achieve accessibility goals.

Accessibility in the context of social exclusion can be traced back to the work of Moseley et al. (1977) on rural transport and more recently has been formalised in UK policy through the introduction of Accessibility Planning as a mechanism to reduce transport related social exclusion (SEU 2003). This approach recognises factors other than spatial separation as being important, and places emphasis on barriers such as information, cost, and safety and security, as well as provision of services and journey times. In doing so it also recognises that accessibility is not just about transport but also the provision of services, and therefore advocates cross-sector working to achieve social inclusion objectives such as reduction of unemployment, missed hospital appointments or those not in education, employment or training (NEET).

While *measures* of accessibility such as those discussed have been used for a long time, the use of these in Accessibility Planning is more recent and can be seen as emerging alongside the recognition of a need for consideration of individual and social impacts in transport planning. Accessibility Planning is one area where measures such as those described above have been applied in policy and this has been subject to criticism (Preston & Rajé 2007; Lucas 2006; Hine & Grieco 2003). A more detailed critique is found in Chapter 5, but in summary there is a fear that reliance on aggregate measures of accessibility will conceal individual level accessibility issues which are most likely to lead to social exclusion. For example, while in theory the aim of a policy may be to reduce health inequalities by improving

accessibility to supermarkets selling fresh food, the kinds of measures and targets against which this is typically measured may not achieve this outcome. Instead it may promote large out of town development easily accessible by the car owning majority, which would reduce journey times for a large proportion of the population due to reduced congestion, but not necessarily those most at risk from exclusion who cannot access the new development.

This raises issues around what constitutes exclusion in accessibility terms and what level of inclusion should be required and or expected. Such an issue is highly subjective and dependent on individual rights, wants and needs. Urry (2002) discusses the need and also the right to travel, which is seen as being tied up in culture with the *'idea that one is both entitled to travel, and indeed should travel'* (Urry 2002 p.257). There is a normative view that there should be a minimum provision of service or level of inclusion (Farrington & Farrington 2005), however, defining what this is, is more difficult. There is a need to understand individual requirements and values attached to accessibility. A given level of accessibility 'provision' may be acceptable for one person yet not for another living in the same building.

Solomon (2004) critiques current approaches as they do not account for individual need or what may be achieved given individual constraints. Instead she suggests a need for accessibility measurements based on benchmarking of a suggested minimum number of trips to be made per week to key destinations, for example initial suggestions for older people are a minimum of two weekly food shopping trips; two monthly comparison shopping trips; two weekly social or recreational activities; two annual holidays and 2-10 weekly structured day time activities appropriate to need (Solomon & Titheridge 2006). Davis et al., (2012) have recently developed a Minimum Income Standard (MIS) based on focus groups to determine minimum requirements for a range of needs, including transport. While the idea of providing minimum benchmarks is a useful concept and represents a step towards focusing on individuals, it does presume homogeneity of need among pre-defined social groupings. Additionally, individual requirements are likely to be substantially different from the minima, with some people desiring much less travel and others requiring far more. This represents a number of problems, such as defining people as excluded who may not themselves feel so, or presuming inclusion because the minimum requirements are met, when only being able to visit the shops twice a week may be very restrictive to some people.

Preston & Rajé (2007) identify three criteria as important in identifying the degree of transport related social exclusion; area mobility (the level of travel in an area as a whole); individual mobility (the level of travel made by particular individuals or groups); and the overall accessibility of the area. They propose a schema of social inclusion and exclusion processes based on individual and area mobility, and accessibility. This is a useful categorisation and highlights the importance of considering both individual and area issues. However it does not provide any solution for incorporating individual issues into the process of Accessibility Planning.

Several studies have employed multiple approaches to identify the issues faced by excluded groups (Casas, 2007; McCray and Brais, 2007). However, these are usually data intensive, utilising travel diary data or in depth qualitative techniques and struggle to incorporate findings into any robust measurement of transport and exclusion or disadvantage. Time-space studies based on Hägerstrand's (1970) time space geography seem to be linked conceptually to ideas of social inclusion and individual requirements, however, it is difficult to see how these approaches can be incorporated into planning.

Many studies of accessibility related social exclusion focus on those without a car, which to some extent advocates the car as a solution to transport related social exclusion. Evidently such a view is not in line with environmental sustainability agendas and would ultimately exacerbate the problem of inaccessibility for those without a car as increased car ownership is seen to be the cause of dispersal of facilities and declining bus services (Knowles, 2006; Preston and Rajé, 2007). However, accessibility targets such as *"% of households with access to..."* could be achieved if car ownership were to be increased. It is therefore important to consider where accessibility planning lies in policy terms. While it is placed within the social inclusion agenda in the UK, in countries such as the Netherlands there is a greater focus on accessibility and land-use planning, and this is arguably a more appropriate policy setting.

In a discussion of wider discourses surrounding accessibility Farrington (2007) places accessibility in the context of sustainability, globalisation and new mobilities and argues for inclusion of accessibility within the discourse of sustainability given that accessibility is a pre-condition for social inclusion, itself a pre-condition for social justice, and that *'true sustainability cannot be envisaged without the condition of*

social justice' (Farrington 2007, p.328). This suggests that accessibility is relevant not only to the social exclusion agenda within which it is recently placed, but to much wider policy agendas such as sustainability. Related to this, the use of social exclusion as a concept in transport has been questioned by Stanley & Vella-Brodrick (2009) who raise concerns regarding the dichotomy of excluded or not, especially where this definition is not self-determined but imposed by policy definitions. This means that populations are often defined as excluded and transport deprived as a function of their physical separation from destinations but does not account for individual wants (Farrington & Farrington 2005), or coping mechanisms (Delbosc, 2012), which may mean that individuals do not feel excluded. Furthermore Stanley & Vella-Brodrick (2009) question whether inaccessibility is a cause or effect of social exclusion. It is argued that social exclusion is not sufficient to encompass the requirement of transport social policy and that there is a need to explore concepts such as wellbeing, quality of life, happiness and community connectivity (Stanley & Vella-Brodrick 2009). This highlights a need to understand accessibility from the viewpoint of individuals and not just apply a top-down approach to assessing needs of population subgroups.

Axhausen (2008) advocates a move towards a more social network and social capital based approach, noting that geographers and sociologists have not readily incorporated the idea of social networks, as related to transport requirements. He explains that in a "shrunk world" access times are quicker, and as a result of this destinations and contacts become more widespread, necessitating greater travel. Interestingly, more people had no local (within 2km) social contacts than had any (Axhausen, 2008); this clearly has important implications in planning terms if people are travelling to meet distant contacts, not specific facilities which can be planned. Indeed, if a person's social capital is dependent upon (distant) social contacts, then maintaining this travel might be important for inclusionary policy.

Social capital has been discussed in relation to transport (Farrington & Farrington 2005; Currie & Stanley 2008). Social capital is defined as "*the advantage an individual can gain from social participation, mutual trust and the use of social networks*" (Currie & Stanley 2008, p.529). Accessibility can clearly facilitate or hinder such participation in society. They suggest that it is a difficult concept to use due to the problems of measuring social capital, and suggest a need for further research into the influence of mobility on social capital. They also suggest problems with

social exclusion in that transport is not the sole cause of, or solution to, exclusion, which means the links are often tenuous.

In terms of wider policy discourses, accessibility is related to social inclusion, sustainable travel, a more efficient economy, quality of life and wellbeing. However, exactly what level of accessibility is to be desired is not clear and policy approaches tend to focus on 'improving' accessibility, when in some cases this may not be necessary or desired (Weber, 2006).

The aim of improving accessibility, through Accessibility Planning or otherwise, is, as with any policy intervention to ultimately improve the wellbeing and quality of life of individuals and society. Measurement of accessibility is therefore one indicator amongst many used to measure progress and compare regions or individuals' change towards a potential utopian state of wellbeing and is included for example in the Indices of Multiple Deprivation (IMD) alongside a range of other indicators. Knox (1980) expressed surprise that accessibility was rarely used as a social indicator, being central to wellbeing and quality of life. Accessibility could be considered a social indicator through its inclusion in IMD and Core Accessibility Indicators (CAI), however beyond a conceptual level links between accessibility and wellbeing are still less clear (Stanley et al. 2011). Although Bergstad et al (2011) find a relationship between satisfaction with travel to activities and subjective wellbeing, this is not related to any objective measure of accessibility. This is also problematic as it cannot be known whether an individual's satisfaction is related to the "actual" provision of transport or influenced by other factors such as varying expectations or differing issues of importance (Stradling et al. 2007). For example, an individual with low expectation may report being satisfied with a bus service and score highly on measures of subjective wellbeing whereas an individual with high expectations could be dissatisfied with the same bus service. There is therefore a need to link subjective measures with the objective conditions which are being assessed.

This section has reviewed the dominant approaches to measuring accessibility based on objective measures but identified that the links between these measures and outcomes sought through changes in accessibility are not always clear. The next section of this literature review focuses on the difference between subjective and objective approaches to measuring accessibility and how the two compare, drawing upon social indicators literature where there are more studies comparing objective

and subjective measures. Studies which measure subjective aspects of transport and accessibility are also reviewed as this section has focused on objective measures and indicators of accessibility which dominate the transport literature.

2.3 Objective and Subjective Measurement

The starting point for this section is a critique of the dominant, objective approach to measuring accessibility in transport planning as established in the previous section.

2.3.1 Definitions

Objective measures are based on a (perhaps subjective) evaluation by policy makers or politicians who choose a measure based on statistical or econometric analyses, whereas a subjective measure is an individual's judgement of their standard of living.

It can be claimed that everything is subjective to some extent and therefore it is questionable whether true objectivity is possible (Muckler and Seven, 1992; Scerri and James, 2010). The terms are widely used in social indicators research (e.g. Diener & Suh 1997; Wish 1986; Parks 1984; Kuz 1978) with subjective relating to citizens' experiences, perceptions and evaluations of their own 'reality', and objective being the 'official reality' as measured by government agencies. For example, van Acker et al. (2010) give the example of low motorised traffic levels meaning a neighbourhood is objectively evaluated as pedestrian friendly but that certain individuals may not perceive it to be so.

For the purposes of this thesis, objective is defined as a government indicator or measure designed to reflect the 'real' situation, and subjective is defined as an individual perception or experience of that reality. As explained by Pacione (1982): objective indicators are *"hard measures, describing the indicators within which people live and work"* (p.498) whereas subjective indicators *"describe the way people perceive and evaluate conditions around them"* (p.498).

Objectivity and subjectivity can be applied to both what is being measured and also how it is being measured (Horn, 1993). For example, time might be seen as an objective concept, but this can be measured objectively, for example using a stopwatch, or subjectively for example by asking people to report time spent doing a particular activity. Conversely, happiness might be seen as a subjective concept which could be measured subjectively by asking people how satisfied they are, but

equally there are attempts to objectively quantify such concepts through development of scales that are administered through multiple questions (although arguably these are still inherently subjective).

Whether true objectivity is achievable or not, indicators such as the Core Accessibility Indicators (CAI) are designed as objective social indicators and therefore are termed as objective for this research, as opposed to subjective measures which are not seeking to represent any objective accessibility reality but to represent the perceptions of individuals. The technical expert evaluation is defined as objective and the individual assessment subjective, while recognising that both seek objectivity yet inherently contain subjectivity (Moser, 2009).

2.3.2 Critiques of Objective measurement

Section 2.2 critiqued the reliance of accessibility in transport policy on objective time based measures. However, objective measures can be also critiqued from a more philosophical viewpoint.

Objective measurement is critiqued in terms of the hierarchical nature of imposing certain values or standards on society (van Praag 1985). In accessibility terms this can lead to the possibility of an individual being defined as being excluded, or lacking accessibility, when they do not feel so themselves. A person living in a rural area may 'suffer' from inaccessibility as a result of their own free choice and it can be argued that it is not up to politicians or researchers to decide on an arbitrary minimum level of accessibility but rather that individuals' wants and needs should be taken into account.

Holden (2009) defined objective knowledge as: *"created by rules and law, untainted by personal interests and idiosyncracies; transparent in meaning and can be widely translated for different audiences; replicable and verifiable; free of human value; and knowledge that corresponds to reality.(Holden, 2009,p.430)"*

In reality it is unlikely that objective measurement is ever value free as decisions have to be made regarding how data is collected and reported and what is measured. Holden (2009) recognises that such objectivity is impossible in social science research, and that indicator systems will always be culturally specific and value laden. Scerri & James (2010) also highlight that natural scientific facts are not value free, and therefore argue for a quantitative approach that is enriched with

qualitative information. Holden (2009) furthermore highlights that: *“the blind quest for measurable benefits can come at significant cost, and this cost can be borne differentially by communities of ethnic and cultural difference (Holden, 2009, p.440)”* emphasising that measures based on the ‘average’ experience may marginalise some groups.

Holden (2009) suggests that many indicators have been developed from the perspective of practitioners with little regard to the interests of the communities they seek to represent, and advocates indicator development that focuses not on the quest for scientific objectivity or standard, comparable indicators, but on representing community interests. Sawicki (2002) on the contrary, suggests that objective “scientific” measurement has its place and expresses concern at the ‘explosion’ of community indicator systems not necessarily based on scientific knowledge of what leads to an improvement, resulting in failure of such indicator approaches (Sawicki, 2002). An approach incorporating both may be best placed to understand both the objective condition and how individuals interact with this. As highlighted by Scerri & James (2010), the two cannot be considered in isolation. *“The problem is that concentrating on indicators-in-themselves fails to bring into question the nature of the human relationships, including the interweaving of the objective and subjective, that go into creating and reproducing a community on sustainable terms.”* (Scerri & James 2010, p.42)

Muckler and Seven (1992) provide a useful overview of the historical role of objective and subjective measurement in the scientific search for truth, suggesting that positivist scientific endeavour has attempted to eliminate subjectivity from measurement, in the belief that *“knowledge is valid (and objective) only when it is not dependent on human processes.... human perception, cognition, and experience distort the appearance of reality”* (pg441). Removing indicators from human influence brings into question their very existence. The very purpose of such measurement is often forgotten in a quest to achieve objectivity, in measurement, of accessibility, or otherwise.

2.3.3 The Importance of Subjective Measurement

The aim of any policy is ultimately to improve the human condition and policies relating to accessibility are no exception. Progress towards this is usually measured by some objective measure such as GDP as a measure of a country’s economic

performance or measures of the physical separation of people from destinations in terms of accessibility. However, there is an increasing trend towards recognition of the importance of understanding individuals' perspectives and recognising that objective measures may not correlate with how someone evaluates their own position in society.

According to Duarte et al. (2010) *"Philosophers correlate wellbeing with how well a person's life is going from their point of view. Therefore, wellbeing is a subjective concept, related to each person's reference of 'what is good' for them (Duarte et al, 2010 p.6)"*; yet Delbosc (2012) suggests that in attempts to improve the human condition in transport studies, quality of life measures have tended to be based on objective data and have not considered individual wellbeing. In a discussion of the measurement of poverty, wellbeing and exclusion, Zajczyk (2002) highlights these can be approached from an objective or subjective angle.

It is clear that accessibility measures are heavily focused on measuring objective accessibility (Section 2.2.2) and aim to present a picture of the 'reality' in terms of the accessibility a person or place has, given the transport and land-use system. However, there has been much less focus on incorporating the subjective or perception based measures, despite outcomes from Accessibility Planning seeking to address issues such as behaviour change and social exclusion. As early as the 1970s the need for measures which encapsulate individuals' perceptions of accessibility, as much as the 'actual' accessibility, was highlighted (Morris et al., 1979), yet progress is limited.

The importance of subjective understandings or perceptions is recognised by the process of Accessibility Planning but this does not translate into measurement. However, subjective measures are used in social indicators research more broadly, and the importance of incorporating these is increasingly recognised. This is highlighted by the recent move towards subjective wellbeing measures as an alternative to GDP (ONS, 2012).

The measurement of accessibility can be seen as one of many social indicators (Wachs and Kumagai, 1973; Morris et al., 1979; Knox, 1980; Koenig, 1980) with the ultimate aim of improving the human condition through furthering wellbeing and quality of life. Such indicators are usually objective but in recent years the importance of incorporating subjectivity has been gaining credence (Diener 1984; Diener & Suh

1997; Oswald 2010) The importance of both objective & subjective measurement is a contemporary issue in social indicators research and is becoming important in transport research as highlighted by the following two quotations from the recent UKTRC workshop series on social impacts and equity in transport policy.

“There is an important theoretical distinction between recorded behavioural outcomes and people’s perceptions of transport and it was felt that that research is lacking in this respect. Do researchers and policy makers mis-perceive issues relative to how ‘the public’ do?” (UKTRC 2010a, p.4)

The same workshop series identified a lack of understanding of the lived experience as a key gap in knowledge, noting,

“A tendency to focus on the ‘average’ experience – this means that there is a lack of knowledge of how complexity, variability and diversity in characteristics and circumstances exacerbate existing patterns of inequality” (UKTRC 2010b, p.5).

The recent behavioural insights toolkit (DfT, 2011a) illustrates the importance of individual and collective objective and subjective factors in travel behaviour. The toolkit illustrates a matrix of individual and collective, and objective and subjective factors which can be used to understand travel behaviour (Anable et al., 2006). Objective accessibility can be seen as a collective objective factor, defined as “‘hard facts’ which relate to things bigger than the individual” (p.4) and perceptions of accessibility are individual subjective factors, “perceptions which relate to the individual” (p.4). Anable’s categorisation also includes collective subjective factors such as group norms or cultural values and individual objective factors such as personal capabilities. The same report, (DfT, 2011a) suggests that:

“The two types of evidence (objective and attitudinal) can be used as a proxy for each other where the relationship between the two is understood. So for example, traffic speeds are associated with perceptions of safety; highest level of education is associated with environmental attitudes.(p.5)”

However while there may be strong relationships between the two they are not necessarily appropriate proxies. If such assumptions are to be made, then there is a need to further understand the relationship between objective and subjective variables as it cannot be expected that they will be the same (Pacione, 1982).

Blacksher & Lovasi (2011) provide a compelling argument for the inclusion of perceptions in environment-behaviour studies. They define a perception as a self-report as opposed to objectively measured environmental characteristics and the

same definition is adopted in this thesis. They explain that while subjective measures have been widely critiqued in terms of their ability to explain physical activity levels, the relationship between perceived environmental characteristics and physical activity is often stronger than for objective environmental characteristics. Morris et al (1979) suggest that this is also the case for the link between accessibility and travel behaviour. Blacksher & Lovasi conclude that understanding the difference between subjective and objective environmental characteristics is crucial for informing interventions that may seek to change physical activity and note that while this is recognised, there has been little empirical attention to understanding the relationship between objective and subjective measures.

Moser (2009) advocates a two stage approach to issue identification; identification of objective environmental conditions, by experts; and individual residents' satisfaction with these environmental conditions, with a clear explanation of the difference between the two:

“The impact on people’s quality of life of a specific neighbourhood may be assessed by looking into the relation between the objective facilities and services on one hand, and the perception and evaluation of people’s quality of life on the other, as these two factors may substantially differ according to personal factors like age, gender and cultural background. (see Diener et al (1999). Identifying the environmental conditions of human wellbeing requires inventories of the specific physical and social conditions that may be threatening individuals’ quality of life. These may be objectively assessed by detached experts, but also via reports by affected individuals about their environmental conditions” (Moser 2009, p.355)

Such an approach to Accessibility Planning is advocated by DfT (2004) which begins with an expert assessment followed by consultation and engagement with citizens. However, the extent to which this has been a success is questioned by this research (Chapter 5).

Delbosc (2012) posits accessibility as one of three key ways in which transport is related to subjective wellbeing, alongside mobility and infrastructure. She sees accessibility as the levels of satisfaction with life domains such as employment, health and relationships which are influenced by an evaluation of access and personal values. This is a conceptual relationship however, and as Delbosc (2012) notes, empirical evidence is lacking.

Uzzell & Moser (2006) further explain the relationship between perceptions of the environment, behaviour and wellbeing *“it is not the quality of the environment, but*

how people interact with it that may be a principal explanatory factor in well-being” (p.4).

It is clear then that subjective measures or perceptions of accessibility are crucial to understanding travel behaviour and wider outcomes such as wellbeing, the ultimate aim of any policy mechanism. However, given that accessibility has usually been measured using objective data only, there is a need to understand whether these objective measures relate to subjective measures so that changes to the objective environmental conditions can lead to change in behaviour. The next section discusses comparisons of the two approaches to measurement.

2.3.4 Comparing objective and subjective measures

While there are extensive studies based on traditional objective measures of accessibility, and equally a large number focused on psychological aspects and subjective determinants of travel behaviour and perceptions of accessibility, few studies incorporate both objective and subjective measures. There is a growing recognition of the need for both objective and subjective measurement (Vine et al., 2012) yet often either objective or subjective measures are used without consideration for how they relate to each other (McCrea et al., 2006; Lotfi and Koohsari, 2009; van Acker et al., 2010).

This section focuses on studies which have combined objective and subjective approaches both within and outside of the field of transport and accessibility. While little transport research has focused directly on the relationship between objective and subjective measures this has been studied in other fields of relevance, particularly quality of life indicators (Kuz, 1978; Pacione, 1982) and more recently studies focused on the relationship between the built environment and human behaviour, particularly in relation to physical activity, often walking (McCormack et al., 2004; Ball et al., 2008; Gebel et al., 2011).

Many studies focus on the relationship between the built environment and health. Interestingly it seems the legacy in this field relies heavily on subjective measures and perceptions, but with some authors more recently noting the need to incorporate objective measures alongside perceptual data (McCormack et al. 2004; Leslie et al. 2007).

Recent work by van Acker et al. (2011) studied the effects of the built environment and car availability on travel behaviour (modal choice) whilst controlling for subjective influences (attitudes and lifestyles). By comparing path models that do and do not include subjective influences they demonstrate the “added value” of considering subjective variables in explaining mode choice. However, they do not directly compare subjective and objective measurement of the same phenomena as posited by van Acker et al (2011). Cerin et al (2007) examined the relationship between objective and perceived measures of Access to Destinations (measured by objective and perceived measures of Land-use Mix (LUM) and perceived proximity to specific destinations) and self-reported walking for transport. Overall they found access to destinations was related to transport related walking, and was also dependent on the type of destination and socio-demographic characteristics. Perceived proximity of workplace was the strongest predictor of transport related walking, and they found no relationship between objective measures of Land-use Mix and transport related walking, although the type of land-use mix was influential, with those living in commercial/industrial neighbourhoods walking more than those in recreational neighbourhoods based on objective profiling of destinations.

In investigating transport mode choice sets for commuters, Van Exel & Rietveld (2009) found that the ratio of perceived to objective travel times strongly influenced modal choice. Car users over-estimated objective measures of public transport times by 46%. This shows that if more can be done to understand the difference between perceived and actual accessibility, then improvements in perceived accessibility, and therefore travel behaviour, may be possible.

In the UK context Solomon (2004) compared self-reported journey times and costs to education amongst students with assessments of whether these were considered ‘reasonable’ and found that roughly 50% found them to be so. However, this study did not incorporate a comparison with objective measures so it is not known whether these self-reported journey times or costs can be compared to objective times such as those reported by accessibility indicators.

Cao and Mokhtarian (2005) use both objective and subjective variables in explaining travel related strategies for commuters in San Francisco, and conclude that consideration of travel related strategies is influenced not only by the (objective) amount of travel but also by individuals’ subjective assessments, desires, affinities,

attitudes, personality and lifestyle. They suggest therefore that basing public policy only on objective mobility or accessibility (as is often the case) means that individuals may not respond to policy designed to change their behaviour in the expected manner. It should be noted that their definition of objective variables related to self-reported measures of quantifiable aspects (e.g. travel time) and subjective relates to perceptions (e.g. of the amount of travel on a scale lots-little). This differs somewhat to the definitions adopted in this study, whereby both of these would represent a subjective measure. Similarly in Germany, Scheiner has undertaken two studies (Scheiner and Holz-Rau, 2007; Scheiner, 2010) which incorporate both objective environmental characteristics and subjective attitudinal, perception and demographic data to explain travel behaviour. Doi et al (2008) begin from the same critical viewpoint of traditional accessibility measures as a simplification of the representation of opportunities without consideration to people's values or behaviour. They recognise physical accessibility as important in influencing quality of life, but note that individuals' values and satisfaction are also important in a quality of life based accessibility measure. They base quality of life on satisfaction with 17 transport-related indicators and use these to weight a traditional location-efficiency accessibility model. This work is a useful example of the move towards incorporating more subjective attributes into accessibility measurement. However, neither Scheiner nor Doi directly assess how these subjective satisfaction measures relate to the objective measures of the same phenomenon. Ball et al. (2008) compared objective, GIS based measures of accessibility to physical activity facilities such as leisure centres or outdoor space with subjectively reported accessibility based on whether a respondent said a facility was within walking distance of their home and found agreement was low, particularly for certain demographic groups

Three studies highlight the importance of understanding both objective and subjective views of factors influencing accessibility, and how these interact to influence behaviour. Tilt (2007) used objective and subjective measures of accessibility and vegetation in a residential area to explore the relationship between these and walking activity and Body Mass Index (BMI). They found relationships between objective and subjective accessibility ($r=0.329$) and found that walking trips per month were related to objective measures of accessibility and to subjective measures of greenness. Gebel et al (2011) undertook a longitudinal study into the relationship between objective and perceived measures of neighbourhood walkability

and changes in walkability and Body Mass Index (BMI) over a four year period. They found that a third of those who lived in a neighbourhood objectively measured as highly walkable, perceived it as low in terms of walkability, and vice versa, a third of those living in low walk neighbourhoods perceived them as walkable. Furthermore they found that for individuals who had a mismatch between perceived and objectively measured walkability (where perception was low compared to objective measure) reduced their walking for transport and leisure, and increased their BMI significantly more over the four year period than those with a greater agreement between objective measures and perceptions. This highlights the importance of the link between perceptions of the walking environment in this case and longer term outcomes such as travel behaviour and health.

Lotfi & Koohsari (2009) use three objective measures (Infrastructure, Activity and Utility based) and compare these with a subjective approach based on interview and questionnaire data. They find that those areas with the highest objective accessibility are not perceived as such by residents (in terms of satisfaction with access to facilities) due to issues of safety and security. In the case of the research undertaken for this thesis, this is the closest research found to one which compares traditional accessibility measures with user perceptions, but it does not directly compare the same aspects of accessibility objectively and subjectively. Furthermore they use one question from qualitative interview data to measure perceptions compared to objective measures rather than detailed survey based perceptions.

Measures of Quality of Life (QoL) are well researched and much can be learnt from research into the relative benefits of objective and subjective approaches to measurement, which is much less researched in transport. Kuz (1978) draws attention to the fact that a high level of correlation between objective and subjective measures of QoL would allow one to be used a proxy for the other and remove the need for one or other of the approaches, as suggested by DfT (2011a). However, his study comparing the use of a range of both objective and subjective measures of QoL in Manitoba, Canada suggests little correlation ($r=0.07$), concluding that QoL can only accurately be measured using a comprehensive range of both objective and subjective indicators.

In an investigation of happiness in transport mode choice Duarte et al (2010) found that stated happiness was influential in mode choice in addition to more objective

characteristics, such as cost and travel time and they concluded that policy should be focused on improving 'transport happiness', acknowledging that further work needs to be done to identify the factors influencing this 'happiness'. Work has also been undertaken comparing reported crime with public fear of crime (Pain et al., 2006) and police perceptions of high crime areas with crime statistics (Craglia et al., 2005) and agreement is generally low. McCrea et al (2006) used structural equation modelling to compare a range of objective and subjective measures of urban quality of life, including access, and found that agreement is low. They therefore suggest caution in assuming the changes to the built environment which result in improvements against objective measures will also lead to improvements in subjective perceptions. However, use of objective measures in policy areas such as Accessibility Planning is based on the assumption that built environment changes will lead to behaviour related outcomes.

At a finer scale, Bugmann and Coventry (2004) explain that there is a non-random and systematic difference between cognitive and actual distances and suggest that the environment mediates the difference between cognitive and actual distances. This lends some support to the idea that there may be a difference between the ways accessibility is perceived in different environments, for example urban and rural areas. This is explored in Chapter 4 which compares survey reported accessibility measures with objective measures using secondary datasets for all of England and looks at the differences across the rural-urban continuum.

2.4 The Research Gap

Accessibility as a concept has not necessarily translated well into policy measures (Handy & Niemeier 1997; Straatemeier 2008; Bertolini et al. 2005). Rather, accessibility tends to be measured by the more traditional approaches of the separation of people from goods and services, but does not relate well to the more people-centred approach promised by the social exclusion agenda in the UK. Often the measures used to assess accessibility interventions are not related to the outcomes they seek to achieve.

Based on a review of international experience to date there is a considerable body of work attempting to develop objective measures of accessibility and also a separate body of work that seeks to understand people's perceptions and experiences of

travel, but there is limited work that directly compares the two approaches to understanding accessibility, for a given area or population group.

Both objective and subjective approaches to understanding human wellbeing at the broader level have been well researched. Accessibility, as a concept in transport planning, however, has traditionally been measured through the use of objective measures, despite the desired outcomes being increasingly related to more individual and subjective factors. The concept of accessibility in transport planning has developed from a purely economic measure of performance to one considering the socio-spatial inequalities and more recently towards a more inclusionary focus on wellbeing and quality of life (Delbosc, 2012). Such a development draws parallels with the changing paradigms of transport planning more generally, outlined by Jones (2009). However, the techniques available for measuring accessibility are still very much associated with aims of improving transport efficiency rather than human wellbeing and the relationship between the two is not well understood.

Pacione (1982) highlighted that any measure of quality of life, of which accessibility is one, must include “*an internal psychological, physiological mechanism that produces the sense of gratification*” and the “*external phenomena which engage that mechanism*” (p.498,Pacione 1982). While measures of accessibility have captured the external phenomena, less is known about the individual mechanisms and more specifically how these relate to objective measures.

In order to effect the change in behaviour demanded by accessibility policies, there is a need to understand in more depth how objective measures and subjective perceptions of accessibility compare. Existing studies have looked at the influence of objective and subjective measures on outcome variables, but few have compared the two directly and those that have, for example in indicator studies, tend to find that agreement is low.

The aim of this research therefore is to understand what factors are important to individuals in their perceived or “lived” accessibility and if and how these are at variance with objective measures of accessibility employed by policy makers. It is hypothesised that perceived levels of accessibility will vary from objective measures for two principal reasons. Firstly, objective measures may not measure what is important in determining individuals’ perceptions of their own accessibility or the calculation methods may mean these are not accurate. Secondly individuals’

perceived accessibility may be affected by external factors, for example lack of information. For example, considering accessibility to doctors surgeries, a measure may be inaccurate due to an incorrect database of doctors, or a measure of time may be inappropriate if comfort is more important for an individual accessing their doctor's surgery, likewise perceptions may be inaccurate if an individual is not aware of a surgery that is more accessible than the one they currently attend, or they are not aware of a community transport service which could provide them with access to the surgery.

It is important to understand local level, household and individual accessibilities in addition to the aggregate, national or regional picture if we are to properly understand the relationship between accessibility and associated outcomes, and therefore target interventions appropriately. Whilst current assessments relate mainly to time barriers, it is clear that time is not always the most important barrier to accessibility, and that there is therefore a need to compare these objective measures to subjective understandings of accessibility.

This idea is not new. Morris et al, 1979, wrote that *“perceived accessibility and perceived mobility – the real determinants of behaviour – will be at variance with “objective” indicators of accessibility and mobility”* (p.92). Despite this there is still little empirical understanding of *how* they vary. Morris et al (1979) further explained that travel arises as a result of the separation of people from places and that to understand individual reactions to transport policy it is necessary to understand household aspirations and activity patterns rather than looking at travel per se, explaining that the problems might be best solved by “non-transport” methods. This view is more prevalent today than in 1979, but it has still not become mainstream and much planning is still undertaken based on traffic modelling outputs rather than an understanding of how and why people travel. There is not one measurable understanding of what accessibility we ‘should have’ (Farrington & Farrington 2005), but instead “a place is not just ‘more’ or ‘less’ accessible, but accessible relative to people in all their different circumstances; people experience more, or less access to places” (Farrington 2007, p.320).

This further highlights the need to incorporate perceptions and subjectivity into accessibility measures; while accessibility is a geographical problem, it is also a social one, so two people in the same place may experience different “accessibilities”

(Handy & Niemeier 1997). Equally the same person will experience different accessibility dependent upon the place they are in at any given time. Rajé (2007b) identified a major consultation gap between users of the transport system and planners, and suggested that existing methodologies under-record and under-represent the barriers to mobility experienced in everyday life. There is therefore a need for transport policy and practice to be informed by local experience.

However, while recognising the importance of subjective measures, it is also necessary to remember the value of objective measurements, and their importance in policy development. Stanley & Vella-Brodrick (2009) explain that:

“while the subjective perspective is important, such measures do not account for value-based social policy social justice principles....an individual may be personally satisfied with their circumstances if they have diminished capabilities, social justice dictates that they should be offered the choice to be able to participate fully in society. This position subsumes the value judgement that it is not sufficient to allow people to simply adjust or accommodate to adverse circumstances” (Stanley & Vella-Brodrick 2009, p.95)

This suggests that simply using subjective measurements would not be an appropriate policy response due to the tendency of people to adjust to adverse circumstances, and perhaps under-assess their need. A method incorporating both objective and subjective measures would therefore be best placed to deepen our understanding of accessibility but the relationship between objective indicators and subjective measures is not well understood (van Acker et al, 2010; Delbosc, 2012).

There is a need to further understand the dynamics of accessibility in the context of individual needs and perceptions. Current methods of measuring accessibility are usually objective and therefore do not always reflect what is important to individuals in terms of barriers to accessing certain activities. It is important to understand the relationship between objective measures and actual lived experiences, perceptions and subjectivity of accessibility in order that interventions to address transport related social exclusion can be appropriately targeted. Differences between objective and subjective social indicators are to be expected otherwise one or the other would be rendered futile (Pacione, 1982) and it is therefore suggested a method incorporating both objective and subjective measures would be best placed to deepen our understanding of accessibility and enable interventions to be appropriately targeted to achieve the desired outcomes.

While there is a considerable body of work attempting to develop objective measures of accessibility and equally those seeking to understand people's perceptions and experiences of travel, there is limited work directly comparing the two approaches to understanding accessibility for the same people or places. If more can be done to understand the difference between perceived and objective policy measured accessibility, then improvements in perceived and therefore realised accessibility, may be achieved, alongside improvements in how accessibility is measured and assessed by practitioners. Research should therefore focus on understanding the role of subjective or perception based measures in assessing accessibility, to understand how these vary with the objective measures upon which current practice is heavily based. Chapter 3 develops the conceptual framework for the thesis and outlines the methodological approach to the research.

3. Methodological Approach

3.1 Introduction

This chapter outlines the study rationale, overall methodological approach and the choice of methods and approach to each stage of the research. Detailed methodology sections are included for each of the empirical stages in the appropriate chapters.

3.2 Study Rationale

The rationale for this research emerges from critiques in the literature review of the ability of accessibility measures to capture individuals' lived experiences, alongside the widespread use of such measures in policy attempting to address problems faced by individuals in accessing goods and services. The research is designed to understand how accessibility measures are currently used in policy making, how they relate to individuals' needs and perceptions of their own accessibility, and in doing so, to provide recommendations for how accessibility practitioners can better incorporate individual perspectives. A critique of the dominant positivist approach to measuring accessibility is central to the research and therefore the methodological techniques adopted are a core aspect of this research.

As highlighted in Chapter 2, existing studies tend to focus either on objective, quantitative measures of accessibility related to the land use and transport system, or subjective and largely qualitative approaches understanding individual needs and perceptions of accessibility but very few studies in transport explicitly examine how the two are related (Van Acker et al., 2010).

In this research subjective measures are based on a secondary dataset; National Travel Survey data (Chapter 5) and primary survey (Chapters 6 and 7) and interview data (Chapter 8) and objective measures are based on the Core Accessibility Indicators (CAI) calculated by the Department for Transport (DfT).

A mixed methods approach is undertaken to address the objectives of the study within this conceptual framework. The research design is outlined in Section 3.3.

3.3 Research Design

This section details the research design, firstly by outlining the epistemological and ontological perspective of the research and then detailing each stage of the research and the methods adopted.

3.3.1 A Pragmatic Research Philosophy

The research adopts a pragmatic perspective, which is focused on solving a particular problem using whichever methods are appropriate (Creswell, 2009). In other words, it is not restricted by a particular worldview but instead takes a pragmatic approach to solving a particular research problem using whichever methods are best suited to the problem at hand. This approach is often used in applied, policy related research. Creswell (2009) defines pragmatism as:

“a worldview or philosophy arises out of actions, situations and consequences rather than antecedent conditions. There is concern with applications –what works – and solutions to problems. Instead of focusing on methods, researchers emphasize the research problem and use all approaches available to understand the problem” (Creswell, 2009, p 231).

A pragmatic approach is suited to the research questions addressed in this thesis as the problem is a real world issue and is relevant to transport policy. A purely objective and therefore positivist worldview is not representative of or able to capture the lived experiences and daily accessibilities of individuals. Given associations of quantitative work with a positivist worldview, a qualitative approach might therefore be expected. However, the applied nature of the research problem means that the importance of quantifiable data for policy makers and practitioners is recognised. Taking only an objective viewpoint is seen as problematic as the way in which accessibility is conceptualised and measured by planners and researchers may not bear relevance to individuals.

An understanding of how people perceive the world is important, however, taking an approach based only on perceptions or subjective measurement would also be problematic as it risks being influenced by more vocal population groups or not accounting for changes in actual accessibility. For example, if a bus service is improved, satisfaction levels may remain the same over time due to a change in expectations. Therefore an understanding of how perceptions relate, quantitatively, to objective levels of accessibility is a useful addition to knowledge.

Furthermore a wholly post-structuralist or social constructionist view would reject the view of knowledge being based on perceptions of an objective 'reality,' or the existence of objective facts, as that objective world does not exist from such a viewpoint (Burr, 2003), but instead all knowledge is socially constructed. Therefore, recognition of the importance of both objective environmental conditions and subjective knowledge lends itself to neither a positivist nor complete rejection of positivism towards more constructionist viewpoints. An approach combining both objective and subjective understandings is therefore required.

Feilzer (2010) associates a pragmatic approach to research with mixed methods, given the recognition that both quantitatively and qualitatively produced knowledge are valid and can be used to approach the same research question in different ways. Such an approach is taken here, given that neither a purely quantitative or purely qualitative approach is deemed capable of appropriately addressing the research objectives. Indeed, the research questions seek to understand the differences between objectively and subjectively produced knowledge, and understand how both of these are important in addressing policy issues, using measures of accessibility set in the context of Accessibility Planning policy.

3.3.2 Mixed Methods Case Study Approach

Taking the pragmatic epistemological perspective discussed in Section 3.3.1 into account a mixed methods research design is adopted. A mixed methods approach is defined as:

“an approach to enquiry that combines or associates both qualitative and quantitative forms of research. It involves philosophical assumptions, the use of qualitative and quantitative approaches and the mixing of both approaches in a study” (Cresswell, 2009, p 230)

Mixed methods approaches are often used in applied research contexts where neither qualitative or quantitative research methods can individually answer the research questions, and where the research is not dominated by a particular epistemology which rejects one method or another. The research design adopted in this thesis uses both qualitative and quantitative methods to draw conclusions regarding how accessibility is measured, and how different methods may lead to different or similar conclusions.

Qualitative methods are associated with subjective understanding and human understanding (Baxter and Eyles, 1997). Given the purpose of this research is to understand the lived experience, ignoring the richness that can be gained from a qualitative approach would be an oversight. Equally, qualitative approaches have been used extensively to explore accessibility issues experienced by individuals and certain groups in society (e.g. Rajé 2007; McCray & Brais 2007) yet problems occur with translating this knowledge into policy which demands a quantifiable evidence base. Current quantitative approaches to measuring accessibility are focused on the objective measurement of the “actual” accessibility; yet do not capture individuals’ experiences. This case study approach therefore seeks to use a quantitative approach to understanding individuals’ perceptions of accessibility, as compared to objective measurement, which is then enriched and complemented by qualitative insights.

It is not intended to focus on a specific demographic group or access to a specific destination. This broadens the scope of this thesis. Stanley et al. (2011) note the tendency for transport mobility studies to focus on samples of older people but suggest there is a need for more generalised samples, both in order to compare with objective measures designed to reflect the aggregate population and also to explore accessibility issues without imposing them. In fact, almost all studies into accessibility, disadvantage, social exclusion and mobility tend to focus on a specific group considered to be potentially ‘at risk’. Examples include the elderly (Spinney et al., 2009), women (Kawase, 1999; McCray and Brais, 2007), unemployed (Wixey et al., 2003) or ethnic minorities (Wixey et al. 2003; Comber et al. 2008; Wang 2007). This study does not focus on the needs of any particular group, or take an a priori stance on who may have accessibility problems, but rather aims to sample the general population.

Similarly, accessibility studies tend to focus on a particular set of destinations, commonly health (Lovett et al. 2002; Knox 1981); employment (Levinson, 1998; Wang, 2003; Geurs, 2006; Fernandez, 2008; Cebollada, 2009) or food (Lee & Lim 2009; Wrigley et al. 2002). Perceptions of accessibility are likely to be more complex and related to accessibility to a particular destination. Therefore this study also takes a generalised approach to accessibility of destinations and does not focus only on

one destination type. The core objective is a comparison of subjective measures from the NTS and primary data collection with the CAI dataset, therefore the destinations and modes of transport in the household survey are bounded by those destinations and modes in the CAI.

A case study research approach is used as it is most appropriate for drawing together multiple sources of information within a real-life research context. This allows in depth study of a particular phenomenon (Yin, 2009). Drawing upon multiple sources of evidence therefore allows complex social phenomena to be explored, strengthens conclusions through triangulation of results from different methods and is appropriate to the real-world rather than experimental research. A case study is utilised at different scales in the research. Firstly, the English approach to Accessibility Planning forms a case study of an application of the concept of accessibility within a policy context, applicable in most developed countries. This draws upon review material, policy documents and practitioner interviews. Secondly, a single local authority, the Greater Nottingham area is used as a case study to explore the relationships between measures of accessibility and the lived experience, utilising survey and in-depth mental mapping interviews.

3.3.3 Ethical Considerations

Ethics are an important consideration in any social research project, given the human subjects of the research (Bryman, 2008). Care has been taken throughout this research to ensure confidentiality of data collected. No individual is identified in any of the results and this was emphasised to participants in the research. The study was approved by the University of Aberdeen School of Geosciences Ethics Committee.

Participants were able to give informed consent. For the household survey, completion of the form implied consent and for interviews participants were provided with information and asked to sign a consent form prior to the discussion.

Each survey was given a unique code linked to the mailing database, and used to track incoming responses and data was input into a separate database which could not be tracked back to the individual's address details. All transcripts from interviews with local authority officers and members of the public are anonymised and any information that could identify an individual removed.

There are also ethical considerations regarding the funding of research and ensuring that results are not affected or biased by the funding body (in this case the University of Aberdeen). This research was also partly supported by collaboration with a consultancy which could be perceived to have a conflicting interest with any results published. In order to ensure that this is not the case the researcher has maintained independence throughout and while feedback has been sought this has not influenced the approach or results of this work. The only substantial influence had been in the selection of the Core Accessibility Indicators as an objective measure as this was the basis for the initial PhD proposal.

The following section details the methods adopted in each stage of the research.

3.4 Methods

The research aims are addressed through a series of objectives as outlined in Chapter 1. An outline thesis structure was shown in Figure 1.5.1. Figure 3.4.1 details the methods adopted in this research and the research objectives addressed by each methodological approach.

The research questions and methods adopted for each stage are outlined below.

3.4.1 Current Approaches to Accessibility Planning

The first main stage of this research is focused on current approaches to accessibility in planning and policy, focusing on the UK, and specifically English approach of Accessibility Planning which was formalised through the requirement for Accessibility Strategies as part of Local Transport Plans covering the period 2006-2011.

This is split into two chapters. Chapter 4 critiques the Core Accessibility Indicators (CAI) and then compares these with subjective survey reported data from the National Travel Survey (NTS)

Chapter 5 reviews the UK approach to Accessibility Planning and draws on interviews with practitioners involved in the process in England to understand how they have approached measuring accessibility.

Using Secondary Data Sources to gain insights into the difference between objective and subjective measures of journey time accessibility at the national level (Chapter 4)

Chapter 4 critiques the CAI and then compares these to self report measures of accessibility from the NTS. This uses a statistical comparison of two approaches to measuring journey time accessibility to local services in England. The NTS includes questions asking how long it takes to reach the nearest of each of six types of destination and the CAI measure this using a GIS approach based on public transport timetables. Differences between these two measures are explored.

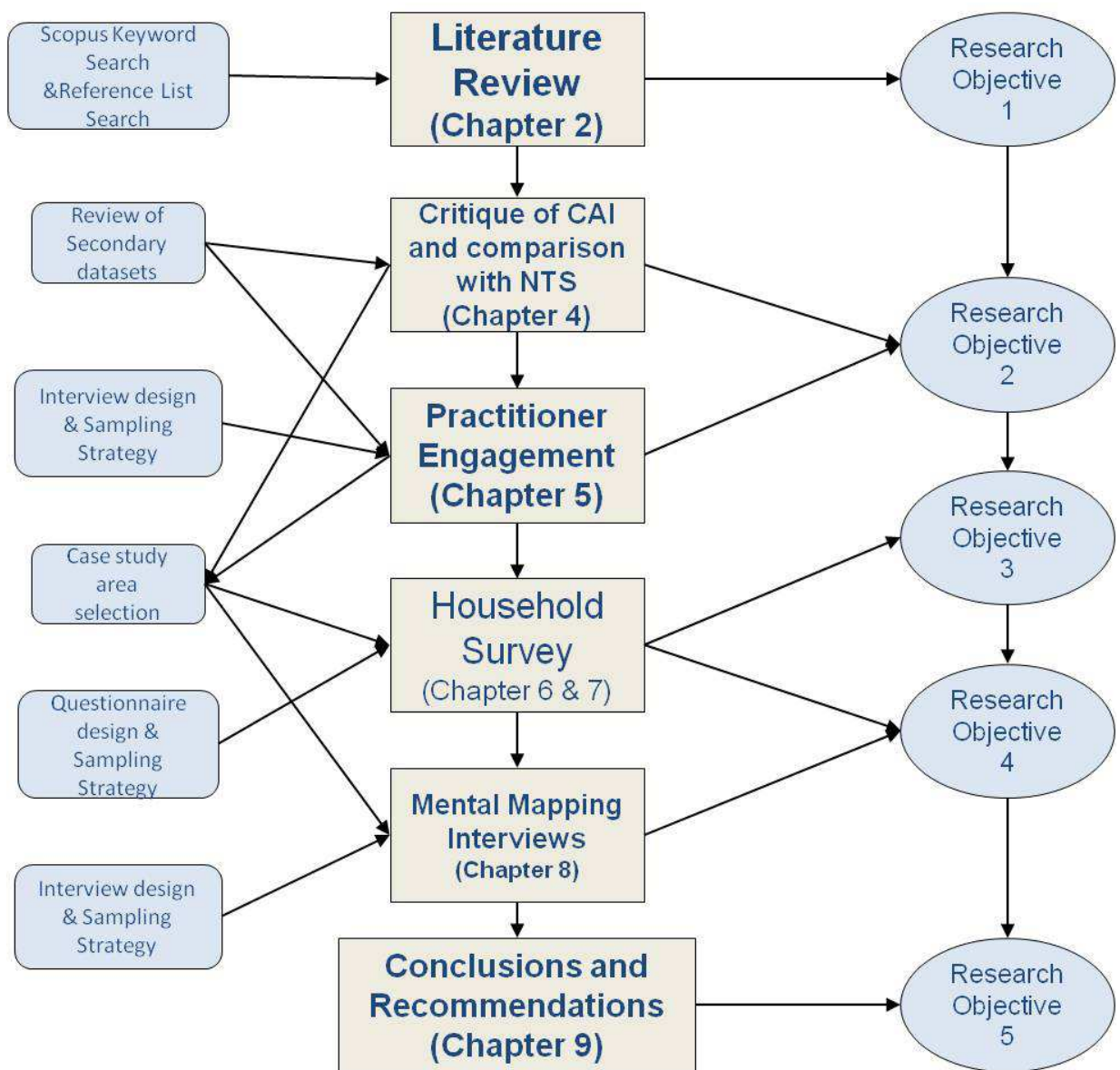


Figure 3.4.1- Research Objectives and Methods

Given the use of the CAI in this thesis it is important to have an understanding of the strengths and limitations of the dataset. Secondly, the comparison with NTS data both highlights the need for considering both objective and subjective approaches to measurement and highlights where potential differences occur to inform the case study selection and questionnaire design.

Engagement with local authority officers involved in the Accessibility Planning process (Chapter 5)

In order to understand how accessibility is currently measured and understood by those responsible for delivery in local authorities, semi-structured telephone interviews were undertaken with local authority officers with responsibilities for accessibility planning in England.

Practitioners provide the link between the theory, literature and public perceptions and are ultimately responsible for delivering any policy. It is necessary to have an understanding of how all three groups define, measure and assess accessibility, as this has important policy implications. If there are differences for example in how policy makers and the public perceive accessibility, then interventions to improve accessibility may not be effective.

If the way in which accessibility is currently measured does not match up the aims of accessibility planning, or to the outcomes, then there is a need to understand what is missing that would enable accessibility planners to meet their objectives. If the tools, techniques or data available are not suitable for the purpose then this presents a research gap. Discussion with local authorities also provides a forum for discussing potential case study areas for the second stage of research.

Interviews were chosen over a survey approach as the best way to engage with practitioners. A survey would have limited the depth of information collected, and would be appropriate if very specific questions were being posed. However, given that the aim of engagement was to explore more broadly the experiences of local authority officers in implementing accessibility planning and measuring accessibility, interviews are deemed to be a more appropriate method, to engage with the way in which practitioners are working:

“If you want to know how people understand their world and their lives, why not talk with them?” (Kvale 1996, p.1)

Telephone Interviews were used instead of face to face interviews to reduce the time burden on both the researcher and the interviewees. This meant that interviews could be arranged to fit in with interviewees’ other commitments and often arranged and re-arranged last minute. It also enabled wider geographical coverage which would have been restricted if the researcher had been required to travel to each interview. While some richness of information may be lost through not meeting face to face this was considered to be outweighed by the benefits of flexibility and geographical coverage.

3.4.2 Case Study Approach to understanding the Lived Experience of Accessibility: Methods

The Greater Nottingham Local Transport Plan area is the case study area for the second main empirical stage. This comprises Nottingham City, and the Nottinghamshire boroughs of Broxtowe, Gedling, Rushcliffe and a part of Ashfield as these form the Nottingham Travel to work area. The process used to select a case study area follows extensive discussion and exploration of alternatives, but ultimately is a pragmatic approach to narrowing the focus of study to within one local authority area which was deemed appropriate to focus the area of study. Local Transport Plan areas are the areas covered by Accessibility Strategies, so it is logical to limit the study area in this way, so as to avoid crossing administrative boundaries which may be subject to different policy interventions and different input datasets to the CAI. A detailed discussion of how Greater Nottingham was selected is included in Chapter 6, as part of the survey methodology.

The case study research addresses the following research questions:

RQ1: How do objective and subjective destination choice sets relate to each other?

RQ2: a) How do objective and subjective measures of journey time accessibility relate to each other?

b) What, other than objective journey time can explain variation in self-reported journey time to destinations?

RQ3: In which way does satisfaction with aspects of accessibility (e.g. journey time, public transport frequency, choice of destinations) relate to objective measures of these aspects?

RQ4: Which factors can be used to explain;

- a) Perceived accessibility to destinations?
- b) Perceived accessibility by mode?
- c) Overall perceptions of accessibility?

The case study is presented in three chapters. Chapter 6 outlines the process used to select the case study area, the questionnaire design and survey sampling and presents the characteristics of the sample. Chapter 7 presents detailed household survey analysis and Chapter 8 presents the results of mental mapping interviews.

Household Survey (Chapter 6 and 7)

Surveys are a common means of collecting subjective data (Fowler, 1993) about people's opinions and behaviours (Dillman et al., 2009). Given that the aim is to collect data regarding people's subjective perceptions of accessibility in order that this can be compared with objective data, a household survey is an appropriate data collection tool. This provides the means by which quantitative subjective data can be compared with objective measures, meeting the research aims. Alternative methods such as face to face interviewing would have been too resource intensive to obtain a sample size large enough for comparative purposes.

A postal approach was therefore chosen so that a random sample of the population within a selected area could be surveyed. The detailed approach to sampling and questionnaire design is included in Chapter 6. In brief, a questionnaire is used to collect survey data regarding perceptions of accessibility to destinations. A multi-stage cluster sampling approach (Bryman, 2008) is used to ensure broad geographic coverage.

Mental Mapping Approach

A cognitive or mental map is defined as a "*psychological representation of places revealed by simple paper and pencil tests*" (Gregory et al. 2009, p.455). It is these mental maps that determine an individual's perception of space and ultimately their engagement with or behaviour in that space. As argued by Mondschein et al. (2007) "*variations in spatial knowledge can result in radically different levels of*

'functional accessibility,' despite similar locations, demographics, and other factors commonly thought to influence travel behaviour" (Mondschein et al. 2007, p.1). It is this "functional" or realised accessibility, based on perceived accessibility, which is of interest here. While survey data has been used to draw direct comparisons between objective and subjective measures of accessibility this approach will allow more in depth insights into differences in perceptions between individuals. For example, Accessibility Planning guidance discusses travel horizons as a key barrier to accessibility but this is relatively under-explored.

Mental mapping and Public Participation-GIS (PP-GIS) approaches, either by directly asking participants to draw maps, or by expert mapping of perception based data, have been used in a range of fields to capture public views (Cinderby and Forrester, 2005; Pain et al., 2006) and are increasingly seen as a useful tool in understanding travel behaviour as an individual's mental map is both a function of and an influence on their accessibility and travel behaviour (Mondschein et al. 2010). It provides a useful approach here to illuminate survey findings and further understand the link between perceptions and travel behaviour, in the context of local accessibility to destinations.

Focus groups and individual interviews were considered as the setting in which to undertake this work. Chapter 2 found that the use of focus groups and mental mapping exercises have been used to understand perceptions of accessibility. However, focus groups have usually been to build up a picture of an *area* based upon multiple viewpoints, where there is a common theme or the participants have something in common. This has already been undertaken to some extent by the survey approach. The aim here is to understand accessibility from an *individual* point of view in order to understand the lived experience, whilst at the same time gaining knowledge of how this compares to measured accessibility. Valentine (1997) explains that *"the aim of an interview is not to be representative but to understand how individual people experience and make sense of their own lives"* (Valentine 1997, p111). An individual interview approach is therefore suited to this stage of research which aims to explore in depth the lived experience of accessibility, building on quantitative work already undertaken.

In relation to the use of a mental mapping interview approach within transport, Weston & Handy (2004) explain, *“mental maps can provide important insights into the choices that travellers perceive to be available to them and the ways they evaluate those choices.....It is possible to assemble the mental maps of a sample of individuals to create and aggregate map that gives a sense of both the average understanding of the environment and the variation in that understanding”* (Weston & Handy 2004, p540)

For Kusenbach (2003) one of the main weaknesses of an interview approach for understanding the lived environmental experience is the static situation in which the interview takes place which does not allow participants to reflect on their experiences as they ‘live’ them. While no substitute for the experiential ‘go-along’ method employed by Kusenbach the use of mental maps does allow participants to contextualise their discussion and also promotes a more inclusionary approach (Kusenbach, 2003) by allowing the participant to take control and frame the discussion around their map, situating the interview.

3.5 Summary

This chapter has outlined the conceptual framework and research questions which this thesis will address and set out the methodological assumptions and approaches upon which the following two sections are based. The approach taken is based on a pragmatic research philosophy and mixed methods are adopted to address applied research questions.

The following sections are based upon current UK approaches to Accessibility Planning: Chapter 4 presents a critique of the CAI and analyses these alongside NTS data and Chapter 5 presents results of interviews with practitioners involved in delivering Accessibility Planning. Chapter 6 introduces the Case Study Area of Greater Nottingham, gives detailed survey methodology and descriptive survey results. Chapter 7 is a direct comparison of self-reported accessibility levels with objective measures and Chapter 8 probes the lived experience of accessibility in more depth, based on face to face interviews as a follow up to the household survey.

Part II: Current Approaches to Measuring Accessibility

4. An Exploration of Two Approaches to Measuring Accessibility in National Datasets¹

¹ The analysis in this chapter was presented as a written paper and oral presentation at the 50th European Regional Science Association (ERSA) in Congress Jonkoping, August 2010.

4.1 Introduction

This chapter presents a critical review of the Core Accessibility Indicators (CAI) and an empirical analysis comparing journey times to destinations in the Core Accessibility Indicators (CAI) and National Travel Survey Data (NTS) across the whole of England. It contributes towards Objective 2 of the research which is to critically assess current approaches to measuring accessibility and accessibility planning.

The CAI provide the basis of comparison for two aspects of this research, firstly compared to survey data from the National Travel Survey (NTS) in this chapter and then locally collected survey data pertaining to perceptions of accessibility (Chapter 7).

Reviewing the literature (Chapter 2) and international evidence (Chapter 4) suggests that such a rich dataset, readily available to policy makers and planners, does not exist in any other country. This provides a unique range of accessibility statistics available at a detailed local level and offers vast potential for research. It is however important to recognise the strengths and limitations before this is used for further analysis and therefore the first section of this chapter presents an overview and critique of the CAI in terms of addressing the aims of Accessibility Planning.

4.2 The Core Accessibility Indicators

The CAI (DfT, 2011b)¹ were originally calculated to support Local Authorities in England in developing an evidence base for accessibility strategies as part of the Local Transport Planning process and to support two of the 198 National Indicators (NI)² against which Local Authorities may choose to report as part of their reporting to the central government. Prior to the change of government and the removal of the requirement for reporting against national indicators (LTT, 2011) this was the means by which central government managed the performance of local government and was linked to funding allocations across a range of sectors. Since there is no longer a formal requirement for accessibility strategies or reporting of national targets, the

¹ Prior to the release of 2010 data the data was referred to as the Core Accessibility Indicators, but they are now called Accessibility Statistics. For the majority of the period of this research the term used has been CAI and therefore this is adopted throughout. However, the change in terminology is worthy of discussion and is discussed in Chapter 9, Section 9.2.

² NI175 - Access to Services and NI 176 - Access to Employment

indicators are produced to support local authorities in accessibility planning (DfT, 2011c), amongst a range of other potential uses such as sustainable travel and travel planning. These were all identified as uses of accessibility measures during practitioner interviews, which are presented in Chapter 5.

Indicators have been calculated annually since 2005¹ using a GIS based accessibility model, originally developed for the Scottish Government in 1999 (Halden et al, 2000) and further refined for DfT in 2003 (DHC & University of Westminster, 2003) using ACCALC software. Given a change in approach the structure outlined in

Figure 4.2.1 is only applicable for 2007 onwards. In depth details regarding the calculation methodology and input datasets are available (DfT, 2011d) but not repeated here. This section provides an overview of the indicators for the purposes of this research, presents a summary of the indicators for the whole of England compared with case study area of Greater Nottingham², and critiques the indicators in the context of their potential furthering the aims of Accessibility Planning.

4.1.1 Types of Measure

A range of accessibility indicators are produced; these can be categorised into Travel Time Indicators, Origin Indicators and Destination Indicators as illustrated in

Figure 4.2.1. Calculations are undertaken at Census Output Area (COA)³ level and aggregated to Lower Super Output Area (LSOA)⁴ and Local Authority (LA)⁵ levels for reporting. There is also a new Business Plan Indicator in 2010 which is calculated taking car ownership into account in order to identify areas of accessibility need with low car ownership.

¹ With the exception of 2006

² The case study area selection was described in Chapter 3 and is the focus of Chapters 6-8 but some analysis is included here for comparison of indicators.

³ Census Output Areas (COA) are the smallest level at which UK census data is output. They were designed to have similar population sizes and be as socially homogenous as possible. In England and Wales 2001 Census OAs are based on postcodes as at Census Day and fit within the boundaries of 2003 statistical ward. The minimum OA size is 40 resident households and 100 resident persons but the recommended size was rather larger at 125 households. (http://www.statistics.gov.uk/geography/census_geog.asp)

⁴ Super Output Areas (SOA) are a level of geography designed for collection and publication of small area statistics and contain an average of 1500 people (min: 1000 people=400 households)⁴ and will therefore vary in size depending upon population density. SOAs are based on aggregation of COAs.

⁵ A Local Authority is a unitary authority or district council, with responsibilities such as housing, council tax, waste collection. In areas where there is a two tier system of governance, responsibility for transport usually lies with the higher level County Council. As at April 2009 there were 272 Local Authorities in England (<http://www.communities.gov.uk/housing/housingresearch/housingstatistics/definitiongeneral/>)

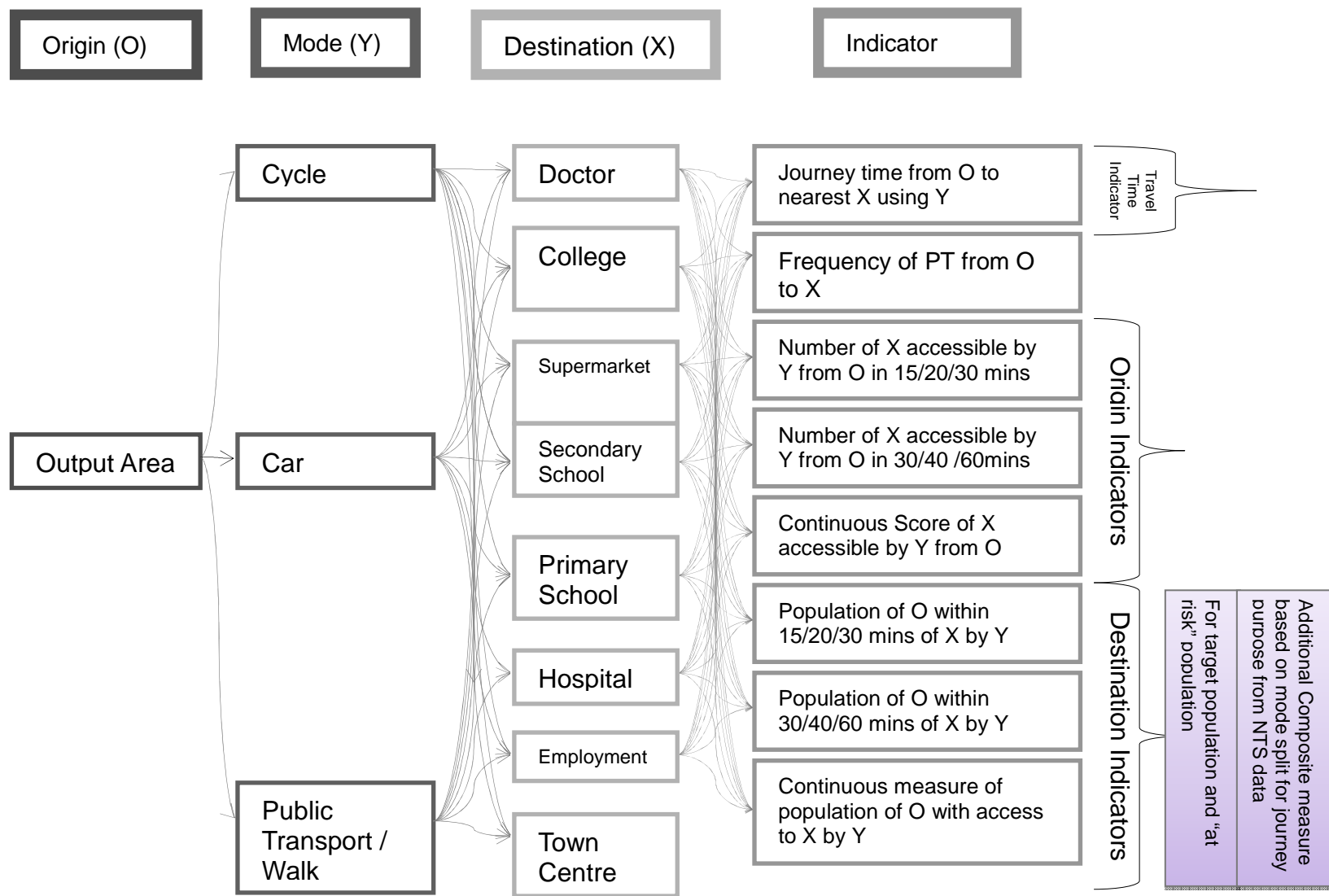


Figure 4.2.1- Structure of the Core Accessibility Indicators (CAI)

Travel Time Indicators report the population weighted average minimum journey time to the nearest destination for all output areas within a LSOA. For example the nearest doctors surgery for a particular LSOA might be reported as five minutes by car, 15 minutes by public transport and 20 minutes by bicycle.

Figure 4.2.2 shows the mean public transport journey time to the nearest of each destination type across all LSOA in England and across Greater Nottingham¹. The error bars show the standard deviation to illustrate the variation around the mean. This is useful given that the mean does not vary significantly geographically. It might therefore appear that there is no difference between England and Greater Nottingham in terms of journey time accessibility. However, while the mean LSOA journey time is fairly stable there are differences in the variation within these areas.

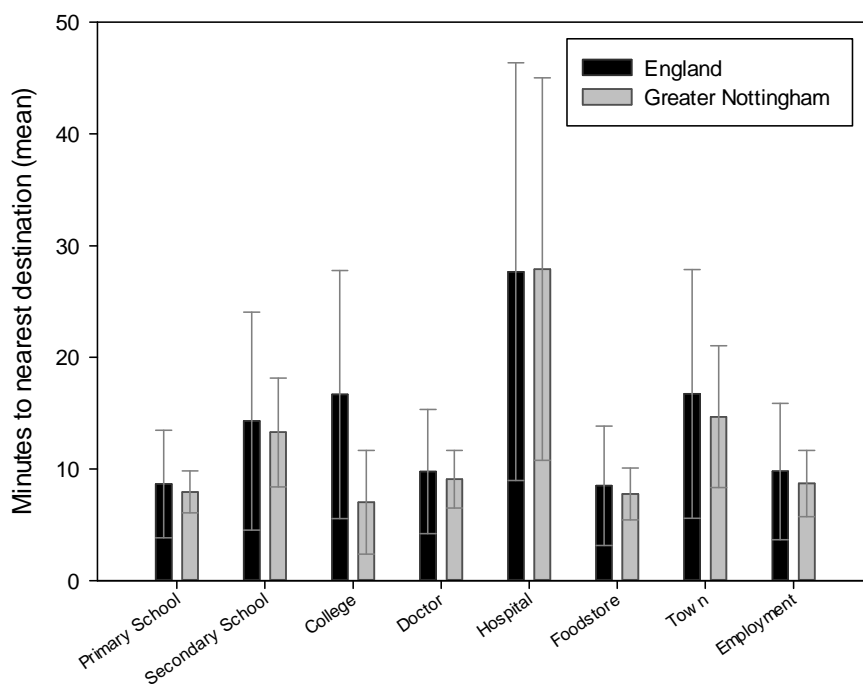


Figure 4.2.2 – Mean LSOA Public Transport (PT) Journey Times (CAI)

¹ Greater Nottingham is included here as a point of comparison, given it is the case study area in later chapters. The selection of Greater Nottingham is detailed in Chapter 6.

For all destinations the smaller error bars for Greater Nottingham show that the range of journey times for LSOA within this region is smaller than for England, as expected. There is considerable variation in public transport journey times to hospitals. While the mean journey time does not differ between England and Greater Nottingham (except for Colleges) there are differences in the variation as would be expected, given that the England level data includes extremes of densely urban London and remote rural areas.

This highlights potential problems with reporting a mean journey time for a local authority area which may not be an accurate reflection of the variation within that area. For car journey times (Figure 4.2.3) there is considerably less variation as shown by the smaller error bars. This graph suggests that the majority of LSOA are within 5 minutes of most destinations (hospitals and Further Education excepted) and that there is little variation around this mean.

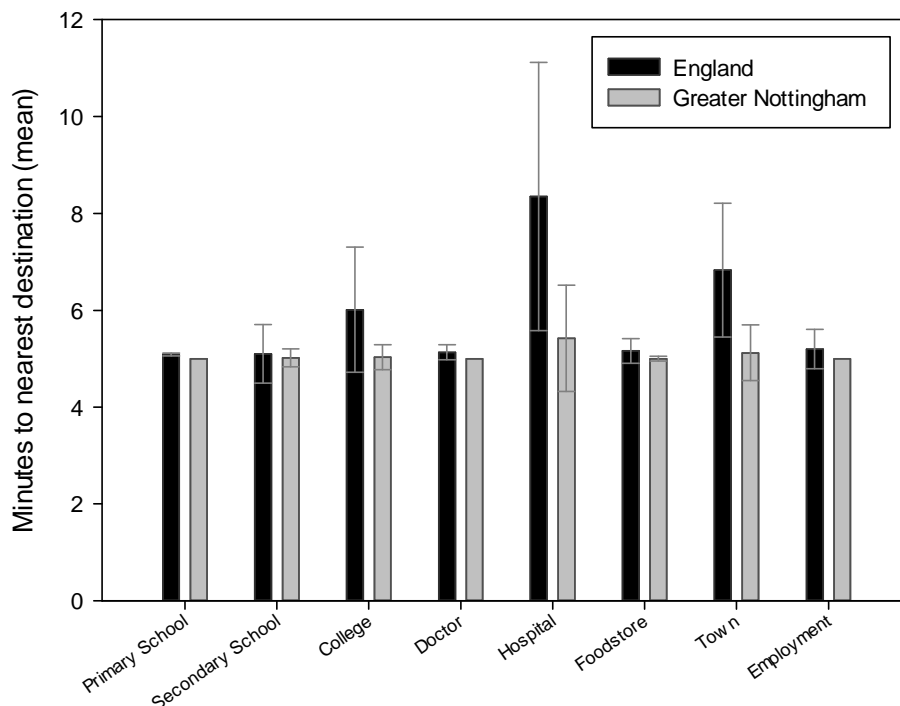


Figure 4.2.3 – Mean LSOA Car journey times (CAI)

Threshold indicators such as the origin and destination indicators reported in the CAI, and described here, are often used to give an indication of the number of people or destinations within certain time thresholds of a given point. These are used

as targets against which performance is measured, for example in Local Transport Plan Accessibility Strategies.

Origin indicators calculate the number of destinations accessible within a given time threshold from an origin point, in this case an output area. When aggregated these measures are a population weighted average of all output areas within a LSOA or LA, reported as threshold measures. For example a measure might be the number of supermarkets accessible within 15 minutes of a given location.

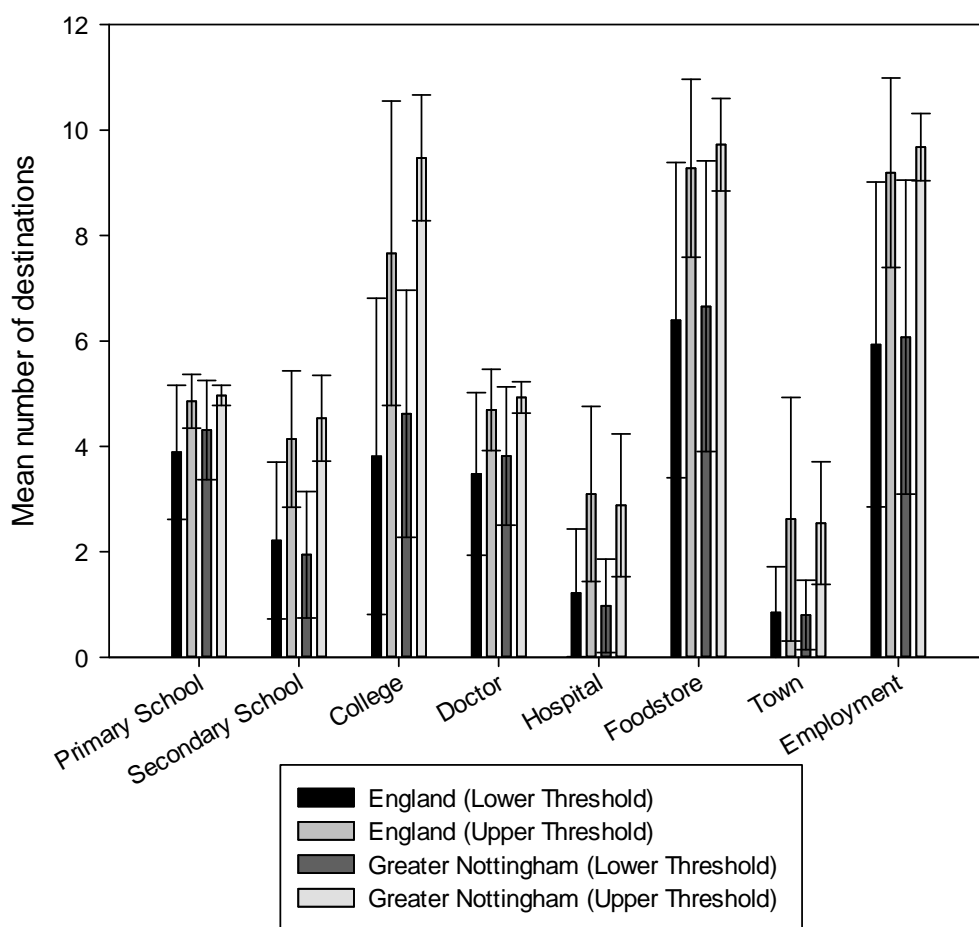


Figure 4.2.4 – Origin indicators showing the number of destinations accessible within X minutes (PT)

Figure 4.2.4 and Figure 4.2.5 show the mean number of each type of destination accessible from LSOA origin points within given time thresholds as reported by the

CAI.¹ Again, the error bars show the standard deviation from the mean. The calculation process takes the nearest five or ten destinations of each type (dependent on the destination) and then reports how many of these are accessible within the given time threshold. It is therefore feasible, and indeed likely, that more destinations are accessible in some instances. Given that there is little difference between the number of destinations available in lower and upper threshold times for car journeys then it would be expected that in reality there is a greater number of destinations accessible within the upper thresholds than are reported in the CAI.

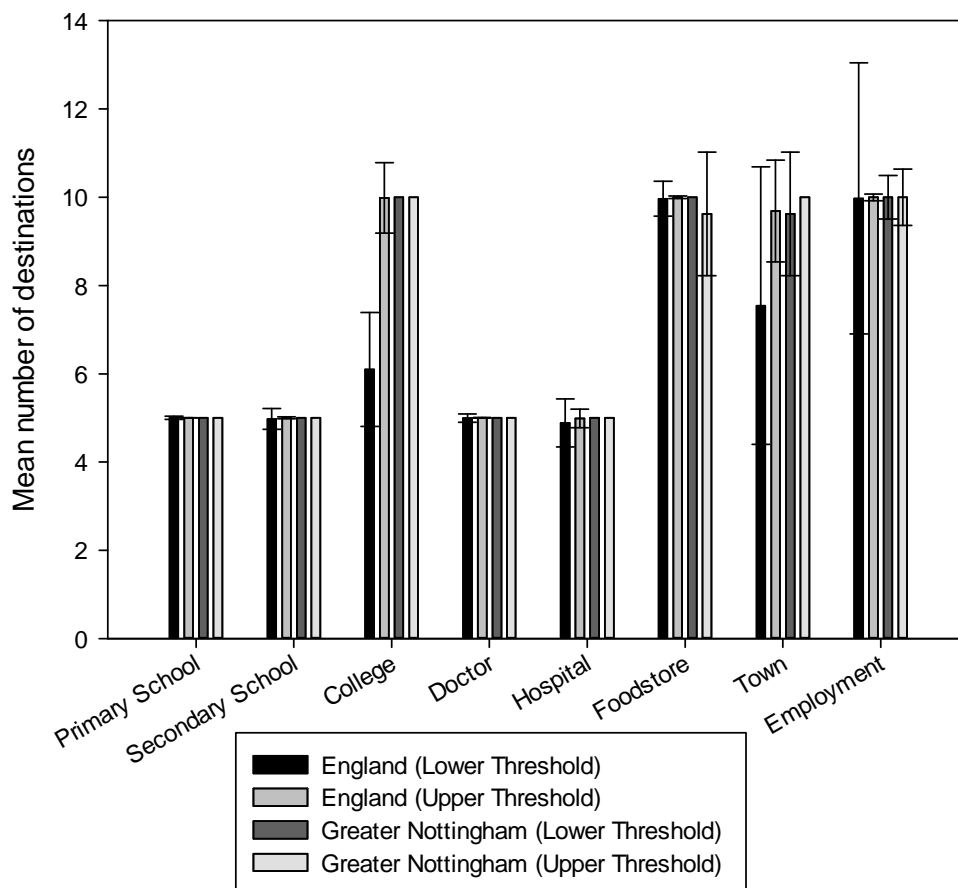


Figure 4.2.5 - Origin indicators showing the number of destinations accessible within X minutes (car)

Destination Indicators relate to the number or proportion of the population that can access a destination within a given time threshold. Results report two time

¹ The lower threshold is 15 minutes for supermarket, town centre, primary school and doctors, 20 minutes for secondary school and employment and 30 minutes for hospitals and further education. The upper threshold is 30 minutes for supermarket, town centre, primary school and doctors, 40 minutes for secondary school and employment and 60 minutes for hospitals and colleges.

thresholds for each destination, a lower threshold of 15, 20 or 30 minutes, and an upper threshold of 30, 40 or 60 minutes depending on the destination¹. These are simple threshold measures and are used to produce outputs such as '80% of the population can access a primary school by car within 15 minutes'.

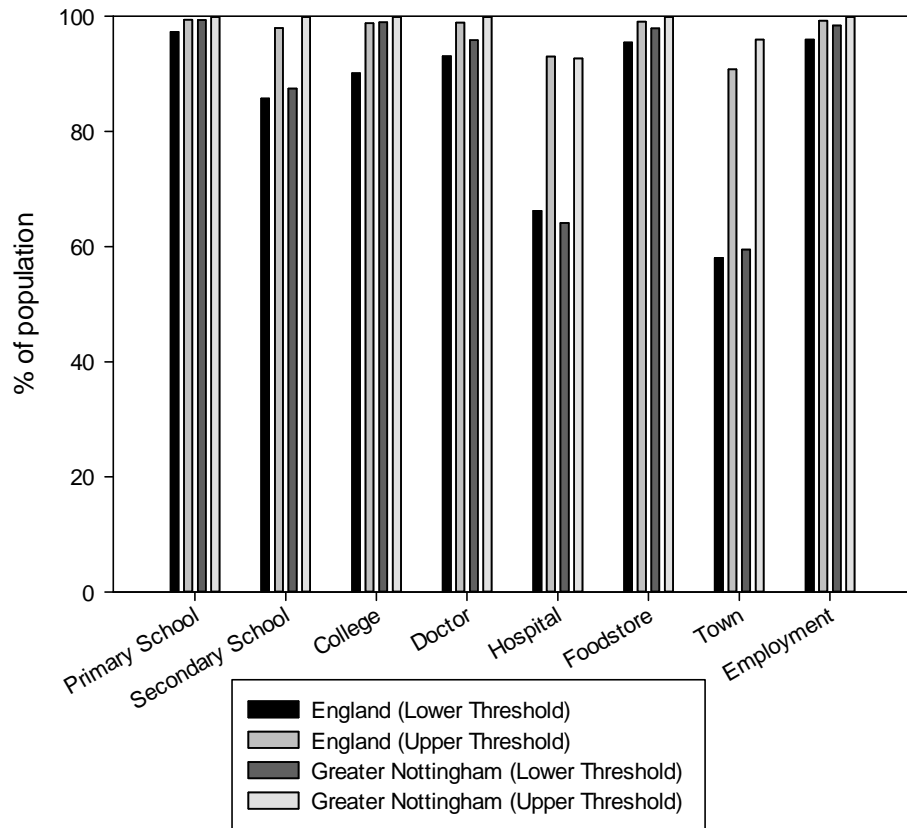


Figure 4.2.6 – Destination indicators showing the proportion of the population having access within X minutes (PT)

Figure 4.2.6 and Figure 4.2.7 summarise the destination indicators for public transport and car. Over 50% of the population has access to all destinations within the lower threshold indicators, both by car and public transport. The fact that almost 100% of the population has access to all destinations within the lower threshold by car, according to the CAI, suggests a need for changing the thresholds used if any discrimination amongst areas in terms of accessibility is to be possible. Car journey

¹ The lower threshold is 15 minutes for supermarket, town centre, primary school and doctor, 20 minutes for secondary school and employment and 30 minutes for hospitals and further education. The upper threshold is 30 minutes for supermarket, town centre, primary school and doctor, 40 minutes for secondary school and employment and 60 minutes for hospitals and further education.

times are now based on Trafficmaster data meaning that they should account for congestion in the network, whereas prior to the 2010 indicators car journey times were based only on applying a speed through the network. Despite this car journey times still appear optimistic.

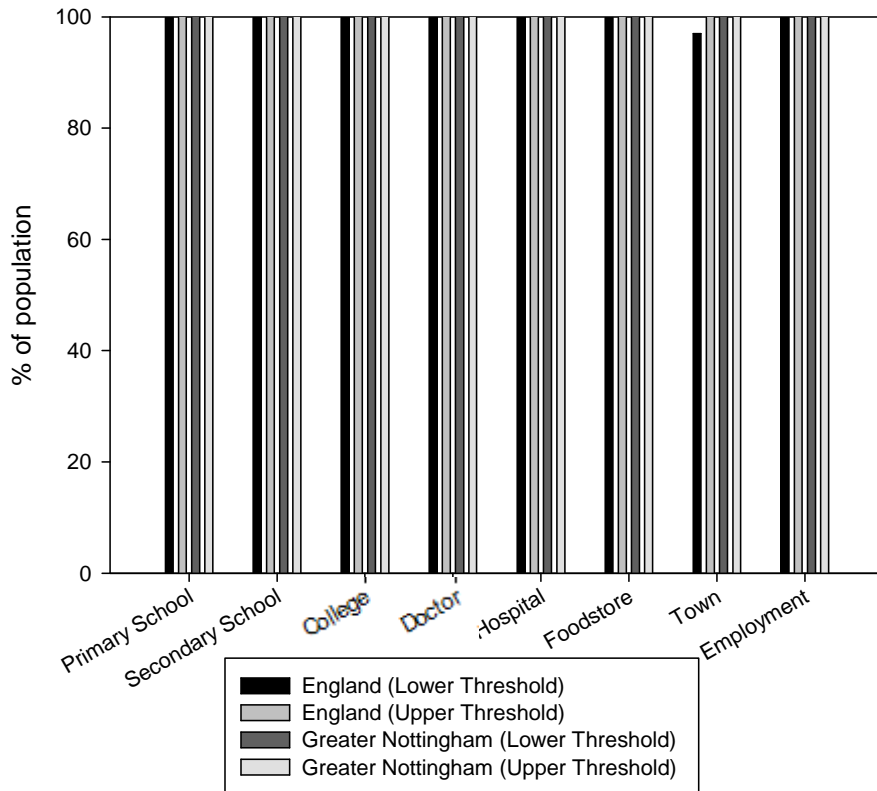


Figure 4.2.7- Destination indicators showing the proportion of the population having access within X minutes (car)

The measures described thus far are threshold measures. These are easily understandable and evidence suggests that transport planners find such measures useful in assessing accessibility and communicating with the public (Chapter 5). However, their limitations should not be ignored. Any threshold is arbitrary. Reporting that 80% of the population can access a primary school within 20 minutes potentially raises more questions than it resolves. It could be that 100% can access a primary school within 21 minutes, or that 80% can in fact access a primary school within 5 minutes. The decision about thresholds applied therefore needs to be given careful consideration to ensure that they are both meaningful and a reflection of what might represent a desirable level of accessibility for a given population. Such thresholds

are likely to differ geographically and modally and therefore the blanket use of thresholds, while allowing comparison is not necessarily useful, especially when the level of the thresholds means there is little discrimination between the two, as is the case here. Rather than reporting against given time thresholds it may be of more use to report in population percentiles, for example the time in which each decile of population can access a destination.

Additionally continuous origin indicators are reported, which report a relative measure of the number of destinations accessible based on a gravity measure of accessibility (Hansen, 1959). This uses a distance decay function based on willingness to travel to destinations from analysis of the National Travel Survey. This is potentially problematic as the frequency of trip making as a function of distance could be as a result of poor accessibility and therefore does not represent suppressed demand. While continuous measures have a more robust theoretical basis (Handy & Niemeier 1997) they are less well understood and as a result underutilised by transport planners. This does not necessarily mean they should not be used but that more guidance on how they can be used is needed.

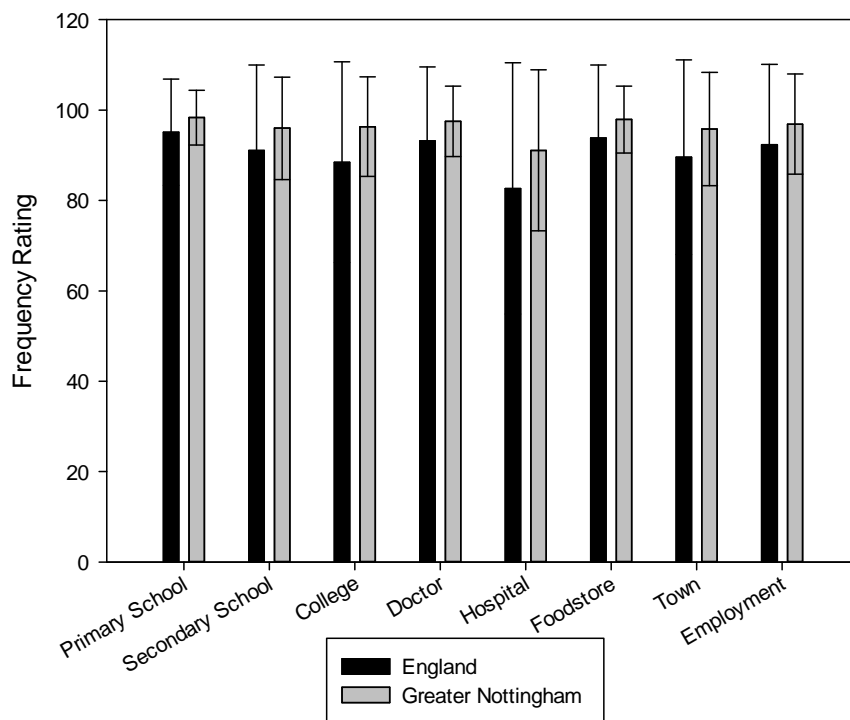


Figure 4.2.8 - Mean Public Transport Frequency rating by destination

A public transport *frequency measure* is also calculated which is a scale rating of the frequency with which the minimum reported journey time can be achieved throughout a 24 hour period. This is potentially useful, for example, used in conjunction with the travel time indicators to highlight areas of high frequency and low journey time as well as those with comparable journey times but limited frequency. However, users of the CAI do easily identify at which times of day the frequency is limited or which particular route poor frequencies might apply to and therefore it is hard to improve against this in practice. As shown in Figure 4.2.8 the frequency measure does not vary considerably across destinations and is generally quite high.

4.1.2 Destination Types

The eight types of destination (doctor, hospital, supermarket, primary school, secondary school, college, employment and town centre) are based on those identified by the SEU (2003) as being vital services for quality of life and social inclusion. However, while these might be seen as *essential* services, evidence from later chapters (Chapter 8) suggests that these are not the most important day to day destinations for the majority of individuals. At a societal level these are essential public services, but arguably so are post offices (Comber et al. 2009), pharmacies (Knox, 1981; Guagliardo et al., 2007) or dentists (Jones 2011) amongst others. Yet for an individual they are less important in defining their everyday accessibility. It might also be postulated that, given that these are essential services, people may be willing to travel further to reach them when necessary, whereas what may actually promote exclusion is lack of access to optional services such as out of school activities, sports facilities or cultural activities, which allow people to fully participate in society. Such destinations are discussed in Chapter 8 as those which are often more difficult to access. This is not to suggest that inaccessibility to these essential services is not important, but that the importance of marginally improving journey time to a hospital may not be as useful in achieving outcomes as ensuring access to a wider range of services.

This is related to the discussion about the setting of thresholds. Improving a bus service journey to a hospital by two minutes, from 21 minutes to 19 minutes could result in a 10% increase in the population that can access that hospital within a given threshold of 20 minutes. However, as any effect on individual behaviour and

perceptions of accessibility is unlikely, whether such an 'improvement' could be seen as meeting the aims of Accessibility Planning is questionable. Efforts could perhaps be better directed towards ensuring that there are a diverse range of opportunities available. It has been suggested that access to a diverse range of services is more important than the presence or not of destinations in the context of commercial destinations (Giles-Corti et al., 2005) and sports facilities (Ferguson, 2010).

The relative importance of different destinations also merits some discussion. Any analysis based on CAI indicators clearly highlights hospitals as having the poorest accessibility levels in the majority of areas and this is supported by Figure 4.2.2 to Figure 4.2.8.

In many cases this has understandably led to a focus on improving accessibility to healthcare (e.g. North East Lincolnshire LTP, South East Dorset LTP, Southampton, LTP). However, consideration should also be given to the fact that for many people the hospital is a less frequently visited destination. In the household survey undertaken in this research, results of which are presented in Chapter 7, 27.4% of respondents never visit a hospital and 63% did so less than once a month. Therefore in some instances, slightly poorer levels of accessibility may not be a problem, especially by public transport as when people do make such a journey they will not be in a position to use public transport. Improving accessibility to other services may be more of a priority, despite not being objectively as inaccessible based on absolute journey time.

The definition of some destinations is also problematic. This is elaborated in Chapter 7 which compares subjective and objective choice sets. The CAI destination set for supermarkets includes small grocers in addition to large supermarkets, without providing any distinction or indication of the range of produce available (although a measure of floor space is included). Likewise all hospitals are listed, including specialist institutions which may not provide an accurate representation of the level of accessibility to hospitals for the general population. This is identified as a weakness (DfT, 2011e) of the indicators, but it is a difficult issue to resolve in a national dataset. It is also likely that the employment indicators over estimate the levels of accessibility to employment as an employment centre is defined as any LSOA with at least 100, 500 or 5000 jobs according to the Office of National

Statistics (ONS) Business Register Employment Survey. It could also underestimate accessibility given that there may be employment centres with less than 100 jobs. This approach takes no account of the range of jobs or whether they are matched to the skills of the workforce in the locality.

The indicators make no distinction between urban and rural areas in terms of thresholds of accessibility (DfT, 2011e), or indeed destination types or modes of transport. This is an important point as expectations, and indeed desired accessibility may be less in rural areas (Farrington & Farrington 2005). Furthermore the differing size of census output areas (COA) in urban and rural areas means that there is a much greater potential for inaccuracies in rural areas. The indicators are calculated from the centroid of each COA. This means that for larger COA (in rural areas) the potential for error is greater as individual households will be a greater distance from the centroid. This could lead to the indicators underestimating journey times as it does not account for the distance of the household from the centre of the LSOA. There is also potential for overestimating journey time. This could happen if a household is near to a town centre offering essential destinations, yet in a different COA to the town centre. The algorithm would calculate the journey time via the centroid of the COA within which the household falls. This shows the vulnerability of the indicators to geographical boundaries and is illustrative of the Modifiable Areal Unit Problem (Openshaw and Taylor, 1981) whereby geographical measures could produce vastly differing results if boundaries are changed.

4.3 Travel Modes

The modes of transport in the CAI can also be critiqued. The availability of indicators for a range of modes is useful and allows comparison of accessibility across different modes. However, the calculation of cycling accessibility and not walking is interesting given the relatively low levels of cycling in comparison to walking and the likelihood that it is not poor time-based accessibility but rather other factors such as segregated infrastructure, safety or awareness which are more likely to lead to a greater uptake of cycling (Pucher and Buehler, 2008). Given the proximity of some destinations such as doctors and primary schools shown in the diagrams in the previous section, greater differentiation between areas could be highlighted through use of walk based accessibility measures. Walking is included in the calculations to

connect to the public transport system but not as a mode in its own right, unless the walk time is shorter than the public transport time. However it is not possible to ascertain from the indicators whether the result relates to public transport and walk or walk only. Such an approach is not a reflection of reality because while a public transport trip may be shorter than walking it does not mean that this provides a better level of accessibility than walking, as perceptions of accessibility, and subsequently behaviour is likely to be affected by much more complicated reasoning dependent on the extent of the difference in time between the public transport and walk trip. For example, someone is unlikely to walk 10 minutes in the wrong direction, get on a bus for 5 minutes, for a journey that would take 16 minutes to walk (this is supported by evidence from interviews in Chapter 8), yet the way in which the indicators are calculated would give a 15 minute public transport journey time and not report the walk time.

The minimum reported cycle time of 10 minutes also means that it is not possible to factor cycle times to walk times based on the assumed walk and cycle speeds adopted in the CAI as this would result an unrealistic minimum walk time of 33 minutes¹. There are further assumptions included in the calculations which may mean the utility of the indicators is reduced. For example a maximum walk of 1.2 miles to a bus stop is assumed, a minimum five minutes to get from the front door to car or cycle, yet no parking time is included for either of these. A maximum 20 minute public transport interchange is included, yet interchange or waiting time is not weighted relative to in-vehicle journey time despite this being likely to affect perceptions (Watkins et al., 2001). Attempting to make some behavioural assumptions, yet selectively doing so, perhaps limits how the indicators can be interpreted. If no such assumptions were included then users of the data could choose to add in extra time for access and egress of the vehicles or not. The indicators may be more useful if they were a more accurate reflection of behaviour, but, given the difficulties in developing a national level indicator which can reflect individual user behaviour the data may be more useful if it was available in a rawer format to be manipulated by users based on their local knowledge.

¹ Based on assumed walk speed of 3mph and cycle speed of 9.9mph on the majority of road types (DfT, 2011d)

4.1.3 Application in Accessibility Planning

Currently, use of the CAI among accessibility planners is low as is identified through practitioner interviews in Chapter 5. This is partly attributable to lack of knowledge and understanding of how the indicators can or should be used. Chapter 5 highlights the mixed views of accessibility planning practitioners with regard to using the CAI. While some respondents felt strongly that the indicators are not a good reflection of accessibility in their local area, others (usually those less technically oriented) were unaware of the data available and often confused the CAI with National Indicators and Accession outputs. Given the vast amount of data it is perhaps not surprising that such confusion arises. Overall, accounting for 8 destination types, 3 mode types and 8 indicator types, with additional indicators for “at-risk” population groups and composite indicators there are 574 indicators in the 2010 dataset alone. If one was to also consider longitudinal comparison (in addition to numerous other potential comparisons, such as modal, or geographical) then utilising the CAI dataset is clearly a daunting task. While any analysis of the dataset should be led by research questions, for a local accessibility planner wanting to build a picture of accessibility the potential is infinite, while resources are finite.

An Accessibility Business Plan Indicator (DfT, 2011d)¹ has been calculated as part of the latest CAI. This is based on accessibility levels and car ownership, with the intention of highlighting the areas of greatest accessibility need. However, the spatial scale of calculations mean that in reality it may be different individuals within an output area who have no car and low accessibility. Furthermore in some rural areas in particular car ownership may be necessitated by poor levels of accessibility. In such cases such an indicator may do more harm than good by concealing accessibility problems related to transport disadvantage.

However, if the outputs are not an accurate reflection of the accessibility provided by the transport system, either in reality or as perceived by users, their utility is questionable. If individual perceptions are not the same as the objective measurement then influencing behaviour, which is ultimately based on perceptions, is difficult, as a true reflection of existing perceived accessibility is not possible.

¹ The business plan is the DfT's strategic document setting out the vision for the transport system alongside key action and indicators, one of which is the Accessibility Business Plan Indicator (DfT, 2011i)

While there are numerous potential pitfalls with the use of such data, they also clearly present great opportunity given the rich level of data available which does not exist elsewhere. It should be acknowledged that the indicators are produced based on the best available data and evidence and are continually improving, for example with the most recent release car journey times are based on TrafficMaster data, incorporating real traffic flow data rather than being based on average speeds through the network as was previously the case. The DfT acknowledges that best practice in this area is evolving (Lloyd and Moyce, 2012) and there are lessons to be learnt, to which this research can contribute.

Therefore whilst recognising the limitations and weaknesses outlined above, the following section compares the CAI to self-reported journey time accessibility measures from the National Travel Survey.

4.4 Comparison of two approaches to measuring journey time accessibility

The second part of this chapter compares the English Core Accessibility Indicators (CAI) in conjunction with another national dataset, the UK National Travel Survey (NTS). Both these datasets contain information regarding the accessibility of key destinations. They approach measurement in different ways, the NTS being based on survey responses and the CAI on modelled journey times. These are both common approaches to measurement of concepts such as accessibility yet the two are rarely compared (McCrea et al., 2006; Lotfi and Koohsari, 2009; van Acker et al., 2010). There is therefore little understanding of how subjective perceptions relate to objective measures. This section addresses this by comparing two types of journey time measure of accessibility to destinations.

4.1.4 National Travel Survey Accessibility questions

The NTS¹ contains questions pertaining to how long it takes for respondents to reach given destinations. This can be seen as a subjective measure as it is based on survey responses rather than objective measurement.

¹ The National Travel Survey (DfT, 2010a) is a UK-wide continuous household survey (since 1988) on personal travel.

The reported intention of asking this question is *“likely to be due to monitoring access to services across different area types, for instance, ensuring that households in rural communities had access to hospitals, chemists, etc”* (DfT, 2010b). Furthermore the NTS guidance states:

*“These questions are **measures of fact, not of opinion**. Interviewers are encouraged to make use of information other than that provided by the household if this provides a more accurate indication of the true position. ‘Walk time’ assumes a walk speed of three miles per hour, and takes no account of, for example, any infirmity or disability of the respondent”* (NTS 2006, p.60).

This suggests that the motivation for including these questions in the NTS is to develop an objective measure of accessibility, information which is available in the CAI, and not as an individual’s subjective perception of their journey time.¹ The results of this comparison are therefore interesting in the context of two different approaches to collecting the same data. Both of these datasets contain similar information relating to the accessibility of key services, and both are designed to monitor the level of accessibility of the population to these services. However, the data collection methods mean that in this analysis the CAI data are regarded as an objective measure, based upon the location of services and the transport networks, whilst the NTS data are regarded as a subjective measure relating to respondents’ perception of their journey time to key services, which will be based upon their perception of the location of services and transport networks.

There are six destinations *common* to both of the datasets: **doctors, hospital, supermarket, primary school, secondary school and college**. These destinations are therefore used in this analysis. The following section describes the methodology used to match the CAI and NTS datasets and then analyses comparing the two are presented.

4.1.5 Methodology: Geographically matching the Core Accessibility Indicators to the National Travel Survey

The two datasets are matched in order to undertake an analysis of the difference between objective and subjective measures of time based accessibility based on

¹ The DfT were asked what they thought the relationship was between this question in the NTS and CAI and whether they were interested in the results of this comparison but did not receive a response.

available existing datasets. This provides a useful starting point for understanding how different approaches to measuring accessibility may vary.

NTS data is currently available up until 2008¹. Using the time based indicators from the CAI dataset and the relevant responses from the NTS a comparison of the objective and subjective measures of *journey time* accessibility to key services can be undertaken.

The level of geography of the two datasets is different so a vital first step is to match the two datasets together. The CAI are reported at Lower Super Output Area (LSOA) and the lowest level of geography available from the NTS is the postcode sector. This was provided as a custom dataset by the DfT as the standard data is available at a much coarser regional level. Postcode sector level is the lowest level at which the DfT were able to provide the NTS data, due to their sampling procedures, which are based around postcode sectors. This means that household, postcode or street level data, which would enhance this analysis, is not available. LSOA contain an average of 1500 people (min: 1000 people=400 households)² and will therefore vary in geographical extent depending upon population density. Postcode sectors are the second level of UK postcode geography and there are 11598 in the UK, containing on average 153 unit postcodes³; these will vary in size with population density. The two units of geography do not fit neatly together, so while postcode sectors are larger than LSOA the boundaries overlap. Each postcode sector contains an average of 14 (min: 1; max: 41) LSOA and each LSOA falls into an average of 3 (max: 26; min: 1) postcode sectors. This is problematic when combining the two datasets as the data cannot simply be aggregated, which in itself would create errors. There are widely reported problems of comparing aggregated data at different spatial scales resulting in potential errors or loss of data. This is known as the Modifiable Areal Unit Problem (Openshaw & Taylor, 1981) and is based on the understanding that analysing spatially aggregated data gives results that are somewhat dependent on the units to which the data are aggregated (Fotheringham et al, 2001). As explained in Section 4.2, CAI at LSOA level are population weighted

¹ Data for 2009 and 2010 was released on 14/2/2012 but by this stage all analyses for this chapter were completed based on the most up to date data at the time which was until 2008.

²<http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do?page=aboutneighbourhood/geography/superoutputareas/soafaq/soa-faq.htm> (Accessed: 27/05/2010)

³ http://www.statistics.gov.uk/geography/postal_geog.asp (Accessed: 27/05/2010)

means aggregated from COA level. Further aggregating to postcode sector can potentially lead to greater errors. To avoid aggregation, one option would be to match the data based on the LSOA within which the postcode centroid falls or vice versa but the resultant loss of data would be large and taking the centre point of an area as large as a postcode sector increases the potential level of error as it ignores the variation of CAI values within each postcode sector.

In order to be as accurate as possible in this analysis, CAI values have been aggregated to postcode sector level by calculating a weighted value of CAI journey time based upon the proportion of each postcode sector covered by each LSOA, representing the range of CAI results within any given postcode sector proportional to the overlap. For example if a postcode sector contains 3 LSOA with CAI journey times of 4 minutes, 5 minutes and 6 minutes, and the LSOA account for 50%, 20% and 30% of the postcode sector respectively the CAI weighted journey time for the postcode sector would be 4.8 minutes $((0.5*4) + (0.2*5) + (0.3*6))$. The combined dataset therefore contains the postcode sector level NTS household responses with additional CAI journey time measurements attached for each of the six destination types.

Responses to the National Travel Survey (NTS) questions are coded into categories and raw reported journey times are not available. For the purposes of this comparison, the CAI were coded into the same categories and the analysis in this section compares the difference between the response categories for the two datasets.

4.1.6 Results: Comparing the Journey Time categories

An initial comparison of the distribution of the NTS (Figure 4.4.1) and CAI (Figure 4.4.2) datasets shows similar patterns. In both cases over 50% of cases of LSOA have a mean journey time of 15 minutes or less to all destinations except for hospitals and very few cases fall into the greater than 60 minutes category.

Despite the patterns being similar there are clear differences in the actual proportions in each category. In Figure 4.4.2 the proportion of each destination type falling into the <15mins category is much greater than in Figure 4.4.1. For example, over 80% of LSOA in the case of doctors, and almost 100% for shopping centre and primary schools have a mean journey time of less than 15 minutes whereas these

are much lower for NTS postcode sectors. On the contrary there are larger proportions of NTS postcode sectors falling into the longer journey time categories, across all destination types.

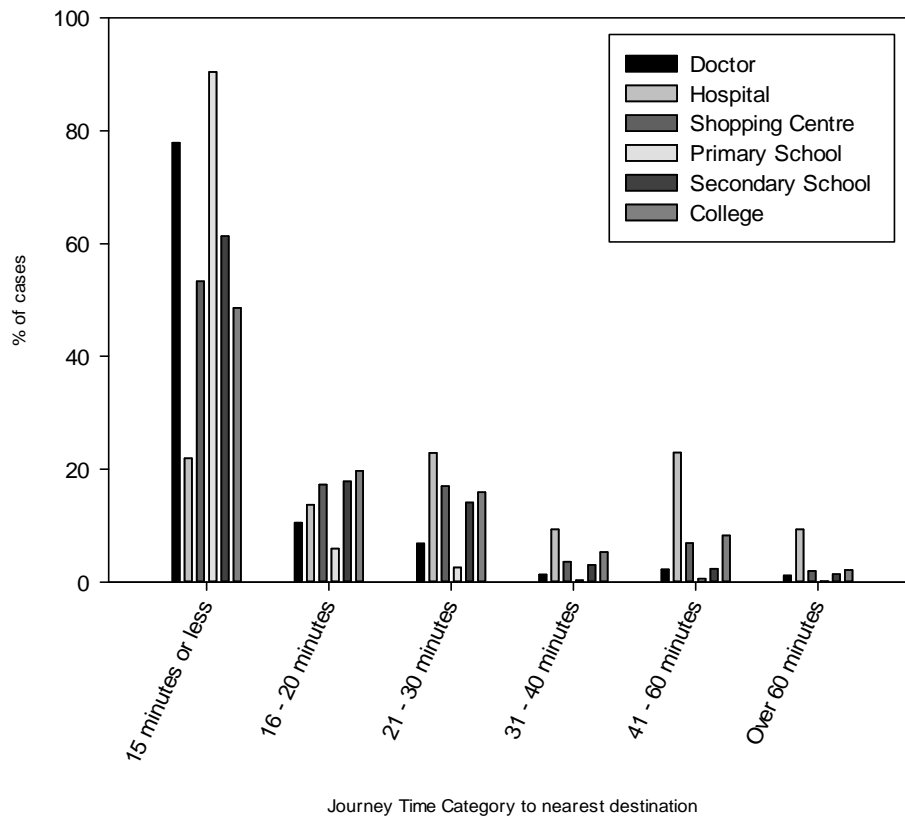


Figure 4.4.1 - NTS reported journey times to nearest destination by PT/walk

This suggests that at an aggregate level CAI journey times to destinations are lower than NTS journey times. However, this shows the general trend across the aggregate national datasets and is not a like for like comparison of the two datasets for a given case (NTS) or geographical area. It could be that the NTS responses are not an accurate geographical reflection and so the journey times are longer because they are concentrated in rural areas for example. By matching the data geographically as described in Section 4.1.5 more robust comparisons based on actual differences in a paired dataset can be made rather than relying on the standard error of the mean difference to draw inferences about difference in an aggregate dataset.

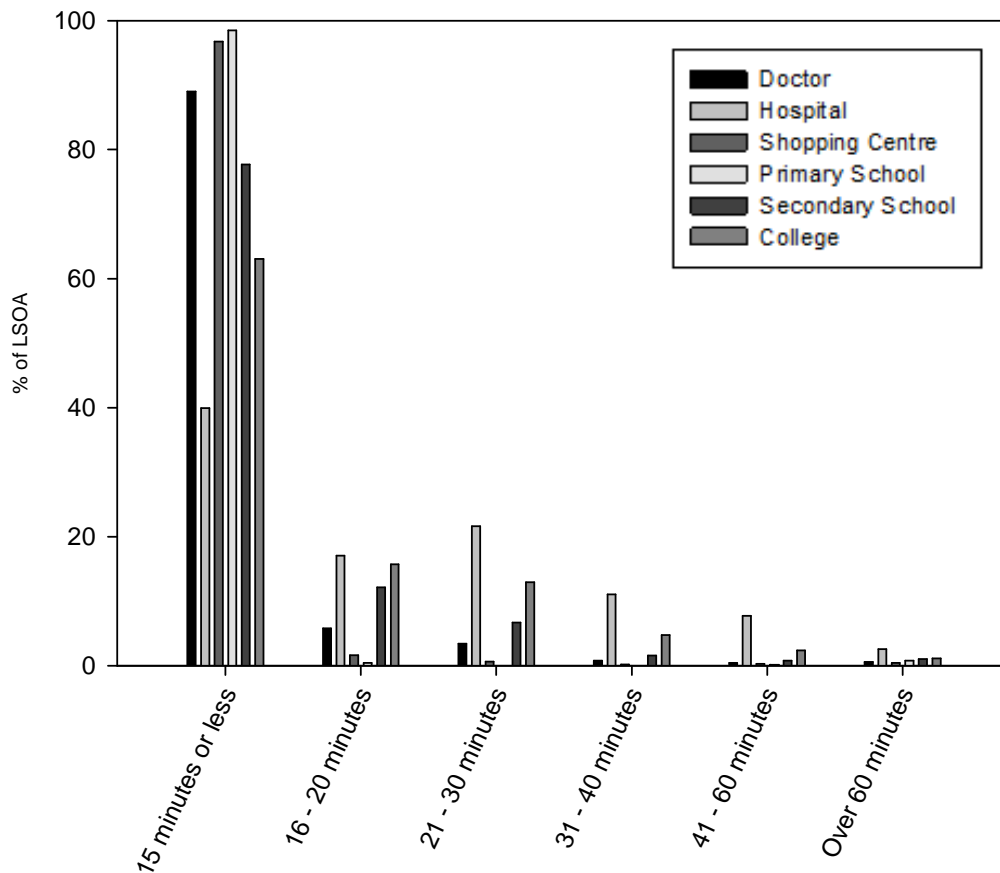


Figure 4.4.2 - CAI journey times to nearest destination by PT/walk

In order that a direct comparison can be made analyses are undertaken to compare the NTS and CAI for a given NTS case.¹ Paired *t*-tests were undertaken to establish whether there is a significant difference between NTS and CAI responses, for all cases in the NTS dataset.

Table 4.4.1 shows the paired *t*-test results. There is a significant difference ($p < 0.05$) in the journey time category between the NTS and CAI for all destination types except for doctor and secondary school. The mean difference and the *t* value is an indication of the direction of the difference between NTS and CAI, where the mean difference is calculated by (NTS-CAI). For all destinations except supermarket the

¹ Each case in the NTS dataset was allocated a CAI journey time to each destination as described in Section 4.1.5.

mean difference is positive, indicating that the CAI journey times are lower than the NTS.

Table 4.4.1 – Paired sample t-test results for difference between in journey time category between subjective (NTS) and objective (CAI) measures of journey time accessibility

	N	Mean difference	St. dev	confidence intervals		t	df	p
				lower	upper			
Doctor	15336	0.01	1.26	-0.01	0.03	0.64	15335	0.53
College	711	0.19	1.65	0.07	0.31	3.11	710	0.00
Hospital	7783	0.65	1.81	0.61	0.69	31.77	7782	0.00
Supermarket	15421	-0.09	0.90	-0.10	-0.07	-12.08	15420	0.00
Primary School	1027	0.08	0.67	0.04	0.12	3.77	1026	0.00
Secondary School	968	0.04	1.38	-0.04	0.13	1.00	967	0.32

The mean difference values appear relatively small and it may therefore be surprising that the differences are significant. However, given that the t-test compares case by case it is theoretically possible to have a significant difference with a mean difference of 0, if the positive and negative differences counterbalance one another. To give an idea of the effect size the difference has been categorised into three categories: no difference, CAI<NTS and CAI>NTS. Figure 4.4.3 illustrates the number of cases where differences occur between objective and subjective measures.

A negative difference (NTS-CAI) indicates that the NTS response category is lower than the CAI journey time meaning that the NTS is an underestimate of the CAI, so survey responses are lower than modelled journey time accessibility. A positive difference means that the NTS is an underestimate of the CAI, so journey time reported by survey respondents is greater than modelled journey time accessibility. Differences between objective and subjective measures occur across destination types, although differences occur more often for hospitals and colleges. There are differences amongst destinations in terms of whether the CAI is greater or less than the NTS journey time to a destination.

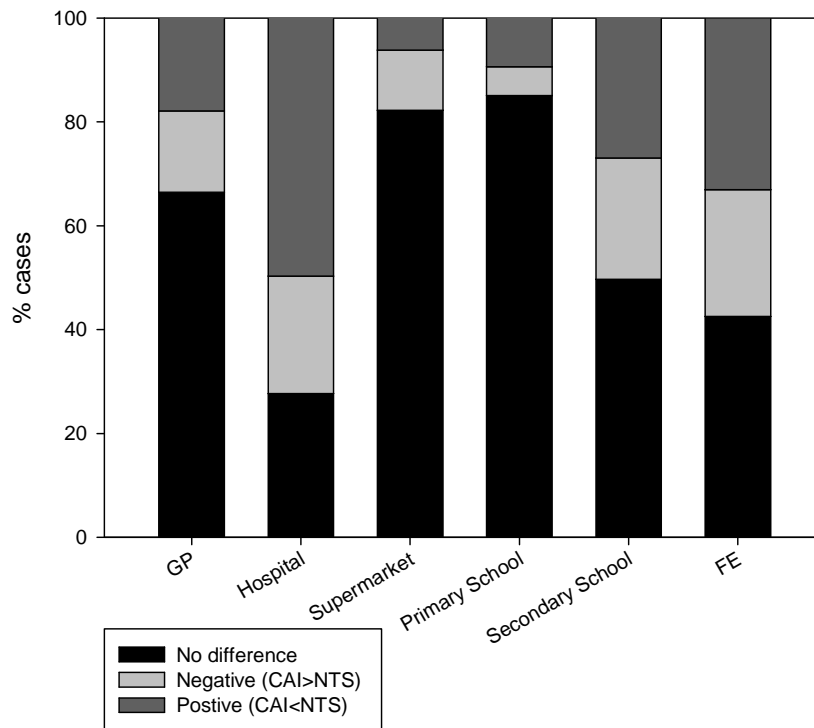


Figure 4.4.3 - Proportion of cases (NTS) where the difference in journey time category with the CAI is zero, positive or negative

For doctors, supermarkets and primary schools there is no difference in the journey time category in over 50% of cases. Differences are more common for hospitals, secondary schools and colleges. When there is a difference this is more often an underestimation of journey time by the CAI (positive difference) for all destinations except supermarket, as supported by the t-tests. For supermarkets CAI is more likely to overestimate the journey time relative to NTS responses. This is potentially due to differences in the definition of a supermarket, although given that the CAI includes small food stores it would be expected that the opposite would be the case and that the CAI journey times may be significantly lower than NTS responses.

In order to explore in more detail whether differences between objective and subjective measures are more likely in different geographic areas analyses are undertaken to understand how the differences vary dependent upon the absolute CAI journey time and across rural and urban areas.

4.1.7 The influence of journey time of the difference between objective and subjective measures

Although the NTS data is categorical, CAI data is continuous but has been categorised for the purposes of this analysis. This means that the differences between the two datasets can be analysed in terms of journey time in order to establish whether differences are more likely over long or short journeys.

One-way ANOVAs confirm that journey time (CAI) varies significantly across categories of difference (i.e. no difference, positive, negative) for all destinations. Figure 4.4.4 shows the mean CAI journey time for cases where the difference is positive, negative or no difference, across destinations.

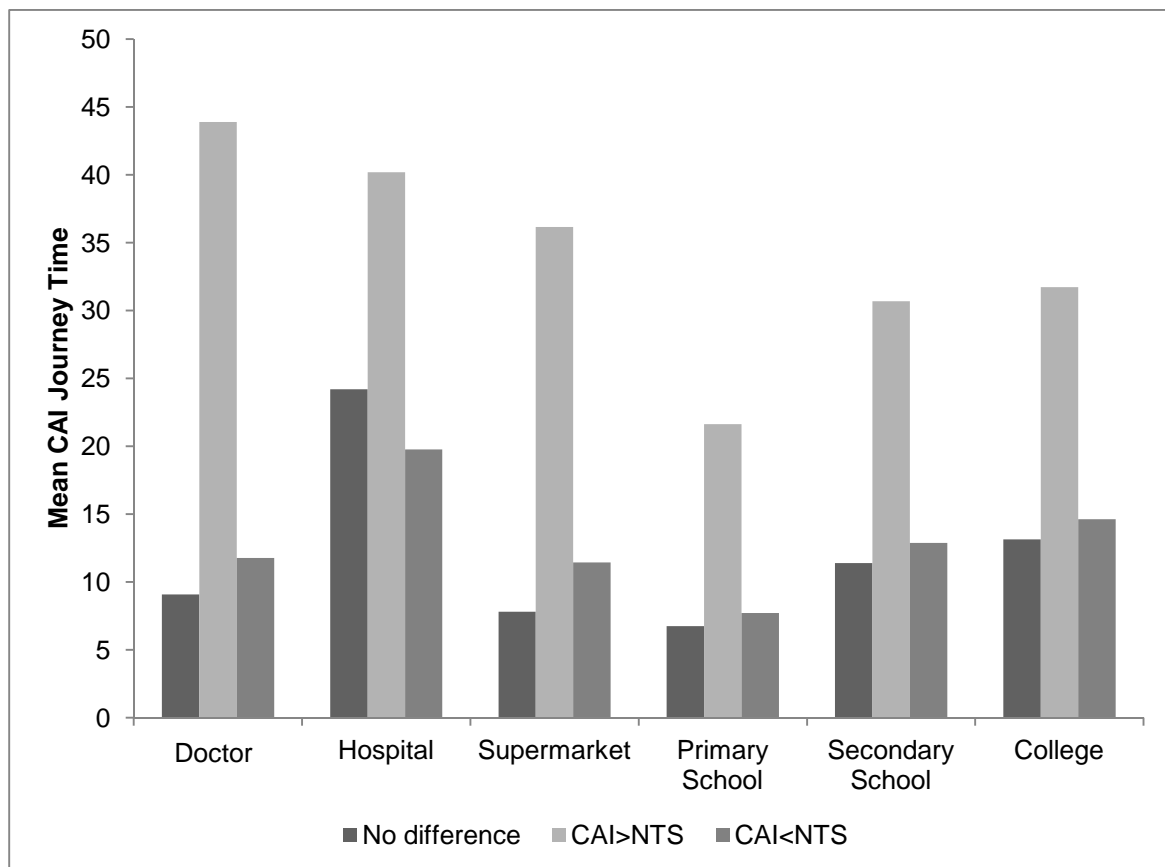


Figure 4.4.4 – Mean CAI journey time when the difference between CAI and NTS falls into the category shows on x-axis

When the CAI is greater than NTS journey times are longer and when CAI is less than NTS journey times are shorter. Except for hospitals, journey times are shortest when there is no difference between the two measures. This suggests that for

shorter journey times there is a greater level of agreement between the two types of measure.

4.1.8 The influence of rurality on the difference between objective and subjective measures

In order to assess the relationship of these results to location, analysis in this section compares results in relation to the urban/rural classification used by the Department for the Environment Food and Rural Affairs (DEFRA), given that different patterns might be expected in urban and rural areas both due to differences in perceptions of accessibility and also because of different types of errors occurring in CAI calculations, for example due to the size of output areas in rural areas.

The rural-urban definition is a categorisation used by DEFRA and defines LSOAs into one of the following three categories:

- Urban (>10k population)
- Town and Fringe
- Village, Hamlet and Isolated Dwellings

The dataset was split into these three categories in order to ascertain the impact of geographical location (and therefore scale of measurement) on the results. In other words this was undertaken to control for the geographical setting, as larger rural LSOA or postcode sectors could have different errors within the CAI dataset, to smaller urban LSOA.

Chi-squared tests confirm that the influence of geographical area is significant in influencing the difference between self-reported (NTS) and modelled (CAI) measures of journey time accessibility to destinations:

- Doctor: $\chi^2 (10) = 11667, p < 0.01$
- College: $\chi^2 (10) = 356, p < 0.01$
- Secondary School: $\chi^2 (10) = 617, p < 0.01$
- Primary School: $\chi^2 (8) = 944, p < 0.01$
- Hospital: $\chi^2 (10) = 2095, p < 0.01$
- Supermarket: $\chi^2 (10) = 13504, p < 0.01$

Odds ratios are a useful way of presenting differences in categorical data and for showing the effect size (Field, 2009).

Figure 4.4.5 shows the odds of there being a difference between objective and subjective journey time categories for each category of rurality, compared to the other two categories. Odds above 1 indicate that there is more likely to be a difference in the urban-rural category shown, compared with the other two categories, whereas if the odds are less than one there is less chance of there being a difference. For example, for supermarkets differences occur seven times more frequently in villages than in urban or town and fringe areas. Differences are more likely in rural areas across all destination types.

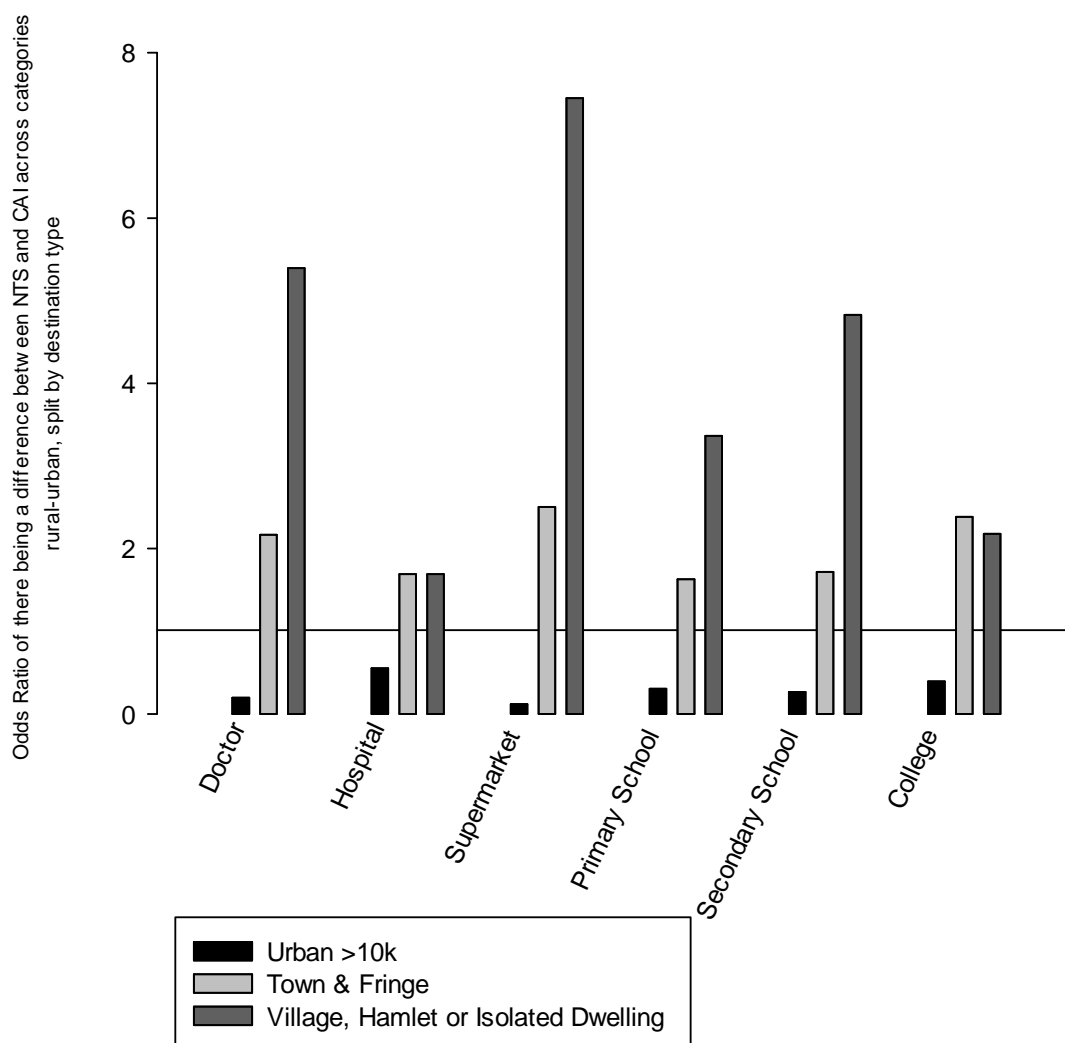


Figure 4.4.5 –Odds of there being a difference between NTS and CAI

Taking only those cases where there is a difference, Figure 4.4.6 shows the odds of this difference being negative (CAI>NTS) and therefore the CAI overestimating the journey time relative to the NTS. The low odds in urban areas show that in these

areas the CAI is more frequently an underestimate of NTS journey times whereas in rural areas the opposite is true and self-reported journey times are usually lower than the CAI.

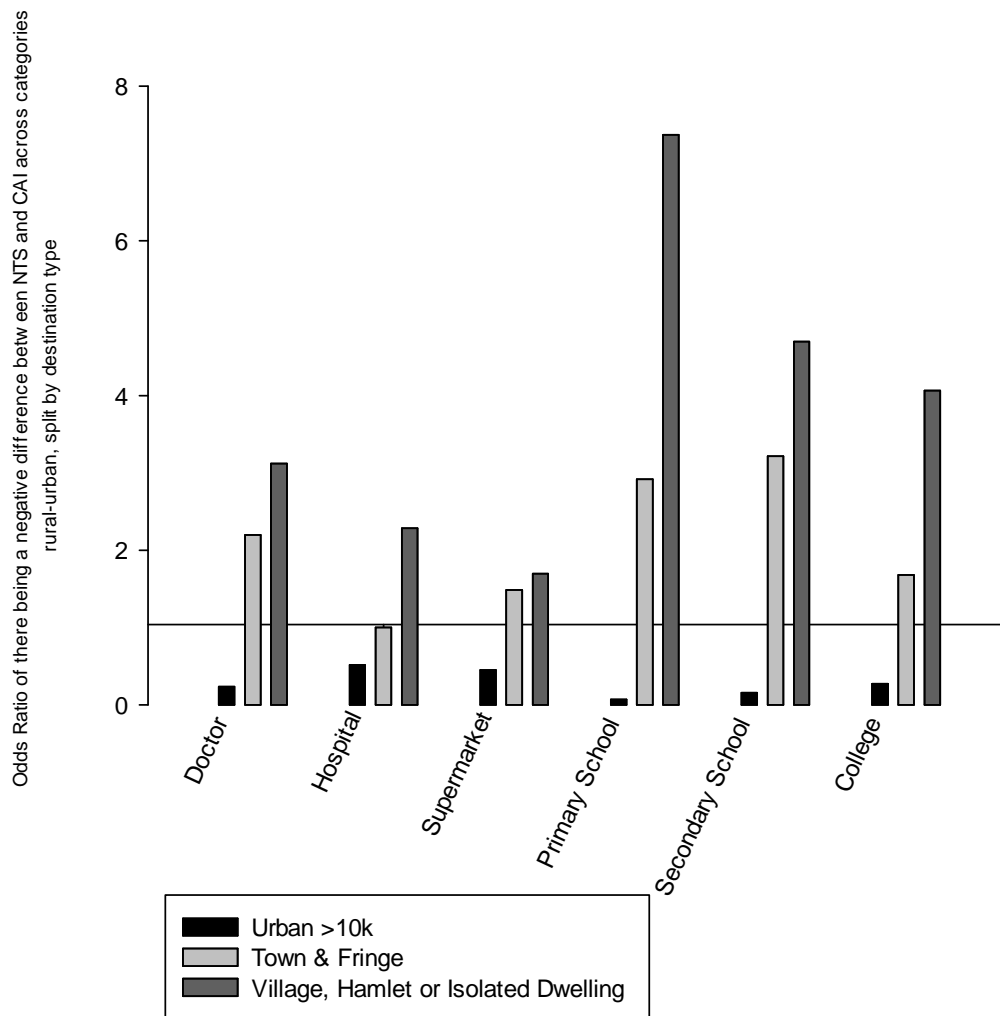


Figure 4.4.6- Odds of CAI being greater than NTS (overestimation of journey time)

4.5 Discussion and Conclusions

The results have shown that there are statistically significant differences between objective (CAI) and subjective (NTS) measures of accessibility. This is important, given that both of these datasets are used by policy makers to make important decisions, and that both datasets are ultimately trying to represent the same thing: the accessibility of people to key services. It is therefore important to understand the

differences between the datasets, and the implications of these for policy, and how such differences can be reduced.

Overall, objective (CAI) journey times are shorter than the subjective (NTS) journey times, except for supermarkets where the CAI measures are larger than NTS. Differences are more likely to occur in rural areas, but in rural areas the pattern is reversed and NTS journey times are shorter than in the CAI. There is a general trend towards subjective journey times being greater than objective measures (NTS>CAI) in urban areas and shorter than objective measures (NTS<CAI) in rural areas.

This could be as a result of the coarse scale of analysis. As little is known about the precise location of NTS responses within a large postcode sector, then the CAI value assigned is not as accurate as it could be, were more detailed geographic information known. For example, if the NTS responses are in quite central areas then the method of accounting for all LSOA CAI values within a postcode sector may be an over-estimate of the NTS values. Alternatively it could be because the CAI values are average valued for the time achievable across an entire day, whereas NTS responses may relate to the minimum time a respondent thinks is achievable. This highlights a need for more accurate detail regarding perceptions or subjective measures of accessibility. Evidence from speaking with local accessibility planners (Chapter 5) suggests that in fact the core indicators are seen as optimistic in more rural areas, so this highlights a discrepancy between this analysis and local knowledge which should be explored in more detail.

At a much more micro scale, and focusing on cognitive differences, Bugmann & Coventry (2004) find that longer distances tend to be psychologically compressed meaning that the same distance covered in a straight line is perceived to be shorter than if lots of turns are involved. This is termed the segmentation hypothesis. Although this concept cannot be directly applied here, as nothing is known about the routing of specific journeys, it does provide some support to the idea that longer journeys may be psychologically compressed relative to shorter journeys and therefore support the findings here that longer journeys are underestimated compared to over-estimation of shorter journeys.

The same general patterns occur across destination types, suggesting that perceptions of journey time accessibility are not necessarily distinguishable to

specific journey purposes, but may be a function of geography, individuals or socio-demographics, all of which could be further explored.

There are however some differences between journey purposes. Table 4.4.1 shows that there is a small mean difference for primary schools and secondary schools. These responses were limited in the NTS to those with children attending school so are related to trips that are made on a frequent basis. Furthermore the CAI destination datasets for primary schools in particular are of high quality, so the comparability of the NTS responses and CAI values for primary schools suggests that where public perception is based on familiar journeys and the quality of the objective measure is good, then there is less difference between objective and subjective measures.

As found by Van Exel & Rietveld (2009) unfamiliar journeys can result in differences of up to 46% between objective and subjective assessments of journey time, so these differences are to be expected for less familiar journey purposes such as hospitals. For destinations such as hospitals, doctors and supermarket there are problems of destination definition which may account for some differences. For example, when asked where the nearest supermarket is, responses may vary between giving the nearest small food shop or the largest supermarket which is further away but which the respondent may use. There may also be differing definitions of hospitals for individuals and within the destinations used in calculating the Core Accessibility Indicators. Furthermore, hospital trips may be infrequent for many people. This shows the importance of considering external factors, such as doctors and school catchment areas, as well as services provided by hospitals and the size of supermarkets, which may mean that consideration of journey time to the *nearest* destination is not always appropriate.

There is clearly a discrepancy between objective measures and subjective measures of journey time accessibility which this work has shown. However, there are some important limitations and gaps in understanding which prevent firm conclusions from being drawn. From this analysis it is difficult to unpick where there are real differences and where there are errors in the datasets. Either way, the difference is important and there is a need for further work to elicit why there is a difference and to understand the implications of measurement techniques. For example, the DfT has

recently concluded that GPS based measurement is not an appropriate means of data collection to replace travel diary data, following a pilot study which showed that results were vastly different (DfT, 2012; LTT, 2012). This suggests that the way in which people record and report their travel activity is vastly different from what they actually do when objectively recorded using GPS (although potential errors in GPS recording should be taken into account).

Differences occur between urban and rural areas, and also depend upon journey length. Some of these differences could be due to the nature of calculations which will give different results dependent upon the size of the zone calculated. This could be a potential problem with national level indicators. The importance of local level indicators is highlighted by Holden (2009) *“The democratic potential of indicators work is slighted by those who promote the use of standard, comparable indicators, with the laudable goals of minimising work”*(p.439). *This suggests that the drive for national level datasets may not be appropriate and in fact efforts may be best placed to develop robust measures at a local level.*

This analysis has highlighted some patterns in differences between a subjective and objective approach to measuring journey time accessibility to destinations in national datasets. However, given the coarse scale of analysis, care in interpreting the results is needed as a difference in category could range from two minutes to 40 minutes. Furthermore zonal level analyses are open to issues of spatial aggregation. Therefore, a more detailed primary data collection exercise is presented in Chapters 6 and 7. This also allows differences among individuals to be explored.

The findings from this analysis and from practitioner interviews in Chapter 5 are used to feed into the selection of a case study area for the second part of the research: a case study approach to understanding the lived experience of accessibility.

5. Current Approaches to Accessibility Planning^{1,2}

¹ This chapter has been published in a slightly different format (Curl et al., 2011)

² The following Appendices relate to material in this chapter: Appendix B – Interview Guide

5.1 Introduction

This chapter addresses how accessibility as a concept in transport planning is currently applied in practice, mainly through focusing on Accessibility Planning in England, but also drawing on examples from elsewhere in the UK and internationally. The first section describes the role of accessibility as a concept in transport planning, and in non transport fields. The focus then turns to contemporary applications of accessibility through accessibility planning, first taking an international overview and then focusing on the UK context, before presenting an empirical review of current practice in England, based on interviews with local authority officers who have been involved in the Accessibility Planning process.

5.2 Accessibility and Transport Planning

Improving accessibility has long been an aim of Transport Planning, although tensions exist between whether the aim of transport planning is to achieve mobility or accessibility (e.g. Ross 2000) as outlined in Chapter 1. The importance of accessibility to destinations, and the physical separation of people from activities have been used in traditional transport modelling, in the sense of using origin-destination data to understand demand between origin and destination zones, which is then fed into the demand model. Indeed Holst (1979) and Metz (2008) suggest accessibility is the aim of public transport planning and on this basis it is certainly not a new concept. Jones (2009) outlined five paradigms that have influenced transport research and policy in recent years. These are vehicle trip based; person trip based; activity based; dynamics based; and attitude based. While they are presented as roughly chronological it is noted that there are overlaps and time lags, so that the changes add dimension and perspective to previous paradigms, rather than representing a classical paradigm shift. Accessibility, in the more recent sense of ease of access to a range of destinations, fits with the activity based paradigm, whereby travel is seen as a means to a [non transport] end, and therefore a consideration of trip types. Jones (2009) suggests that the activity based paradigm has facilitated the debate around whether mobility or accessibility should be the primary aim of transport policy and that present policy concerns surrounding social inclusion and sustainable lifestyles further advance this debate. This shows that accessibility as a problem in transport planning has existed for several decades, but

has re-emerged, or been re-focused with the rise of sustainability and inclusionary agendas, and also sits well with the most recent attitude based paradigm (Jones, 2009). Accessibility as understood in traditional transport modelling has been interpreted as the time or distance based separation of people from activities, centred on the presumption that reducing travel time is the primary aim of transport planning. However, recent debates (Metz, 2008) have questioned this presumption and strengthen the need for an accessibility based approach which considers other barriers to travel. Commensurate with this is the development of Accessibility Planning, taking a person-centred approach and framing the problem in terms of social exclusion, as discussed in Section 5.3.

5.2.1 Applying Accessibility in non transport fields

While placing responsibility for Accessibility Planning in the UK with transport departments has made it a transport-centred issue, this was not necessarily the intention. Both the Social Exclusion Unit (SEU, 2003) and Department for Transport (DfT ,2004) emphasise the need for a cross-sectoral approach to solving accessibility problems in local areas. Given that (in terms of providing accessibility to services) transport is a derived demand, responsibility could have been placed with any number of government departments, including individual departments responsible for services such as health or education, but arguably may have been best placed in planning (e.g. Department for Communities and Local Government (DCLG)). In academia, accessibility is studied in a wide range of fields, from health (Knox, 1981; Yang et al., 2006; Guagliardo et al., 2007); food (Smoyer-Tomic et al. 2008; Wrigley et al. 2002; Lee & Lim 2009; Oppewal et al. 1997) and employment (Geurs and Van Eck, 2003; Geurs, 2006; Fernandez, 2008) There are also examples of accessibility being applied outside of transport in practical applications such as the Health Service Travel Analysis Tool (HSTAT) or Food Mapping Toolkit, described in Chapter 2.

5.3 Accessibility Planning in the UK

While accessibility has long been an aim of transport planning, the advent of *Accessibility Planning* has come about more recently as a result of New Labour's social exclusion agenda, with the origins commonly traced to the SEU Report, 'Making the Connections.'(2003) This has resulted in a requirement for Accessibility

Strategies within Local Transport Plans in England, and greater consideration of accessibility and inclusion issues with the New Approach to Appraisal (NATA) (England's Transport Appraisal Guidance) and Scottish Transport Appraisal Guidance (STAG). These approaches have brought about a more people focused accessibility agenda, focusing on the ability of people to participate in society, and using accessibility planning as a mechanism for promoting social inclusion.

The SEU (2003) report defines accessibility as the ability of people to get to key services at reasonable cost, in reasonable time and with reasonable ease. It focuses on the links between accessibility and social exclusion. The report highlighted five key barriers to access that might be considered when assessing accessibility. Similar to Church (2000) these are: journey time; cost; physical availability of services; safety and security; and travel horizons. However, as identified in Chapter 2, measurement of accessibility tends to focus on journey time and physical availability of services.

Prior to the SEU recommendations accessibility had been considered within land use planning, through (the English and Welsh) Planning Policy Guidance (PPG) 13: Transport, which stated that;

'A key planning objective is to ensure that jobs, shopping, leisure facilities and services are accessible by public transport, walking and cycling. This is important for all but especially for those who do not have regular use of a car, and to promote social inclusion. In preparing their development plans, local authorities should give particular emphasis to accessibility in identifying the preferred areas and sites where such land uses should be located, to ensure they will offer realistic, safe and easy access by a range of transport modes, and not exclusively by car. RPG [Regional Planning Guidance] should set a framework for this exercise through the use of public transport accessibility criteria for regionally or sub-regionally significant levels or types of development' (PPG13: Transport.(DCLG 2001, p.8)

This shows that although *Accessibility Planning* may have been brought about as a result of the SEU's 2003 report, the idea of accessibility as an objective in town planning is older. What perhaps is new is the consideration of the needs of a wide range of different social groups, and the recognition that problems encountered are not the same across the whole population, or in different types of area.

5.4 Accessibility Planning as part of Local Transport Planning

Following the recommendations of the SEU report, responsibility for accessibility was placed with the DfT and subsequent guidance (DfT, 2004) released. Local Transport Authorities in England were required to submit an Accessibility Strategy¹ as part of Local Transport Plan 2 covering the period 2006-2011.

The process of Accessibility Planning in England is a five stage process, as shown in Figure 5.4.1. This approach combines the use of local and national indicators with stakeholder involvement at all stages of the process, combining top-down and bottom up approaches. The process has brought about more cross sector working, with a number of stakeholders often involved at the problem identification stage, including the public and non-transport organisations (Jones 2011).

Results of accessibility audits are usually presented as contour maps showing geographical journey times to the nearest destination of a set (e.g. hospitals) from each origin or the time from all origins to one destination, e.g. a town centre, or in expressions such as *“45% of those aged over 65 have access to a hospital within 30 minutes”*.

Accessibility strategies focused on some or all of the key destinations highlighted by the SEU: healthcare; education; employment; and food.

A range of interventions were proposed by Local Authorities to solve accessibility issues. Kilby & Smith (2012) categorise these into personalised travel planning, ‘wheels to work’ schemes, demand responsive transport community transport and mobilised services.

A software tool, Accession was developed to support local authorities in developing their accessibility strategies. This software enabled mapping exercises, and accessibility calculations such as those described above to be undertaken.

¹ Alongside strategies for three other ‘shared priorities’; road safety; congestion; air quality.

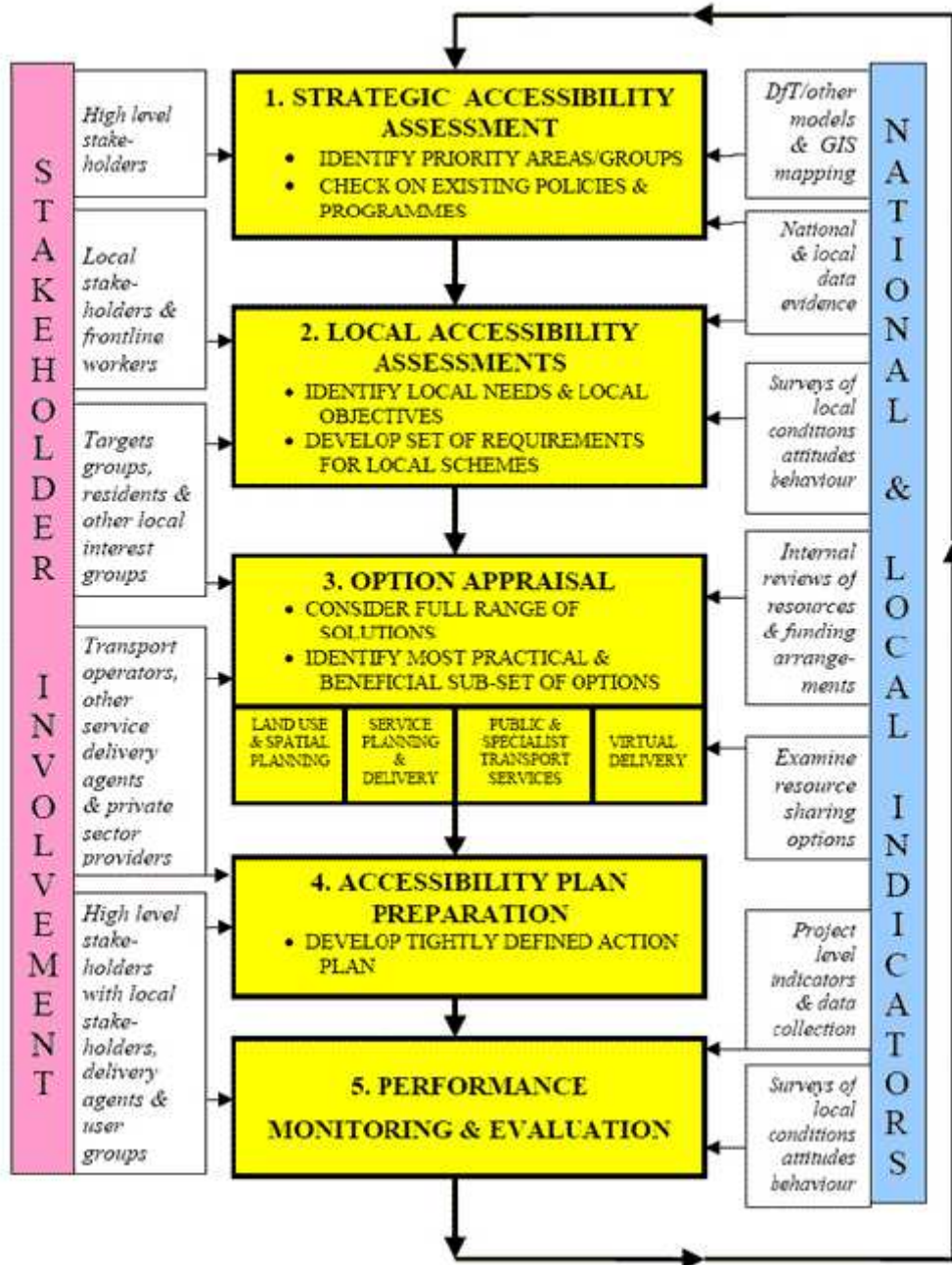


Figure 5.4.1 - Main Stages of the Recommended Accessibility Planning Process (Source: DfT Accessibility Planning Guidance)

The annual publication Core Accessibility Indicators (CAI) was introduced alongside Accessibility Planning. These are calculated at the Output Area (OA) level and reported at Lower Super Output Area (LSOA) and Local Authority (LA) to seven different destinations and by car, public transport and cycling. These are used to benchmark Local Authorities and were for reporting against two national indicators

prior to the abolition of National Indicator performance monitoring following the election of the new government in 2010. More detail was included in Chapter 4.

Some examples of accessibility measures from Local Transport Plans are:

- % of households within 30 minutes of a Further Education Establishment (*Essex*)
- Access to employment by public transport within 40mins (*Greater Bristol*)
- % of households who live in the top five most deprived Wards in the Borough who do not have access to a car living within 40 minutes travel time to Whiston Hospital. (*Halton*)
- Percentage of people who consider accessibility is 'good' (*Hampshire*)
- Increase people attending job interviews: Interviewees per year via access initiatives (*West Midlands*)

These vary in terms of how well they might address accessibility related social exclusion, with the West Midlands the only measure focusing on an expected outcome rather than output. The Hampshire measure considers perceptions, but does not compare this to the actual level of accessibility provided by the transport and land-use system. The first three targets are based on arbitrary thresholds which may not lead to real improvements in accessibility for a deprived population.

5.4.1 Accessibility in Transport Appraisal

The English Transport Appraisal guidance, New Approach to Appraisal (NATA) includes four accessibility objectives: to increase option values; to reduce severance; to improve access to the transport system; and personal affordability (DfT, 2011f). Assessment of the first two is largely qualitative and not included in the calculation of a Benefit Cost Ratio (BCR). Until recently detailed calculation guidance for measuring the accessibility impact of transport schemes was not included in appraisal guidance. However, following release of new Web-TAG¹, the guidelines for measuring access to the transport system are more detailed than previously. New guidelines follow a similar process to the new requirement for considering Social and Distributional Impacts (TAG Unit 3.17, (DfT, 2011g)). The five stage Accessibility Analysis process outlined in TAG Unit 3.6.3 (DfT, 2011h) is:

¹ Web- Transport Appraisal Guidance)

- Stage 1:** Identification of the area impacted by changes in accessibility;
- Stage 2:** Analysis of the demographic profile in the area impacted by changes in accessibility;
- Stage 3:** A screening process, to determine if it is appropriate to undertake further analyses of the changes in accessibility;
- Stage 4:** The core accessibility analysis process
- Stage 5:** The collation and presentation of the outputs from the accessibility analysis process.

The Core Accessibility Analysis is a three stage approach consisting of developing an evidence base (Identify Existing Accessibility Evidence); Accessibility Analysis (using GIS to assess the 'before' and 'after' scenarios; and Accessibility Audit (using the data gathered with accessibility analysis worksheets to appraise the impacts for different groups. However this is based on geographic concentrations of demographic groups and as previously identified may obscure scattered instances of accessibility problems. Given that guidance for measuring social and distributional impacts in transport appraisal is fairly recent, there is little evidence of how successfully this has been applied in practice.

Scottish Transport Appraisal Guidance (STAG) includes the requirement for an accessibility and social inclusion report. The guidance for Accessibility and Social Inclusion is combined and appraisals should include comparative accessibility; community accessibility; and an equality impact assessment. Comparative Accessibility considers the distribution of impacts by 'people group' and 'geographic location'. Community Accessibility relates to Public Transport Network Coverage and Local Accessibility relates to opportunities to walk and cycle to facilities. The guidance also notes the inclusion of expressed or revealed accessibility (i.e. demand to travel) in the economic appraisal, captured through Transport Economic Efficiency (Transport Scotland, 2008).

Welsh transport appraisal had previously followed STAG, until the introduction of Wel-TAG in June 2008. Part of the requirement of Wel-TAG is for a social inclusion or accessibility report. Accessibility and social inclusion issues are also expected to form part of the Scottish and Welsh Regional Transport Plans, and Scottish Local Transport Strategies submitted by each local authority, although a separate

accessibility strategy is not required. In Northern Ireland the roads planning department follows a similar appraisal method to NATA.

There are two means by which Accessibility Planning is delivered in the UK, through the local transport planning process and transport appraisal, with the balance between the two varying between constituent regions of the UK.

As established in Chapter 2, any measure of accessibility is essentially a social indicator with the ultimate aim of improving the human condition. In the UK, outside of local transport planning and transport appraisal, accessibility is used as a social indicator through the Indices of Multiple Deprivation (IMD) in England, and Scottish Indices of Multiple Deprivation (SIMD) in Scotland. These are measured in the same way, based on geographical distance from service measures. As described in Chapter 4, Accessibility is also included in National Travel survey based on self-report measures of time taken.

5.4.2 International approaches to Accessibility Planning

Chapter 2 described the trend towards consideration of social issues in transport internationally. A report by the FIA Foundation (2007) examined the consideration of social exclusion issues in transport across seven nations: USA; Canada; France; UK; Germany; Japan and Italy. It suggests that the UK is unique and ahead of other nations in considering access to a range of services, such as healthcare, education and healthy food in the context of social exclusion. In the other nations, only access to employment was usually considered in the context of promoting inclusion, and France and the USA were seen to be most advanced in this area, for example through the Transport Equity Act and welfare to work schemes in the US.

Approaches to accessibility in the Netherlands are heavily land use focused (Bertolini et al. 2005; Geurs 2006; Willigers et al. 2007; Geurs & van Eck 2003), suggesting accessibility is considered more in the context of sustainable land use planning, and the accessibility of destinations, rather than people. The same is true from evidence in South East Asia, where Light Rapid Transit schemes have been justified on the basis of improving the accessibility of the city centre (Zhu and Liu, 2004).

In Sweden, Wennberg et al. (2009) have reviewed how municipal authorities implement accessibility for older people in planning, but their focus is very much on a more micro accessibility, related to disability legislation.

Accessibility measures in North America have tended to be car focused. However, more recently work has been undertaken focusing on the public transport and social inclusion aspects of accessibility, drawing more similarities with work in the UK; for example, a study of women and low income groups use of public transport in Quebec City (McCray and Brais, 2007). There has been a considerable body of work undertaken in relation to the Oregon, Portland Household Survey. (e.g. Farber & Páez 2009; Buliung & Kanaroglou 2006). In the North American (US and Canada) policy context, the term Accessibility Planning refers to the more micro level of planning for those with limited physical mobility, but accessibility as a concept in Transport Planning is important, with evidence in some states suggesting this is becoming more important (Litman, 2003).

Integrated Rural Accessibility Planning (IRAP)¹ is an approach developed from the International Labour Organisation (ILO) and used in rural areas in developing countries, having its roots in Africa and Asia. The emphasis is very much on community planning and a needs based approach. Indeed many parallels can be drawn with the UK approach, including the staged approach to implementation.

Outside of Europe most academic studies are car focused, although Mavoa et al. (2011) developed a public transport and walking accessibility model for New Zealand, noting the lack of accessibility studies using public transport as the mode of travel.

There is evidence that approaches in New Zealand and Australia are developing, based on the UK approach (DHC, 2007; Daniels and Mulley, 2010). Curtis & Scheurer (2010) discuss the development of tools to support accessibility policy in Australia, describing the development of a tool capable of different types of measures which has been developed in conjunction with practitioners.

¹ http://www.ifrtd.org/new/issues/irap_gateway.php (Accessed 12/01/11)

5.4.3 Critique of Accessibility Planning

Accessibility Planning recognises the importance of factors other than journey time and spatial location (SEU, 2003) yet, given the availability of data, accessibility measures and indicators have tended to focus on the objective journey time or distance of people to destinations, and do not usually consider factors such as convenience, physical mobility, safety and cost.

While the accessibility planning process in England, Scotland and Wales provides the toolkit for understanding various barriers to transport, there can be an over reliance on journey time barriers, particularly in the later stages of option appraisal and performance monitoring, as this provides a quantifiable measure by which improvements can be measured. However, this does not necessarily address the issues raised by the SEU in terms of addressing the risk of social exclusion, but instead highlights areas of good and bad provision of transport and services.

Just because a public transport service exists does not mean that it can be used or is used. Hine & Grieco (2003) suggest that Accessibility Planning is based on largely anecdotal evidence. While accessibility audits, and use of tools such as GIS are useful in identifying accessibility problems, and raising awareness with stakeholders, it is important not to adopt the 'black box' approach feared by Lucas (2006) who highlighted the potential problem: *'however sophisticated the model, it will be unable to identify people's actual activity patterns, or other 'softer' barriers to access such as low travel horizons, cognitive and mental mapping abilities, which can often be more of a barrier than the availability and timing of transport services, (p.805)'*. However, with the use of increasingly sophisticated measures of accessibility it is all too easy for them to be seen as providing *the* answer, rather than placed in the wider context. While many, mainly speculative problems were anticipated there is limited evidence of how these have played out following full introduction of the process.

While an area of spatially concentrated elderly people may be identified as typically "at risk", and therefore targeted by accessibility measures, there may be some people in that age group living in an area of less concentrated 'older people', which is relatively accessible, and therefore individuals are not identified as excluded, although they are perhaps more so if they cannot access the transport infrastructure. Equally, while measures may be designed to address areas of low car ownership, it

is perhaps those living in areas of high car ownership, but without access to a car that are more at risk, but often the assumption is that areas of low car ownership are those most at risk. However, given that the smallest unit of analysis is the usually the census output area, containing approximately 125 households, an output area with 95% car ownership will have around 6 households without a car. It is perhaps these that are most “at risk” of exclusion according to current practices, as such an area will not receive as much attention as an area with 5% car ownership. Additionally it may not be deemed a problem if an area with high car ownership has poor public transport accessibility, given the high levels of car ownership. This is supported by Preston & Rajé (2007) who suggest that while *‘mapping exercises identify spatial and social clusters of those adversely affected by social exclusionary processes, they do little to detect more scattered manifestations’*(p.154). Furthermore, Grieco (2003) suggests that while some groups facing social exclusion will be geographically clustered, others will be scattered and that accessibility measures *‘will not capture the mobility constraints of the infirm or the aged, and that the infirm and the aged are likely to be scattered rather than clustered in terms of location.’* (Grieco 2003, p.18)

This highlights the problem of assuming homogeneity within pre-defined social groups, for the purposes of transport planning. While older people, for example, may share many of the same problems and issues when accessing healthcare, not all older people will do so, and in fact the problems may be greater in areas of lower concentrations of a particular groups, which the current types of analyses would not pick up. It is perhaps therefore more appropriate to identify those with problems at the outset, for example, those who miss appointments, or are NEET, rather than assuming all people within a certain geo-demographic groups will experience transport related social exclusion.

Accessibility analyses may tend to focus on the “average” person’s accessibility, whether this is the average person living in a certain geographical area, or the average person within a certain demographic group. The problem may be that those most at risk of exclusion are not the average or normal citizen, but those falling outside of this categorisation.

Jones (2011) notes that since passing responsibility for Accessibility Planning to the DfT there has been a rather narrow focus on transport related accessibility, and less emphasis on cross-sector working, where the problems may be initiated and best solved. He also suggests that reliance on quantitative tools has meant consideration of other aspects of accessibility (non time/non transport related) have been neglected. To rectify this (Jones 2011) presents a simple spreadsheet based tool that is designed to be used with stakeholders to identify solutions to a range of accessibility problems. His research acknowledges that such an approach is resource intensive and that individual accessibility problems need to be verified through use of more extensive data sources. The tool is designed to complement spatial representations of accessibility.

This section has outlined some of the critiques of Accessibility Planning in the literature, dated mainly prior to the process being implemented. This remainder of this chapter provides a more up to date discussion of how Accessibility Planning has been implemented following its full introduction across English local authorities. Lucas (2006) provides a useful discussion of the piloting of Accessibility Planning in eight local authorities, and many of the potential problems highlighted resonate with some of the emergent problems of the process found in this discussion with practitioners.

5.5 Practitioner Perspectives

This section draws on results from semi-structured interviews with officers from English Local Transport Authorities (LTAs). An understanding of their perspectives and experiences with the process and with utilising accessibility measures is vital given the pivotal role played by LTAs in delivering transport improvements. If the link from theory of accessibility measurement to practice of accessibility improvements is not understood then the process will not achieve its full potential.

Halden (2011) explains that the *“purpose of Accessibility Planning is to help people, companies and agencies engage constructively to deliver practical solutions that improve access”* (p.14) but that the flexibility afforded by the process means that it is open to abuse by those involved. Given the potential for ‘abuse’ or misinterpretation of guidance (Halden, 2011) it is therefore essential to understand the perspectives of

those involved in the delivery of Accessibility Planning to understand how they have implemented Accessibility Planning and how they believe it does or does not allow them to meet local objectives and improve accessibility.

It is important to represent the views of practitioners responsible for implementing accessibility related policies, as they are responsible for shaping policy and utilising measures of accessibility. Wennberg et al. (2009) present planners' views in relation to incorporating accessibility into planning in Swedish municipalities, but otherwise there is limited evidence of how planners have implemented the concept of accessibility into planning and policy.

5.5.1 Methodology

A shortlist of 15 Local Transport Authorities was contacted by email and post during February 2010 to invite them to participate in a short telephone interview discussing their experiences with Accessibility Planning. A similar approach was used by Canning et al. (2010) to understand local transport authorities' views towards devolution of transport powers, and proved an effective method of eliciting views from transport professionals. The shortlist was drawn from a total of eighty-three authorities who had submitted Accessibility Strategies covering the period 2006-2011.

The short listing process was designed to ensure broad coverage of representation in terms of geographical region, rurality, quality of accessibility strategy (according to a scoring procedure undertaken by the DfT and levels of accessibility (as measured by the 2008 CAI).

A spreadsheet was used to collate data for each Local Authority. Data used was IMD; whether or not an authority had chosen one of the accessibility national indicators (NI 175 or NI 176); whether the authority had been selected as a 'beacon' authority for accessibility; the score given to their accessibility strategy by the DfT scoring; levels of accessibility across a range of destinations (CAI) and the range of accessibility across the local authority area using the inter-quartile range of accessibility for the LSOA within each local authority. Rurality was also taken into account and remote rural areas were not included.

Three of the shortlisted areas were metropolitan areas where a joint LTP had been submitted with the relevant Passenger Transport Executive (PTE). PTEs are responsible for co-ordinating transport across different local authorities within metropolitan areas. In these cases contact was made with both the PTE and the individual metropolitan boroughs. Twelve positive responses were received and semi-structured telephone interviews were undertaken between February – April 2010. Those interviewed included one PTE, four unitary authorities falling within metropolitan PTE areas, and six county councils. The individuals targeted for interviews were officers with responsibility for Accessibility Planning. Once the shortlist of Local Authorities had been decided, individuals with responsibility for Accessibility Planning were identified through existing contacts where possible. If a named individual contact could not be established contact was made with the transport department of the relevant local authority for the attention of an Officer with Accessibility Planning responsibilities.

Engagement with Local Authorities had four primary objectives:

- 1) To gain an understanding of how Accessibility Planning is being implemented by English Local Authorities as part of the Local Transport Planning Process ; what are the aims of Accessibility Planning and the tools being used to implement it?;*
- 2) To establish whether the tools and data currently used and available to practitioners allow them to undertake their jobs effectively, and result in their desired outcomes;*
- 3) To understand what (if any) gaps in knowledge or resources exist preventing authorities obtaining more desirable outcomes; and*
- 4) To identify examples of where modelled accessibility differs from perceived accessibility.*

The semi-structured interview schedule (Appendix C) was designed around these four objectives. With the interviewee's permission the interviews were recorded, and subsequently transcribed. A qualitative data analysis tool (NVivo) was then used to code the data into themes related to the interview schedule, as well as other emergent themes.

Background to Interviewees

This section discusses the role of the individual within the organisation and their involvement in the Accessibility Strategy as well as the accessibility priorities for the local area. A range of responses were received from officers involved at different

levels of responsibility or stages within the process of Accessibility Planning. The levels of involvement can be split into three broad types: 1) Policy and Strategy (strategic level work involving production of the accessibility strategy and the LTP); 2) Technical (detailed appraisal and analysis work, and the monitoring and measurement of accessibility) and; 3) Delivery (delivery of accessibility improvements, usually in the guise of a sustainable travel or ‘Smarter Choices’ (behaviour change) team within the local authority), although there is some overlap. Interviews were conducted with a range of individuals representing different levels of involvement in Accessibility Planning, and therefore a range of perspectives are covered.

When discussing the authorities’ accessibility priorities, the majority of respondents referred to the key areas outlined by the SEU (2003). These are employment, healthcare, education, food and leisure. There were some exceptions; for example where an area-based approach was taken, reported priorities were often based around regeneration or economic development.

5.5.2 Aims and expectations of Accessibility (Planning)

This section explores how local accessibility planners understand accessibility, what they seek to achieve (desired outcomes) and perceived barriers to accessibility.

The majority of definitions given derive from the SEU (2003) definition of accessibility as the ‘ease with which people can access goods and services’. Many respondents emphasised the difference between ‘physical accessibility’, seen as specifically relating to access onto a bus or into a building and associated with disability legislation, and accessibility more broadly, as defined in the context of Accessibility Planning. It was clear the “accessibility” respondents were talking about was a broader concept relating to, and affected by, a wider range of factors ranging from air quality to road safety. Indeed accessibility was described as a “buzzword” and an “umbrella term”.

As shown by Figure 5.5.1 definitions had a clear theme surrounding issues of equity, social exclusion and transport-related deprivation. There is also a clear ‘sustainable’ theme to understandings of accessibility, with many definitions relating to improving non-car accessibility.



Figure 5.5.1 –Local Authority Officers’ Definitions of Accessibility (Planning)

Most respondents viewed accessibility as a normative policy goal; as illustrated by Figure 5.5.1 definitions focused on non-car based accessibility and improving access to opportunities for deprived populations. While there was some recognition that an

increase in accessibility might lead to excess travel, this was not a widely held view and the general perception was increased accessibility would have economic and social benefits, both within and outside of the transport sector by improving the range of opportunities individuals have access to (using non-car modes).

A number of barriers to accessibility were identified, and can be broadly categorised into those relating to the transport system, the land-use system, societal factors and individual factors. Specifically, cost, interchange and reliability of services were the most frequently mentioned as barriers to use of public transport in accessing key destinations. It was generally believed reducing or eliminating these barriers would improve accessibility and therefore lead to enhanced social inclusion, greater equality and modal shift. These outcomes were seen as broad ranging, and not only impacting transport but a wide range of sectors, particularly health, as well as employment and overall quality of life. In terms of measuring this change, difficulties were stated by respondents, many of whom suggested that the way in which accessibility is measured and reported does not allow many of these barriers to be considered.

Accessibility, in terms of its definition, aims and expectations is interpreted as a broad ranging concept and it is difficult to find a definitive understanding. This is not problematic in itself, indeed it is a useful concept around which transport planners can frame certain problems. However, how this translates into measurements of accessibility is less clear.

5.5.3 Approaches to measuring accessibility

This section focuses on the different ways accessibility is measured by local authorities and how measures are related to the definitions and expected outcomes of Accessibility Planning. Interviewees were asked what they thought made a good measure of accessibility, how they measure accessibility, the tools and data they use for this, how they agreed their Local Transport Plan (2) accessibility targets and finally, how they think their targets reflect the aims of Accessibility Planning.

Respondents had difficulty explaining what would make a good measure of accessibility, suggesting there cannot be one single measure and emphasising a good measure would draw upon a number of sources which is reflective of the multi-dimensional concept of accessibility. A number of respondents suggested a good

measure would incorporate how people perceived accessibility, yet there was frustration that measuring perceptions is difficult to achieve because most evidence tends to be anecdotal and difficult to quantify. Respondents mentioned use of non time-based measures, with frequency and cost being important. Overall there was recognition among practitioners that there is no one “good” measure of accessibility, and each problem or application should be approached differently. This is encouraging given some of the concern that the process could have led to a “black-box” approach (Lucas, 2006). How this recognition translates into practice is discussed in the rest of this section.

Considering how accessibility is currently measured resulted in much more uniform responses, although this was closely connected with continued debate about the “correct” way to measure accessibility. Almost all authorities said they used Accession software to measure accessibility and report against local and national targets. Few respondents mentioned use of national CAI, calculated for reporting against national targets and benchmarking local authorities, and where they were discussed there was little understanding of how to use them. For example in discussion of using the CAI:

“I’ve tried to on a number of occasions and I’ve found them very difficult to get hold of, to access and very difficult to understand and to be honest I think when you have national indicators they’re pretty meaningless.”

In practice, the types of measures most often used were based on cumulative or contour accessibility measures. Respondents were hesitant to discuss the use of more complex measures such as gravity-based measures (although there is functionality for this within Accession) and where these were discussed they were dismissed as being flawed, too difficult to explain to stakeholders, as well as being difficult to compare longitudinally. There were some exceptions to the use of threshold based measures with one authority using a measure of accessibility based upon satisfaction with local bus services. However, given this was an authority wide measure and not geographically disaggregated in relation to bus service provision it is arguably no more beneficial than other measures of accessibility as it is not known how this measure of satisfaction varies in relation to provision of bus services, and therefore how it could be improved.

Although Accession was used as a tool to measure accessibility almost without exception by the LTAs interviewed, the extent this was deemed acceptable varies. Some authorities found it a useful tool, whereas others felt pressure to use the software had limited their ability to approach the issue independently. It was felt going against the DfT guidance would have created problems for the authority in terms of the increased workload associated with presenting a more robust alternative. Limitations were discussed in relation to the level of detail captured, such as not being able to incorporate micro-level accessibility issues for pedestrian routes, such as dual carriageways or dropped kerbs, and in terms of assumptions made such as modelling an unlimited number of interchanges or use of the nearest destination point possible.

As noted, use of the national CAI is limited, despite the richness of information readily available. The stated reasons behind this were firstly, some respondents were not aware of the availability of these indicators. Those that were, often did not feel comfortable using them, finding it difficult to penetrate the quantity of information available, not understanding how to use it, having little control over the calculation methods and data inputs, meaning they could not manipulate the data for their requirements. Secondly, there were issues of trust, as results generated were often different to their “own” Accession calculations and in many cases respondents felt the CAI over-estimated the “real” levels of accessibility, particularly in rural areas.

It emerged there is a wide range of data used to support decisions in the process of Accessibility Planning, outside of the straightforward measurement of accessibility used to report against targets, including widespread use of census data and IMD, which are a nationally calculated index based on seven domains and used to rank areas in terms of relative deprivation. There was also discussion of using outcome-based data such as number of missed hospital appointments, or job centre usage, although it was difficult to find clarity on how this is used and how outcomes can be directly attributed to accessibility improvements. Data relating to evaluation of a specific initiative had also been used, such as bus patronage figures or uptake of specific initiatives such as ‘Wheels to Work’¹ (a moped loan scheme designed to allow those who cannot access jobs or training to be able to travel independently).

¹ <http://www.wheelstowork.org/>

Questionnaire data is also used, again usually in relation to perceptions or satisfaction with a specific initiative as well as council-wide surveys such as citizens' panels. Interestingly, this sort of data was much more widely used in evaluation rather than problem identification, where views of individuals were more likely to be represented through anecdotal evidence or from qualitative research based around focus groups. Some respondents suggested that since it is difficult to quantify the importance of issues arising from qualitative approaches this can lead to an evidence base highly dependent upon measurable aspects of accessibility, such as journey time, giving more weight to time-based barriers, even if this is not always the most important barrier to accessibility; for example:

“the main issue for me is that although it wasn't intended that things like mapping would be the principal source of information I think it has gone that way a little bit and I think that has tended to make it take focus away from other, less quantitative sort of analysis, so the importance of going to talk to people about accessibility difficulties and the more very localised accessibility differences in terms of the benefits you can get by putting seats at all your bus stops or having pedestrian crossing in particular places and those sort of very localised things, I think they get a little bit lost, and also some of the limitations in the measurement tools probably give a false impression of accessibility”

There is some evidence of a feeling of being restricted by DfT guidance in terms of deciding priorities and targets for the local area:

“the scope's sort of narrowed a lot... the sort of implicit thing within the DfT guidance is that they have a big focus on travel time indicators and that may not be the only benefit”

and furthermore the process of reporting targets to DfT was only a small part of the picture:

“...went for a simple threshold measure, but only on the basis of, that it was kind of like, it wasn't gonna bother us that much, you know what I mean it wasn't going to cause us any difficulty and we could get on with doing accessibility.”

Evidence suggests that for some respondents the target setting process was simply a box-ticking exercise and the real “getting on with it” did not depend too much on measures and targets. Respondents suggested the only way to impact on targets was to improve public transport services, although this may not be the best way to meet the needs of socially excluded populations, a sentiment echoed by Hine & Grieco (2003). In contrast, the types of initiatives seen by practitioners to improve

accessibility are smaller schemes, whose benefits might not be evidenced through measuring accessibility but could be assessed by those with local knowledge who “knew” what schemes would be and were being effective.

Respondents were convinced of the impact their work is having in improving outcomes, but this is not necessarily linked to the targets or measures set out in the Accessibility Strategies. While respondents were critical of measures and able to discuss the problems with target setting it was harder to talk directly about how these targets might relate to desired outcomes of Accessibility Planning. Often the only way to improve against targets was seen to be through bus service changes or relocation of facilities, and it was clear these were not seen to be the things perceived as making a “real” difference. Interestingly, this was not always expressed as a problem. Rather, the local level of working and implementation of accessibility improvements might be viewed as separate to the more strategic policy making and target setting agenda, but both are important:

“well we need an indicator to sort of raise it in the profile in the strategy and something to report on and sort of gets it in the process, raising the profile of it so people recognise that it’s something that needs to be addressed but then more locally we have all the other work which I think you can influence when it comes to a more local level.”

Strategic level accessibility measures are useful for tracking longitudinal changes in accessibility across a region, but less useful for measuring small local level changes in accessibility for individuals or targeted sections of the population. Respondents describe tension between the political and technical process, in particular tension arising between a requirement for targets at the policy level and local knowledge at the delivery level. Another important point to emerge is *who* accessibility provides improvements for. Use of accessibility measures will give an overall picture of accessibility for a specific area or population but may not address the trade-offs this creates for other areas or groups. This was highlighted by some respondents:

“one of the potential scenarios we were envisaging would be beneficial for most people, but just a small area would get slightly worse accessibility.”

This leads to debates surrounding who should benefit and whether the aim should be to improve accessibility for all, for targeted populations or to reduce inequalities in accessibility. Farrington & Farrington (2005) discuss the difference between absolute

and relative accessibility, drawing upon issues of social justice, rights and wants. Such issues are important, especially when investment decisions might be based on how one area compares with another.

5.5.4 Expected and realised outcomes of Accessibility Planning

This section addresses whether local authorities have realised their expected outcomes through Accessibility Planning and what initiatives have been implemented as a result, and also how they have been able to communicate the benefits of Accessibility Planning to non-transport stakeholders.

A very wide range of transport and non-transport initiatives were mentioned as having emerged from the Accessibility Planning process. These range from bus service improvements (quality, frequency, routes, interchanges) ticketing changes, bus subsidies, information such as signage or leaflets including “how to guides”, demand responsive transport, moped loan schemes, changes to walking and cycling infrastructure and changing location of service provision, such as hospital clinics, to reflect the needs of the population.

The “joined-up”, cross-sectoral nature of Accessibility Planning was emphasised by the SEU (2003). However, many of the LTP targets are transport, and specifically mobility focused, and likewise initiatives mentioned during engagement with practitioners tended to be transport solutions. Therefore the level of engagement with non-transport stakeholders was discussed in the interviews, particularly in terms of how cross-sectoral benefits of Accessibility Planning can be demonstrated. There is evidence of engagement with a wide range of non-transport stakeholders, but the quantifiable benefits of this are less well evidenced. Respondents were positive in terms of having achieved engagement with stakeholders and having put the issues on their agendas, but felt accessibility problems were still often regarded as a transport problem, rather than a shared objective. A common example is in the healthcare sector where relocation of services to less accessible locations often takes place due to rationalisation within the National Health Service (NHS), for example in relation to reducing missed appointments:

“for instance do you know what the cost of missed appointments is because if you worse[en] accessibility that’s one of the potential outcomes and you’re going to be paying for more missed appointments, locally there doesn’t seem to be a particularly big grasp of that. They know what the cost of missed

appointments is but not what percentage of that is down to people having accessibility difficulties, and so there's a lack of information for them to make an informed decision on that."

Demonstrating the benefits of improved accessibility in terms of targets in non-transport sectors would therefore be a useful step in making accessibility a shared responsibility and being able to impact non-transport agendas.

In general respondents were positive in terms of what has been achieved from the process of Accessibility Planning, even if the evidence is not quantifiable:

"I would say there has definitely been awareness benefits in terms of having it there and I think it's definitely raised the profile of accessibility among planners and engineers... I would say the emphasis that's been put on the use of mapping and Accession hasn't had the benefits that were intended, probably because of some of the limitations that it has."

However, identifying and quantifying outcomes is more difficult. As highlighted by definitions of accessibility (Figure 5.5.1), expectations are broad ranging and multi-dimensional. Expectations of improved accessibility are related to social exclusion and mode shift policy objectives, and it is evident many practitioners envisage a utopia where accessibility can be improved for all. Tensions exist between a desire to improve accessibility for a majority versus reducing inequalities and improving accessibility for targeted segments of the population.

5.5.5 Perceptions, Measures and Realities of Accessibility

Attempting to understand how well measures of accessibility capture reality and how perceptions might differ from this was a theme running through the design of the interviews. This section therefore draws together examples of where accessibility measures might differ from perceptions and the 'reality'. While measurement and mapping exercises have been useful in some ways, they can divert from exploring the "real" and more localised issues:

"so the importance of going to talk to people about accessibility difficulties and the very more localised accessibility differences in terms of the benefit you get from putting seats at all of your bus stops or having pedestrian crossings in particular places and those sort of very localised things.... if you do an accessibility map of this [and it] is within 60 minutes travel time of the hospital say, that may not match people's impression because it'll include journeys that people may not be prepared to make or may not be aware they can make."

This quotation is one example of many highlighting that an individual's knowledge and travel horizons can mean perceptions may differ from the official or objective 'reality' presented by accessibility measures. The issue of interchanges was mentioned on several occasions. There was concern that journeys may seem possible from model outputs but as there is no limit on the number of interchanges built into these calculations, these may not be realistic options for many. One example given of this was the implementation of a direct bus service between two hospitals, which according to a satisfaction and patronage survey undertaken by the authority had improved perceptions of accessibility and use of the route, but this particular journey when measured using Accession had worsened due it taking longer than a previous journey involving a change. Crime and the fear of crime were mentioned as reasons why some destinations or modes of transport might be perceived as inaccessible, especially at certain times of the day, highlighting that factors other than journey time are considered important by accessibility planners and the public.

While for some respondents there was a clear distinction between the strategic, target setting measurement of accessibility and the local delivery of schemes to improve accessibility, it is clear there can be tensions between these

“if we were to put a lot of money into say, wheels to work because we thought that was best, you know that was going to meet people's needs that wouldn't be reflected when we used Accession.”

There was recognition that using Accession based measures of accessibility only tells part of the story and the real barriers to individuals' accessibility are much more complex and harder to understand and quantify. Some authorities had considered the use of a perception based measure, and some have adopted this approach in their accessibility strategies, but they have concerns about the best way to implement this, the expense involved, and how valid such an approach is as compared to existing measures. Such issues raise the point that both “objective” measures and perceptions are needed to understand the whole picture of accessibility issues in an area (Stanley & Vella-Brodrick 2009)

Drawing from the examples discussed, the reasons for differences between perceptions and measures of accessibility seem to be twofold – firstly, problems with calculations methods and data inputs mean the measures presented are not always

considered accurate reflections of the “real” situation and may not capture all aspects important in determining accessibility, and secondly people’s perceptions may not reflect reality due to lack of information, fear, or importance of issues not captured in the measures.

5.6 Discussion of findings

This section draws together the findings outlined in the previous section from the engagement with Accessibility Planners and discusses the implications of this.

Accessibility Planning in England is generally viewed positively by the practitioners involved, as it has allowed local authorities to raise the profile of the importance of accessibility in transport planning. The aims, and expected outcomes of Accessibility Planning are broad ranging but can be summarised as being related to quality of life, social inclusion/exclusion and use of non-car travel modes.

There is a clear mismatch between the strategic level measurement of accessibility and reporting of targets, and the individual level improvements expected from many initiatives implemented under the banner of Accessibility Planning. However, this is not always seen as problematic as it is well recognised by accessibility planners. In some cases the requirement for reporting against targets and developing measures is seen to take away resources from focusing on where improvements for individuals are seen to be made, but on the other hand the process has raised the profile of such issues and placed them on the agenda in authorities where they may have previously been given little attention. Initiatives such as walking and cycling infrastructure, smarter choices measures, and demand responsive transport were seen as effective in addressing many of the social-exclusion related issues but quantifying the benefits and outcomes of interventions in terms of the measures used to identify accessibility problems is more difficult.

While practitioners are clear about the outcomes they seek to achieve, less clear is whether these outcomes are realised and how “success” in achieving them is ascertained. The success of interventions in improving accessibility can be measured using the same technical process by which problems are identified. For example, a new bus route will mean a higher proportion of the population can access destinations within a certain time threshold, or a new doctors surgery will increase

the proportion of the population with access to doctors, signifying an increase in potential accessibility for a given population. However, such an approach does not determine whether this accessibility is realised, and therefore whether the behavioural outcomes in terms of mode shift or reduced exclusion are achieved. On the other hand, some interventions would not necessarily show an improvement against accessibility measures and success can be measured differently, for example, by using patronage or satisfaction data. Measurement in this way is more closely related to improvement against the outcomes expected from the process of Accessibility Planning. The difference of approach to appraising accessibility problems and outcomes, comes from a recognition that improving potential accessibility (against accessibility measures) does not necessarily lead to changes in realised accessibility, or behaviour of individuals. Therefore, if “what matters” is improving individuals’ quality of life and reducing social exclusion, efforts should be focused on ensuring this is what is measured so that interventions can be suitably targeted.

It is important to consider not just “what matters”, but who it matters for. Practitioners optimistically envisioned a global improvement in accessibility, leading to greater inclusion, with less consideration given to the likely trade-offs, and potential increased exclusion involved. A policy focused on improving accessibility for one particular group in society may result in a net reduction in accessibility measured across a geographical area, and likewise policies focused at improving spatial accessibility over an area may disproportionately impact on different people and therefore be more exclusionary than inclusionary. The CAI use measures based on the whole population and an “at risk” population so in theory it is possible to examine the impact of a policy on both the population as a whole and a target group, yet there is less evidence of this being used, and again increases in potential accessibility will not necessarily lead to changes in behaviour or realised accessibility. It is therefore important to consider the impact of solutions or policies emerging from Accessibility Planning both in terms of *what* they are addressing and *who* is benefitting or not benefitting. In general, respondents were comfortable in “knowing” how best to achieve their desired outcomes, even if this clearly differed from how they might reach accessibility targets.

A perception – measure gap was recognised and respondents felt their work would benefit from a better understanding of perceptions, but only if their extent could be quantified. Policy requires a robust and quantifiable evidence base and this leads to difficulties when taking public views into account. Concerns were raised regarding how large a particular issue might be and that a few people with extreme views could be over-represented. Emphasis was placed on the importance of local knowledge, with respondents suggesting measures provide background and can be verified and enriched with local knowledge (both of planners and citizens). Measures were in some instances considered a poor reflection of the real situation and seen to over-estimate the levels of accessibility, for example:

“the results indicate that we have perhaps very good accessibility but the reality may be very different”

5.7 Conclusions and Recommendations

Local authorities need to ensure they have a clear definition of accessibility, and clear objectives for Accessibility Planning, otherwise confusion and contradictions can occur between improving accessibility and achieving the outcomes of Accessibility Planning. As suggested by Preston & Rajé (2007) simply pursuing improvements against accessibility targets will lead to implementing mobility related solutions such as more bus services, which may not best meet the needs of local populations but will show improvement in measured accessibility. It is therefore important to be clear about how such measures relate to the objectives of Accessibility Planning. Many interventions emerging from the process of Accessibility Planning tend to be mobility based and as highlighted by Kenyon (2003) increased mobility for some, at the expense of others can result in the social exclusion issues to which accessibility planning is linked. She therefore advocates long term *reduction* in mobility as the means to address social inclusion. Accessibility solutions therefore need to focus on changes to the land-use system to allow accessibility without mobility.

It is clear from this research with local authority practitioners that the work being undertaken at the local level is heavily influenced by central government requirements and guidance. The Accessibility Planning guidance is widely welcomed by local planners but there is some frustration that the requirement for targets

creates an excessive work burden, taking away resource from having 'real' impacts on the ground. In a similar vein, Marsden et al. (2009) noted a tension between support for the local transport plan process and the burden placed on local authorities. Despite this there is uncertainty as to what would make a better measure and recognition of the difficulties surrounding use of a perception based measure. Central government therefore needs to ensure the requirement for performance measures does not overshadow the work taking place at a local level. It is important to provide clarity regarding the outcomes expected from the process and ensure the way in which accessibility is measured is commensurate with this. If the outcomes are long-term land-use changes to improve local accessibility, then the use of traditional accessibility measures provide a useful tool to benchmark changes. If outcomes are focused on individuals or targeted sections of the population then spatial accessibility measures are less appropriate.

In light of discussions about the role of software such as Accession versus local knowledge in delivering Accessibility Planning, it might be suggested the use of Accession as a strategic measurement tool has little benefit over CAI in terms of quality of output, given its costs. However, this is not recognised by those involved in using Accession as they find the CAI data hard to penetrate and use, an issue also identified by Halden (2011). In addition, practitioners reported issues surrounding trust and reliability of the data. If the DfT could do more to make this data accessible and more easily manipulated by local planners then this data could be better utilised to deliver time and cost savings compared to use of Accession. This would enable efforts to be concentrated on understanding more localised and individual accessibility problems, hence delivering the kinds of improvements that matter. A detailed review of how CAI compare to Accession outputs could be undertaken to understand the impact of such an approach and this could then be communicated to planners. The use of Accession is seen as useful for planners and has not necessarily resulted in black box thinking (Lucas, 2006). It allows them to make decisions over parameters which may be more appropriate at the local rather than national level, however, it is important to consider the benefits against the costs of using such an approach and ensure the widespread use of such software does not take resource away from where it is best placed; providing valuable local knowledge and delivering small scale improvements.

The involvement of land-use planning and development control in delivering Accessibility Planning could be greater. Some authorities have succeeded in incorporating accessibility indicators into planning guidance and felt this was a positive move. Strategic accessibility indicators might be best applied in this arena, rather than in attempting to solve more individual issues surrounding transport disadvantage and social inclusion, often more easily solved by individual mobility solutions or personalised travel planning, in the short term at least. Ferreira & Batey (2007) suggest a similar approach beginning with a land-use planning approach and using mobility based solutions last.

Both locally and nationally, good progress has been undertaken towards raising the profile of Accessibility Planning within the transport planning arena, and it is important not to let this slip in light of economic circumstances. Related to this, the focus on access to a range of services, not just employment should be applauded, and is indeed recognised internationally (FIA Foundation, 2007).

Accessibility Planning can and does address “what matters” (both to individuals and planners) but the measures used to assess and evaluate accessibility changes do not necessarily relate to the desired outcomes. Indeed, they may actually be counter-productive in achieving the kind of change that matters, or delivering real improvements in accessibility where it is needed.

The process of Accessibility Planning has been useful in raising the profile of accessibility and social exclusion related issues within local authorities, although in many cases the work was already being undertaken, albeit under a different label. Nevertheless, it has helped officers to highlight the importance of this kind of work at a corporate and strategic level, as well as with stakeholders. While the work is likely to continue without the formal process of Accessibility Planning it might be harder for planners to justify the need for this and give importance to accessibility-related improvements. However, new funding mechanisms such as the Local Sustainable Transport Fund (LSTF) could provide opportunities for funding Accessibility Planning.

Those involved in Accessibility Planning are aware of multiple non-time barriers to accessibility, and often place emphasis on these; however, they struggle to reflect these in target setting. While setting targets at the strategic level is only a small part

of the work undertaken by Accessibility Planners, the government requirement for measurable targets means efforts may be focused on setting and measuring against these targets, and implementing change that improves against these targets at the expense of other, potentially more beneficial improvements. While such measures are seen as useful for large scale projects, they can be time-consuming and make smaller projects cost ineffective. Accessibility Planners recognise there is not one single measure of accessibility, but in the absence of an easily quantifiable alternative there is often heavy reliance on time based threshold measures. Perceptions are seen as important but difficult to quantify. This does not however, mean they should be ignored, as simplifying the concept of accessibility into a single measure means some issues are not fully represented.

Accessibility has become a buzzword in transport planning, and while the higher profile this gives to such issues is to be welcomed it is also important not to let this cause confusion. Both central and local government need to be clear what is meant by “accessibility” and what they are trying to achieve through Accessibility Planning. Linked to this is the distinction between accessibility and Accessibility Planning. While the process of Accessibility Planning may lead to reductions in transport related social exclusion and improvements in quality of life, unchecked increases in levels of accessibility, as assessed by some measures will not always lead to the kinds of outcomes sought.

Engagement with local authority practitioners involved in Accessibility Planning in England has highlighted the importance of understanding local level, household and individual accessibilities in addition to the aggregate, national or regional picture if we are to properly understand the relationship between accessibility and associated outcomes, and therefore target interventions appropriately. However, objective measurements, against which progress can be monitored, are a requirement of government policy and their usefulness is recognised by planners.

Since the interviews and analysis in this chapter were completed a report has been published by the DfT (Kilby and Smith, 2012) evaluating Accessibility Planning. Similar to this thesis, broad ranging understandings of accessibility among local authorities were highlighted. The report also notes that the presence of a ‘local

champion' seemed important in the success or not of promoting Accessibility Planning within a local authority.

Part III: Case Study Approach to understanding how the “lived experience” relates to objective measures of Accessibility

6. Survey Design and Implementation^{1,2}

¹ Appendix D: Survey Sampling and Response Maps, relates to this chapter

² The approach to selecting a case study area and sampling areas was presented at the 5th International Transport Demand Management Symposium, Aberdeen, 2010.

6.1 Introduction

This chapter outlines the research design and methodology for the household survey. The first stage of the overall research approach was to critically assess current approaches to accessibility planning, as addressed in Chapters 4 and 5. The second major stage comprises of a case study approach to understanding the lived experience of accessibility, consisting of a household survey and a mental mapping approach.

This chapter outlines the survey design and implementation and Chapter 7 presents the results. Firstly the selection of a case study area for the research is described. The detailed sampling strategy is then described followed by the questionnaire design. Finally, the survey response rates, and overview of the sample characteristics and methods of analysis are described. Justification for the choice of methods was discussed in Chapter 3.

6.2 Selection of case study area

This section details the selection of a case study area. Data analysis in Chapter 4 and interviews presented in Chapter 5 informed the selection of a case study area. The selection of a case study area was limited to the Local Transport Authorities who were interviewed for Chapter 5. A wide range of data for these areas was collated from various sources and at various geographic scales. Data collated included Core Accessibility Indicators (CAI), Indices of Multiple Deprivation (IMD), Rural-Urban Classifications and Census data, at geographic scales ranging from Output Area (OA) to Government Office Region (GOR). While all these data sources could be used for selection and have potentially interesting and relevant implications in terms of how accessibility is perceived and measured, some discussion and assessment of the merits of each of these, bearing in mind the overall aims, led to the adoption of the simplified approach presented below.

Following practitioner engagement, it emerged that the two main expected and/or desired outcomes of Accessibility Planning are related to reducing social exclusion and encouraging mode shift towards non-car modes of transport. On this basis it is useful to categorise areas based on their objectively measured accessibility and these two key outcomes expected from changes in this accessibility. IMD is used as

an indicator of social exclusion, and while this is problematic, given that deprivation and exclusion are different concepts and one is not dependent on the other, interviews highlighted that it is a commonly used measure and is used here as an indicator of the potential for exclusion. Likewise, Census 2001 data on travel to work is used as an indicator of sustainable travel, and while this is neither up to date nor a true reflection of all travel, it provides a useful starting point for area selection, and helps in ensuring that a selection is made that covers a range of possible outcomes.

Using this framework as a starting point, Lower Super Output Areas (LSOA) in the “interview” areas and for comparison, in the whole of England are split into 8 types. Using the mean split to categorise areas as being above or below the mean gives each LSOA a score as high or low (within the Local Transport Authority Area(LTA)) on each of the three indicators.

1. Objectively measured public transport journey time accessibility to a range of facilities (CAI, 2009);
2. IMD Score 2008; and
3. Proportion of the population travelling to work using public transport, walking or cycling (Census 2001).

Table 6.2.1 illustrates this categorisation and a code assigned to each type of area. Therefore Area A relates to an area that is accessible, deprived and has a high level of car use, whereas Area H relates to an area that is inaccessible, less deprived and had a low level of car use.

Table 6.2.1 Categorisation of Lower Super Output Areas

Average Journey Time to a range of services as an indicator of accessibility	Level of deprivation (based on IMD) as an indicator of potential social exclusion	% of non-car travel to work as an indicator of Sustainable Travel	Code assigned
High Access (low time)	High deprivation	Low	A
		High	B
	Low deprivation	Low	C
		High	D
Low Access (high time)	High deprivation	Low	E
		High	F
	Low deprivation	Low	G
		High	H

An alternative approach was also tested, using those LSOA in the highest and lowest quartiles for each LTA but this meant that not all LSOA would be categorised and some areas would have an absence of some categories (i.e. no LSOA fall into the highest quartile on all three indicators). It was therefore deemed more logical to classify all areas according to the three criteria discussed.

Table 6.2.2 shows each of the areas from the interview stage, giving the total number of LSOAs and the average score for each of the three criteria. The JT Score is a score of each LSOA relative to others but does not have a unit value as it is based on aggregating journey times to seven different destinations and the data has been standardised to allow this to be collated. Equally the IMD is based on the rank of each LSOA against others.

Table 6.2.2 - Area characteristics

LTP Area	# LSOA	Average JT Score	Average IMD rank	Average % non car TTW
<i>Birmingham</i>	641	0.33	7647	39
<i>Derbyshire</i>	486	0.37	17078	23
<i>Greater Nottingham</i>	394	0.35	15128	32
<i>Merseyside</i>	1105	0.33	10326	33
<i>Peterborough</i>	104	0.35	13477	28
<i>Redcar & Cleveland</i>	92	0.35	11839	31
<i>Sheffield</i>	339	0.35	13044	35
<i>South Yorkshire</i>	845	0.35	11850	32
<i>St Helen's</i>	118	0.35	11097	29
<i>Staffordshire</i>	525	0.37	18930	21
<i>West Midlands</i>	1687	0.33	10488	33
<i>Wolverhampton</i>	158	0.34	9519	33
<i>England</i>	32482	0.34	15346	24

From this analysis and discussion of all local authority areas who participated in the interview stage, the Greater Nottingham LTP area was selected as a case study area because it:

- exhibits a range of types of area from the stratification process;
- is representative of a mid-sized English city;
- consists mainly of urban and accessible rural areas¹

Each area was discussed in turn and Greater Nottingham was selected as best suiting each of the factors. Greater Nottingham was selected based on consideration of a number of factors, including the size of the Local Transport Plan area, the urban-rural balance, the distribution of the eight category types assigned and findings emerging from the interviews with accessibility officers. This selection did not follow a strict scientific method. Such an approach was considered but given the multiple sources of data that could be used to attempt scientific selection, the selection of criteria for inclusion would be as subjective as the discussions appraising the suitability of each area for selection.

6.2.1 Accessibility in Nottingham

Greater Nottingham comprises Nottingham City, and the Nottinghamshire boroughs of Broxtowe, Gedling, Rushcliffe and a part of Ashfield as these form the Nottingham Travel to work area. Figure 6.2.1 shows the location of the case study area within England.

According to 2009 mid-year population estimates² the population of the Greater Nottingham area is 753,153, an increase of just fewer than 50,000 since the 2001 census.

Based on the categorisation developed to select a case study area the Greater Nottingham Area has slightly higher proportions of Lower Super Output Areas (LSOA) in the more accessible categories (A,B,C,D) and slightly less in the less accessible (E,F,G,H) than England as whole. This is to be expected given that it was selected based on the requirements of being urban and accessible rural, where accessibility issues and perceptions are expected to be substantially different from remote rural areas.

¹ these are deemed to have different characteristics from remote rural areas, which are not the subject of this research

² The latest available at the time of sampling and case study area selection. Further population information is in Table 6.6.1. At present there is not a detailed enough geographical breakdown to provide 2011 census data.



Figure 6.2.1 – Location of the Great Nottingham Study Area within England

Accessibility was given extensive consideration in Greater Nottingham’s Local Transport Plan 2 (LTP2). The area was also a Beacon Authority¹ for piloting the process of Accessibility Planning. In line with the findings in Chapter 5, that many local authorities consider accessibility to be a mechanism for improving sustainability, the Greater Nottingham LTP2 defines accessibility as;

¹ The Beacon Scheme for Local Authorities was a precursor to the Local Innovation Awards which are designed to recognise innovative public services which benefit citizens <http://www.localinnovation.idea.gov.uk>

“This means achieving sustainable access to work, learning, healthcare, food shops and other essential services with the greatest focus being given to those most in need. Improving access to leisure and tourism is also of growing local economic importance. It also means planning the location and delivery of services to make best use of existing transport provision.” (Nottingham City Council & Nottinghamshire County Council 2006a, page 39, Chapter 2 - Vision and Objectives)

Table 6.2.3 summarises the indicators that Greater Nottingham identified as being relevant to their accessibility objectives. Two of these, accessibility of a town centre and accessibility to healthcare, are based on the ‘traditional’ time-based measures of accessibility outlined in Chapter 2. However, as outlined in their strategy, given existing high levels of accessibility they chose to focus on other types of measures such as satisfaction with public transport services, mode shift and perceptions of safety.

The range of indicators is vast, although there is a clear focus on improving sustainable accessibility. The recognition of the importance of satisfaction and perceptions related to accessibility and in behaviour change is clear making this an interesting case study area and is important as it means findings are likely to be of interest to the officers engaged in accessibility planning. However, there is little evidence of how such perceptions might relate to the geographical provision and availability of transport, the objective accessibility provided by the transport land use system.

Table 6.2.3 – Indicators identified as relating to Accessibility in the Greater Nottingham Accessibility Strategy as part of Local Transport Plan 2 (2006-2011)

Indicator	Description	Target
Local Public Transport/Bus Patronage	Patronage figures for services across the LTP area for boardings within Greater Nottingham only	8% increase (baseline of 68,500)
Satisfaction with local bus services	Percentage of users satisfied with public transport	11% increase (baseline of 64%)
Accessibility of a town centre	Percentage of households within 30 minutes travel time by bus, tram or rail, of a town centre, with no more than a 400m walk to a bus stop	Maintain above 90% (baseline of 93%)
Cycling trips	Usage of Greater Nottingham cycle network (indexed)	Increase from 100 to 107
Mode share of journeys to school	Percentage of pupils travelling to all schools by car	3% reduction (baseline of 28%)
Bus Punctuality	Percentage of buses starting a route on time	3% increase (baseline of 92%)

Indicator	Description	Target
	Percentage of buses arriving at intermediate timing points on time	5% increase (baseline of 77%)
	Average excess waiting time incurred on frequent service route	Reduce from 0.71 minutes to 0.66 minutes
Single occupant car journeys to work	Percentage of journeys by employees working in an organisation with a travel plan in place	Retain at 69%
Commuter Travel Plans	Percentage of employees covered by a workplace travel plan	5% increase (15% baseline)
School Travel Plans	Percentage of schools adopting a travel plan	65% increase (15% baseline)
Bus journey times	The number of services that have benefitted from a 5% reduction in travel time	5 services
Bus reliability	Percentage of scheduled services operating	Maintain at 99.5%
Accessibility of Healthcare	Percentage of households within 45 minutes travel time by bus or tram of a hospital with no more than a 400m walk to bus stop	3% increase (baseline of 87%)
Accessibility for the elderly	Percentage of eligible population taking up elderly concessionary entitlements	8% increase (baseline 62%)
Satisfaction with Public Transport Information	Percentage of users satisfied with public transport information	6% increase in city (72% baseline) 9% increase in county (52% baseline)
Rights of Way	Percentage of footpaths and other rights of way which are easy to use by the public	6% increase (61% baseline)
Accessible bus routes	Number of fully accessible bus services	Increase from 2 to 7
Disabled facilities at pedestrian crossings	Percentage of crossings with facilities for disabled people	10% increase (baseline of 80%)
Real Time Information Provision	Number of services where buses are real time enabled	Increase from 4 to 9
Use of brown field land for housing		4% reduction (from 89%)
Perception of safety when using the bus at night	Percentage of users who feel safe when using the bus at night (after 7pm)	2% increase (65% baseline)
Level of walking	The footfall on the primary pedestrian network (indexed)	Increase from 100 to 107

Adapted from Greater Nottingham Accessibility Strategy (Nottingham City Council & Nottinghamshire County Council, 2006b)

6.3 Questionnaire Design

The questionnaire was designed according to the research design outlined in Chapter 3 in order to address the research questions below, and with the structure of the CAI in mind:

RQ1: How do objective and subjective destination choice sets relate to each other?

RQ2: a) How do objective and subjective measures of journey time accessibility relate to each other?

b) What, other than objective journey time can explain variation in self-reported journey time to destinations?

RQ3: In which way does satisfaction with aspects of accessibility (e.g. journey time, public transport frequency, choice of destinations) relate to objective measures of these aspects?

RQ4: Which factors can be used to explain;

- a) Perceived accessibility to destinations?
- b) Perceived accessibility by mode?
- c) Overall perceptions of accessibility?

As such the key elements which the questionnaire is designed to elicit are:

- an overall perception of accessibility
- subjective assessment and satisfaction with key aspects of accessibility
- perceived journey time accessibility to allow direct comparisons with the Core Accessibility Indicators (CAI)
- Demographic data, attitudinal questions and current travel habits for comparative purposes.

The final questionnaire (Appendix D) contained 4 sections under the headings:

Section 1: How do you get around?

Section 2: How easy is it for you to get to places?

Section 3: What do you think about the trips you make?

Section 4: Finally, a few questions about you....

Section 1 asks questions about car ownership, current use of modes and frequency of travel to destinations. These questions were included so that analysis of

perceptions can be understood in the context of mode use and of frequency of travel to key destinations of the respondents. The first three questions relate to car ownership and car availability. The next two questions asked respondents to rate their frequency of travelling by different modes of transport and to different destinations (based on those included in the CAI). Finally respondents were asked by which mode they would usually travel to a destination.

These straightforward questions were asked first to reduce strain on the respondent and ease them into answering the following questions.

Section 2 measures overall perceived accessibility, starting with general questions about accessibility in the local area, and then asking about specific destinations. This was included before the more detailed questions focused on accessibility in Section 3 of the questionnaire to try to elicit a 'snap' reaction towards accessibility from respondents before they had given it considered thought. The phrasing of the questions is based on the definition of accessibility as 'ease of access.' The questions use a five-point scale, from Strongly Disagree to Strongly Agree. A satisfaction scale with local transport and services was also included, on a five point scale from Very Dissatisfied to Very Satisfied. These are the independent variables in analysis of perceptions of accessibility.

Section 3 is the longest section and asked about key aspects of accessibility in detail, with the aim of understanding which of these factors can best explain the perceptions expressed in Section 2.

The first three questions use a semantic differential scale to rate aspects of accessibility related to modes of transport. These questions are designed so that different attributes of accessibility can be compared to explore their contribution to explaining variance in overall perceptions of accessibility. The next set of four questions asked respondents to rate destinations on a five-point Likert type scale according to their importance, satisfaction, choice and time taken. Importance and satisfaction are perception ratings to understand the salience of different destinations to respondents. Choice and time ratings are included firstly to compare how ratings of these attributes compare to objective measures of accessibility, and secondly using ratings of attributes of accessibility, alongside time in minutes as independent variables in explaining overall perceptions of accessibility.

The next page of questions relate to the self-reported journey time to destinations, allowing direct comparison with the CAI. First of all, respondents were asked to report their journey time, in minutes, to each of seven destinations, by walking, public transport and by car, to arrive at 9am, even if they did not usually use a destination or mode. They were then asked to write the specific destination they had reported the time for, (e.g. the name of the supermarket). This is to allow geo-coding and comparison of destination sets with the CAI and calculation of distances. Finally respondents were asked if they were referring to their nearest (e.g. school) and whether this was a destination they usually used. This provides contextual data for analysis.

The next question asked in this section asked respondents to rate destinations on a five-point scale from difficult to access to easily accessible. This is conceptually similar to the 'ease of access' rating asked in Section 2. However, pilot testing suggested a difference in how respondents answered and therefore both items were included. The final set of questions are attitudinal statement, on a scale of strongly disagree to strongly agree. The items were chosen based on statements included in other surveys (Handy et al. 2005; Aditjandra 2008) but a much reduced version. They are included to elicit attitudes to travel, neighbourhood and environment, which may affect how an individual might perceive accessibility.

Section 4 The final section of the questionnaire contained demographic questions asking age; sex; employment status; education level; household income; number of children; number of adults and disability. These all potentially influence travel behaviour, perceptions and attitudes and as such are important to understand and control for in analyses.

6.4 Sampling Strategy

A multi stage cluster sampling approach (Bryman, 2006) was used for the household survey. In this approach the primary sampling unit is not the units of population to be sampled but a grouping of those units. In this instance the primary sampling units are Lower Super Output Areas, (LSOA) selected through stratified sampling within study area in accordance with the classification of LSOA outlined in Chapter 3, and then simple random/systematic sampling of households within each LSOA, based on the electoral register.

There are four stages within the multi-stage cluster sample as shown in Figure 6.4.1 and each is discussed in turn.

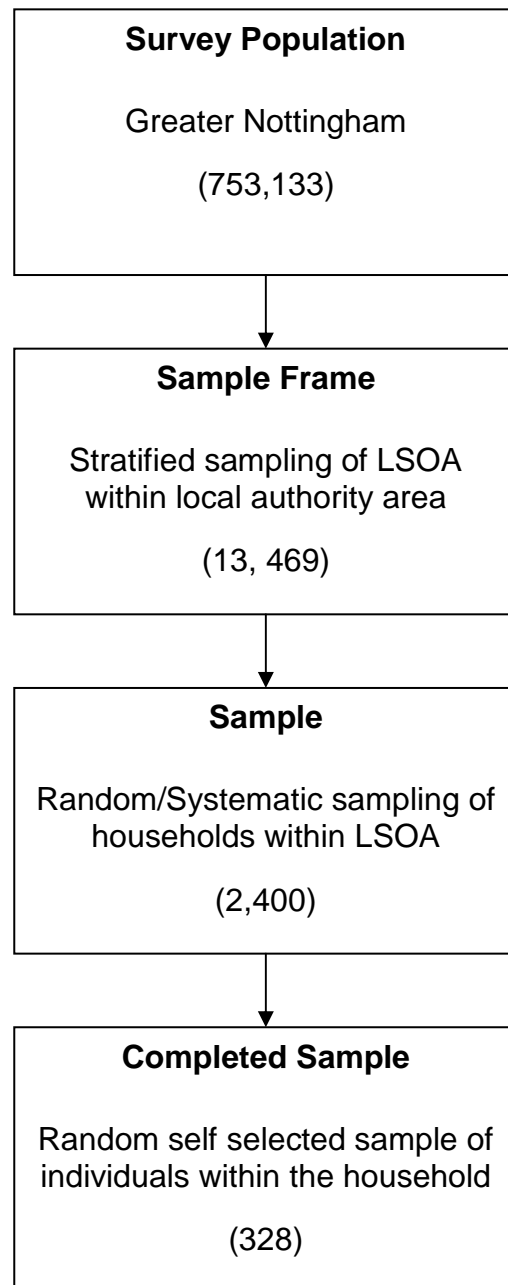


Figure 6.4.1 - Multi-stage cluster sampling (number of people at each stage indicated in brackets)

6.4.1 Selection of Local Authority Area

The first stage of the multi-stage cluster sampling was the selection of a local authority area as described in Section 6.2.

6.4.2 Stratified sampling of LSOA within local authority area

In order to select areas for sampling, a classification of areas was developed based on accessibility, as well as IMD and mode of travel to work. Within each local authority area, lower super output areas (LSOA) were stratified into eight categories based on the three criteria. In a study of the impact of neighbourhood design on travel behaviour, (Aditjandra, 2008) used a “hotspot” methodology to select neighbourhoods on the basis of key demographic criteria and a similar approach is adopted here.

A range of areas were selected to ensure that the survey population exhibits a range of characteristics, based on the link between accessibility and inclusion and mode shift, expressed during the interviews with accessibility officers. Using LSOA as the primary sampling unit enables “objective” characteristics of geographical areas to be linked with individuals’ attitudes with regard to accessibility, in order to understand the relative importance of objective (CAI) and subjective (survey) factors in influencing accessibility perceptions and ultimately travel behaviour.

LSOA represent a small area geography utilised by the Office of National Statistics (ONS) amongst other agencies for the output of a wide range of statistical data. Output Areas (OA) are the smallest level at which statistical data is generally available, although the data available at this level is much more limited. Notably, the CAI are reported at the LSOA level. OAs (and therefore LSOAs) are built from clusters of adjacent unit postcodes and are designed to have similar population sizes and be socially homogenous. A LSOA therefore provide an ideal area of study as given the readily available data, and size (a LSOA contains on average 1500 residents and a minimum of 400; maximum 500 households) lending itself towards studies at the neighbourhood level and have been used by other similar studies (Aditjandra, 2008). LSOA are therefore used to represent a neighbourhood and unit of study for surveying.

One LSOA was randomly selected from each of the eight stratification categories at this stage of the multi-stage cluster sample¹. The areas selected are shown in Figure 6.4.2. Detailed maps of each sample area are in Appendix E.

¹ Initially two LSOA were randomly sampled, but this was reduced to one given a reduction in the overall number of questionnaires to be sent, it was decided it was better to keep the same number (300) to each of 8 LSOA,

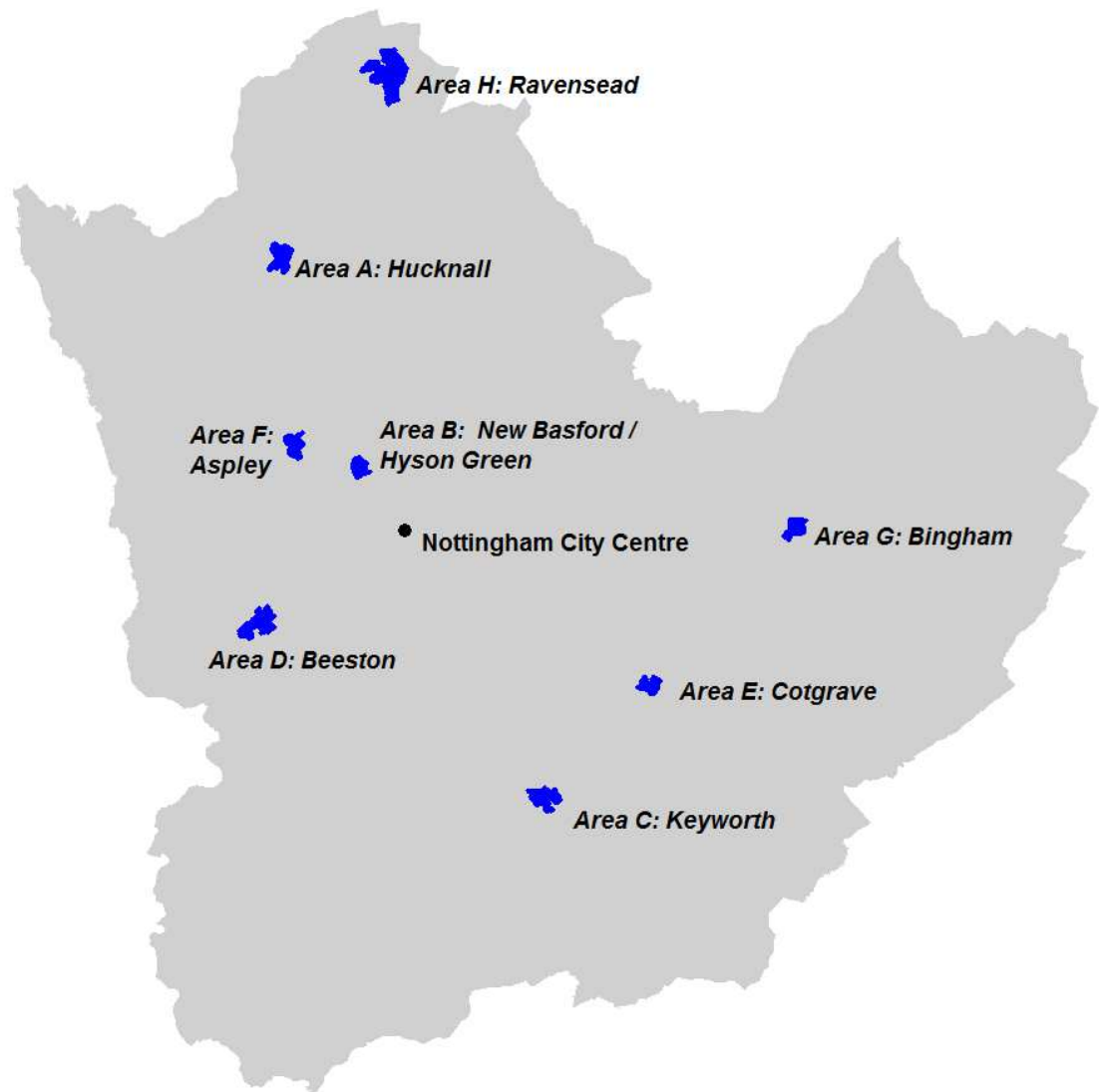


Figure 6.4.2 - Sample areas within Greater Nottingham

This approach results in over-sampling in some types of area, relative to the population. Each category will represent 12.5% of the sample whereas in the population categories, area types A,D,E and H represent less than 12.5% and will be over-represented in the sample, and types B and G represent more than 12.5% and will therefore be under-represented in the sample, presuming a uniform response rate across the types of area. However, it must be remembered that this is an *area* categorisation and a categorisation based on individual characteristics, which will be ascertained from survey responses. The purpose of stratifying is to ensure individuals with a wide range of possible characteristics are surveyed, and to understand if and how these relate to the objectively measured characteristics of the area in which they live. Over sampling in areas that are not well represented in the

rather than spread the 2400 more thinly across 16 areas. The number of surveys which could be distributed was limited by resources.

population increases the chances of respondents exhibiting these characteristics, and ensures that the attitudes and opinions of such people are represented. This may not have been the case if a random sample across the entire local authority area was taken. A key aim of accessibility planning and social inclusion policy is to ensure that certain individuals are not excluded and therefore this approach has been taken to ensure representation of people living in different types of areas, rather than a strictly representative sample of the population. Given an anticipated lower response rate among more deprived sections of the population following a pilot, over sampling in deprived areas increases the chances of reaching these individuals. As explained by Babbie (1990) given that the aim is to explain the relationship between the variables rather than behaviour per se in each area, then the differences between the sample and the population are of less importance. In his work on residents' perceptions of their neighbourhoods Greenberg (1999) notes a lack of studies that cover a spectrum of neighbourhood and resident characteristics. This adds weight to the use of an approach that attempts to cover the range of possible neighbourhood types, and understand how perceptions may differ between these, rather than focusing on one neighbourhood type or one socio-demographic group.

6.4.3 Random/Systematic sampling of households within LSOA

Within each of the 8 areas selected for the sample, 300 individual households were targeted, using the Postcode Address File, giving a total target sample of 2400 households, which is designed so that enough responses will be achieved based on the *minimum* 10% response rate expected based on similar recent household surveys in the UK (Farrington et al. 2004; Sugiyama & Ward Thompson 2007; Sahlqvist et al. 2011; Pooley et al. 2011; Aditjandra 2008) though often a much higher rate can be achieved. A 10% response rate (n=240) would give a sample size large enough to ensure estimates regarding the population (of the eight sampled areas) would be within ± 7 percentage points, with a 95% confidence interval (Dillman et al., 2009).

Sample Frame

In the UK there are two main sources of information from which to develop a sampling frame for administering a household survey;

1. *The Postcode Address File (PAF)*¹ is the Royal Mail's household address file, containing all known UK addresses and postcodes and is updated monthly.
2. *The edited Electoral Register (ER)* is available to purchase from district councils or from various online suppliers. This contains the most up to date electoral record for individuals who do not opt out of having their details on the register. Rates of inclusion and costs of supply vary.

PAF is now widely used as a sampling frame for face to face household interviews and is seen as superior to the ER for this purpose due to its accuracy and coverage. However, the disadvantages in terms of being unable to personalise mailings mean that it is not ideal for postal surveys, given that personalisation is seen as a key factor in improving response rates of such surveys (Dillman et al., 2009). Recent 'Place Surveys' prescribed by the Department for Communities and Local Government (DCLG) used self-completion surveys based on the PAF file as a sampling frame but there is no information on how the non-personalised mailings impacted response rates (DCLG, 2008).

The ER has a tendency to under-represent certain households, and introduces bias in the form of self-exemption from the survey (Duffy et al., 2002) and the Electoral Commission reports long term decline in the accuracy of the electoral register (Electoral Commission, 2010). Tipping & Nicolaas (2006) explain the difficulties with the use of the electoral register since 2002, now that households can opt out of the publicly available edited register and their analysis showed that a sample drawn from ER would exclude two out of five adults in UK and show that for comparison a sample drawn from CACI's Commercial Register (CR) would exclude one in three people. Exclusion of this kind is important and regarded as under-coverage, particularly of those aged 18-24 and those renting from private landlords. They conclude that the ER and CR are insufficient but that if the PAF is to be the only reliable frame for postal addresses then steps need to be taken to reduce non-response from impersonalised mailings and self-administered techniques, perhaps through the use of mixed mode surveys or combining sampling frames, although no practical examples of these are given. In contrast, Lynn & Taylor (1995) found no significant differences between the ER and PAF in terms of an individual's likelihood of being surveyed but conclude that the PAF is superior given its coverage. In another study Lynn (1997) analysed the change to using PAF instead of ER for the British Crime

¹ http://www2.royalmail.com/marketing-services/address-management-unit/address-data-products/postcode-address-file-paf?campaignid=paf_redirect (Accessed 14/02/2011)

Survey and concludes that the PAF brings about benefits in terms of precision and bias.

Based on the advantages and limitations of each sampling frame an approach based on combining the two methods was utilised in this survey, following the suggestion of Tipping & Nicolaas (2006) for combining sample frames and mixed mode sampling.

In order to avoid problems of non-enrolment on the electoral register, the PAF was used as the base for the sample frame. Within each of the sample areas selected during stratified sampling, 300 household addresses were randomly selected, giving a sample frame of 2400 addresses. In order to overcome some of the problems of non-personalisation of mail these addresses were then searched using an online electoral roll search engine¹ and for those where a match was found the survey was addressed to the first named individual on the electoral register. In total 47% of outgoing surveys were addressed to individuals, having been located on the ER, and 53% were addressed to 'The Householder', utilising the PAF only.

This approach gives the benefit of the coverage of PAF and removes the bias of those who have opted out of the ER, but has the benefit of personalising mail where ER records are available. There is a limitation in view of the fact that those who have opted out from the ER are those who are also less likely to be engaged in society and therefore potentially less likely to complete a survey (Lynn & Taylor 1995), especially where the survey is not personalised. On the other hand some people may be less inclined to respond if the mail were personalised as they object to their details being available, and by adopting this approach individuals are not automatically excluded as they would be using solely the ER. The electoral register is also biased in that it will not include households where no person is eligible to vote (for example on the basis of nationality). The effect of using this combined sampling frame provides some interesting methodological perspectives which are discussed in Section 6.5.2.

6.4.4 Random/self selected sampling of individual within the household.

The fourth element of the multi-stage cluster sampling is the individual within the household who completes the questionnaire. Although some surveys were personally

¹ <http://www.1stlocate.co.uk/>

addressed, the selection of who completes the survey is not necessarily pre-determined by stipulating whom the respondent within the household should be¹. If based on the electoral register then the envelope was addressed to a specific individual but another individual within the household might complete the survey. There was also an option for more than one individual within a household to complete the survey by requesting another copy or completing the online version. While, this does not strictly adhere to random probability sampling, it is in recognition of the fact that there will be differences between individuals within households, and that this survey is designed to elicit individual and not household perceptions, and therefore every individual within a household was given the opportunity to complete it.

6.5 Survey Administration

6.5.1 Testing and Pilot Study

Piloting of the questionnaire was undertaken in two stages. Firstly peer-review of the questions (n=35) using an online version, and secondly a full postal pilot study in Aberdeen (n=22). Recipients of a postal questionnaire also had the option to complete online.

Four streets were selected for the pilot against the following criteria:

- High overall SIMD score; High Accessibility SIMD score
- High overall SIMD score; Low Accessibility SIMD score
- Low overall SIMD score; High Accessibility SIMD score
- Low overall SIMD score; Low Accessibility SIMD score

Within each of the selected streets a survey was delivered to 20 households, giving a total distribution of 80. Surveys were delivered on both sides of the street, to every other household. Households were then revisited on two occasions, and a reminder left if nobody was in on the first visit. Overall 22 responses were received, consisting of 12 collected on call-backs, 4 completed online and 2 received in the post. This represents a response rate of 27.5%.

One advantage of testing the survey online was the ability to check how long it took respondents to answer, whilst recognising that times taken to complete online and

¹ For example, some household surveys aim to survey the person with the next birthday

paper versions may differ, this provided some indication of how long it took to respond. Excluding two extreme outliers the online responses took an average of 18 minutes for the test sample (n=34) and 22 minutes for the pilot (n=4). This informed the decision to suggest a completion time of 15-20 minutes on the instructions for the main survey.

All variables were checked for response rates and distribution following the pilot and no major amendments were necessary. The response rates confirmed that most questions were understood by respondents and that a reasonable (27.5%) response rate could be achieved.

6.5.2 Full Survey

Where possible the principles of Dillman et al's tailored design method for survey implementation were followed (Dillman et al., 2009) however time and resource restrictions meant that the full principles could not be followed. Their approach consists of personalisation, incentives, multiple contacts, timing of contact and format of mailing.

Surveys were personalised where possible using the electoral register but a trade off with sampling technique meant that not all were as described in Section 6.3. Dillman et al. (2009) recommend the use of an advance rather than promised incentive and present the evidence for the success of such incentives, suggesting that it plays on social exchange, and encourages respondents to reciprocate by completing the questionnaire. However, such an incentive would not have been possible within the financial limits of this survey, as it would have added to both outlay and postage costs. A promised incentive in the form of a prize draw was therefore used. In terms of making multiple contact Dillman et al. (2009) advocate a five stage approach consisting of a pre-notice letter, a questionnaire mailing, a thank you postcard, a replacement questionnaire for non-respondents, and finally a contact made by different mode of delivery. Again, given that postage costs made up a significant proportion of overall budget such an approach was outside the scope of this research, but a reminder postcard was sent, following the advice for a change of format. In terms of timing of mailing the suggested two week gap between initial questionnaire and reminder was followed although problems with the postal system during the time of the survey means that in reality the gap between arrival times may have been smaller. Finally, as suggested by Dillman et al. (2009) the use of the

university franking system ensured the mail looked official and would not be mistaken for marketing or junk mail, and individually numbered questionnaires ensured that respondents could be tracked so as to ensure that reminders were only sent to those who had not responded, although delays in the postal system means that a large proportion of those who responded prior to the reminder being sent out may still have received a reminder postcard.

Following the sampling strategy outlined in Section 6.4 2400 surveys were posted during the week beginning 29th November 2010 with reminder postcards being sent to those who had not responded 2 weeks later. The initial suggested date for reply was 17th December, however, this was extended through use of a reminder postcard due to the poor weather conditions during the period in which the responses were expected, having significant impact upon the postal service¹, meaning that some respondents did not receive the survey until close to the deadline. It is also expected that the weather may be one factor in a lower than desirable response rate, as discussed in Section 6.6, as the delay in outgoing post meant the surveys were received closer to the festive period than initially hoped. This may have reduced responses for several reasons. If the survey was received close to or even after the initial deadline then respondents may have thought it was too late to complete the survey and therefore thrown it away before receiving the reminder postcard with the extended deadline. Additionally if surveys arrived later in December it may have been a busy time for respondents and they were perhaps less likely to respond at this time of year.

Surveys were number stamped so that returns could be traced geographically and according to whether they had been sent using the Electoral Register (ER) or Postcode Address File (PAF) only. This information is stored separately to the responses, so the responses are not attributed to individual addresses, but only to unit postcodes and to one of the eight areas to which the surveys were posted, for analysis purposes.

A freepost return address label was included for return of the surveys. These were printed with a letter corresponding to the area to which the survey was posted as an additional measure to ensure that responses could be attributed to a sample area,

¹ <http://www.bbc.co.uk/news/business-11904765> (accessed 04/12/2010)

given that this is crucial for the analysis. Return envelopes were not included but a freepost return address label was and it was suggested that respondents re-use the outgoing envelope, for both environmental and budgetary purposes¹. An opportunity to enter a prize draw was included as an incentive for respondents. Respondents were also asked if they would be willing to be contacted to participate in follow up workshops, and 55 indicated they would.

The survey was also available online as an alternative method of response, which may be preferred by some respondents. This also provided the option for more than one person in a household to complete the survey.

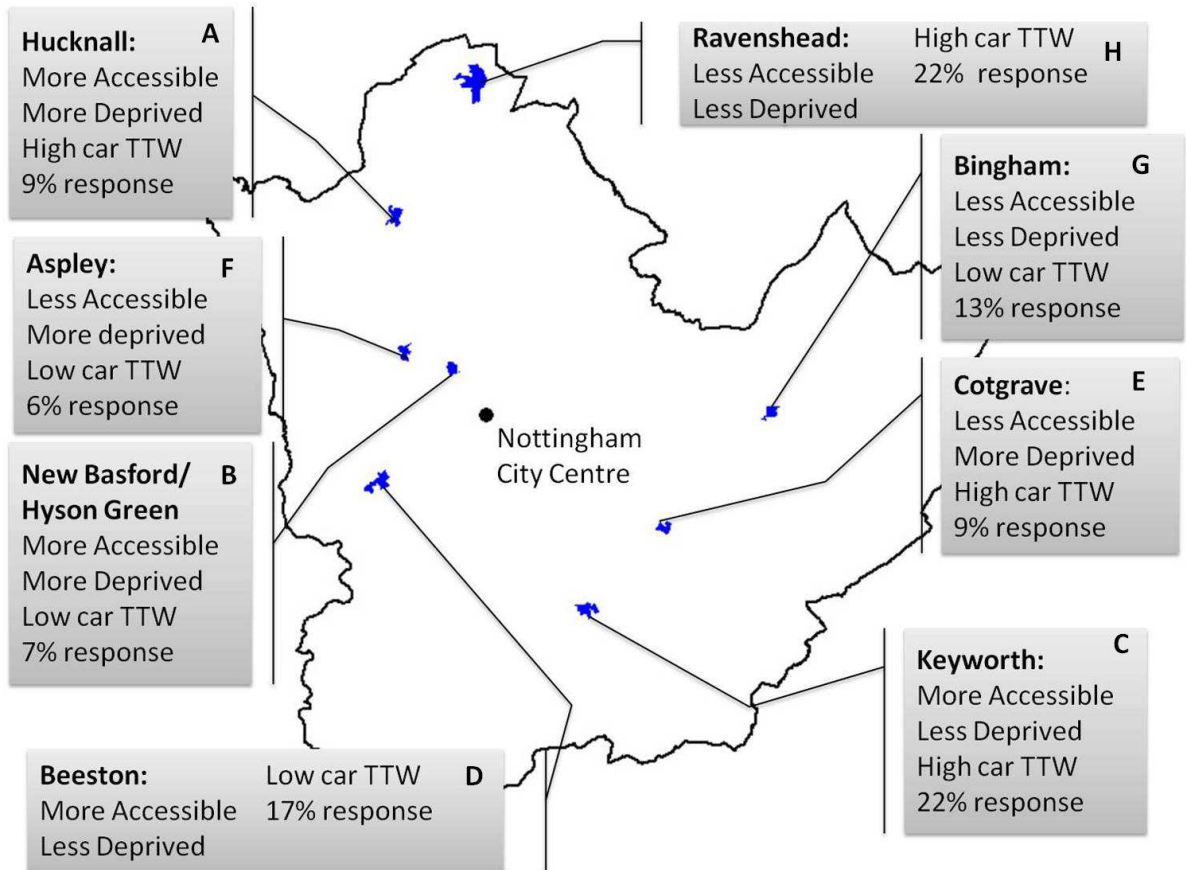
6.6 Response rates and characteristics of survey sample

In total 328 responses were received, giving a response rate of 13.7% of all 2400 surveys administered. 2% (n=52) were returned to sender by Royal Mail indicating deadwood in the PAF, so the effective response rate, discounting these from the sample frame is 14% (328/2348).

Of these 308 responses were received by post and 20 (6%) were completed online. It is not possible to ascertain whether the ability to complete the survey online resulted in an increased response rate, or whether the respondents would have completed the survey by post had the online option not been available. Comparison of the characteristics of the online respondents with the postal respondents shows that the main differences occur in gender, education and income levels. Compared to the sample as a whole, those who completed online tend to be more educated, have higher incomes and be male. 77.8% of those completing the survey online were male, compared to 40.2% male in the sample. 68.4% of those who completed online have a degree, compared to 36.8% of the sample. Overall 18.4% of the sample has no qualifications, whereas 5.3% of online completions have no qualifications. Those completing the survey online also tend to have higher incomes, with 36.8% of those who completed online having a household income of more than £45,000 per year compared to 19.8% in the sample overall. This is perhaps unsurprising, yet is important in the rise of internet only surveys, which may further marginalise certain groups and therefore supports the use of a more costly postal approach in this

¹ However, this approach is not recommended. Envelopes were tucked in rather than sealed so that respondents would not tear and could re-use and seal the envelope. This was not looked upon favourably by the university mail room as unsealed envelopes are more likely to jam in the franking machine.

research to ensure a wide demographic coverage. The 2011 census could also be completed online and resulted in a much higher online response rate of 16.5%¹ although the mandatory completion may have affected the proportion completed online rather than by hand. Figure 6.6.1 shows the response rate by sample area.



*TTW=Travel to Work

Figure 6.6.1 - Response rate by area

Analysis of missing variables highlighted few cases with a high number of missing variables and subsequently 13 cases were removed from the analysis. Therefore the analysis is based on 315 responses, giving an effective 13.13% response rate. This rate of response was highly variable across the eight areas sampled as shown in Figure 6.6.1. Table 6.6.1 summarises the characteristics of the sample as compared to the population of the sampled areas, Greater Nottingham, and England based on 2001 Census data (the release of 2011 census data will not be until late 2012 for local authority level summaries, and 2013-2014 for small area statistics, so

¹ www.ons.gov.uk/ons/guide-method/census/2011/the-2011-census/the-2011-census-project/2011-census-updates-and-evaluation-reports/internet-take-up-rates.xls

unfortunately a more up to date census comparison cannot be included in this thesis).

Comparing response rates across the eight areas against the categorisation in Table 6.2.1 it is clear that the IMD score is a distinguishing factor, with the four areas with a low IMD score (more deprived) Hucknall (Area A), New Basford/Hyson Green (Area B), Cotgrave (Area E) and Aspley (Area F) having an overall response rate of 8% compared to the four areas with high IMD score (less deprived) Keyworth (Area C), Beeston (Area D), Bingham (Area G) and Ravenshead (Area H), which had an overall response rate of 19%. This is illustrative of the difficulties encountered with engaging with people in more deprived areas.

Obtaining a typical response rate for household surveys is difficult as there are multiple factors affecting the rate of response that can be expected. Moser & Kalton (1979) report response rates from household surveys in the range of 10-90%. Those at the higher end tend to have benefited from pre-notice letters and multiple follow ups, personal contact and topics of specific interest to the targeted population. In unsolicited surveys similar to this one, lower response rates are more typical (Farrington et al. 2004; Sugiyama & Ward Thompson 2007; Sahlqvist et al. 2011; Pooley et al. 2011) It is not the low sample number in itself that is problematic (Moser & Kalton, 1979), rather the issue of non-response bias, in that those who do not respond typically differ to those who do, and as such the reported results are biased towards a particular type of person who is more likely to respond and engage with the survey.

It is clear from the response rate that those over 65 are over-represented relative to the population, although the extent of this is probably somewhat less than suggested by comparison to 2001 census data due to changing demographics of the population since 2001. Interestingly Sugiyama & Ward Thompson (2007) report a similarly low response rate for a household survey targeted towards an older population, and based on follow up focus groups suggest that survey fatigue was a major contributory factor. They suggest that survey fatigue is apparent across the population, and therefore that the issue of non-response bias is perhaps reduced as it is not restricted to one particular group, therefore those not responding are not necessarily noticeably different from respondents. This may have some relevance here, although Table 6.6.1 does suggest some noticeable differences in response rates across

demographic groups and geographical areas which leads to potential non-response bias.

Reminder postcards were sent out one week after the initial survey. Given the weather conditions, which caused delay in the arrival of the initial survey and postbacks it is difficult to isolate the impact of the reminders. However a boost to online responses, and emails and telephone contact following post out of reminder post cards suggests they did serve the purpose of reminding some people to complete the survey and therefore increased overall response rates.

The multi-method sampling approach based on the Postcode Address File and supplemented by the Electoral Register was designed to improve response rates through personalisation where possible. However, responses suggest no effect with 13.6% of PAF only surveys being returned and 13.5% of PAF plus ER surveys. This is interesting and suggests personalisation in this instance added nothing to the response rate. Future surveys could use PAF only, benefitting from coverage and ease of use. A brief comparison of response rates across demographic groups has been undertaken, but without knowing the characteristics of the full sample frame, including non-respondents it is not possible to ascertain whether or not differences in the response mode occur. For example, whilst differences were noted in terms of educational status (a greater proportion of those respondents with no qualifications being “PAF + ER”) and age (“PAF + ER” on average 4.35 years older than “PAF only”), this could be because more “PAF-only” surveys were sent to younger and more educated people, so difference could be attributable to the population than the rate of response among different groups. Nevertheless if adding personalised details through the electoral register means that older and less educated people are more likely to be reached then this could be of interest for those trying to survey hard to reach groups.

The maps in Appendix E show the geographical distribution of survey responses relative to all postcode points within each sample area. The graphs show all postcode points, all postcode points to which a survey was sent, based on random sampling within each area and then all postcode points from which surveys were received. It can be seen that there is no geographical bias to the responses with the responses being fairly evenly distributed across each sample area.

Table 6.6.1 – Population and Sample characteristics

	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Sample Area	Greater Nottingham	East Midlands	England	England 2011 Census
Number of responses	28	21	68	53	29	19	68	42	328				
Response Rate	9%	7%	23%	18%	10%	6%	23%	14%	14%				
Population (2001 Census)	1,635	1,406	1,430	1,650	1,435	1,635	1,431	1,520	12,142	703,331	4,172,174	49,138,831	53,012,500
Population (2009 mid-year estimates)	1,992	1,870	1,418	2,135	1,336	1,736	1,435	1,547	13,469	753,133	4,451,240	51,809,741	
Sex													
Male	<i>sample</i> 29%	35%	35%	47%	22%	28%	54%	47%	41%				
	<i>population</i> 48%	51%	48%	51%	51%	49%	48%	49%	49%	50%	49%	49%	49%
Female	<i>sample</i> 71%	65%	65%	53%	78%	72%	46%	53%	59%				
	<i>population</i> 48%	51%	48%	51%	51%	49%	48%	49%	51%	50%	51%	51%	51%
Average Age	<i>sample</i> 49.9	39.7	62.2	58.9	52.7	47.2	62.8	65.1	54.8				
	<i>population</i> 49.0	37.1	51.6	46.3	43.8	40.9	54.8	48.9	46.9	46.4	47.7	47.3	47.7
Age Category													
Age 18-24	<i>sample</i> 4%	0%	0%	0%	0%	6%	0%	0%	1%				
	<i>population</i> 8%	26%	7%	16%	9%	15%	5%	9%	12%	13%	11%	11%	12%
Age 25-44	<i>sample</i> 39%	74%	18%	23%	31%	41%	8%	8%	24%				
	<i>population</i> 40%	48%	29%	37%	50%	52%	20%	37%	38%	37%	37%	38%	34%
Age 45-64	<i>sample</i> 39%	26%	32%	38%	46%	24%	44%	27%	35%				
	<i>population</i> 26%	17%	38%	26%	28%	20%	47%	32%	30%	29%	32%	31%	33%
Age 65-74	<i>sample</i> 18%	0%	29%	21%	19%	18%	32%	43%	26%				
	<i>population</i> 12%	5%	14%	9%	8%	8%	16%	11%	10%	11%	11%	11%	11%
age 75+	<i>sample</i> 0%	0%	21%	19%	4%	12%	16%	22%	15%				
	<i>population</i> 14%	4%	12%	12%	5%	5%	12%	12%	10%	9%	10%	10%	10%
Average household size	<i>sample</i> 2.0	2.2	2.3	2.4	2.6	2.3	2.2	1.8	2.2				
	<i>population</i> 2.1	2.2	2.3	2.2	2.8	2.6	2.3	2.5	2.2	2.3	2.4	2.4	
Households with dependent children	<i>sample</i> 18%	38%	24%	23%	31%	42%	16%	10%	22%				
	<i>population</i> 25%	26%	26%	21%	47%	54%	22%	35%	31%	28%	30%	29%	
Household Car ownership													
No car.	<i>sample</i> 29%	60%	10%	16%	12%	61%	6%	38%	22%				
	<i>population</i> 38%	51%	13%	34%	26%	53%	9%	31%	32%	31%	24%	27%	
1 car	<i>sample</i> 46%	40%	57%	52%	65%	33%	32%	48%	47%				
	<i>population</i> 43%	41%	50%	40%	55%	39%	40%	46%	44%	44%	44%	44%	
2 car	<i>sample</i> 25%	0%	30%	28%	23%	6%	52%	13%	28%				
	<i>population</i> 15%	7%	32%	21%	17%	7%	42%	20%	20%	20%	25%	24%	
3+ car	<i>sample</i> 0%	0%	3%	4%	0%	0%	10%	3%	4%				
	<i>population</i> 3%	1%	5%	5%	3%	1%	9%	3%	4%	4%	6%	6%	

		Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Sample Area	Greater Nottingham	East Midlands	England	England 2011 Census
Employment Status														
Employed full time	<i>sample</i>	35%	43%	26%	23%	39%	28%	21%	20%	27%				
	<i>population</i>	49%	33%	46%	44%	45%	33%	42%	45%	42%	44%	47%	47%	
Retired	<i>sample</i>	29%	9%	49%	43%	25%	28%	48%	58%	41%				
	<i>population</i>	15%	7%	21%	12%	10%	9%	25%	12%	14%	14%	14%	14%	
Other	<i>sample</i>	35%	48%	25%	34%	36%	44%	31%	23%	32%				
	<i>population</i>	36%	59%	32%	45%	45%	58%	33%	42%	44%	42%	39%	39%	
Education														
First or higher degree	<i>sample</i>	15%	45%	30%	68%	28%	0%	47%	23%	37%				
	<i>population</i>	15%	40%	35%	61%	13%	10%	37%	20%	30%	19%	17%	20%	
Post 16	<i>sample</i>	22%	25%	19%	16%	16%	17%	27%	6%	19%				
	<i>population</i>	5%	16%	9%	11%	5%	4%	7%	5%	8%	10%	8%	8%	
Secondary School	<i>sample</i>	33%	15%	34%	12%	24%	61%	19%	29%	26%				
	<i>population</i>	39%	25%	38%	18%	44%	38%	36%	36%	34%	33%	36%	36%	
None	<i>sample</i>	30%	15%	16%	4%	32%	22%	8%	43%	18%				
	<i>population</i>	38%	32%	19%	17%	38%	46%	17%	38%	30%	31%	32%	29%	
Income Category														
<15		36%	45%	29%	11%	29%	71%	10%	55%	30%				
<30		36%	30%	34%	37%	38%	21%	35%	24%	33%				
<45		20%	5%	19%	13%	24%	7%	27%	12%	18%				
<60		8%	15%	10%	17%	5%	0%	15%	3%	10%				
<75		0%	5%	2%	9%	5%	0%	8%	3%	4%				

The response rate was slightly lower among males, and higher among females compared to 2001 Census data for the same areas. While the age profile of the sample and the population follow broadly the same pattern, there is underrepresentation amongst younger age categories, and over representation amongst older age categories. Given changes in the age structure of the population since 2001, this over-representation of older age categories is less stark than this data shows, but nevertheless it is present and noticeably different from the population profile. Mid 2010 population estimates suggest that those in the over 65 age category comprise 20% of the population in 2010 and 2001¹. Over the same time period there was an increase in the proportion of 16-29 year olds suggesting a strong under-representation of this category in the survey responses received. Household car ownership in the sample and the population follow broadly the same profile, with a slight under representation of households with no car, and over-representation of households with one or two cars. Comparing the employment status' of the respondents to the population shows an under-representation of those employed full-time and over-representation of retired, as would be expected from the age profile of respondents, a general increase in the retired population since 2001, and a tendency of retired people to complete such surveys. The highest educational qualification of survey respondents compared to the 2001 population highlights a higher response rate amongst those with higher educational qualifications. Direct comparisons of income with census data are not possible as income is not reported in census outputs.

Figure 6.6.2 shows mode of travel by frequency of use for the survey respondents. Overall walking and car driving are the most frequently used modes. Bus and car as passenger are less frequently modes used and train, tram, bicycle and taxi even less so.

¹ Source: Own analysis of ONS mid-year population estimates for small areas (<http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15106>)

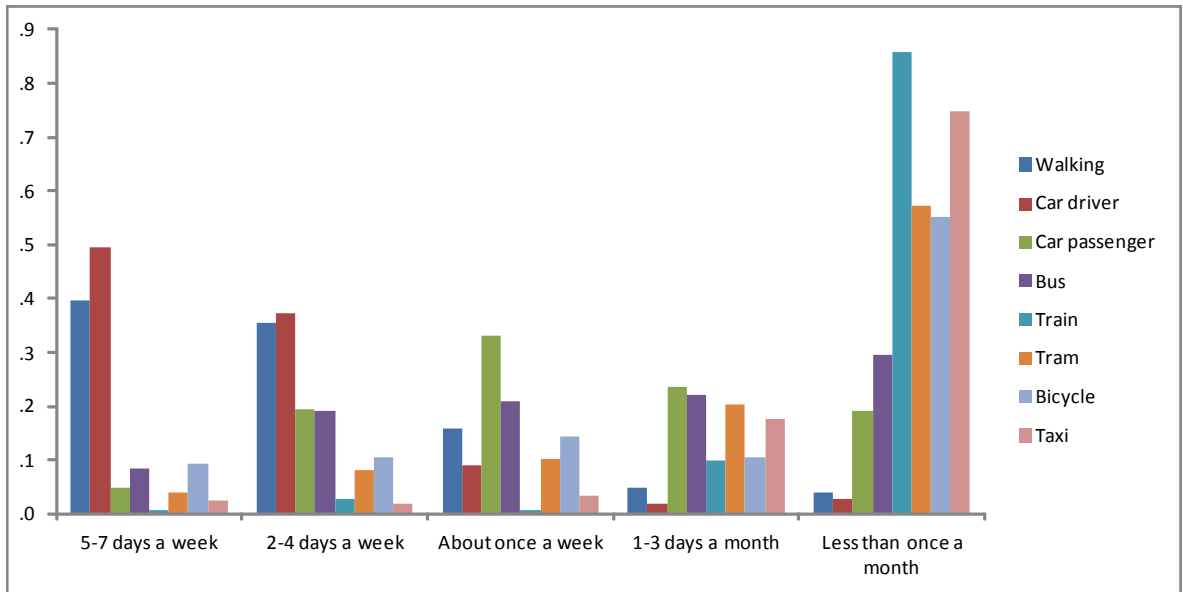


Figure 6.6.2 - Mode of Travel: Frequency of use

Figure 6.6.3 shows the frequency of travel to the destinations. A large proportion of respondents never visit schools or colleges, as would be expected given the age profile. As would be expected destinations such as work and schools are visited more often, compared to hospitals and doctors, which are much less frequently visited.

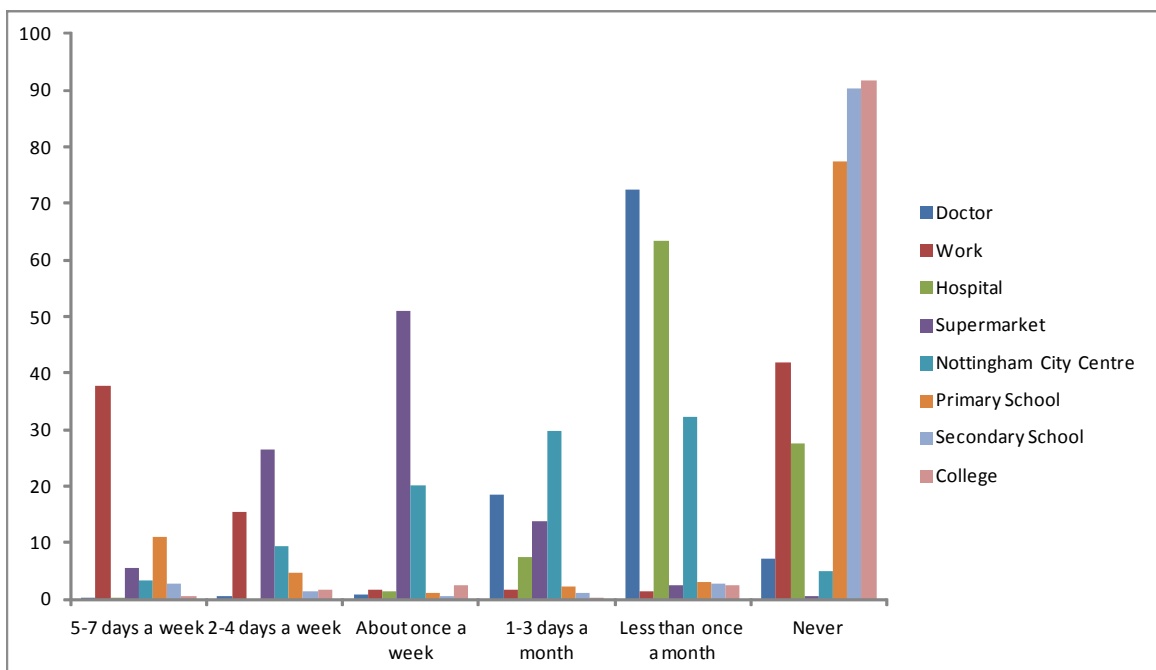


Figure 6.6.3 - Destination: Frequency of use

Figure 6.6.4 shows the destinations by usual mode of travel. Across all destinations except for doctors and Nottingham City Centre, car as driver is the most used mode.

Bus accounts for a large proportion of journeys to hospital and the majority of journeys to Nottingham City Centre.

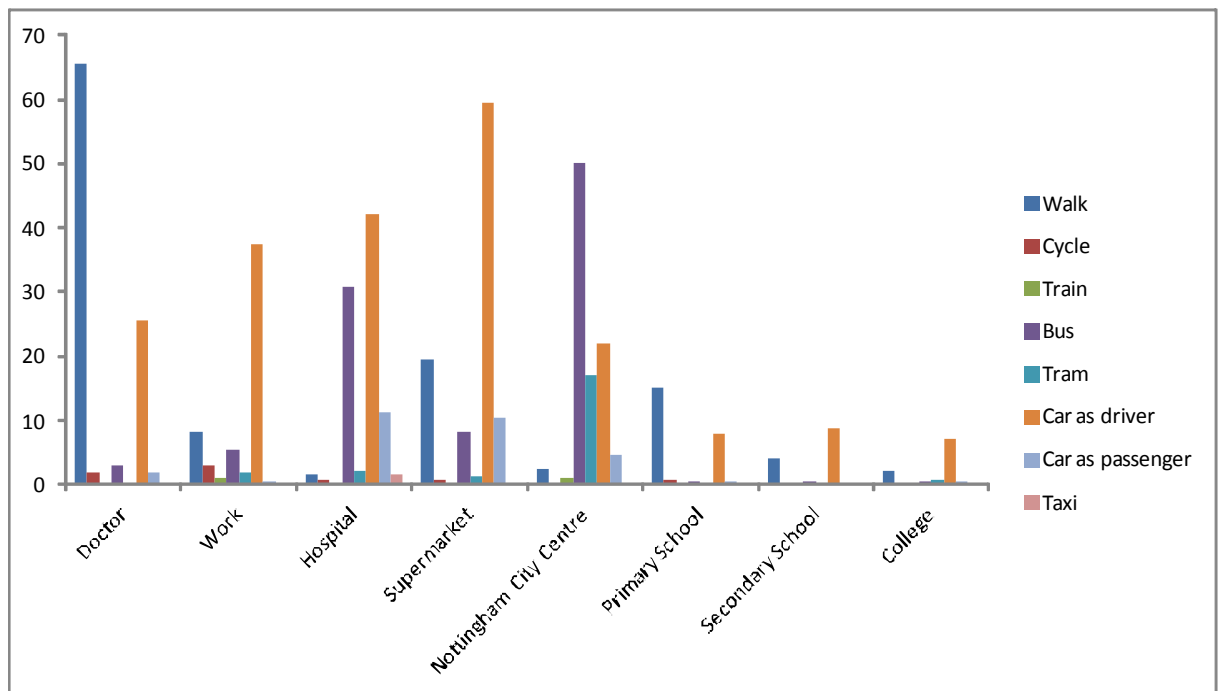


Figure 6.6.4 - Destination: Usual mode of travel

6.7 Methods of Analysis

This section outlines the methods of analysis used in the following chapter to analyse the survey results and the qualitative methods applied to the mental mapping interviews.

The survey data was manually entered into and analysed using SPSS software. MapInfo GIS package was also used to map the locations of survey respondents and the destinations they used. In order to compare the two datasets it was necessary to first match up the survey responses to the CAI dataset. Each survey response was matched to the LSOA and the corresponding CAI data were attached as variables.

6.7.1 Weighting of data

Several options for the weighting of data were explored to ensure that the conclusions are not affected by the predominance of a certain group in the dataset. For example, if perceived accessibility is better in the dataset than it is in the population because there is an over-sampling of individuals living in a more accessible area the results would be biased. However, for a number of reasons the

data is not weighted. Firstly, an exploration of the influence of various demographic variables on key outcome variables suggests there are numerous factors affecting the outcome variables and the relationships are complex and overlapping. Therefore there is no immediately obvious variable to weight against. Secondly, population data from the 2001 census is over 10 years old and therefore not necessarily a true reflection of the population, indeed it may be that the sample is a better representation, particularly in terms of age, which is one variable upon which the data might have been weighted. Thirdly, in order to weight against key population demographics (e.g. area and age were considered) then for each permutation of area and age that exists in the population there needs to be a corresponding case in the sample which can be weighted to the population. Where this does not exist (e.g. no individual aged 54 in area B) then the weighted sample size will be significantly reduced. Finally, scale weighting is important where assumptions about the population are to be made or forecast. However, this work does not intend to make assumptions about the population, but rather explore relationships between the variables in the dataset. While it could still be important to proportionally weight the variables within the dataset, for reasons outlined above it is not proposed to do so. An exploration of the influence of demographic variables on outcome variables has been undertaken and this will be used to guide the analysis and interpretation of results to ensure false conclusions are not drawn from results influenced by confounding variables.

6.7.2 Removal of Outliers

Given that the aim of this research is to reflect *individual* reported journey times, some consideration was given to the removal of outliers and whether this would be antithetical to the underlying ontological approach. Figure 6.7.1 shows the distribution of reported journey times by destination and mode. There is a large variation in the times reported as expected. Negative skew in the data, shown by the uneven 'whisker' lengths, results from a small number of large reported journey times, which also implies that standard deviations are high. The stars represent significant outliers and, particularly for walk times to more distant destinations, there are a noticeable number of large outliers.

While it is considered important to reflect the range of perceived journey times given by respondents, inordinately high responses are likely to bias results, for example

when comparing with the CAI, a small number of high reported journey times may lead to significant differences overall.

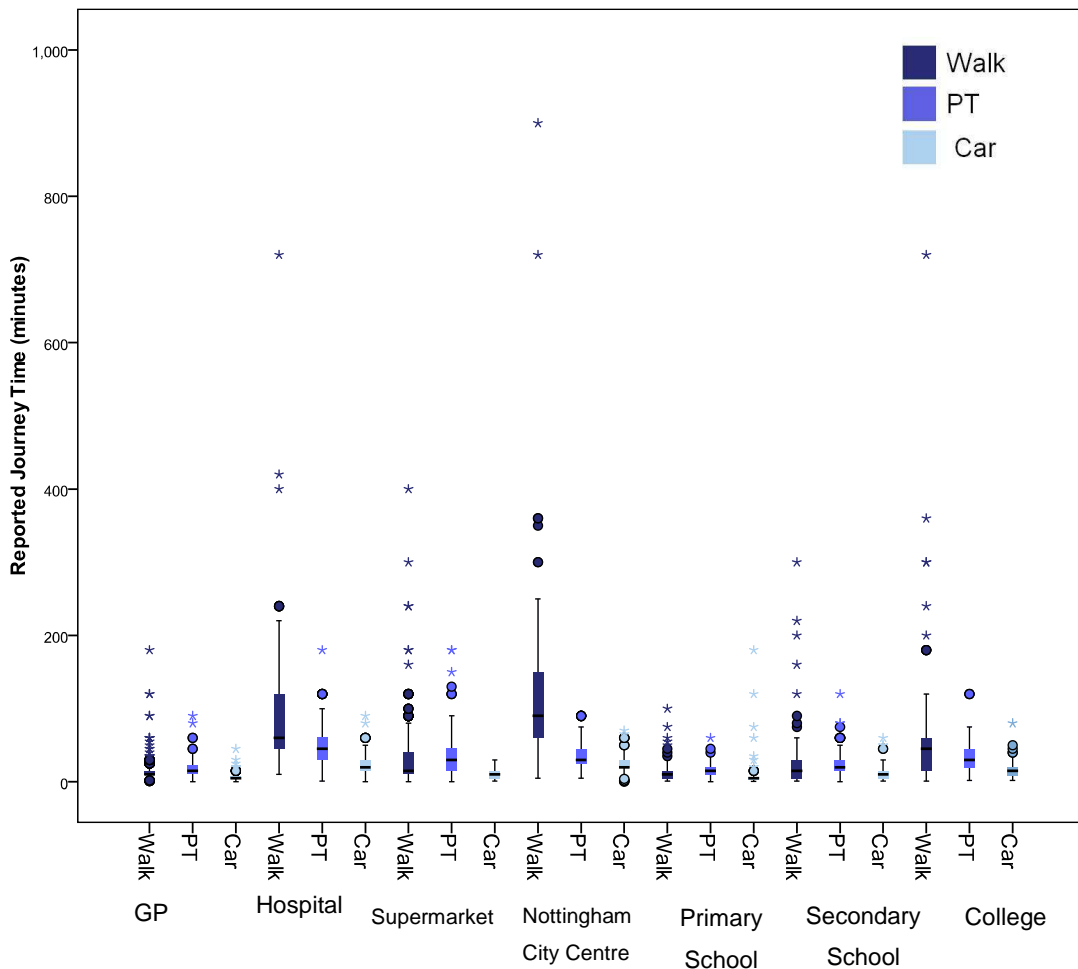


Figure 6.7.1 - Reported Journey Times (including outliers)

Examination of the data suggests that high public transport and walk journey times were reported (e.g. > 2 hours) when respondents did not think a journey was possible. Therefore a pragmatic decision was made not to use the journey times reported by outliers as they reflect estimations of unrealistic journeys or a belief that a journey is impossible. Outliers were replaced using thresholds discriminated by mode and destination. Thresholds were set based upon the distribution of each variable and what was considered a reasonable maximum based on the mode/destination and CAI mean in each case. Reported journey times above these thresholds were reduced to the threshold, meaning that the high reported journey times are still reflected although set to a reasonable maximum. Moreover the dataset was not unnecessarily reduced. Figure 6.7.2 shows the distribution reported journey times after removal of outliers. Compared to Figure 6.7.1, there are noticeably fewer

intervals are not necessarily equal, and values are limited to specific discrete numbers, they are also not nominal given that there is some order to the data. Opinions remain divided and inconclusive with regard to the treatment of attitude scales such as Likert Scales as continuous linear scales for the purposes of data analysis. Field (2009) supports this suggesting that while in economics or mathematics the norm would be to use loglinear or logit modelling, such techniques are less common in social sciences, and the tendency is to treat attitudinal scales as continuous.

Oppenheim (1992) gives an example of Socio-Economic Status categories being treated as continuous data, highlighting that while in 'strict measurement terms this is wrong', the use of such approaches in order to apply parametric data analysis is not uncommon in social science and Field (2009) uses an attitudinal 10 point rating as an example of a continuous predictor, contrasting this with gender as a categorical predictor. While a single Likert scale may be best analysed using non-parametric techniques due to its inherent categorical nature, when summing several scales they can be analysed using parametric techniques and treated as interval data measuring a latent variable. However Mollenkopf et al (2011) suggest the use of single item scales is often as good as multiple item scales particularly for satisfaction. Of more importance is that the scales being used are conceptually robust and reflect the phenomenon being measured.

In research of this nature high levels of multi-collinearity among predictor variables can present a problem in regression analyses. This is only likely to be an issue if correlation among variables is very strong (greater than 0.80 according to Field, 2009). In order to check for multi-collinearity when undertaking regression analyses, variance inflation factors (VIF) were calculated for each co-efficient. The VIF is an indication of how much the predictor variables correlated within other variables and would be a cause for concern if it exceeded 10 (Field, 2009), although a value above 1 indicates some level of correlation. Multi-collinearity diagnostics for all regression analyses are reported in Appendix H.

6.8 Summary

This chapter has described the approach to choosing Greater Nottingham as a case study area for the primary data collection section of the thesis. The questionnaire design and multi-stage sampling approach were then outlined. This utilised a mixed-mode approach to selecting the sample frame based on the PAF and ER. However, it did not seem to have any effect on response rates. A response rate of 14% (328) was achieved across the sample areas. This is comparable to other unsolicited household surveys. Compared to the population (2001 census) the sample was more likely to be older and female.

The approach to data analysis has also been outlined in this chapter; the following chapter presents the detailed results of the analysis of the household survey.

7. Comparing Objective Measures to Perceptions of Accessibility^{1,2}

¹ Appendix F: Destination Mapping and Appendix G: Variables Glossary relate to this chapter

² Some of the analysis presented in this chapter was presented as a written paper and oral presentation at the Universities Transport Studies Group (UTSG) Conference in Aberdeen, January 2012

7.1 Introduction

As outlined in Chapter 2, there is a gap in understanding of how objective and subjective measures are related. It is important to understand subjective accessibility alongside objective measurement because behaviour is more closely related to perceptions, or subjective measures, but changes to accessibility provided by the transport and land use system are monitored through objective measurement. If changes in accessibility are to lead to changes in behaviour there is a need to understand how objective measurement relates to subjective perceptions in order that change can be effected.

This chapter compares objective measures of accessibility with subjective or perception based measures, using the Core Accessibility Indicators (CAI) as objective measures and primary household survey data as subjective accessibility measures (as described in Chapter 6).

The CAI include four types of accessibility measure, journey time to reach destinations, number of destinations of a specific type accessible from an origin within a given time threshold (referred to as choice), the population accessible to a destination within a given time threshold and frequency of public transport to destinations. These are described in more detail in Chapter 4.

The aim of this chapter is to understand how three of these indicators relate to survey respondents' perceptions of each of these aspects of accessibility¹. Moreover, perceptions of accessibility are explored more broadly. The chapter is structured into four main sections and addresses the following research questions:

Section 7.2: How do objective and subjective destination choice sets relate to each other? **(RQ 1)**

Section 7.3: How do objective and subjective measures of journey time accessibility relate to each other? **(RQ 2a)**

What, other than objective journey time can explain variation in self-reported journey time to destinations? **(RQ 2b)**

¹ The destination measures which calculate the population with access to a destination within a given time threshold are not suitable for comparison with subjective measures.

Section 7.4: In which way does satisfaction with aspects of accessibility (e.g. journey time, public transport frequency, choice of destinations) relate to objective measures of these aspects? **(RQ 3)**

Section 7.5: Which factors can be used to explain,;

- Perceived accessibility to destinations? **(RQ 4a)**
- Perceived accessibility by mode? **(RQ 4b)**
- Overall perceptions of accessibility? **(RQ 4c)**

7.2 Comparison of Objective and Subjective Destination Choice Sets

In the CAI the accessibility of seven destination types is assessed. These include hospitals, doctors, primary schools, secondary schools, colleges, supermarkets and town centres. This section compares the destination datasets used in the CAI calculations to the destinations described by survey respondents for all destinations except town centres¹. A destination set is the destinations of any one type (e.g. hospitals) that are used in an objective accessibility assessment or that are considered by an individual in their subjective choice set.

A subjective choice set is the destinations that a person perceives as being available to them and may differ from the objective opportunities available (Van Exel & Rietveld 2009). The CAI use “official” destination datasets, which may or may not correspond to subjective datasets as defined by survey respondents. A difference between subjective and objective destination choice sets is one of the key potential reasons for differences between objective measures and individuals’ subjective understandings of accessibility.

The destination set is a crucial component in measuring accessibility to destinations and the inclusion or exclusion of certain destinations will impact the results of calculations by changing the level of accessibility in a given area. By comparing the CAI destination sets to the survey responses it is possible to learn which destinations included in some national datasets may or may not be of relevance at the local level and subsequently improve the quality of national calculations.

¹ The CAI town centre destination set includes local shopping centres. This was not included in the survey but instead questions were asked about Nottingham City Centre to give a destination that is comparable across all respondents.

The questionnaire (Appendix D) asked respondents to give the name, street name or neighbourhood of the destination they used or the destination that was their nearest for six destination types¹. These were geo-coded using a range of sources² to assign postcodes to the destinations listed and each unique destination was given a code to create a destination choice set based on survey responses. These could then be compared with the destination sets used in the CAI.

The maps in Appendix F show the CAI datasets compared to the datasets built from survey responses. There are noticeable similarities and differences between the CAI destination dataset and the user-defined or subjective dataset, although the extent of such differences varies by destination and case study area. The omission of a destination from the subjective dataset does not necessarily mean it is not used by, or important to, the local population, as highlighted by subsequent analysis in Chapter 8, simply that it was not mentioned by the survey sample. It is also of interest if there are destinations that are missing from the CAI but which were mentioned by survey respondents. As noted in Chapter 4, accessibility analyses rely on the quality of input data and there are issues with the CAI, some of which are illuminated by this comparison with subjective datasets in the case study area. A comparison was undertaken through a systematic process of comparing destinations within each of the sample areas using the maps created using MapInfo and a spreadsheet based approach which consisted of matching the two datasets using lookup tables on an area by area basis and highlighting where a match was not found in either the survey responses or the CAI destination datasets.

The CAI and questionnaire destination datasets are compared at two levels of geography. Firstly, for destinations within the boundaries of the eight sample areas and secondly at a broader scale for the whole of the Greater Nottingham region and beyond if appropriate, given that individuals do not confine their choice sets to administrative boundaries. Each type of destination is discussed in turn below.

¹ doctors; hospital; supermarket; primary school; secondary school; college (selected on the basis of their inclusion in the CAI)

² Google maps, Local Authority websites, NHS website and individual supermarket store finders

7.2.1 Destinations related to healthcare

This section compares doctors and hospitals. Comparisons were made firstly for destinations falling within each sample area and secondly further afield. There are no hospitals within the boundaries of any of the eight sample areas.

For doctors surgeries, on the whole all of those in the CAI were mentioned by respondents and vice versa. However, there were a few discrepancies. In Hucknall (Area A) there is a doctors surgery listed in the CAI that was not mentioned by survey respondents. However given that there are three in the CAI and two of these were mentioned it could be chance that the third was not mentioned. Nevertheless, given its proximity to respondents' households and another doctors surgery this is surprising. NHS choices¹ and Google Earth Streetview² suggest the surgery does exist (in 2008).

Within the Greater Nottingham area there are four hospitals in the CAI dataset, two of which were mentioned by survey respondents. The omission of two hospitals across the entire survey sample suggests they are not relevant to the general population. The NHS website suggests that one of these is a private hospital and the other offers Geriatric Medicine only. This provides explanation for why they are not seen as generally relevant to the population. However, this does not mean they are not important destinations for some individuals. It does bring into question whether they should be included in national calculations if they are not important to the general population, yet omission would also be problematic if these destinations are important to some sections of the population. It is therefore important to be clear what an accessibility measure is representing, and as suggested in the CAI guidance, it may be useful to have a separate measure for hospitals with Accident and Emergency (A&E) admissions. However, the appropriateness of such a measure should also be considered given that public transport or cycling are unlikely to be realistic options for those requiring A&E. Two further hospitals, beyond the Greater Nottingham boundary, in Mansfield and Newark, were mentioned by a number of respondents, both of which were also in the CAI dataset. While not necessarily an issue in this case as both of these are within Nottinghamshire, which works closely with the Greater Nottingham LTP area, the importance of cross-boundary

¹ This is the NHS database of services, upon which the CAI destination dataset is based.

² Accessed 04/06/12; Image date 2008

accessibility is one not always considered in Local Transport Plans. Some accessibility assessments only include destinations within the local authority boundary which clearly has the potential of misrepresenting accessibility levels.

7.2.2 Supermarkets

For supermarkets, Hucknall (Area A), Keyworth (Area C) and Bingham (Area G) have supermarkets listed in the CAI which were not mentioned by survey respondents. These are all smaller convenience stores and therefore it is likely that they are not considered in respondent's subjective choice set when asked about supermarkets. This suggests that the CAI includes destinations which are not considered by respondents and therefore could give an inaccurate picture of accessibility. Furthermore, the survey design specifically asked for supermarkets whereas the CAI uses the definition foodstores which is broader and includes smaller shops. The survey aimed to use familiar terminology that would be understandable and clear to all respondents and peer testing of the questionnaire suggested that foodstore is not a commonly used term and therefore created ambiguity. This could have been improved by also asking for the nearest convenience store or small grocer in addition. However, in some cases smaller convenience stores were cited by survey respondents showing that these are important in subjective choice sets, but some respondents may not have mentioned them due to the survey wording.

There are two further points of interest in relation to the comparison of objective and subjective supermarket choice sets. Firstly in Beeston (Area D) only 3 respondents mentioned Tesco compared to 38 mentioning Sainsbury's. This is of interest given that the distance between the two stores is approximately 300 metres and the Tesco supermarket is a much larger store. Interviews undertaken with some survey respondents (Chapter 8) made it clear that Tesco was a fairly new supermarket in the area and several participants said they shopped in Sainsbury's because they always had. For some participants this was more of an ethical or moralistic issue as there had been some local controversy regarding the building of the supermarket and as such they were making a conscious decision not to shop there. Such factors as loyalty, habit, or values affecting the subjective choice set and subsequently an individual's perceived accessibility is something which is difficult to represent in an aggregate accessibility measure and such issues are further explored in Section 7.5. Secondly, in Hyson Green (Area B) an international supermarket was listed by a

number of participants which was not in the CAI. This shows an example of somewhere that is important to a particular population not being represented in the national indicator datasets.

Taking a broader scale and focusing on destinations within the surrounding area of each sample area, smaller convenience stores tended to be mentioned if there was no nearby supermarket. For example in Ravenshead (Area H) and Bingham (Area G) where no large supermarkets are close by the nearby local shops were mentioned by the majority of survey respondents. This is in contrast in areas such as Beeston (Area D) and Hyson Green (Area B) where large supermarkets are within close proximity and there was no mention of any smaller convenience stores.

Overall, there is a high level of concordance between the two datasets for larger supermarkets but for smaller convenience stores, there is a large contrast. This highlights the importance of different types of food store in different localities suggesting a potential difficulty in using a national level dataset as there cannot be a uniform definition of a destination type such as a supermarket, and furthermore the requirements and expectations of different individuals and communities are likely to differ.

7.2.3 Destinations relating to education

There is a high level of consistency between the two datasets for both primary schools and secondary schools, extending beyond the sample areas. There are a few cases where a secondary school was not mentioned by survey respondents but is in the CAI; dataset and vice versa. Where a school was not mentioned by participants despite its proximity this was in one case a Catholic school and in another there were two other nearby schools which may have been better known by survey respondents. In another instance several respondents mentioned a school not in the CAI, upon further investigation this school no longer exists and had been mentioned by elderly respondents, who may not be aware of this. This is an example of where subjective data can be “wrong” and irrelevant (in terms of an elderly person needing access to a school) and therefore it is important that policy does not rely on subjective viewpoints alone.

Large discrepancies exist between the CAI and survey responses for Further Education. There are a number of colleges that were mentioned by respondents but

are not in the CAI. Three of these are different campuses of New College, which does have its city centre location in the CAI and so it is possible that only the main campus details were available, yet clearly all campuses offering courses could be of importance. A further two are specialist language colleges and also Nottingham University and Nottingham Trent University were commonly mentioned as colleges by survey respondents. This is again a problem of definition: given the specific nature of courses offered by colleges. Responses were varied, as proximity is not the only factor affecting accessibility to education but the courses offered by each college play a strong role.

Differences can also be partly attributed to the survey design which asked about colleges, whereas the CAI includes any establishment offering post-16 education and therefore includes a large number of secondary schools. This offers a potential explanation for the large differences between reported journey times to colleges discussed in later sections of this chapter (Section 7.3.2).

7.2.4 Reason for not using nearest destination

Respondents were asked to report their journey time to each of seven destinations, even if they did not use them. Some respondents listed their nearest and some listed one they usually used which was not their nearest destination. In such cases they were asked why they did not use their nearest. The results are summarised in Table 7.2.1

Reasons are often based on choice or preference, but sometimes are not a choice but have been forced, for example through hospital appointments, doctors' waiting lists or school catchment areas. None of the results are particularly surprising and are all reasons that might be expected from anecdotal evidence. However, it does highlight the complex and varied decision making processes which influence accessibility to destinations, over and above the journey time to the nearest destination, which is often the subject of objective measurement. Therefore more consideration needs to be given to the diversity of destinations and facilities provided rather than assuming homogeneity.

Table 7.2.1– Reasons for not using the nearest destination of each type

Destination	Reasons
Doctor	<ul style="list-style-type: none"> ▪ Unaware of alternatives ▪ No availability ▪ Allocated elsewhere ▪ Poor Service ▪ Family/ registration history ▪ Moved house but remained with previous ▪ Preference ▪ Proximity to work
Hospital	<ul style="list-style-type: none"> ▪ Speciality services/clinics ▪ No choice in where appointment is allocated ▪ Preference for different hospital ▪ Nearest difficult to access ▪ No A&E
Supermarket	<ul style="list-style-type: none"> ▪ Choice of produce ▪ Price ▪ Busy ▪ Ethical reasons ▪ Preference ▪ Go with family/take parents ▪ Habit ▪ Convenience (e.g. on way home from work) <p>Note: many mentioned a ‘big’ weekly shop and using smaller shops locally during the week</p>
Primary School	<ul style="list-style-type: none"> ▪ Better quality ▪ Religious ▪ Fit in with family (near grandparents home) ▪ Moved since starting school ▪ Facilities at school
Secondary School	<ul style="list-style-type: none"> ▪ Better quality ▪ Religious ▪ Primary school fed to school ▪ Preference
College	<ul style="list-style-type: none"> ▪ Better quality ▪ Choice of courses ▪ Not sure where nearest is

7.2.5 Summary of destination comparison

This section has explored just one potential reason for differences between objective and subjective measures of accessibility, which is a difference in definition of destination choice sets. Focussing on destinations within the sample areas there is high concordance between the CAI and the destinations listed by survey respondents, but for destinations further away there are more discrepancies.

However, in some cases survey respondents did not mention destinations listed in the CAI and in other cases they listed destinations not mentioned in the CAI.

This is a fundamental issue in the calculation of accessibility. If objective measures include destinations in their calculation which are not included in subjective choice sets then there is clearly potential for inaccurate measures. Equally if destinations are missing from objective datasets which are included in local subjective choice sets objective measures may again not be a good reflection of local perceived accessibility. The findings in this section can explain some of the differences found later between objective and subjective measures of journey time accessibility. Most notably differences exist for further education colleges, supermarkets and hospitals and less so for doctors, primary and secondary schools.

The findings in this section add empirical weight to the assertion by Handy & Niemeier (1997) that accessibility depends on the destinations that an individual perceives to be accessible rather than all destinations possible.

'The set of destination opportunities to include depends on assumptions as to the perceived choice set, in other words, the set of potential destinations that residents perceive to be available to them.....The choice sets for a study of accessibility for different socio-economic groups should reflect the actual choices available to each socioeconomic group..... Measures that include all potential destinations are likely to overestimate accessibility for any particular individual at any particular time, given his or her personal constraints and the reality of limited hours of operation for most businesses.' (Handy & Niemeier 1997, p.1179)

Furthermore it should be stressed that perceptions alone will not be an accurate reflection of the level of accessibility within a given area and that consideration needs to be given to whose perceptions are reflected if such an approach is adopted.

Typical accessibility analyses will include all hospitals, or all schools regardless of the specialist facilities or catchment areas of schools. It is therefore important to consider more closely the destinations included in accessibility calculations, so that only those appropriate to the people being considered are included, and also to account for the choice of destinations, rather than focusing on the nearest.

It is important to have dialogue between local people and objective datasets, because neither will be entirely accurate. The DfT encourages professional users of the CAI to feed back if destinations are incorrect in the local area, but this could

perhaps be enhanced by use of open source GIS or public mapping of destinations to verify those used in calculating the CAI. However, given that changes will not be incorporated into calculations until the following year this does not improve the immediate quality of the dataset for the user.

7.3 Journey time accessibility measures

Understanding how objective and subjective measures of accessibility are related to each other is a key aspect of this research. As highlighted in previous chapters, time based accessibility measures dominate current approaches as a result of time being more easily measurable than other factors. The approach to Accessibility Planning in England sought to broaden this and address non-time barriers to accessibility such as safety and cost. Yet the quantification and target setting aspects of Accessibility Planning still rely heavily on time based measures. Objective journey time measures are sophisticated and well developed, especially in Accessibility Planning and journey time is also an easily understood, although not unproblematic, concept that could be measured by the questionnaire in this thesis.

Previous chapters have critiqued the reliance on time based measures based on the assumption that objective time measures differ from the way time is perceived by individuals. This section aims to explore this assumption and compares the objective journey times with the perceived or subjective journey times of individuals. The analysis focuses on how time based measures produced by the DfT to support the process of Accessibility Planning relate to individuals' own reported journey time accessibility. Section 7.5 explores factors other than time based measures which can explain overall perceptions of accessibility.

Mean self-reported journey times and mean CAI journey times are compared (Section 7.3.2), followed by regression analyses to understand what variables other than objective journey time measures can explain variation in reported journey time (Section 7.3.3).

7.3.1 Variables used in analysis

Objective journey times are measured using Lower Super Output Area (LSOA) level mean journey times to the nearest destination from the CAI. Subjective journey times are measured using survey responses reporting the journey time to destinations.

Survey respondents were asked how long it would take them to travel to seven different destinations¹ by walking, public transport and by car.

CAI measures the mean journey time from each LSOA to the nearest destination of each type. In order to be directly comparable with the CAI in the following comparisons only those using their nearest destination were included in the analysis, however, the relevance of using the nearest is discussed in Section 7.2.4.

The CAI measures are geographically weighted means for the population within a LSOA. Therefore as the survey responses represent a random sample² of the population within each LSOA the mean of survey responses is expected to be the same as the CAI geographically weighted mean.

7.3.2 Comparison of objective and subjective journey time measures

This section presents a comparison of journey time measures to the nearest destination as measured by the CAI and as reported by survey respondents for Public Transport (PT) and car³.

Objective and subjective journey time measures are compared using two different analyses. Firstly the mean differences are explored at an aggregate level to gain an understanding of the direction of the differences (Figure 7.3.1). Secondly t-tests are presented to compare on a case by case basis (Table 7.3.1).

Figure 7.3.1 summarises the mean difference between the CAI and survey reported journey time by mode and destination at an aggregate level derived by calculating the difference for each case and presenting the mean of the difference. The error bars reflect the 95% confidence intervals of the mean difference.

¹ doctors; hospital; supermarket; Nottingham City Centre; primary school; secondary school; college – These were chosen on the basis of those that could be compared to the CAI data and Nottingham City Centre was added as a destination that would be common to all respondents and would therefore provide a good basis for comparison

² Visual inspection of responses relative to the population (based on postcode data) confirms the geographical representativeness of the survey responses, with at least one response at 56% of postcode points and no obvious geographical bias. Maps in Appendix D show the geographical distribution of survey responses compared to the sample frame targeted and postcode centroids within the sample areas.

³ Walk journey times are not calculated by the CAI. Cycle times using the road network are and it was initially envisaged that these could be factored using an average walk speed to calculate walk times. However, the CAI report a minimum cycle journey time of 10 minutes which means that applying a factor to this would give a minimum walk time of over 30 minutes, meaning local walk journeys could not be captured.

Overall the mean difference is positive across modes and destinations implying that self-reported journey times are greater than objective measures. In some cases the confidence intervals include zero, suggesting that we cannot be confident that the difference significantly differs from zero. Nevertheless, the trend in all cases is in the same direction. If the differences are not significant then this suggests that the objective measures are a more accurate reflection of self-reported journey times.

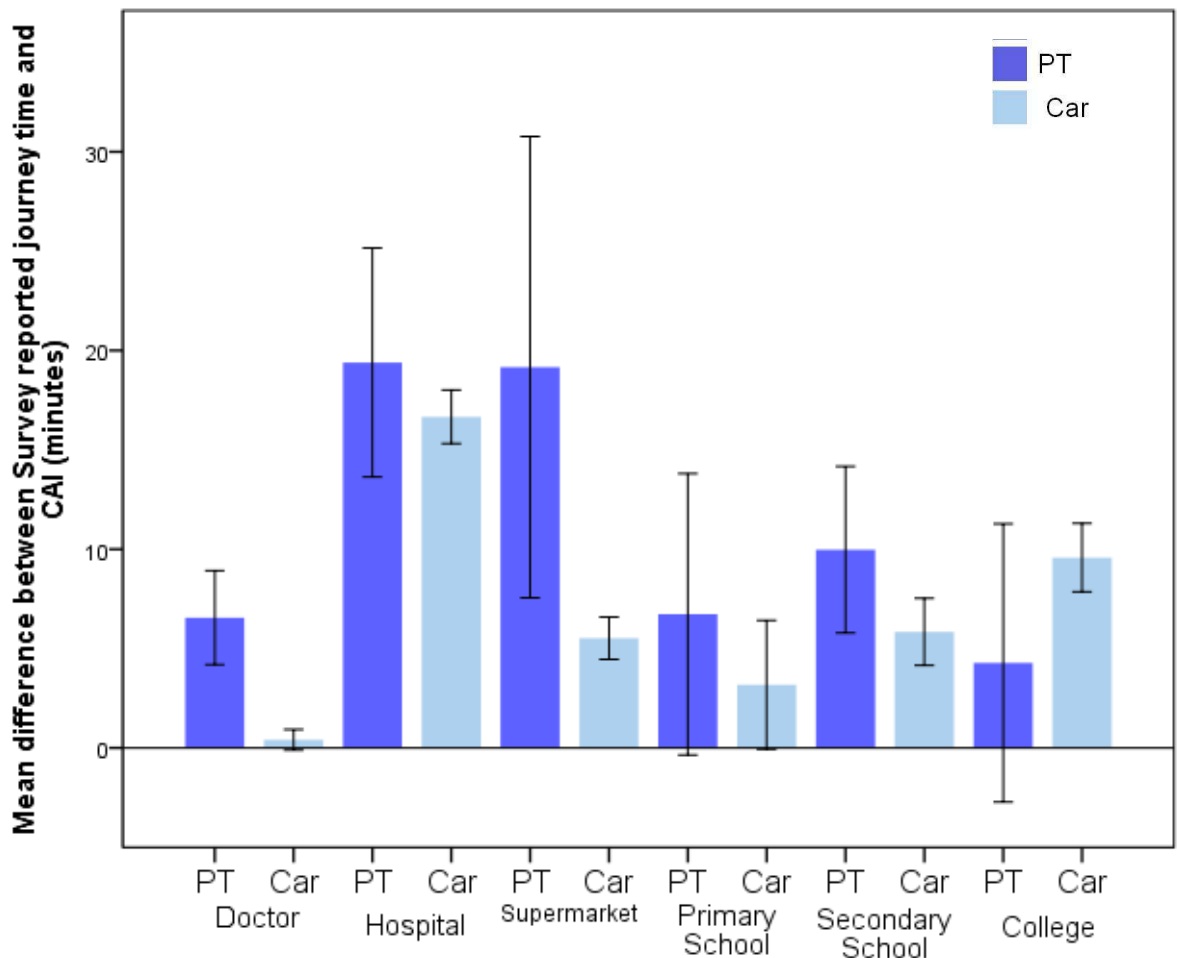


Figure 7.3.1 - Mean difference between survey reported and CAI journey times to nearest destination by mode

In the majority of cases differences in car journey times are lower than for public transport journey times. This implies that there is less difference between objective and subjective journey times for car journey times and greater variation for public transport. The only exception is for colleges where differences in car journey times were greater than public transport.

The mean differences are as much as 20 minutes for some PT journey times, notably to hospitals and supermarkets implying that perceptions and CAI measures differ

more greatly for these destinations, perhaps because of differences in their definition as discussed in Section 7.2. Reasons are further explored in Section 7.3.3.

Next, the data was analysed in more detail using paired t-tests to compare survey reported journey times with CAI measures on a case by case basis.

There are clearly differences between the two measures at an aggregate level and the general trend is for CAI measures to be lower than self-reported journey times. However, it is theoretically possible that the mean difference could be zero, yet for the actual difference between each case to be large. Paired t-tests therefore allow a case by case comparison of the statistical significance of the difference between objective and subjective measures.

Table 7.3.1 shows the CAI measure of journey time to each of six destinations alongside the mean survey responses for that sample area. The mean differences (survey-CAI) and percentage difference for each area are reported for each destination by car and public transport.

As with the aggregate comparison in Figure 7.3.1, the overall trend across all areas shows the same picture of self-reported journey time measures being greater than those in the CAI. Differences are significant in all cases except for car journey times to doctors and primary schools. This suggests either that the survey responses over-estimate the time taken, or that objective measures under-calculate the time taken. This is consistent with the results in Chapter 5 comparing CAI to National Travel Survey (NTS) data, which found that in urban areas the CAI measures were lower than NTS responses. In proportional terms it can be seen that in some cases the mean difference is as large as 500% suggesting large differences in some cases.

Table 7.3.1 –Average journey time to nearest destination based on CAI and household survey results, showing the mean difference between CAI and survey responses, broken down by sample area

Area	n	Doctors					Hospital					Supermarket				
		CAI	Survey Mean (SE)	Mean difference	Mean % difference	n	CAI	Survey Mean (SE)	Mean difference	Mean % difference	n	CAI	Survey Mean (SE)	Mean difference	Mean % difference	
A. Hucknall	PT	7	5.00	10.29 (3.82)	5.29	1%	22	26.00	39.27 (3.55)	13.27**	51%	17	5.00	17.06 (3.54)	12.06**	382%
	Car	18	5.00	4.72 (0.57)	-0.28	-6%	21	6.00	22.86 (2.03)	16.86**	281%	26	5.00	6.38 (0.66)	1.38*	28%
B. New Basford / Hyson Green	PT	7	9.00	16.43 (4.04)	7.43	83%	18	14.00	30 (3.38)	16**	114%	9	9.00	10.56 (2.91)	1.56	17%
	Car	13	5.00	8.12 (1.43)	3.12	62%	18	5.00	18.06 (1.86)	13.06**	261%	16	5.00	5.88 (1.26)	0.88	18%
C. Keyworth	PT	35	11.00	15.23 (1.42)	4.23**	38%	53	24.00	56.25 (3.66)	32.25**	134%	23	5.00	28.52 (4.05)	23.52**	679%
	Car	56	5.00	5.38 (0.38)	0.38	8%	55	7.00	23.06 (1.46)	16.06**	229%	42	5.00	11.26 (1.33)	6.26**	125%
D. Beeston	PT	8	6.00	17.5 (2.11)	11.5**	2%	46	51.00	25.54 (1.3)	-25.46**	-50%	14	6.00	19.86 (5.03)	13.86*	231%
	Car	24	5.00	5.5 (0.56)	0.5	10%	46	5.00	17.78 (1.2)	12.78**	256%	34	5.00	6.03 (0.53)	1.03	21%
E. Cotgrave	PT	14	9.00	17.79 (4.13)	8.79	98%	19	11.00	63.16 (4.7)	52.16**	474%	16	9.00	24.31 (3.99)	15.31**	170%
	Car	21	5.00	6.52 (1.43)	1.52	30%	20	8.00	28.25 (2.24)	20.25**	253%	18	5.00	12.17 (1.78)	7.17**	143%
F. Aspley	PT	10	10.00	18 (3.89)	8	80%	14	26.00	36.07 (3.93)	10.07*	39%	14	11.00	27.5 (5.02)	16.5**	163%
	Car	10	5.00	6.5 (1.7)	1.5	30%	15	5.00	19 (1.56)	14**	280%	13	5.00	10.62 (1.19)	5.62**	112%
G. Bingham	PT	6	9.00	12.67 (2.96)	3.67	41%	48	28.00	59.06 (3.29)	31.06**	111%	42	9.00	41.31 (2.38)	32.31**	383%
	Car	52	5.00	3.85 (0.33)	-1.15**	-23%	59	5.00	20.97 (0.9)	15.97**	319%	48	5.00	15.52 (0.85)	10.52**	210%
H. Ravenshead	PT	14	9.00	15.29 (3.83)	6.29	86%	29	33.00	66.62 (5.26)	33.62**	108%	16	5.00	30 (4.67)	25**	588%
	Car	26	5.00	6.31 (0.86)	1.31	26%	25	9.00	36.64 (2.56)	27.64**	320%	22	5.00	15.09 (1.94)	10.09**	202%
TOTAL	PT	101	9.28	15.63 (1.08)	6.35**	77%	249	29.38	48.32 (1.63)	18.94**	101%	151	7.42	28.53 (1.54)	21.11**	371%
	Car	220	5.00	5.41 (0.26)	0.41	8%	259	6.12	22.76 (0.65)	16.64**	274%	219	5.00	10.83 (0.06)	5.83**	117%

Area		Primary School					Secondary School					College				
		n	CAI	Survey Mean (SE)	Mean difference (C	Mean % differenc e	n	CAI	Survey Mean (SE)	Mean difference	Mean % differen ce	n	CAI	Survey Mean (SE)	Mean difference	Mean % difference
A. Hucknall	PT	5	8.00	14.4 (5.92)	6.4	80%	6	11.00	12.83 (2.83)	1.83	17%	5	11.00	26.43 (2.55)	15.43	9%
	Car	8	5.00	5.88 (1.27)	0.88	443%	11	5.00	11.73 (2.97)	6.73*	162%	8	5.00	13 (1.83)	8	68%
B. New Basford / Hyson Green	PT	6	5.00	8.33 (2.47)	3.33	67%	5	5.00	24.2 (10.54)	19.2	142%	6	10.00	13.67 (4.22)	3.67	37%
	Car	11	5.00	5.18 (1.04)	0.18	13%	11	5.00	9.64 (2.44)	4.64		10	5.00	9.7 (2.08)	4.7*	
										93%						94%
C. Keyworth	PT	13	9.00	13.31 (3.26)	4.31	48%	11	6.00	13.73 (3.48)	7.73	129%	23	6.00	34.13 (3.09)	28.13**	456%
	Car	33	5.00	4.59 (0.52)	-0.41	165%	35	5.00	4.63 (0.91)	-0.37	10%	32	5.00	18.34 (1.14)	13.34**	2%
D. Beeston	PT	9	7.00	20.56 (5.23)	13.56*	194%	15	15.00	17.73 (2.19)	2.73	18%	14	16.00	21.5 (2.77)	5.5	23%
	Car	27	5.00	5.7 (0.46)	0.7	18%	24	5.00	9.92 (1.16)	4.92**	115%	22	5.00	8.04 (1.06)	3.04*	50%
E. Cotgrave	PT	8	9.00	11.13 (2.97)	2.13	24%	11	30.00	28.18 (3.59)	-1.82	-6%	10	26.00	43.18 (4.05)	17.18**	71%
	Car	12	5.00	5.33 (0.71)	0.33	7%	11	6.00	15.91 (1.89)	9.91**	165%	10	7.00	25 (2.17)	18**	3%
F. Aspley	PT	4	7.00	13.75 (2.39)	6.75	96%	2	10.00	15 (5)	5	50%	2	10.00	27.5 (2.5)	17.5	2%
	Car	8	5.00	4.63 (1.29)	-0.38	5%	5	5.00	4.6 (1.44)	-0.4	-8%	3	5.00	4 (1)	-1.00	-20%
G. Bingham	PT	6	7.00	20 (4.47)	13*	186%	29	17.00	37.07 (3.64)	20.07**	126%	21	14.00	34.93 (3.53)	20.93**	2%
	Car	30	5.00	4.8 (0.5)	-0.2	3%	34	5.00	14.32 (1.2)	9.32**	186%	24	5.00	15.47 (1.51)	10.47**	2%
H. Ravenshead	PT	3	8.00	28 (9.69)	20	250%	3	10.00	9.33 (3.18)	-0.67	-7%	8	10.00	36.33 (9.05)	26.33*	3%
	Car	12	5.00	6.08 (0.87)	1.08	130%	12	5.00	8.92 (2.04)	3.92	112%	9	5.00	28.3 (4.64)	23.3**	5%
TOTAL	PT	54	7.70	15.33 (1.63)	7.63**	104%	82	15.60	25.1 (1.96)	9.5**	75%	89	12.71	30.01 (1.81)	17.3**	200%
	Car	14	5.00	5.16 (0.24)	0.16	63%	143	5.07	9.98 (0.64)	4.91**	107%	118	5.20	15.78 (0.88)	10.59**	183%

*p<0.05, **p<0.01 for paired t-tests of the difference between CAI and survey responses

Although there are significant differences between objective and subjective measures of journey time, in the majority of cases there is also significant positive bivariate correlation between the two. This shows that although self-reported journey times are generally greater than objective measures there is correlation between the two, suggesting that they are related. However, given that this is not a perfect relationship and that there are significant differences between the two, there is some variation in self-reported subjective journey times, which can be explained by other factors than objective journey time.

When the results are broken down by sample area the pattern is occasionally reversed and in a few cases the CAI measure is greater than the mean survey response, although negative differences are generally not significant. A difference in this direction is only significant for mean reported journey time by public transport to hospital from Beeston (Area D). The CAI journey time of 51 minutes here is surprising and suggests error in the CAI, rather than significant underestimation of journey times by survey respondents as the Queens Medical Centre (University Hospital) is in close proximity to this sample area. This shows how, at the very least, survey data could be useful to verify and highlight issue with the CAI data.

It might be argued that survey responses could be greater than CAI measures due to rounding of survey responses, for example it is unlikely that somebody would report an 8 minute journey time, but rather round it up to 10 minutes. However, this does not seem to be a valid argument as rounding tends to work in both directions and has been shown not to affect results overall in a study comparing self-reported and measured distance (Witlox 2007).

In some cases mean reported car journey times from the survey are lower than the five minute minimum reported by the CAI, and given the uniformity in this measure (with almost all sample areas having five minute access to some destinations) perhaps having a minimum reported journey time in the CAI should be reconsidered.

It is likely that differences occur between the two measures both because of inaccuracies in the CAI and inaccuracies in survey responses, with the 'reality' falling somewhere between the two. The CAI report an average journey time throughout the day, whereas the survey responses relate to a journey to arrive at 9am. However the CAI measures are heavily weighted towards peak time journeys and this was therefore the most realistic time to use in the questionnaire. Car journey times are

based on TrafficMaster data to account for the level of congestion on the road network. As explained in Chapter 4, prior to the 2010 indicators, car accessibility measures were based on speeds through the network. While the new congestion-based indicators provide the potential to be a more accurate reflection of reality a comparison of the sample areas using both types¹ of indicators in the 2010 CAI data suggests that the final indicators have not changed. This might suggest that car based indicators are still an under representation of the time actually taken. Both of these factors offer potential reasons for the survey responses being greater than the CAI measures.

An objective measure by definition is not expected to reflect the individual variation but to be a generalisable population average and this section has indeed shown that although self-reported journey times are clearly related to objective measures, they are also generally greater. The mean values obtained from two different approaches, objective and subjective, do differ significantly for the majority of destinations by both car and public transport. This is problematic if one is assumed to be a proxy for the other and evidence suggests this can be the case (DfT 2011a; DfT 2010a).

Demographics of survey respondents could explain some differences. For example, given that the sample is slightly older than the population, ($\bar{x} = 54.8$, $\mu = 46.9$, based on 2001 census data) and analysis in Section 7.3.3 shows that *in some cases* age is related to longer reported journey times this could provide some explanation for overestimates of subjective journey times compared to CAI². The following section is based on regression analyses using self-reported journey time as the outcome variable to understand what, other than objective journey time, can help to explain variation in self-reported journey times. It is useful to have an understanding of what explains self-reported journey times other than the actual measurable journey time so that it can be highlighted where certain people or geographical areas may not be well represented by aggregate accessibility measures and this is explored in Section 7.3.3.

¹ Those calculated using TrafficMaster data and those using the standard network speed approach

² Consideration has been given to weighting the analysis by age. However, as population age is based on outdated census data, weighting could result in errors in the opposite direction. Mid-year population estimates report in age categories that are a) not comparable to census data and b) have different male and female age categories 50-64 (Males), 50-59 (Females). This makes a simple weighting difficult. Given that age is not correlated with reported journey times across all modes or destination types weighting is not necessarily appropriate. Instead the decision was taken to present data in its raw format here and explore reasons for differences in later sections.

7.3.3 Explaining self-reported journey times

Building on the previous section which explored differences between objective and subjective measures of accessibility, this section explores what factors, other than objective journey time can explain reported journey times. While the differences between objective and subjective measures detailed in Section 7.3.2 are to be expected (Pacione, 1982), understanding for whom and where differences occur is interesting and useful if measures are to be improved.

Table 7.3.1 illustrated the differences between objective measures and survey-reported journey times but did not explain factors that may account for some of these differences. For example van Exel & Rietveld (2009) found that car users over-estimated public transport journey times by up to 46%. It would therefore be of interest to see whether there is a difference in reported journey times between those who do and do not use a specific mode to access a destination. Frequency of visiting a destination, and therefore familiarity with the trip could also affect the reported journey time. Demographic factors may be another source of variation because, older people for example may experience longer journey times related to their physical ability and therefore report longer journey times than other age groups.

Objective journey time is an important explanatory variable for this analysis. Firstly because it is likely to account for a significant proportion of the variation in individuals' reported journey times and secondly because when exploring the influence of other explanatory variables it is important to control for objective, or "actual" journey times first of all. For example, a certain demographic group may report longer journey times to a destination but it is first necessary to account for the fact that they may actually live in an area with longer journey times.

Multivariate linear regression analyses were undertaken to identify the contribution of factors other than objective journey time measures to explaining variation in reported journey time. Multiple regression is used to analyse the contribution of one or more independent variables to the variance in an outcome or dependent variable. In this analysis the dependent variables of interest are the self-reported journey times provided by respondents in the household survey. Separate regression models were used to explain reported journey time for each mode and destination type.

Blocked regressions were undertaken to first confirm the percentage variance in individuals' reported subjective journey times explained by the objective measures

and then to explore the additional variance (if any) that can be explained by other variables controlling for objective measures of accessibility. Additional variables were selected on the basis of correlation with self-reported journey time or based on evidence from previous research.

The frequency of going to a destination and mode of transport used are included to account for familiarity. It is expected that those familiar with a particular trip may report journey times that are closer to an objective measure (Van Exel and Rietveld, 2009). Age and gender are likely to have an impact on travel choices and perceptions. Furthermore personal car availability is included, as the car is found to be a reference point for perceptions of accessibility (Chapter 8) so those with a car available may perceive journey times differently to those who do not.

Table 7.3.2 shows the regression results by mode and destination. The control variable is slightly different for walk journey times as a directly comparable CAI measure is not available. Objective accessibility is controlled for using a binary variable of accessible or not accessible.¹

Objective journey time contributes significantly to the explanation of variance in the self-reported journey time in most cases, which was to be expected. However, in some cases objective journey times is not a strong predictor of subjective journey time, for example for PT and car journey times to doctors and primary schools. In all cases adding demographic variables to the model in Block 2 resulted in a much higher R^2 , meaning that the additional factors explain more of the variance in reported journey times than when using objective journey time alone.

A much better model is predicted when socio-demographic variables are added as predictors. This shows that self-reported journey times are explained by objective journey time but that much more variance is explained when including socio-demographic variables. Therefore individual differences cannot be ignored.

¹ Based on the categorisation of areas used in the sampling methodology (Chapter 6). Whereas with the CAI objective journey time measure, the higher the journey time, the lower the assumed accessibility, this is a binary explanatory variable coded (0=less accessible; 1=more accessible). This means that the higher journey time accessibility (lower journey times) equates to lower subjective journey times so there is a negative relationship.

Table 7.3.2 – Regression models for explaining self-reported journey time to destinations

Predictors		Supermarket			Hospital			Doctors			
		PT (n=144)	Car (n=211)	Walk (n=190)	PT (n=240)	Car (n=245)	Walk (n=145)	PT (n=98)	Car (n=215)	Walk (n=244)	
<i>Block 1</i>		r^2	.028	.180	.263	.090	.220	.157	.051	.003	.034
		F	4.041	45.996	66.955	23.506	69.584	26.641	.252	.655	8.537
Objective JT Accessibility (CAI)			.166*	-.425**	-.512**	-.300	.401**	-.396**	.051	.055	-.185**
<i>Block 2</i>		r^2	.187	.308	.343	.191	.264	.213	.269	.078	.216
		F	4.476	12.905	13.572	7.809	12.369	5.306	1.003	2.502	9.270
Objective JT Accessibility (CAI)			.245**	-.382**	-.494**	-.318	.399**	-.387**	.069	.071	-.117*
Age			.228**	.203**	-.069	.238	0.39*	.036	-.128	-.005	-.015
Frequency of going to destination			.023	-.102	.04	-.027	.050	-.122	-.004	.059	.157*
PT user (to destination) ^a			-.056	-	-	-.167*	-	-	.110	-	-
Car user (to destination) ^a			-	.233*	-	-	.104	-	-	.023	-
Walks to destination ^a			-	-	-.158*	-	-	-.046	-	-	-.382**
Gender ^b			.077	.009	-.035	-.060	1.221*	-.073	.020*	-.065	.022
Disability ^c			.038	.044	.034	.059	.435	.120	.231	.237**	.072
Car Availability ^d			.281^	.034	.175*	.083	.025	.150	.056	-.049	-.009
Predictors		Primary School			Secondary School			College			
<i>Block 1</i>		PT (n=52)	Car (n=137)	Walk (n=161)	PT (n=80)	Car (n=139)	Walk (n=142)	PT (n=87)	Car (n=115)	Walk (n=91)	
		r^2	.000	.000	.029	.092	.051	.356	.022	.119	.114
		F	.001	.012	4.777	7.909	7.395	77.253	1.901	15.241	11.483
CAI journey time			-.003	.009	-.171*	.303**	.226**	-.596**	.148	.345**	-.338**
<i>Block 2</i>		r^2	.056	.049	.155	.216	.149	.475	.173	.214	.219
		F	.376	.955	4.021	2.833	3.270	17.346	2.359	4.168	3.316
CAI journey time			-.023	.025	-.156*	.306**	.250**	-.567**	.142	.335**	-.322**
Age			.017	.023	-.061	.169	.175	-.075	.221	.172	.066
Frequency of going to destination			.063	-.029	.442**	.052	-.031	.124	.247*	-.025	.288**
PT user (to destination) ^a			.013			-.032			-.130		
Car user (to destination) ^a				0.68			.086			.180	
Walks to destination ^a					-.414**			-.138			-.244*
Gender ^b			.092	.033	.143^	-.158	-.046	-.081	.048	-.084	-.024
Disability ^c			.039	.182*	.163*	.247*	.213*	.289**	-.155	.007	.075
Car Availability ^d			.195	-.075	.042	.090	.052	.189**	.210*	.194	.144

^a(0=non user; 1=user) ^b(0=female;1=male) ^c(0=no disability;1=disability) ^d(0=no car available; 1=car available) *variable significant at p<0.05; **variable significant at p<0.01, ^ approaches significance

The influence of socio-demographic variables varies across modes and destinations. The negative relationship between reported journey times and CAI measures for car journeys to supermarkets is unexpected. Those that drive to the supermarket report longer journey times by car than non-car users. Furthermore, those with a car available report longer public transport and walk journey times than those without a car. Although this analysis uses only respondents who said they were using their nearest supermarket, it is possible that car users travel further to the supermarket and this would go some way to explaining these results. Indeed, the mean (straight line) distance travelled to a supermarket is 2.11 (SD 3.4) miles for car users compared to 0.59 (SD 1.4) miles for non-car users ($t=-6.319, p<0.01$). This means that car users travel further to the supermarket, despite both car and non-car users describing the supermarket listed as their nearest. This would suggest a difference in perception of what constitutes a supermarket for car and non-car users. While for a car user the nearest may be a large out of town supermarket, for non-car users more local stores are considered in their subjective choice sets.

Those that use public transport to access hospitals report shorter public transport journey times than those that don't, suggesting that familiarity and experience with this journey means shorter reported journey times. Interestingly men report significantly longer car journey times to hospital than women. Those that visit the doctors more often report longer walk journey times. Although the model controls for age and disability it could be that those that visit more often are more ill and therefore take longer to walk, or that they are usually transported to the doctors and are unaware of how long it would take to walk. This could be supported by the fact that those that do walk report shorter walk journey times after controlling for objective accessibility.

Those with a reported disability reported longer car journey times to doctors, longer walk journey times to primary schools and longer journey times for all modes to secondary school. Age is a significant explanatory variable for reported PT and car journey times to supermarkets and for car journeys to hospitals. Older people report longer journey times, after controlling for objective journey times. Even if older people in the sample live in a more inaccessible area they report longer journey times than younger people living in the same area. This is expected as older people may have reduced physical mobility and therefore experience longer journeys.

Those with a car available report longer walk times to secondary school and public transport times to colleges. This could be because those who have a car travel further to these destinations, or because they perceive the same walk more negatively given their comparison with car times.

Table 7.3.3 shows the model for Nottingham City Centre separately given that this does not use CAI as an objective measure, but instead uses the binary variable accessible or not based on the sampling strategy.. It shows that age is a significant factor explaining reported journey times to Nottingham City Centre. For all modes older respondents report longer journey times to the city centre. For public transport and walk, those that visit the city centre more often report shorter journey times and those that use public transport report lower public transport journey times than non public transport users showing that trip familiarity and experience are important. Men report lower car journey times than women. Interestingly those with a car available report longer car (and walk) journey times than those without a car.

Table 7.3.3 – Regression for self-reported journey time to Nottingham City Centre

Predictors	Nottingham City Centre			
		PT (n=279)	Car (n=257)	Walk (n=159)
<i>Block 1</i>				
	r^2	.129	.055	.154
	F	40.869	15.870	28.621
	Objective JT Accessibility	-.359**	-.242**	-.393**
<i>Block 2</i>				
	r^2	.089	.161	.181
	F	10.753	8.010	10.886
	Objective JT Accessibility (CAI)	-.310**	-.215**	-.363**
	Age	.143*	.237**	.129*
	Frequency of going to destination	-.101^	.002	-.273**
	PT user (to destination) ^a	-.140*	-	-
	Car user (to destination) ^a	-	.033	-
	Walks to destination ^a	-	-	-.051
	Gender ^b	.021	-.141*	-.085
	Disability ^c	.094	.056	-.009
	Car Availability ^d	.093	.252**	.206**

^a(0=non user; 1=user) ^b(0=female;1=male) ^c(0=no disability;1=disability) ^d(0=no car available; 1=car available)

*variable significant at p<0.05; **variable significant at p<0.01,^ approaches significance

This section has focused on a direct comparison of objective journey time accessibility measures with survey responses reporting journey times and exploring what other factors can explain variation in reported journey times after accounting for objective journey time. As expected, there is a strong relationship between objective measures of journey time accessibility and the journey time reported by survey respondents. However, differences do occur and on the whole reported journey times

exceed those reported by the CAI. After controlling for objective measures, demographic variables, particularly age and car availability, are useful in contributing to understanding reported journey times. The influence of demographic variables ranges across destinations.

So far this chapter has focused on comparing objective and subjective measures of *journey time* accessibility, but has not explored whether certain levels of accessibility are seen as acceptable or not to respondents. For example, while for one person a journey of 30 minutes to a hospital may be seen as good, for another, this may be unacceptable. Individuals vary in their accessibility needs and wants (Farrington & Farrington 2005) meaning that a level of accessibility acceptable to one person will not be acceptable to another. The following section focuses on satisfaction with the level of journey time accessibility to destinations.

7.4 Satisfaction with accessibility compared to Core Accessibility Indicators

A direct comparison of journey time accessibility measures from the CAI and survey responses was the focus of Section 7.3. The survey also asked respondents to rate their perception of various aspects of accessibility and this section compares these perception-ratings to the CAI measures. Therefore, rather than focusing on comparing the actual reported journey times to objective measures, this section compares whether an individual rates their journey time as good or bad (time-satisfaction rating) compared to the measures of objective and subjective journey time.

As identified in Chapter 2, while many studies of accessibility, and transport studies more broadly, have focused on user-satisfaction with aspects of travel (e.g. Stradling et al. 2007) and equally many on measurement of objective conditions, rarely is it evident whether user-satisfaction relates to the objective condition (Van Acker et al., 2010). This was also identified as an issue in the current Accessibility Planning process during practitioner interviews (Chapter 5). One Local Authority (LA) had adopted a perception based measure of accessibility collected through a local council satisfaction survey for use in the Accessibility Strategy and as local targets. However, the LA had no understanding of how citizens' responses varied geographically and therefore whether or not levels of satisfaction were related to objective accessibility

conditions. This would make it difficult to improve perceptions, if they have no evidence of how changes in infrastructure may or may not lead to improvements in perceptions. This section addresses this gap by comparing perceptions of time, choice and frequency to objective measures.

7.4.1 Variables used in this analysis

This section uses satisfaction with aspects of accessibility measured through use of five point scales. The variables used are time-satisfaction, choice-satisfaction and frequency-satisfaction. A measure of general satisfaction with destinations is also reported but not compared with objective measures as there is no such measure in the CAI.

To measure *time satisfaction*, respondents were asked to rate the time taken to destinations as poor to good on a five point scale using their usual mode of travel. Similarly *choice-satisfaction* is based on a five point scale from limited choice (1) to wide range of choice (5) of each type of destination. *Frequency-satisfaction* was measured using a semantic differential scale to rate public transport services on a scale of 1-5 between frequent and infrequent.

The subsequent sections compare the time, choice and frequency satisfaction ratings with the objective measures and subjective journey times in order to understand whether levels of satisfaction relate to objective conditions.

7.4.2 Time Satisfaction

This section compares the (objective and subjective) time taken in minutes to the time satisfaction rating. Figure 7.4.1 shows the mean time satisfaction ratings by destination. Time-satisfaction is greatest for doctors and the least for colleges. Overall, results for all destinations suggest that people are very satisfied with time taken to destinations.

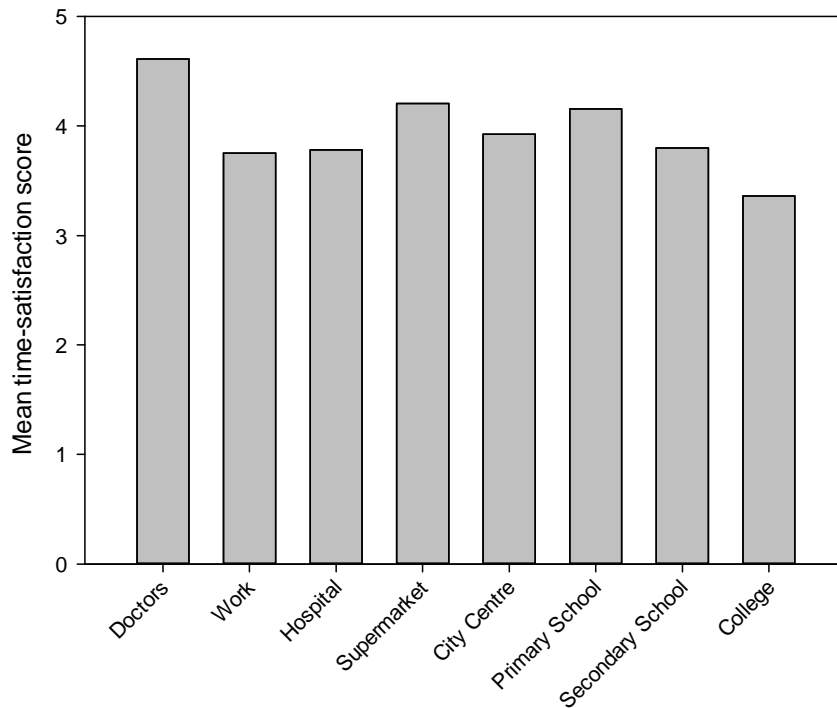


Figure 7.4.1- Mean time satisfaction ratings by destination

Figure 7.4.2 shows the mean time-satisfaction broken down by mode usually used by respondents to access each destination. This shows that satisfaction ratings are fairly consistent across modes, although absolute journey time varies as reported in Section 7.3.2.

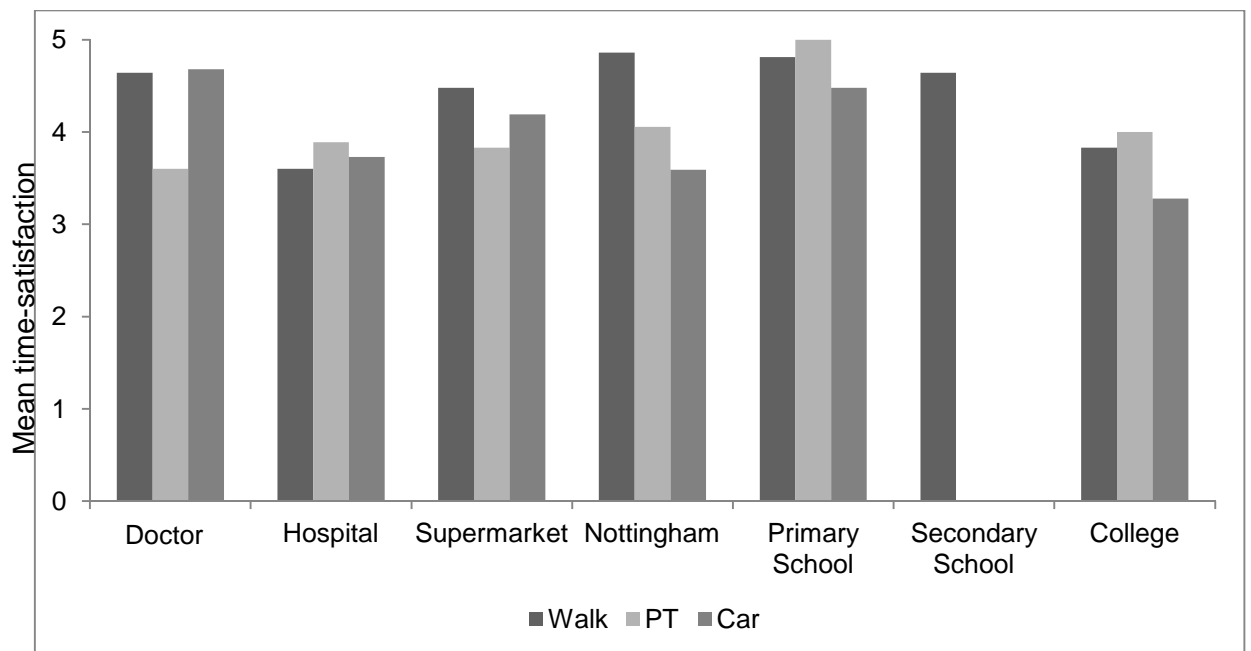


Figure 7.4.2- Mean time-satisfaction by destination split by main mode used to destination

This would suggest that respondents pin their satisfaction to the mode they use, rather than an expectation compared to other modes. For example, those who walk to the supermarket may take longer, but are not less satisfied by this. For doctors, supermarket and Nottingham city centre, time-satisfaction ratings are highest amongst those who walk. This is in contrast to findings in Chapter 8, suggesting that the time-satisfaction with modes is judged in comparison to other modes, specifically car.

Bivariate correlations of time-satisfaction ratings with both objective and subjective journey times are shown to understand in more detail the influence of absolute time on time-satisfaction.

Table 7.4.1 - Bivariate correlation between time-satisfaction and objective journey time measures (CAI)

Time-satisfaction	PT Journey Time		Car Journey Time	
	<i>All mode users</i>	<i>PT users only</i>	<i>All mode users</i>	<i>Car users only</i>
Doctors	-0.05	-0.339	c	c
Hospital	.130*	0.162	-.189**	-.210**
Supermarket	-.028	0.145	c	c
Nottingham	-.210**	-.160**	-.285**	-.263*
Primary School	0.029	c	c	c
Secondary School	-.174*	[No PT users]	-0.118	[No car users]
College	0.065	-.198	-0.054	0.096

* correlation is significant at $p < 0.05$, ** correlation is significant at $P < 0.01$ c-CAI JT is constant across sample areas

Table 7.4.1 shows correlation between the time-satisfaction ratings and objective journey time measures from the CAI for car and PT journey times. As respondents were asked to rate the time based on their usual mode to that destination, a breakdown is shown for only those respondents using each mode. Respondents are less satisfied with longer journey times. There is significant negative correlation for car journey times to hospitals, both car and PT times to Nottingham, and PT times to secondary schools. However, for other destinations time-satisfaction is less clearly related to the time taken to get to the nearest destination based on the CAI, suggesting that factors other than the absolute time taken are important in affecting satisfaction with time taken. For hospitals, longer journey times are rated more positively by PT although this could be affected by the erroneously long journey time to hospitals from Beeston as identified in Section 7.3.2 which means that a long journey time is incorrectly reported by the CAI and could affect these results.

Table 7.4.2 shows the relationship between subjective journey time to destinations and time-satisfaction. It can be seen that the relationships are much stronger than with objective journey times. The negative relationship is as expected, meaning that respondents are more satisfied with shorter journey times to destinations and vice-versa. The stronger correlation suggests a closer relationship between self-reported journey times and time-satisfaction than between objective journey times and time-satisfaction. This is to be expected, given that subjective journey times are individually reported and not area based measures so are more likely to be related to an individual's perceptions than an aggregated measure.

Table 7.4.2 Bivariate correlation between time satisfaction and subjective journey time

Time-satisfaction	PT Journey time		Car Journey Time		Walk Journey Time	
	All	PT users only	Car	Car users only	All	Walk users only
Doctors	-0.118	-.571 [^]	-0.12	-0.355 ^{**}	-.212 ^{**}	-0.251 ^{**}
Hospital	-.268 ^{**}	-.213 [^]	-.228 ^{**}	-.283 ^{**}	-.317 ^{**}	-0.636
Supermarket	-.291 ^{**}	-.688 ^{**}	-.320	-.382 ^{**}	-.225 ^{**}	-.329 [*]
Nottingham	-.274 ^{**}	-.241 ^{**}	-.216 ^{**}	-.191	-.423 ^{**}	0.555
Primary School	-0.006	c	-0.15	-.479 [*]	-0.149	-0.218
Secondary School	-0.197	-	-.437 ^{**}	-	-.387 ^{**}	-0.131
College	-.336 ^{**}	-0.739	-.386 ^{**}	-0.454	-.341 ^{**}	-0.581

* correlation is significant at $p < 0.05$, ** correlation is significant at $P < 0.01$, [^]approaches significance $p < 0.1$

Table 7.4.3 shows the results of a multiple regression analysis to explore factors other than absolute journey time that can explain variance in time-satisfaction ratings. Although the previous analyses showed that objective journey time was a significant explanatory variable for subjective journey time, the co-efficients were not substantially large (Field, 2009 suggests correlations above 0.80 are problematic) as to cause concern about multi-collinearity in this analysis as confirmed by the variance inflation factors reported in Appendix H which fall below 10, the level at which a problem is likely (Field, 2009). Therefore both are included as explanatory variables in this analysis.

Objective and subjective journey times are important, but after controlling for these socio-demographic and travel activity variables add to understanding time-satisfaction. The mode of travel, frequency of using a destination, gender, income, age and car availability are added in Block 2.

After controlling for objective accessibility, men are less satisfied with the time taken than women to a number of destinations, notably schools. Those that visit Nottingham more often score time satisfaction more positively, but the reverse is true for doctors.

Those with a car available have more positive perceptions of the time taken to doctors (approaches significance) and supermarkets. This appears to be regardless of the mode used to travel to the doctors, although those using PT to the doctors have a more negative view of the time taken. Those who go to Nottingham more often have a more positive view of the time taken, and the opposite is true for time taken to the doctors.

Table 7.4.3- Multiple regression analysis for time-satisfaction

Predictors		Doctors (n=259)	Hospital (n=250)	Supermarket (n=262)	Primary School (n=168)	Secondary School (n=150)	College (n=123)	Nottingham City Centre (n=254)
<i>Block 1</i>								
	r^2	.034	.044	.096	.039	.123	.065	.117
	F	4.453	5.636	13.798	3.367	10.301	4.156	16.611
	Objective JT Accessibility ^a	.084	.117 [^]	.145*	.025	.005	.083	.248**
	Subjective JT Accessibility ^b	.163**	.143*	.214*	.194*	.348**	.218*	.210**
<i>Block 2</i>								
	r^2	.129	.059	.138	.218	.192	.099	.191
	F	3.658	1.506	4.032	4.385	4.201	1.226	5.739
	Objective JT Accessibility ^a	.066	.111	.117 [^]	-.030	-.041	.059	.227**
	Subjective JT Accessibility ^b	.129*	.141*	.219**	.207**	.365**	.220*	.143*
	Walk to destination ^c	.010	-.026	.109	.245 [^]	.102	.055	.100
	PT to destination ^d	-.181**	.022	-.025	.030	-	.121	.106
	Car to destination ^e	.056	-.065	-.03	.136	-	.048	.016
	Frequency of using destination	-.127*	.024	-.002	.038	.051	.046	.161**
	Gender	-.070	.023	-.020	-.132 [^]	-.182*	-.127	-.113 [^]
	Household Income	.016	-.012	-.029	.101	.123	.069	-.026
	Age	-.044	.017	-.006	-.124	-.037	-.013	.109 [^]
	Car availability ^f	.124 [^]	.125	.239**	-.057	.046	-.025	-.018

^a(0=inaccessible; 1=accessible) ^b(0=inaccessible; 1=accessible) ^c(0=does not use mode to destination; 1=mode user to destination) ^d(0=does not use mode to destination; 1=mode user to destination) ^e(0=does not use mode to destination; 1=mode user to destination) ^f(0=no car available; 1=car available)

*variable significant at p<0.05; **variable significant at p<0.01, [^] approaches significance

Age does not significantly contribute to the explanation of time-satisfaction, although it approaches significance for Nottingham City Centre. This is interesting, given that age was associated with longer reported journey times in some cases, yet this is not reflected in a more negative rating of the time taken. This would suggest that while older people may experience longer journey times than younger people living in the

same area they do not have a more negative view of this, perhaps suggesting that older people adapt their accessibility expectations.

Subjective journey time is an important factor in explaining time-satisfaction. However, socio-demographic variables can add to explaining the variance, although the variables that contribute vary across destinations.

7.4.3 Choice Satisfaction

The number of each type of destination available within given time thresholds is measured by the CAI. To compare perceptions of choice with this measure, respondents were asked to rate the choice of each destination type on a scale of limited choice (1) to wide range of choice (5). Figure 7.4.3 shows the mean choice-satisfaction rating by destination.

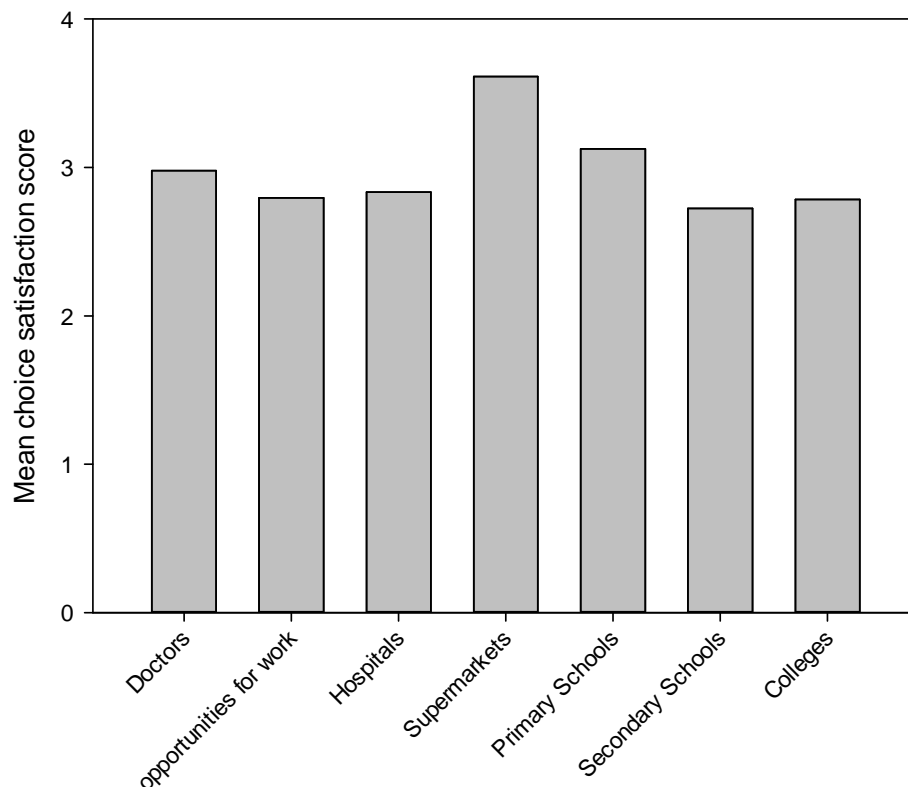


Figure 7.4.3- Mean rating of choice satisfaction

Mean ratings of choice are fairly consistent across destinations although supermarkets are scored more highly than other destinations, representing a greater perceived level of choice. In order to compare the choice-satisfaction measure to

objective measures of the number of destinations available choice-satisfaction treated as a categorical variable (with five categories) and each category is compared to the mean number of destinations within a given time threshold based on the CAI. This is illustrated in Figure 7.4.4, which shows the mean number of doctors within a 15 minute PT journey time (CAI)¹ for each category of choice-satisfaction. It can be seen that for the lowest rating, (limited choice) there are on average the least number of doctors accessible within 15 minutes and this increases as perceived choice-satisfaction increases, with the most doctors being available for those respondents who said they had a wide range of choice.

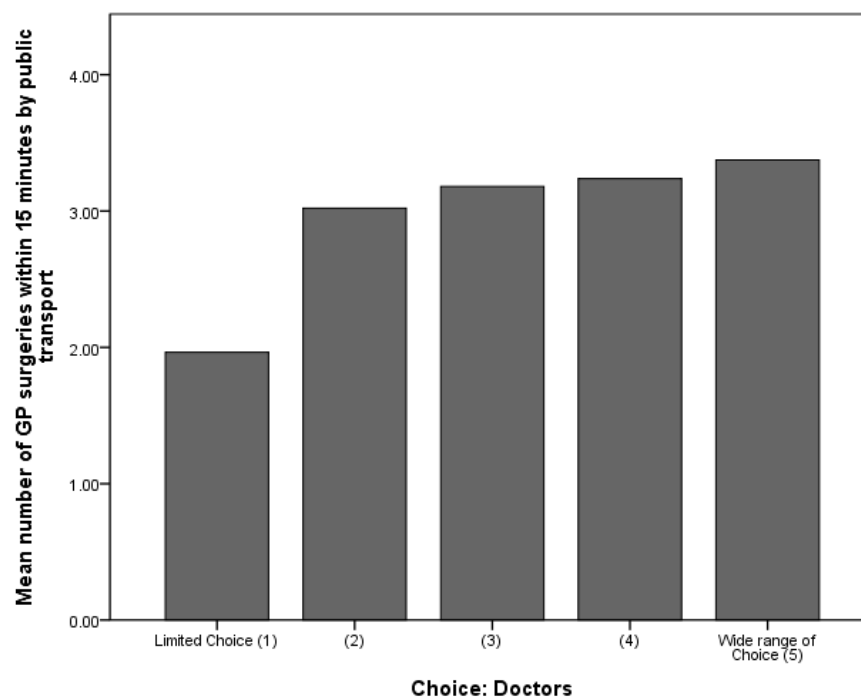


Figure 7.4.4– Mean number of doctors available in 15 minute PT journey by category of choice-satisfaction rating

This comparison was undertaken for each destination, in each case comparing the choice-satisfaction measure to six CAI measures². Table 7.4.4 shows the results of one-way ANOVA for each destination type and CAI measure. There is a significant relationship between objective measures and ratings of choice of destinations for doctors, primary schools, secondary schools and colleges but not for hospitals and supermarkets. Given that car-choice CAI measures are constant across all sample areas (as highlighted in Chapter 4), there is no variation in number of destinations

¹ This is based on the thresholds used by the CAI in reporting these measures

² Number of destinations available within upper and lower time thresholds, and a continuous measure for PT and car. (3 measures * 2 modes = 6 measures per destination).

within given time thresholds from the CAI across categories of choice-satisfaction from the survey. In other words as all sample areas had the maximum number of destinations accessible within the minimum time thresholds it is not possible to compare variation in objective measures of choice with perceptions of choice for car journeys.

Table 7.4.4- F-ratios of one way ANOVA comparing choice-satisfaction to CAI measures

	PT			Car		
	<i>Lower Threshold</i>	<i>Upper Threshold</i>	<i>Continuous</i>	<i>Lower Threshold</i>	<i>Upper Threshold</i>	<i>Continuous</i>
Doctors	15.994**	-	12.877**	-	-	7.764**
Hospital	0.384	0.159	0.231	-	-	0.19
Supermarket	1.337	0.642	1.604	-	-	1.311
Primary School	3.004*	4.421**	5.433**	-	-	2.792*
Secondary School	2.284*	0.855	1.676	-	-	2.743*
College	2.365^	-	2.45*	-	-	2.224^

*Significant at $p < 0.05$; **significant at $p < 0.001$

Given the limited geographical discrimination in objective measures of choice, more detailed analysis is difficult. Choice here is used to mean the number of facilities of a given type available within a given threshold. However, this does not really reflect a choice between different destinations and assumes all destinations of a type (e.g. supermarkets) are equal. Other research (Ferguson, 2010) has shown the value in diversity within types of destinations, which has not been considered here, although the importance is shown by the variety of destinations mentioned and reasons for using them both in the survey and in interviews described in Chapter 8.

7.4.4 Frequency Satisfaction

Respondents were asked to rate the frequency of public transport overall, but not to different destinations as this was considered to be too difficult to answer. Additionally, prior analysis of CAI suggested little variation across destination types in terms of PT frequency measures. Given the high level of agreement among frequency to each of the destinations in the CAI ($\alpha=0.851$) a combined objective frequency measure was calculated by taking the mean across destinations. This shows significant positive bivariate correlation ($r=0.410$, $p<0.01$) with the questionnaire item asking respondents to rate the frequency of public transport to local destinations (on a five point scale from infrequent (1) – frequent (5)).

In order to explore which other factors can explain differences among individuals' ratings of public transport frequency, blocked linear regression analysis has been undertaken to identify the contribution of different explanatory variables in explaining the frequency rating (Table 7.4.5).

Table 7.4.5 - Regression results for explaining frequency-satisfaction ratings

Predictors		<i>Rating of Public Transport Frequency (n=277)</i>
<i>Block 1</i>		
	r^2	.162
	F	51.127
	Objective Frequency (CAI)	.402**
<i>Block 2</i>		
	r^2	.190
	F	20.606
	Objective Frequency (CAI)	.423**
	Age	.162**
	Gender ^a	-.074
<i>Block 3</i>		
	r^2	.397
	F	24.342
	Objective Frequency (CAI)	.202**
	Age	.153**
	Gender ^a	-.019
	Perceived ease of using public transport	.268**
	Frequency of using public transport	-.013
	Satisfaction with provision of public transport	.289**
	Car Availability ^b	-.048

^a(0=Male;1=Female); ^b(0=no car;1=car available for personal use);*variable significant at $p<0.05$; **variable significant at $p<0.01$

Perceived ease of using public transport and satisfaction with provision of public transport significantly contributed to the explanation of the model. This suggests that those who have a positive attitude towards public transport are more likely to perceive it to be more frequent, after controlling for objective frequency. However, it is important not to presume causation. It is also possible that perceiving public transport to be frequent causes a greater level of satisfaction and greater perceived ease. The results may indicate tendencies for some people to score all items relating to public transport use more or less favourably, indicating an underlying positive attitude towards public transport. This is explored further in Section 7.5.

Older people rated frequency of public transport more positively, after controlling for an objective measure of public transport frequency. This could be related to greater use and experience of using public transport, yet this is included and is not significant. Alternatively it could reflect a difference in expectations and needs of an elderly population. They may perceive the same standard of service as better than a younger person who may have more demands on their time and perhaps makes more time-critical journeys which might demand a greater level of service.

7.5 Understanding perceptions of accessibility

This section builds on the previous two sections which have focused on the relationship between self-reported and CAI measures of *journey time* accessibility. One of the main objectives of this research was to understand what influences perceptions of accessibility.

The purpose of this section is therefore explorative research into perceptions of accessibility more broadly, in addition to the analysis above which has focused on comparing self-reported measures of aspects of accessibility with objective measures. The questionnaire also included measures to capture overall perceptions of accessibility. Respondents were asked about perceptions of accessibility to each destination, by mode and an overall measure. This section first presents analysis of perceptions of accessibility to destinations, then by mode and finally overall perceptions, not specific to a mode or destination.

7.5.1 Perceptions of Accessibility by Destination

This section explores perception of accessibility reported by destination.

Respondents were asked to rate destinations firstly by 'ease of access' on a five point Likert type scale of disagree to agree and secondly by how 'accessible' they are on a scale of inaccessible to accessible. The phrasing of the questions was such that 'ease of access' related to how easy an individual would find it to access a destination, whereas 'accessible' was an assessment of the facilities available in the local area, and was less specific to individuals.

For all destinations except for Nottingham City Centre, doctors and hospitals, the mean score was greater for 'accessible' than 'ease of access' suggesting that respondents may feel there is a generally good level of accessibility, whilst

experiencing difficulty accessing places themselves. The opposite is true for Nottingham City Centre, doctors and hospitals where the results would suggest that on average respondents felt they could easily access these destinations but that the level of accessibility in general is poor¹.

There is a high level of agreement between the answers to the two questions, ($0.6 < \alpha > 0.8$) for all destinations meaning they can be reliably combined to form a measure of perceived accessibility to destinations. The mean of these two items was taken for each destination and this variable was then used in a series of regression analyses to understand factors influencing perceived accessibility to each destination. Figure 7.5.1 shows the mean for each destination.

Perceptions of accessibility are generally positive, although there are differences among destinations. Hospitals and Colleges are perceived as the least accessible and Doctors, Supermarket and Primary Schools as most accessible.

Correlation between self-reported journey times, objective journey times and perceived accessibility is generally negative and significant which, as expected, means that longer journey times are related to poorer ratings of accessibility and shorter journey times to more positive ratings of accessibility.

¹ Response rates were related to frequency of visiting a destination. As might be expected, those who never visited a destination were less likely to answer questions relating to their accessibility. In general over half of those that didn't use a destination didn't answer the two questions relating to perceived accessibility and almost all of those that did not answer these questions reported that they never visited the destination. The exceptions are hospitals and Nottingham City Centre where most respondents answered despite never visiting, possibly because they saw them as relevant and were able to assess accessibility regardless of use, as opposed to educational establishments where none of those who never visited answered the questions and they deemed them irrelevant.

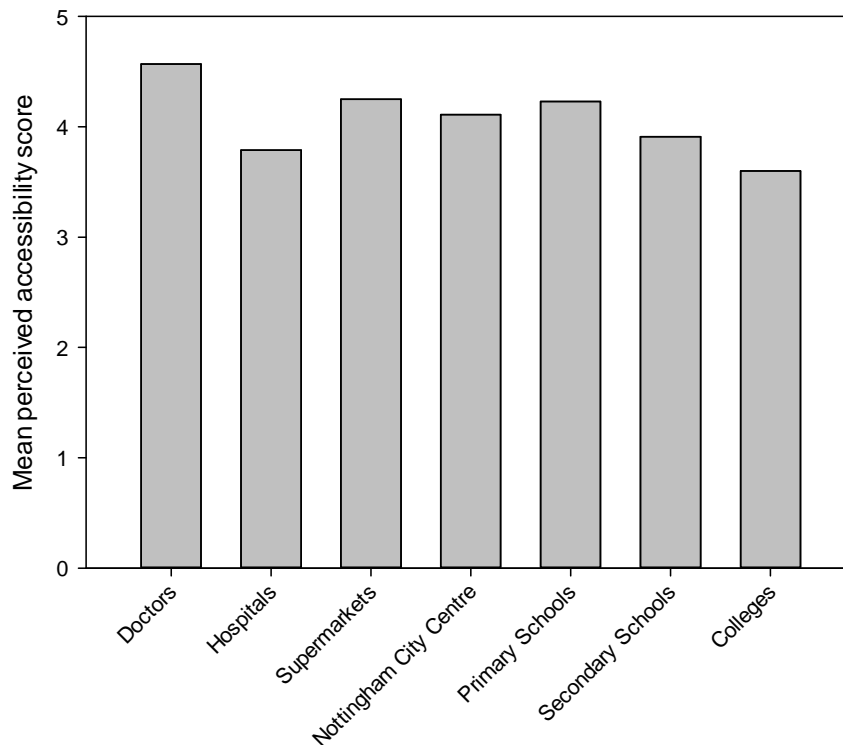


Figure 7.5.1-Mean perception of accessibility by destination

To explore factors other than journey time accessibility which can be used to explain perceived accessibility, multiple regression models were estimated for each destination type (Table 7.5.1)

Given that reported perceptions are not mode specific and that including all five measures of journey time accessibility¹ would result in a high degree of collinearity, two binary variables are used to control for objective and subjective journey time accessibility². The intention of this analysis is to understand and explore the relative influence of a range of variables, and the role of journey times has already been explored.

¹ In total each destination has three self-reported journey times (car, PT, walk) and two CAI journey times (car & PT) but one survey measure of perceptions of accessibility to the destination

² The objective binary variable is based on whether or not the area was classified as accessible or inaccessible in the sampling procedure. The subjective binary variable is based on the median split of the mean reported journey time to each destination across three modes. The level of correlation and agreement between these was significantly high to justify this. Another option was to weight or to only include the mode a respondent used to the destination. However, this would mean that journey times would (in general) be longer for those walking or using public than car and would affect the ability to use this as a continuous explanatory variable related to perception measures.

Including the variables in this analysis is therefore mainly to control for journey time accessibility in the analysis and understand their importance relative to other variables.

Blocked regressions were used so that firstly the contribution of objective and subjective journey time to explaining perceptions of accessibility by destination could be understood.

Using blocked regressions allows different variables to be added, identifying their additional contribution to the model and is a useful way of building up the analysis. It also means the additional R^2 achieved by adding variables is clear, removing problems usually associated with multi-collinearity such as difficulties identifying which variables are contributing to explaining the variance and clearly highlights the contribution of variables both individually and together.

In the first block the relationship between objective journey time (CAI) accessibility and perceived accessibility is evident for all cases except for primary schools. In those areas that are more objectively accessible, perceptions of accessibility are significantly greater.

However the low R^2 values show that the model fit is poor and that while being significant, objective accessibility only accounts for a small proportion of the variation in perceived accessibility, compared to the previous analysis which showed a strong relationship between objective and subjective journey time accessibility.

Table 7.5.1- Multiple Regression analysis of perceived accessibility to destinations

Predictors	Doctors (n=294)	Hospital (n=277)	Supermarket (n=292)	Primary School (n=164)	Secondary School (n=146)	College (n=121)	Nottingham (n=285)
Block 1							
r^2	.015	.067	.112	.012	.068	.033	.087
F	4.554	19.619	36.4	2.048	10.454	4.058	27.046
Objective JT Accessibility ^a	.124*	.258**	.334*	.112	.260**	.182*	.295**
Block 2							
r^2	.112	.109	.170	0.65	.102	.091	.131
F	18.416	16.713	29.666	5.611	8.099	5.884	21.278
Objective JT Accessibility ^a	.123*	.197**	.201**	.097	.166^	.110	.273**
Subjective JT Accessibility ^b	.311**	.214**	.277**	.230**	.207*	.251**	.211**
Block 3							
r^2	.217	.148	.196	.182	.170	.114	.238
F	8.728	5.167	7.634	3.817	4.030	1.583	10.778
Objective JT Accessibility ^a	.0178	.149*	.175**	.044	.083	.092	.217**
Subjective JT Accessibility ^b	.190*	.191**	.230**	.212**	.155^	.268	.156**
Straight line distance to destination	-.160**	-.095	-.061	-.165**	-.203*	-.044	-
Walk to destination ^c	.158^	.003	.095	.265^	.071	-.011	.110^
PT to destination ^d	-.046	-.011	.030	.046	-	.125	.336**
Car to destination ^e	-.005	-.194*	-.019	.097	-	.052	.089
Frequency of using destination	.146*	.065	.051	.005	.145^	-.008	.166**
Age	-.139*	-.030	-.042	-.119	-.096	-.068	-.040
Car availability ^f	.105^	.151*	.163*	-.012	.032	-.019	.046
Block 4							
r^2	.463	.567	.498	.531	.492	.422	.543
F	18.568	24.452	21.215	13.046	11.819	5.998	32.617
Objective JT Accessibility ^a	.027	.077	.110*	.021	.120	.023	.084^
Subjective JT Accessibility ^b	.141**	.111*	.109^	-.112^	.008	.165	.062
Straight line distance to destination	-.076	.004	-.013	-.024	-.032	-.016	-
Walk to destination ^c	.136^	.010	.031	.127	-.021	-.045	.049
PT to destination ^d	.025	-.034	.021	-.004	-	.049	.248*
Car to destination ^e	-.046	-.145*	-.037	.001	-	.007	.068
Frequency of using destination	.094	.059	.051	.137	.032	.001	-.044
Age	-.087^	-.015	-.058	-.025	-.035	-.028	-.097*
Car availability ^f	.048	.058	.023	-.007	-.012	-.008	.082^
Importance of destination	.034	-.020	-.057	-.069	.036	.032	.086
Satisfaction with destination	.174**	.267**	.203**	.307**	.254*	.182^	-
Choice of destination	.012	.012	.102*	.110^	.052	.173*	-
Time-satisfaction to destination	.420**	.482**	.404**	.431**	.435**	.349**	.579**

^a(0=less accessible;1=more accessible) ^b (0=less accessible;1=more accessible) ^c(0=does not walk;1=walks to destination)

^d(0=does not use PT;1=uses PT to destination); ^e(0=does not use car;1=uses car to destination); ^f(0=does not have car;1=has car available);

*variable significant at p<0.05; **variable significant at p<0.01; ^variable approaches significance (p<0.1)

Adding a binary variable, subjective journey time accessibility¹, in Block 2 increases the overall fit of the model for all destinations. Subjective journey time is a significant explanatory variable in all cases. This means that over and above objective journey times, subjective journey time significantly contributes to explaining variance in perceived accessibility to destinations. Objective accessibility remains significant, except for educational establishments.

In Block 3 a further seven variables were added to the regression models. Firstly, the straight line distance between the household postcode and the destination postcode. This is included to reflect a more individualised objective measure of separation to the actual destinations used, as opposed to the CAI area based measure of journey time to the nearest. Theoretically distance and time could interact to influence perceived accessibility, rather than just time. Perceptions of accessibility might not depend on time per se, but on how long it takes relative to the distance travelled, in other words speed. This was included following the analysis of follow-up interviews (Chapter 8) which suggested that perceptions were influenced by time taken relative to expectations. A negative relationship of distance with perceptions is found suggesting shorter (straight line) distances are perceived more positively after controlling for the time taken. This suggests that both time and distance are important and not substitutes, in explaining perceptions of accessibility.

The usual mode of travel to each destination was included to account for perceptions perhaps varying dependent upon familiarity with a journey. These are represented by three binary variables indicated whether a respondent walks, uses public transport, or car to a destination. The influence is not as much as might be expected based on research by Van Exel & Rietveld (2009) who found large differences between users and non-users of public transport, although their research focused on a specific trip.

Walking to a destination approaches significance for doctors and Nottingham City Centre. Those who walk perceive these destinations as more accessible than those who don't walk, after accounting for the journey time and distance meaning that they consider them more accessible even accounting for the fact that they probably are closer, especially if people are walking. Those who usually travel by public transport

¹ Given high agreement and correlation in self-reported journey times across modes the mean reported journey time across modes was taken for each destination and then the median split used to create a binary variable

perceived Nottingham City Centre to be more accessible than those who used other modes. This is supported by the positive attitudes towards public transport to the city centre found during qualitative interviews with respondents (Chapter 8). However it is also possible that, despite the questions being non-mode specific they were interpreted as relating to public transport accessibility. Later analysis shows strong relationships between positive attitudes to public transport and positive perceptions of accessibility and therefore that those who use public transport, have more positive perceptions of accessibility.

The frequency of visiting a destination was also included and may indicate familiarity with travel to a particular destination. For doctors, secondary schools and Nottingham City Centre visiting destinations more frequently was associated with more positive perceptions of their accessibility. Of course, this is not necessarily a causal relationship; a positive perception of accessibility to a destination may mean that people visit more frequently, or visiting more frequently could mean a more positive perception is developed due to familiarity.

Age is negatively associated with perceptions of accessibility to all destinations but is only significant for doctors. Older people perceive accessibility more poorly. This is in contrast to age being not significant for satisfaction with aspects of accessibility, but consistent with longer self-reported journey times.

Individuals with a car perceived accessibility to supermarkets and doctors more positively. This is of particular interest given that travel to supermarkets is often cited as a justification for having a car (findings in Chapter 8 support this).

In Block 4, 4 variables relating to satisfaction with destinations and the importance of a destination to an individual were included. These improve the R^2 significantly. Both 'satisfaction with destinations in the local area' and time-satisfaction ratings are significant for all destinations. This would suggest that it is an individual's satisfaction with time, rather than the actual time taken that is more important in determining perceptions. Choice-satisfaction is significant for supermarkets and colleges. This is interesting given that these two destinations are most likely to be open to choice, and not controlled by catchment areas or LA boundaries, whereas doctors and schools may be. However care must be taken in interpreting this analysis as satisfaction and perception are closely related in the literature and satisfaction is often used as a

measure of perception. It could therefore be that these questions are measuring the same thing; a positive attitude towards accessibility. This being the case it is not surprising that these predictors are significant. This demonstrates the advantage of using blocked regressions to 'build up' the analysis and identify the contribution of variables before adding others.

7.5.2 Perceptions of Accessibility by mode

This section presents analysis of perception of the accessibility using different modes. It was initially envisaged that the survey could collect data regarding perceptions of accessibility to each destination using each mode, similar to the reported journey time questions. However, to do this would have placed unrealistic burden on respondents¹ and resulted in a vast amount of data for analysis. Therefore separate questions were asked for mode related and destination related accessibility.

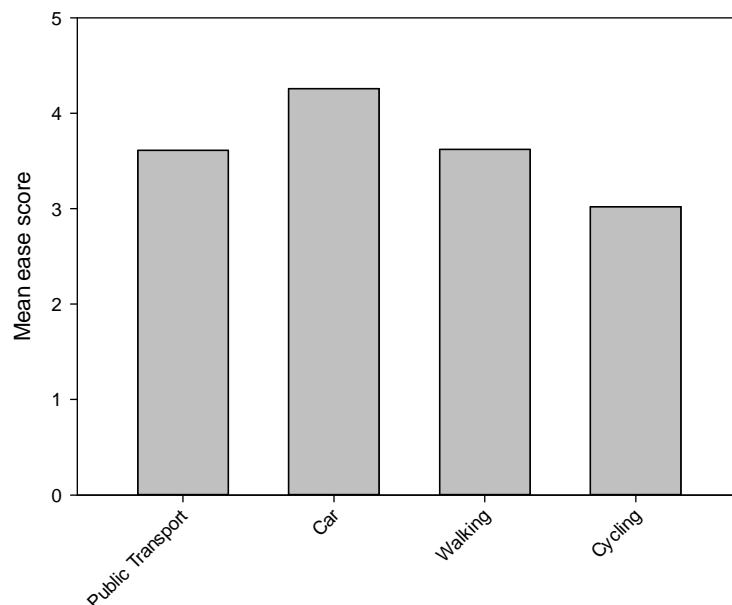


Figure 7.5.2-Mean scores and standard deviation of ease of access by mode

Figure 7.5.2 shows the mean scores for ease of access by different modes², showing that on average car is rated most highly in terms of enabling ease of access. PT and walking are almost equally rated. Cycling is included here to give a general

¹ Three modes and up to nine destinations would result in 27 sub-questions for each question asked

² Note that this summarises four different variables for all respondents and is not related to whether a respondent uses a particular mode or not which is explored in subsequent analysis

impression of ease of access but is not analysed subsequently due to the small numbers of respondents who cycled¹.

Figure 7.5.3 shows the distribution of responses to questions pertaining to mode related attributes of accessibility which were assessed using semantic differential scales. There is a general high level of agreement tended towards positive viewpoints. Where bars do not add up to 100%, responses were neutral or missing. Respondents were more likely to rate car use as easy, safe, enjoyable, reliable, quick and convenient, but slightly more expensive compared with public transport. Respondents were less likely to think that car and public transport are cheap.

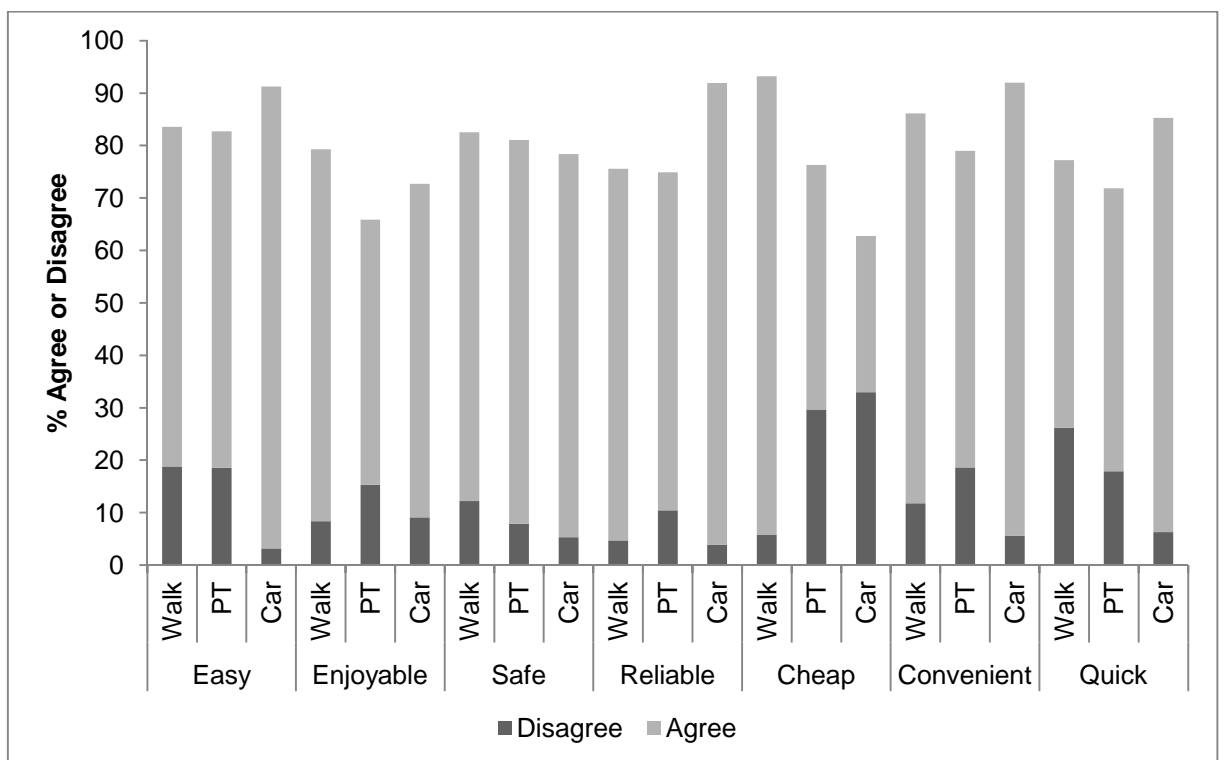


Figure 7.5.3– Agreement with attributes of accessibility by mode

In order to explore what attributes affect mode based perceptions of accessibility multiple regression analysis (Table 7.5.2) is used to understand which of these attributes of accessibility are influential for perceived mode accessibility.

¹ Only 12% of respondents cycled more than once a month, and 70% never do so. Perhaps not surprisingly a one way ANOVA shows a significant effect of frequency of cycling on the perceptions of ease of cycling, $F(5, 190) = 9.705, p < 0.01$) and post hoc tests confirm the significant differences are between those who cycle 2-4 days a week or once a week, and less than once a month or never. However, surprisingly 42% of those that agreed and 24% of those that strongly agreed that it was easy to cycle, never cycled.

Table 7.5.2 – Multiple Regression analysis for perceptions of accessibility by mode

		Public Transport (n=244)	Car (n=241)	Walking (n=240)
Predictors				
<i>Block 1</i>				
	r^2	.061	.011	.066
	F	15.629	.030	16.764
	Objective Accessibility ^a	.243**	.011	.257**
<i>Block 2</i>				
	r^2	.208	.283	.233
	F	21.0	10.382	36.018
	Objective Accessibility ^a	.116 [^]	.012	.187**
	Frequency of using Mode	.246**	.283**	.415**
	Objective frequency of PT	.243*	-	
<i>Block 3</i>				
	r^2	.221	.316	.249
	F	11.176	5.217	15.553
	Objective Accessibility ^a	.125 [^]	.039	.192**
	Frequency of using Mode	.233**	.258**	.411**
	Objective frequency of PT	.213**	-	-
	Gender ^b	-.074	-.089	-.059
	Household Income	.069	-.074	-.102 [^]
	Age	-.059	-.089	.010
<i>Block 4</i>				
	r^2	.520	.500	.388
	F	19.145	6.925	13.122
	Objective Accessibility ^a	.054	.039	.173**
	Frequency of using Mode	.080	.258**	.234**
	Objective frequency of PT	.064	-	-
	Gender	-.041	-.064	-.027
	Household Income	-.041	-.046	-.169**
	Age	-.201**	-.086	.001
	Enjoyable	.260**	-.035	.248**
	Safe&Secure	.005	-.058	-.078
	Reliable	.088	.250**	.104
	Cheap	.063	.100	-.027
	Frequent (PT)	-.114	-	-
	Convenient	.452**	.112	.139 [^]
	Quick	.041	.112	.074

^a(0=less accessible;1=more accessible) ^b (0=female;1=male)

*variable significant at p<0.05; **variable significant at p<0.01; [^]variable approaches significance (p<0.1)

Block 1 shows that objectively measured journey time accessibility is significantly related to perceived accessibility by public transport and walking but not by car, while the low R² shows that little variance in perceptions can be explained by objective accessibility alone. The model fit is significantly improved by adding frequency of travelling by a particular mode, and for public transport an objective measure of PT

service frequency in Block 2. For all modes, the more frequently they are used the more positive perceptions are.

Perceptions of public transport are also more positive for respondents who live in areas with a higher level of public transport frequency as measured by the CAI. Demographic variables are not significant in Block 3. In Block 4 mode related attributes of accessibility (Section 6.3 and Appendix G) were added and these significantly added to the explanatory power of the model and also increased the significance of some demographic variables.

Income significantly contributes to perceptions of walking with those on lower incomes having more positive perceptions of walking. This might be expected given that those on lower incomes may walk more often or live in areas with greater levels of walking access, but this result is significant even after controlling for journey time accessibility and frequency of walking to destinations. The negative association between age and perceptions of public transport shows that older people find it more difficult to use public transport as might be expected.

Different mode-related attributes of accessibility are important for explaining perceptions of accessibility, depending on the mode. Enjoyability is positively associated with public transport and walking; those that perceive these modes to be more enjoyable have better overall perceptions of accessibility by that mode, whereas reliability is only significant for car. Convenience is significant for public transport and approaches significance for walking. This variation across modes suggests that different factors may be important in determining mode use dependent upon the mode and supports (Guiver, 2007) who found using a qualitative study that people talk differently about different modes. This would suggest that comparing modes on a like for like basis using the same criteria is therefore not always appropriate.

7.5.3 Perceptions of Accessibility Overall

In addition to the perceptions measured by mode and destination described above an overall, non-destination or mode specific measure of perceived accessibility was calculated based on the mean of three questionnaire items measured on a five-point Likert type scale: Ease of getting to places I need to get to (\bar{x} =4.02; SD=.993); Range of local facilities available to meet my needs (\bar{x} =3.83; SD=.975); and Accessibility of

places I need to get to on a regular basis (\bar{x} =4.18; SD=.976). There is a high level of agreement among these statements (α =.739). These measures were combined to capture an underlying perception of accessibility that was not mode or destination specific. (\bar{x} =3.95; SD= .884).

A multiple regression model (Table 7.5.3) is used to explore the factors that can explain variation in perceived accessibility.

Table 7.5.3 - Regression results for overall perceived accessibility as outcome variable

Predictors		<i>Overall Perceived Accessibility (n=286)</i>
<i>Block 1</i>		
	r^2	.101
	F	15.905
Objective JT Accessibility		.179**
Subjective JT Accessibility		.213**
<i>Block 2</i>		
	r^2	.111
	F	6.989
Objective JT Accessibility		.175**
Subjective JT Accessibility		.223**
Age		-.025
Gender		.011
Car Availability		.095
<i>Block 3</i>		
	r^2	.398
	F	16.490
Objective JT Accessibility ^a		.055
Subjective JT Accessibility ^b		.017
Age		-.120*
Gender		.054
Car Availability		.107*
Perception of walking		.074
Perception of PT		.310**
Perception of car		-.004
Overall satisfaction with destinations		.099 [^]
Overall satisfaction with choice of destinations		.177**
Overall time satisfaction		.191**

^a(0=less accessible;1=more accessible); ^b(0=less accessible;1=more accessible)

*variable significant at p<0.05; **variable significant at p<0.01; [^]variable approaches significance (p<0.1)

In Block 1, both objective and subjective journey time accessibility are significant explanatory variables. Those who live in more accessible areas and those who report

shorter journey times to destinations have more positive perceptions of their accessibility overall. Three demographic variables, age, gender and car availability, are added in Block 2 but these are not significant. However once perception based variables are introduced in Block 3 age and car availability show significance. Older people have poorer perceptions of accessibility and those with a car available have more positive perceptions, controlling for objective and subjective journey time accessibility. This is interesting given that a positive perception of public transport¹ is also a significant explanatory variable whereas car and walking are not.

The satisfaction with destinations and time-satisfaction and choice-satisfaction variables were averaged across destinations and included in this analysis. Both choice-satisfaction and time-satisfaction are positively associated with positive perceptions of accessibility overall.

The results suggest that objective and subjective journey times are important predictors of overall perceived accessibility, but that after controlling for this age, car availability and satisfaction with destinations, choice and time-satisfaction can contribute to understanding overall perceptions of accessibility. This suggests that while journey times are important in explaining perceptions of accessibility, they only account for approximately a third of the variance. Demographic variables and satisfaction with aspects of accessibility can significantly add to understanding.

7.5.4 Exploring Attitudes and Perceptions

The results above suggest that after controlling for levels of objective journey time accessibility there is a relationship between having a positive belief towards attributes of accessibility and perceptions of ease of access. It is therefore perhaps hard to separate perceptions of accessibility from positive attitudes.

A number of questionnaire items were related to respondents' attitudes towards car use, the environment and community, which may be related to perceptions of accessibility. These questionnaire items were included in order to explore the role of subjective beliefs and attitudes in more depth. The questions used to measure overall perceived accessibility, and a measure of satisfaction with public transport, were added to these statements as these can also be seen as attitudes towards accessibility. These thirteen statements capture some diverse attitudes but factor

¹ Calculated based on mean score across PT attributes

analysis was used to detect whether any unifying themes exist among them. Factor analysis identifies underlying constructs that explain the patterns of correlations within a set of variables and enable identification of what these factors represent conceptually. This approach can be useful in reducing large numbers of variables into a smaller set of uncorrelated variables for further analysis. In this case, factor analysis¹ reduced the attitudinal statements to three factors which each reflect aspects of accessibility. Table 7.5.4 shows the factor loadings for each statement for the factor on which it is most heavily loaded. The label attributed to each factor is inferred from the variables that load most highly onto it.

One statement (*I would travel further each day if I could live in a nicer area*) was removed given that it did not cluster with any other statements and was a factor on its own which is hard to interpret and may have in fact been confusing to respondents. The Kaiser-Meyer-Olkin measure of sampling adequacy ($KMO = .768$) is good and confirms the data is suitable for factor analysis (Field, 2009) as there is a compact pattern to the correlations and partial correlations between variables and therefore factors should be distinct and reliable.

Five statements combine to a factor labelled as pleasant neighbourhood and community. The positive loadings on these statements indicate similarity in the way in which these questions were answered. Those who score highly on this factor have a positive attitude towards the environment and their neighbourhood and a sense of community.

The four factors that contribute to the 'accessibility' factor are similar to those used in Section 7.5.3 to measure overall perceptions of accessibility with the additional variable, satisfaction with public transport. It is interesting that positive attitudes to public transport are so strongly associated with (non mode specific) attitudes to accessibility. This was also evident in the analysis shown in Table 7.5.3 where a positive PT-perception is associated with positive perceived accessibility. This might indicate that the questionnaire was understood to be about public transport accessibility and therefore respondents were considering this when answering general perceived accessibility questions.

¹ Principal components analysis (PCA) was used with Varimax rotation. PCA produces uncorrelated factors which makes it suitable when, as in this case, the factor scores for individual cases will be used in further analyses. Furthermore PCA seeks to produce factors which explain the maximum variance in the variables. Rotating the factor solution makes the results more understandable by producing a result that clearly identifies each variable with a single factor.

Table 7.5.4 – Factor loading for beliefs towards car use, the environment and community

	Factor Loadings			
	Pleasant neighbourhood / community	Accessible	Car Dependency	
There is a good sense of community in my neighbourhood	.811			
The buildings, streets and public spaces in my neighbourhood make it a pleasant place to live	.839			
I like my neighbourhood	.790			
I know my neighbours well	.717			
Overall, I can easily access goods and services essential to my needs	.498			
I care about the environment	.481			
Satisfaction with Provision of Public Transport		.797		
Ease of getting to places I need to get to		.767		
The range of local facilities available to suit your needs		.787		
Accessibility of places I need to get to on a regular basis		.701		
I need a car to do most of the things I do			.765	
People without a car are at a disadvantage			.672	
I can reach important places by foot			-.681	
	α	0.797	0.815	0.644

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 Rotation converged in 5 iterations.

The final factor, car dependency, groups together statements about reliance on a car, both in terms of personal dependence and the perception that those without a car are at a disadvantage. A statement relating to walking accessibility also loads negatively on this factor. This captures attitudes towards actual or perceived car dependency.

It is interesting to understand whether these attitudes relate to objective levels of accessibility and how they vary across demographic groups. High alpha scores among the variables that cluster on each factor indicate these can reliably be combined to create a single variable. Anderson-Rubin¹ factor scores are used to create variables based on these factors and compare across sample areas and demographic groups.

The resultant factor scores are used as outcome variables and demographic, area characteristics and frequency of mode use used as explanatory variables to understand variations in attitudes.

¹ The Anderson-Rubin method calculates factor scores with a mean of 0 and SD of 1. The resultant factors are uncorrelated with each other factors.

Table 7.5.5 shows the results of three regressions to explain the accessibility attitude-factors. In Block 1 three area characteristics were used as explanatory variables. Objective accessibility (as measured by the high/low variables used to select sample areas) is (as might be expected based on previous analysis) significant in predicting positive attitudes towards accessibility. It is also significant in predicting car dependency and the relationship is negative which would suggest that those with a car-dependent attitude live in areas of poorer accessibility based on objective journey time measures. Given that this analysis does not allow us to conclude anything regarding the direction of causality, this raises the issue of self selection and whether or not those who are more car dependent choose to live in areas where they need a car.

Table 7.5.5- Multiple Regression analysis for attitudinal factors

Predictors	<i>Pleasant neighbourhood / community (n=158)</i>			
		<i>Accessible (n=158)</i>	<i>Car Dependency (n=158)</i>	
<i>Block 1</i>				
	<i>r</i> ²	.117	.062	.250
	<i>F</i>	6.813	4.441	17.094
Objective accessibility ^a		.032	.221**	-.273**
IMD ^b		-.243**	-.112	-.103
TTW ^c		-.286**	.046	-.431**
<i>Block 2</i>				
	<i>r</i> ²	.179	.076	.408
	<i>F</i>	5.470	3.156	17.350
Objective accessibility ^a		.031	.224**	-.269**
IMD ^b		-.251**	-.071	-.078
TTW ^c		-.210*	.029	-.283**
Car availability		-.138	.141	.113
Frequency of driving		.275*	-.031	.279*
Frequency of using PT		-.110	.192	-.080
<i>Block 3</i>				
	<i>r</i> ²	.331	.073	.425
	<i>F</i>	8.147	2.380	12.133
Objective accessibility ^a		.061	.231**	-.249**
IMD ^b		-.156*	.048	-.062
TTW ^c		-.142 [^]	.059	-.273**
Car availability		-.218*	.149	.128
Frequency of driving		.281*	-.024	.282**
Frequency of using PT		-.162 [^]	.165 [^]	-.086
Gender		-.207**	-.115	.058
Household Income		.314**	.019	-.079
Age		.373**	.085	.070

^a(0=less accessible;1=more accessible);^b(0=less deprived;1=more deprived)^c(0=high car travel to work;1=low car travel to work)
*variable significant at p<0.05; **variable significant at p<0.01; [^]variable approaches significance (p<0.1)

Area deprivation is also significant for perception of pleasant neighbourhood and community. Those in more deprived areas have less positive attitudes towards their neighbourhood. Those living in areas of low car travel to work (TTW) have more positive perceptions of neighbourhood and lower perceived car dependency.

Adding variables relating to mode use in Block 2 shows that frequency of driving is associated with a more pleasant neighbourhood perception and increased car dependency.

Block 3 shows that there is a relationship between demographic variables and perceptions of a pleasant community or neighbourhood but not other factors. Males, those on higher incomes, and the elderly perceive better neighbourhood and community spirit.

7.6 Discussion & Conclusions

This chapter has addressed the objective of understanding how perceptions of accessibility relate to objective measures in four main stages. In order to consolidate the findings from several analyses, Table 7.6.1 summarises each analysis undertaken and the key findings.

A comparison of the destinations in objective and subjective choice sets highlighted that there is a need to ensure consistency in the definition of destination data sets.

Overall the results show the importance of ensuring that destination datasets (and subsequent calculations) are locally relevant. It might therefore be questioned whether a national dataset can reflect the requirements and differences in local areas.

Comparing the reported journey times to destinations with the mean journey time to the nearest destination from the CAI, revealed that in most cases the objective measures were lower than the subjective reported journey times. This varies by mode and destination and in general there is less difference between car journey times than public transport. There are a number of explanations for these differences, including inaccuracies in CAI calculations, as highlighted by one obvious example of the public transport times to hospital from Beeston.

Table 7.6.1 – Summary of statistical analyses in Chapter 7

Analysis Undertaken	Section	Summary of Key Points
Comparison of objective (CAI) and subjective (survey) destination choice sets.	7.2	Large degree of similarity for destinations within the sample areas. When drawing comparisons at a wider scale, some discrepancies occur mainly related to definition of destinations. Greater engagement of local people in building accessibility assessments could ensure accuracy of destinations included.
Comparison of survey reported and CAI journey times to destinations (<i>t-tests</i>)	7.3.2	In most cases the CAI journey time is lower than self-reported journey times.
Explaining self-reported journey time to destinations as outcome variable (<i>multiple regression</i>)	7.3.3	Socio-demographic variables significantly contribute to explaining self-reported journey times, after controlling for objective journey time.
Bivariate correlation between time satisfaction and objective journey times (<i>pearson's correlation</i>)	7.4.2	Time-satisfaction related to objective time for Nottingham City Centre and hospitals, but less clearly for other destinations.
Bivariate correlation between time satisfaction and subjective journey times (<i>pearson's correlation</i>)	7.4.2	Strong negative correlation between self-reported journey time and time satisfaction, suggesting longer journey times perceived more negatively.
Explaining time satisfaction as an outcome variable (<i>multiple regression</i>)	7.4.2	Subjective JT important in explaining time-satisfaction. After controlling for this, gender is important, age is not.
Comparison of choice satisfaction and CAI origin measures (<i>one-way ANOVA</i>)	7.4.3	Significant relationship between choice-satisfaction and number of destinations accessible within upper and lower time threshold for PT.
Comparison of PT frequency-satisfaction with CAI frequency measures (<i>multiple regression</i>)	7.4.4	Strong relationship between objective measure and frequency-satisfaction to destinations. Older people are more satisfied with PT frequency.
Perceptions of accessibility by destination (<i>multiple regression</i>)	7.5.1	Subjective JT more important than objective JT in explaining variance in perceptions. Socio-demographic and satisfaction measures are also important.
Perceptions of accessibility by mode (<i>multiple regression</i>)	7.5.2	Positive perceptions are associated with use of mode. Different attributes are important for explaining perceptions of different modes.
Perceptions of accessibility overall (<i>multiple regression</i>)	7.5.3	Objective and subjective journey times are important predictors of overall perceived accessibility. After controlling for this age, car availability, satisfaction with destinations, choice-satisfaction and time-satisfaction can contribute to understanding.
Attitudes to accessibility (<i>factor analysis and multiple regression</i>)	7.5.4	Different accessibility related attitudes can be attributed to different objective area measures and to socio-demographic variables.

Furthermore, socio-demographics account for differences between objective and subjective measures. If certain demographic groups perceive (and actually experience) longer journey times than others then consideration should be given to reflecting this in objective measures by weighting for population characteristics.

On the other hand, differences may occur because of perceptions differing from the reality due to misperception or lack of knowledge of survey respondents, which could be shaped by their experience. For instance, in some cases car availability was an explanatory variable for longer reported journey times. In the case of supermarkets one potential reason has been explored; that car users travel further. However, when car availability predicts longer subjective public transport journey times it is possible that this is due to unfamiliarity with other modes.

Satisfaction with time, choice and frequency of public transport to destinations is related to objective measures but the strength of this relationship varies. Where a comparable subjective measure is available for time, satisfaction is more closely related to this than the objective measures, although this is to be expected as an objective measure does not capture the individual variation that a subjective measure can. More variation in the CAI choice (or origin) measures is needed for meaningful comparison as was also highlighted in Chapter 5. The fact that age was not significant in explaining time-satisfaction but it was for reported journey times suggests that while older people take longer, they do not view this in a more negative light, but have lower expectations, have adapted to circumstances, or are simply less time pressured.

There was a relationship between the perception of accessibility to destinations and objective journey measures, although subjective journey time adds to the explanatory power of the model. After controlling for journey time, perceptions are influenced by a range of demographic variables, dependent on the destination. Furthermore time, choice and overall satisfaction with destinations are related to more positive perceptions of accessibility which perhaps highlights underlying positive or negative attitudes.

In terms of perceptions of accessibility by mode, objective measures are important for explaining perceptions of public transport and walk accessibility, but not for car. This is interesting as it may be that accessibility by car is less reliant on the levels of

accessibility provided by the transport and land use system and to some extent car use may provide the 'perfect' accessibility. This message came across in the interviews presented in Chapter 8, whereby car was seen as the baseline, against which other modes are compared. It could also be that people may see poor car accessibility as something they have chosen based on where they live and therefore do not view it negatively, whereas for the same people public transport is rated poorly. However, it is also possible that the questionnaire was perceived to be about public transport accessibility¹ and therefore the perception questions were answered with this in mind. Those using a mode more frequently tended to have a better perception of the accessibility by that mode, which could signify that familiarity leads to better perceptions.

Interestingly age is significant in explaining overall perceptions of accessibility, although it was not significant for time-satisfaction, destination or mode specific accessibility. Additionally those with a car available had more positive perceptions of accessibility overall. A positive perception of public transport attributes was also significantly related to overall perceptions of accessibility which supports the possibility that the questionnaire was interpreted to be about public transport accessibility and as such questions were answered based on this. The fact that accessibility by public transport falls into the same factor as statements relating to overall accessibility further supports this.

It is possible that perceived journey times may differ from objective measures for two reasons. Firstly, because for a particular individual, (e.g. an elderly person) accessibility is worse than for the average individual for whom an accessibility measure is calculated. Secondly, because an individual's attitudes or lifestyle (e.g. car user) means that they perceive accessibility to be different to what it is. Each reason would clearly lead to very different policy responses to improve accessibility and therefore warrants further research to understand the reasons for such differences. If the aim of Accessibility Planning is to influence behaviour, for example to achieve social inclusion or mode shift goals, then both objective and subjective measures, the differences between the two and the reasons for these need to be clearly understood. If a certain demographic group perceives or experiences

¹¹ Some of the additional comments provided by respondents suggested they thought the survey pertained to public transport.

accessibility differently then accessibility measures could be weighted to account for this.

The final section of this chapter explored the relationship between accessibility, perceptions and attitudes. Perceptions of accessibility are related to both objective conditions and individual attributes. The results suggest a tendency to rate all aspects either positively or negatively. This highlights the importance of controlling for objective conditions in social surveys, because otherwise there can be no certainty as to whether positive perceptions occur due to environmental conditions or an individual's attitudes. The role of attitudes in influencing perceptions is explored in more depth in Chapter 8.

The results presented in this chapter reflect a case study sample to demonstrate how differences can occur between objective and subjective measures. The results are not generalisable to the population and nor did they intend to be as they set out to examine specific sets of relationships between accessibility measures, attitudes and demographic characteristics. Regression models are used as exploratory models and analysing the relationships between variables in this dataset. The analysis has demonstrated how perceptions of accessibility vary, with objective accessibility but also a range of other factors. Differences are found across destinations and modes of travel. However, the models applied and results are specific to this sample.

However, the results have shown the contribution that adding demographic and attitudinal variables can make to explaining perceptions of accessibility. There are significant differences between objective and subjective journey times which need to be considered in any survey relying on self-reported measures and in any objective measure intended to influence perceptions.

8. The Lived Experience of Accessibility¹

¹ Appendix H: Mental Maps relates to this chapter.

8.1 Introduction

This chapter presents qualitative work undertaken to build a more in-depth picture of the differences in individuals' perceptions of their accessibility, addressing the fourth objective of this research which is to understand perceptions of accessibility.

Quantitative analyses in Chapters 4 and 7 has highlighted the variation in individual perceptions of accessibility and how this relates to objective measurement. This chapter further explores some of the reasons for such differences in perceptions among individuals. The quantitative analysis can demonstrate differences amongst individuals; qualitative enquiry provides the richness needed to *understand* the subtleties that affect an individual's everyday accessibility (Beirão and Sarsfield Cabral, 2007).

8.1.1 Background

The lived experience relates to how an individual subjectively perceives and experiences the world around them (Flaherty and Ellis, 1992) and may be at odds with attempts to objectify and measure these experiences. This has traditionally been the case in transport planning, whereby existing approaches fail to represent the everyday (im)mobility and (in)accessibility experienced by individuals (Rajé, 2007a), although an increasing number of studies focus on social aspects of transport (Rajé 2007a; Hine & Grieco 2003; Preston & Rajé 2007; Delbosc & Currie 2011). One of the main aims of this thesis is to develop a deeper understanding of the way in which individuals' lived experience, subjectivity or perceptions compares with objective measures of accessibility, in the context of the process of Accessibility Planning in England which sought to develop a user-focused perspective to solving transport issues (Halden, 2011).

So far this has been approached quantitatively, addressing a research gap which usually equates perceptions and subjectivity with qualitative methods and objectivity with quantitative methods. The household survey approach demonstrated that perceptions can also be measured quantitatively and such measures compared with objective measurements of the same phenomenon. However, this was restricted in its focus on certain destinations (dictated by those currently measured in policy) and by only asking about certain aspects of accessibility. In order to truly understand how accessibility to destinations is perceived and enacted by individuals in their everyday experience, a more engaged qualitative approach is required.

Mental maps were developed by behavioural geographers (Gregory et al., 2009) as a way of representing the internal, individual or imagined geography which drives behaviour in space. Mental mapping is ideally suited to understanding how an individual perceives accessibility in their local area, based in their own mental map. Mondschein et al (2007) found that individuals who relied on different modes had different 'functional,' or realised, accessibilities and suggest that cognitive mapping is the "*key to understanding both travel behaviour and accessibility in cities*" (Mondschein et al. 2007, p1). A more detailed rationale for this approach was provided in Chapter 3. The following section describes how this was applied in practice.

8.1.2 The Mental Mapping Interview Approach

The detailed methodological approach and rationale for the mental mapping approach was described in Chapter 3. This section reflects on the approach taken and considers the usefulness of the data gathered.

Mental maps were used in this research as an interview aid. By encouraging participants to draw maps and using these as a discussion prompt, more meaningful and focused insights could be drawn about their daily lived accessibility. In addition, the mapping exercise made the exercise more interesting for participants, many of whom expressed this opinion during the interview. More formal approaches to mental mapping have been developed, for example, Gould & White (1986) developed an approach that quantified and aggregated assessments of a place to establish place preferences. Public participation GIS is a more recent development based on representing lay understandings of place through mental mapping incorporated with GIS. Such an approach is often used in stakeholder and participatory planning settings (Elwood, 2006; Dunn, 2007). However, as an underlying concept a mental map can be applied in a number of ways and given that the aim here was not to assess place preference or draw group consensus, mental mapping was simply used as a way to explore constructs of perceived accessibility in the local area on a one to one basis through a semi-structured interview.

A cognitive map is an individual's internal representation of environmental information (Tolman, 1948) and does not necessarily bear any representation to a cartographic map. Consideration was given to use of cartographic maps in the mental mapping to allow respondents to overlay their mental maps as this would

have enabled comparison with the objective maps more easily. However this would influence and force people to express their mental map within the limits of a cartographic map and it was therefore decided that a “blank sheet of paper approach” would allow more meaningful insights into individual perceptions to be gained and furthermore would not alienate respondents who felt uncomfortable reading or understanding cartographic maps.

Initially a workshop or focus group approach was considered. However, a group approach is more suited to identifying a set of issues or trying to build a consensus among a group of people. As an aim of this research is to understand how individuals perceive accessibility in their local area a one to one interview approach was deemed more appropriate.

8.1.3 Interview Schedule

The structure of the interviews was deliberately left flexible. While an interview guide was used this was not rigid, in order to enable the interviewees to discuss their accessibility, and to enable the individual’s lived experience to come through.

Interviews were semi-structured. While there was an interview guide to determine the structure, the shape of the interviews was largely determined by the discussion with each participant. This approach is typical in qualitative face to face interviews and allows the experiences of the participant to be drawn out, whilst retaining some level of structure pertinent to the research questions (Bryman, 2008).

The interview began by asking participants to talk about places they visited in a usual week. Asking participants to draw a map kept the focus on accessibility to local services and provided a useful reference point throughout the interviews. This enabled the participants to reflect on and refer back to their maps giving useful insights. It also helped the interviewer to understand and situate the places that participants discussed and became a point of reference for both interviewer and interviewee throughout.

Given that the aim of the approach was largely to gain an in depth understanding of how individuals perceived accessibility in their local area, the discussion started by asking the participants to describe the places they went to during a typical week. They were then asked to draw these places relative to their home on a blank sheet of

interesting and enjoyed drawing the maps suggesting this sort of approach could be useful in getting people to think about their travel and the places they go to, for example for the purposes of personal travel planning (Haq et al., 2008). They were also positive about the household survey, although this might be expected when speaking with those who had both filled out the survey and expressed an interest in participating further. More useful insights into the survey would be gained from speaking with those who had chosen not to return it, although engaging this population would be more difficult.

8.1.4 Participant Recruitment

Participants for the interviews were recruited through self selection as questionnaire participants were asked to opt in to participating in a follow up study. Fifty-five (17%) participants indicated an interest. All of these were contacted with a letter or email in February 2011 to inform them of the timescales and to ask for their availability. Of these, 12 responded positively and 9 interviews were subsequently arranged during May 2011.

While the demographic characteristics of the interviewees varied, covering a range of age, sex, employment and lifestyles, such a small number cannot be and is not designed to be statistically representative of any of these groups (White et al. 2003). A qualitative approach is not designed to present a representative picture of an area or demographic group. However, what is gained from this approach is in depth insights into how different individuals within a small and therefore relatively homogenous environment (based on objective accessibility measures) make sense of their accessibility and how they behave accordingly, in order to understand the lived experience.

8.1.5 Characteristics of Participants

The nine participants varied demographically, covering ages from 25 to 70, three were men and six lived in the same geographical sample area as shown in Table 8.1.1.

All of the participants were very aware and reflective of their travel behaviour and in many cases tried to use modes of travel other than the car to some extent. However, the reasoning for this varied, for some participants this was based on environmental values, but for others it was more of a lifestyle decision such not wanting to be

“rushing about”, or valuing the physical activity benefits of non-motorised travel. For others never having had access to a car meant their lifestyle decisions were based on no car availability. Either way the majority of participants clearly had an interest in the topic which is difficult to avoid in this type of research. However, it must be recognised that the results and conclusions will be biased because of this. This aspect of the research did not capture those with particular difficulties accessing destinations, who would have a different perspective. However, the aim was not to highlight accessibility difficulties *per se* but to explore what can influence perceptions of accessibility in the general population. Furthermore, social exclusion studies of accessibility tend to focus on specific groups who experience accessibility issues and may be at risk of exclusion (Wixey et al., 2005; McCray and Brais, 2007) yet little is known about the accessibility of the general population which is also of importance in a more inclusionary approach and in understanding differences between perceptions and general population measures of accessibility.

Table 8.1.1 – Participant Characteristics

Participant ID	Characteristics	Sample Area
1	Female, works part time, 3 children, car owning, age 41	D – Beeston
2	Female, retired, grown up children, never owned a car, age 70	D – Beeston
3	Female, employed, no children, car owning, age 36	D – Beeston
4	Female, recently retired, grown up children, car owning, age 61	D – Beeston
5	Female, unemployed, no children, no car, age 32	B – New Basford/Hyson Green
6	Male, retired, grown up children, car owning, age 68	D – Beeston
7	Male, employed, 2 children at home, car owning, age 46	D – Beeston
8	Male, employed, no children, car owning, age 35	B – New Basford/Hyson Green
9	Female, unemployed (through choice), no children, car owning, age 47	C - Keyworth

Social exclusion is a strong theme in research on accessibility, yet those interviewed here, and to a large extent the household survey respondents, were not those typically seen as deprived or at risk of social exclusion. However, social exclusion is a dynamic process, and especially transport related social exclusion can affect anybody at anytime. The results from practitioner interviews in Chapter 4 highlighted that mode shift is an aim of accessibility planning, as much as reduction of

inequalities. It is therefore interesting to understand the perception of accessibility from the perspective of those who have choice and ability to change mode.

8.1.6 Methods of Analysis

Interviews were recorded, transcribed and transcripts were coded using NVivo (v8) software. An adapted form of grounded theory, termed abbreviated grounded theory (Willig, 2008; Graham-Rowe et al., 2012) was used as an approach to analyse the transcripts. Grounded Theory is systematic approach to data analysis, most commonly used in qualitative data analysis, which uses codes, grouped into concepts and formed into categories which are then used as a basis for theory development. As the purpose of this analysis is not necessarily to develop new theory but to gain insight into how individuals perceive their accessibility, the approach adopted here is based on grounded theory analysis as a methodological tool and not with the intention of producing a new theory (Gardner and Abraham, 2007; Graham-Rowe et al., 2012). Grounded theory as a methodological approach produces results that are grounded in the data and in individual experience. It does not seek truth, but rather an empirical conceptualisation of the data. It is useful when there is a general research topic, here perceptions of accessibility, but not necessarily a predetermined research problem. It is therefore an appropriate technique to apply to this data, seeking to draw out key concepts relating to individuals' perceptions of accessibility. A structured and systematic approach to analysing the data is also consistent with a pragmatic research philosophy (as detailed in Chapter 3), which, while recognising the value and insights gained from grounded and qualitative approaches, demands structured outputs that can be applied further afield.

Initial coding was undertaken organising the data into underlying themes that were influential in affecting individuals' perceptions of accessibility and according to the interview schedule. Grounded theory builds on concepts emerging from the data through initial coding, followed by grouping and re-coding of the themes emerging. The first stage was to code the data according to factors influencing how individuals described or conceptualised their everyday access to destinations as well as the destinations they used. It became clear that perceptions of accessibility are determined by how people perceive their trips in general, including perceptions of their mode of transportation, destination and how this trip fits into their daily routine. A

range of factors were identified, as outlined in Table 8.3.1. Factors influencing perceived accessibility included those more usually studied such as time, cost, frequency of public transport and safety. However, a number of less tangible influences were also identified relating to factors such as how convenient or pleasant a particular mode of transport felt to an individual or whether or not the trip they were making fitted in with their lifestyle or fitted their identity.

Following this initial coding it became clear that an existing theoretical framework provided a useful way of organising these factors. Although the intention at the start of the analysis was not to apply a pre-existing theoretical framework but to take an inductive approach to analysis of the data, through the coding process it became clear that the coding structure had parallels with Dittmar's (1992) categorisation of motives for consumer behaviour usually used in psychology. Therefore, ultimately a more deductive approach was taken, fitting pre-coded factors into this framework.

The factors can be categorised into instrumental, affective and symbolic factors (Dittmar, 1992; Steg, 2005).

Instrumental factors are the tangible, 'measurable' attributes of accessibility which have thus far been the focus of this research, and accessibility studies in general. This includes for example the time, cost and frequency (both real and perceived) which can be used to measure accessibility.

Affective factors are related to emotions and feeling attached to accessibility. For example, where participants express favour towards a particular mode or destination, because of the way it makes them feel. Emotions may include stress, relaxation, excitement, in control or having a sense of freedom (Anable & Gatersleben 2005)

Symbolic factors relate to the sense of self or social identity that may influence how one perceived their accessibility. Symbolic factors are known to be important in purchasing behaviour as people buy products that fit with their self image and identity. In this analysis some participants contextualised their non-car use in terms of trying to achieve a certain lifestyle which was part of their desired identity. They therefore were more likely to be pro-sustainable travel because it fitted with their perception of an ideal lifestyle.

This framework is often used in studies of travel behaviour (Anable & Gatersleben 2005), particularly in explaining car ownership or use (Steg et al., 2001; Steg, 2005; Bergstad et al., 2011) or more recently car purchasing decisions (Schuitema et al., 2012). However, there is less evidence of this framework being applied to other modes, Steg's (2003) study of attitudes to car and public transport among frequent and infrequent car users is one exception, and there are no examples of its application to perceptions of accessibility more broadly.

Many accessibility studies focus merely on the instrumental factors of accessibility, i.e. the 'objective' aspects, such as costs and time but from the discussion with participants in this study there were clearly a range of other, less tangible factors that can influence how accessibility is perceived.

Following the first stage of coding of transcripts, the initial codes were grouped into instrumental, symbolic and affective factors attached to individuals' understandings of their accessibility. This process of coding and re-coding is normal in qualitative analysis and an aspect of Grounded Theory as methodology, as new meanings emerge from the text. In this case new meanings fitted into an established framework which provides a useful structure for the analysis and discussion although this framework was not intended at the outset. The first round of coding the interview transcripts suggested a dominance of factors related to desired lifestyles and attitudes which are seen as underlying symbolic factors. Analysis in Chapter 7 found that the effect of socio-demographic variables on overall perceptions of accessibility was reduced once attitudinal variables were added to the regression model and Bergstad et al. (2011) found that affective-symbolic and instrumental-independent motives mediated the effect of socio-demographics on car use. This chapter therefore offers the potential to understand in more depth which kinds of attitudes (instrumental, affective or symbolic) are most influential in conceptualising the way in which individuals make sense of their daily accessibility

Given that perceptions of accessibility are assumed to affect travel behaviour (Morris et al., 1979) the instrumental, affective and symbolic factors underlying perceptions of accessibility can potentially be of use in understanding how accessibility and travel behaviour are linked and add to the understanding of travel behaviour which was not explored in the quantitative analysis.

Following a discussion of the destinations mentioned throughout the interviews in Section 8.2, Section 8.3 discusses the factors that underlie individuals' perceptions of accessibility, structured into the instrumental, affective and symbolic meanings attached to accessibility perceptions and drawing comparisons with how these are currently accounted for in Accessibility Planning.

8.2 Destinations of importance to participants

This section illustrates the places mentioned by participants. So far this research has been predominantly focused around the destinations used in the Core Accessibility Indicator (CAI) dataset given the key objective of understanding how perceptions relate to such objective measures. A second objective is to explore the lived experience of accessibility and factors that may influence this. Based on this the interviews, were not restricted to the 'essential' destinations used in the CAI, but encouraged individuals to discuss destinations that were salient to them. This enables comparison with those advocated as important in a policy context.

Figure 8.2.1 shows the places mentioned by participants in talking about their day to day travel, with the size of the text representing the number of times a place was mentioned.

Although Nottingham is not a focal point of any individual's discussion it clearly emerges as the most mentioned destination here as it is common to all participants. This could be seen as an ecological fallacy (Robinson, 1950) whereby incorrect inferences are made about individuals based on the characteristics of the population. Nottingham was not of particular importance to any of the individuals interviewed, yet judging by the outcome of this analysis alone it might be presumed to be the most important destination.

Individuals did tend to have one or two particularly important destinations, around which they structured their travel (and residential location) decision making, but this varied widely, including churches, allotments, schools and workplaces. Such breadth is not highlighted in Figure 8.2.1, but it does give an aggregate picture of places of importance to the population as well as showing the range of destinations visited by this small sample.

It is evident that there is a wide range of destinations that are important and these include, but are not limited to the destinations in the CAI. The places mentioned are discussed below in sections relating to everyday places, difficult places and important, but less frequently visited, places. This follows the structure of the interview whereby participants were first asked to discuss destinations they regularly visited, then places they found difficult, followed by those that were important but they did not use regularly.

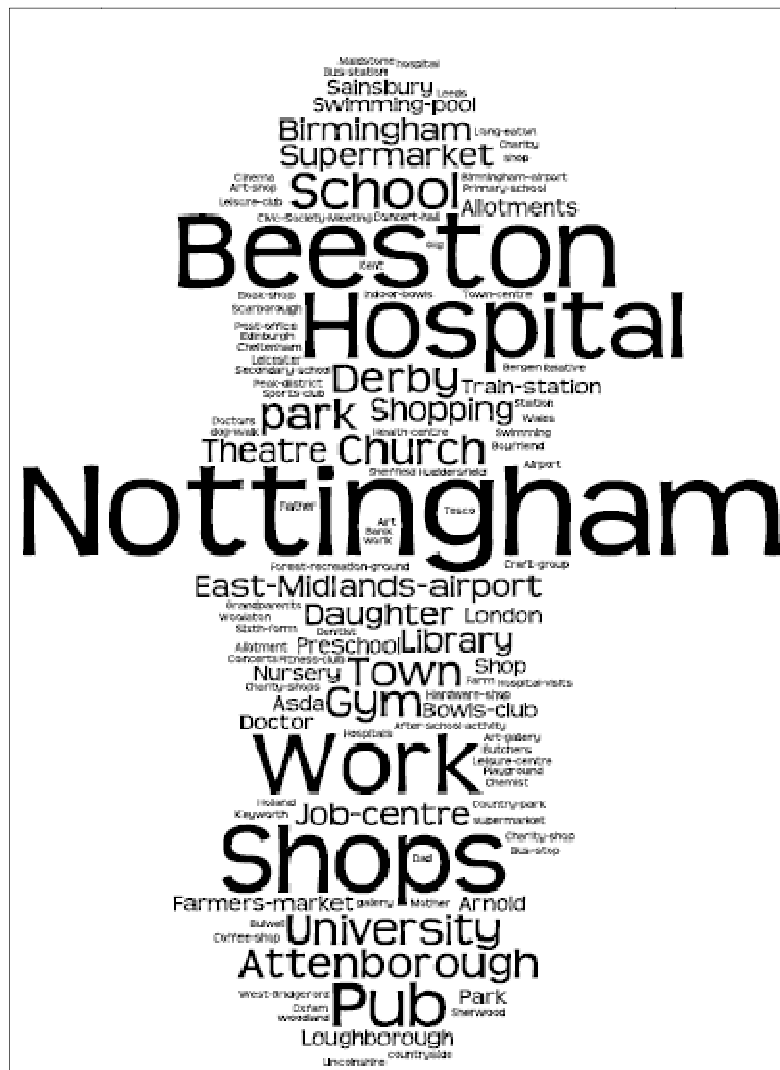


Diagram produced from interview transcripts using www.wordle.net

Figure 8.2.1 - Destinations mentioned by participants

8.2.1 Everyday places

As previously suggested, in general a small number of places define each participant’s daily accessibility and, in the case of employed people, this is usually work. Where someone works could be described as a reference point, or anchor point, for how they perceive their accessibility to other places, and in some cases is

more important than home location in influencing what they can and cannot do. When asked to describe a typical day and then draw their destinations on the map, work was the first place employed participants mentioned. Even for non-working participants, a previous place of work or partner's work was often mentioned early on in the interview.

For those that did not work, there is still often a destination that is more important than others and around which the discussion focused. For example, the allotments or the church. Participants with children naturally focused a lot of their discussion around schools, although the location of these did not appear to be a large influence on accessibility issues. Primary schools were generally nearby enough to not be an accessibility issue (this echoes the survey analysis in Chapter 7) and secondary schools seemed to be less of an issue for adult interviewees and children usually travelled to school on their own.

Family, and structuring the day around where family members live is a prominent part of many participants' lives and in many cases a chore placing demands on their time and requiring more distant travel. Visiting family was one of the few regular trips found to be difficult, often due to distance, and to some extent an uncontrollable element of where family lives and having to fit around them, particularly looking after elderly relatives;

"I mean my parents live in Lincolnshire, in a fairly inaccessible part of Lincolnshire, so we'd have to use, that would be a car journey to get to them, and I suppose the main other factor that keeps me having a car is that my grandad lives in Yorkshire and I'm his next of kin, sort of lots of family issues" (Participant 1)

"I've got family commitments in Kent" (Participant 4)

"cos my dad's not been very well I've done that journey three times in the last 2 weeks. Sheffield on the train, Leeds. That is an hour and three quarters roughly" (Participant 7)

Clearly it is not possible to account for family commitments in a national dataset such as the CAI, but this, and long distance travel were important for many of the respondents for which there is hardly any policy consideration. The importance of such trip purposes is echoed by the National Travel Survey (DfT, 2009c) which

shows that 16% of trips are for visiting friends and a further 20% for other escort and personal business¹.

Local shops and town centres are also important, both for the services available there, but also as a hub providing onward connections or as a reference point around which comparison with other places is made by the participants. For recreational purposes, access to the park (particularly for dog walking) or children's playgrounds, the gym and the pub are the most frequently mentioned places.

Participants find the majority of places they regularly used easy to access. This is perhaps not surprising. As might be expected they structure their lives in such a way that the places they use are easy or become easy to access through familiarity. For this reason, the interviews explored whether there are places (specific destinations or geographical locations) that participants find difficult to access and whether this difficulty influences whether or not they visit them.

8.2.2 Difficult places

Participants found it hard to think about places they didn't go to, or that they might want to go to if it was easier to access them. While it must be remembered that those interviewed are not regarded to be those for whom inaccessibility might be a cause of social exclusion or deprivation, it is still feasible that there are places they find difficult to reach. The difficulty in discussing such places is perhaps due to habitual behaviour or difficulty thinking about what one might do given infinite possibilities, but perhaps also raises a wider issue of adapting to adverse circumstances, known as a satisfaction paradox whereby people become satisfied with (objectively) adverse circumstances (Mollenkopf et al., 2011).

Amongst destinations that were mentioned as more difficult are after school activities for children, country pubs, tourist destinations such as historic houses and gardens, London and jobs on industrial estates as well as family commitments as discussed above. Potential reasons for difficulties are discussed in Section 8.3 which explores factors affecting perceptions of accessibility.

¹ <http://assets.dft.gov.uk/statistics/releases/national-travel-survey-2009/nts2009-04.pdf>

8.2.3 Important but infrequently visited places

Towards the end of the interviews participants were also asked if there were places in their local area that they had not mentioned but that they valued even if they did not regularly use them. Interestingly, most of those mentioned were local authority services such as the library, swimming pool and parks, or healthcare such as doctors and hospitals. Post offices, gyms and banks were mentioned, but not frequently, though they could be seen as equally important as services such as primary schools and secondary schools which were also less frequently mentioned overall but important at a societal level and included in the CAI. It is hard to quantify the importance of places that are not visited but upon which importance is placed. Interestingly places mentioned are those that are often deemed at risk of closure in the UK due to under-utilisation (Comber et al., 2009). This raises the issue that places can contribute to affecting perceptions of accessibility even if those places are never used by a particular individual. In the wider context of planning therefore it might be considered whether utilisation figures alone can provide the basis for the importance of a destination in the local area or whether wider societal values need to be considered. The places mentioned here are just small samples of the vast range of places that are important in shaping the daily accessibility of individuals. However, it gives some representation of the way in which accessibility is shaped around a small number of places on a day to day basis, but that perceptions of accessibility may be affected by places less often visited.

8.3 Factors which influence perceptions of accessibility

This section focuses on how people perceive and talk about accessibility in their local area. Local is a loose term. While participants were encouraged to talk about their day to day accessibility, the spatial distribution of activities undertaken by some participants might not be considered local, yet are clearly still important in defining their accessibility and so were discussed during the interview. The differences in what might be seen as everyday accessibility can be seen from the maps drawn by participants in Appendix I which show wide geographical variation in destinations mentioned by participants when discussing their 'usual' travel.

It became clear from the mapping approach that the travel horizons, or more accurately, perception of local, or day to day travel varied widely among the

participants. As discussed, these horizons were most often usually focused around work related travel. Furthermore there was a clear relationship with age, with the older retired participants drawing much more localised maps. Longer distance trips were also mentioned occasionally. In a study comparing daily activity based on GPS-tracking to in depth interviews Vine et al (2012) found that the definition of neighbourhood was much broader than that usually employed in research studies (e.g. 10 minutes walking distance from the home), in fact participants' definitions, and actual behaviour implied a much broader definition of the neighbourhood.

One participant was considering her job options, and the search was geographically restricted to places she had been or knew were easy to get to using public transport.

"I think that's kind of my mental limit, of kind of the furthest I would go for a job and it'd have to be a good job to make it worth it... so doing a long distance commute is possible" (Participant 5)

Table 8.3.1 summarises the factors identified, according to the categorisations outlined in Section 8.1.6. The category they fall into and an example quotation from the interview transcripts are shown in the table and each factor is discussed in turn in the remainder of this section.

8.3.1 Instrumental Factors

Instrumental factors are tangible influences on accessibility such as physical effort, transport provision, cost, safety, weather, journey time, responsibilities and quality, either of the transport or the destination. These factors could be defined as objective attributes of the external environment and the transport and land use system or individual factors such as physical effort or family responsibilities, similar to Anable et al's (2006) categorisation of collective and individual objective factors as described in Chapter 2. However, subjective perceptions of these instrumental factors also play an important role in perceived accessibility, as shown by the analysis in Chapter 7.

Physical Effort

Effort can be instrumental or affective: Stradling (2002) discusses physical and cognitive effort. Physical effort is related to the physical strain and difficulty involved, for example in climbing stairs, being able to carry heavy shopping or walk long distances. Based on this analysis physical effort is an instrumental factor related to individual constraints. There is evidence of physical effort as an accessibility constraint in the interviews, for example:

“maybe that’s a 10 minute walk but that’s downhill, so its uphill on the way back which limits the amount of shopping that I can carry” (Participant 5)

Another participant discussed how it would be physically impossible for her mother to get to the hospital on the bus. Cognitive effort is discussed below as an affective factor.

Cost

Cost was a consideration in participants’ minds, only rarely for local trips and more so for long distance journeys or regular journeys to work. One participant described how she rationalised the cost of a taxi:

“Once you’ve got your bus pass you see you save a fortune on bus fares, and you’ve really got to remember that, and then you can use the money for taxis without feeling guilty or whatever you might feel, that it’s extravagant, because it isn’t” (Participant 2)

She went on to describe how when it was necessary or made life easier (mostly for trips to the hospital) she did not feel guilty about using a taxi, despite the cost as it made the journey easier. Other participants compared the cost of the car and train for long distance journeys and this, associated with the convenience, often of being able to visit family at the last minute, was a justification for many participants having a car.

Absolute cost was not an issue for participants, they only evaluated cost relative to the cost of other modes or how much costs had increased or the value related to other factors. For example in the below, the absolute costs are not mentioned but the interviewee expresses preference for using the bus because driving would be a waste of money.

“I mean I hate driving into Nottingham and parking, I think it’s just a waste of money so I’d just catch the bus” (Participant 1)

However, while cost is clearly the instrumental factor in this decision, affective factors (“hating” driving) and to some extent symbolic – the individuals’ social values mean they consider it to be a waste of money. This illustrates the interplay of complex decision making processes, affected by a range of factors.

Table 8.3.1 - Summary of some of the themes 'describing accessibility' that emerge from participants discussions of accessibility

Categorisation	Theme	Example Quote
Instrumental	Effort (Physical)	<i>"I've only got so much energy" (Participant 9) [I1]</i>
	Cost	<i>"I would go to London, if the price were better, an hour and a half, er an hour and forty minutes, it's very, it's very good" (Participant 3) [I2]</i>
	Transport Provision	<i>"They're all green [easy to access], because we live so near to the bus station you see" (Participant 2) [I3]</i> <i>"Well because I've got a range of options [of travel modes], everywhere's easy" (Participant 9) [I4]</i>
	Weather	<i>"if the weather's bad you don't want to spend 15 minutes walking carrying your groceries" (Participant 1) [I6]</i> <i>"so that's tram or bike depending on whether it's raining" (Participant 5) [I7]</i> <i>"in the winter I did think it would have been quite nice to have a car" (Participant 2) [I8]</i>
	Time	<i>"I think you have to be willing to travel 90 minutes, yeah on public transport, that's quite a long way, you could be in London nearly" (Participant 5) [I9]</i>
	Responsibilities	<i>"the main factor that keeps me having a car is my granddad lives in Yorkshire" (Participant 1) [I10]</i> <i>"I come home at lunchtime, I've got a dog so I come home at lunch and take her for a walk" (Participant 8) [I11]</i>
	Quality	<i>"It's not cheap cheap bus you get good quality stuff" (Participant 9) [I12]</i>
Affective	Effort (Cognitive)	<i>"there's no direct, you know there's no alternative there isn't a direct bus or anything but it's a centre worth going to that you make the effort" (Participant 5) [A1]</i> <i>"but it just takes a lot more organising really" (Participant 1) [A2]</i>
	Pleasantness	<i>"...get the bus and I'm gonna read and do some knitting and listen to the radio and whatever and you just get a bit more, yeah yeah.... It was a really good opportunity to find my way around so I feel like I know the city and county more than I did before that" (Participant 5) [A3]</i>
	Convenience	<i>"most places I would go by car, just for the convenience really" (Participant 3) [A4]</i>
	'Nice and safe'	<i>"I think that's why we have chosen Beeston because you can walk and have a coffee, it's a nice place to be, it feels safe" (Participant 5) [A5]</i> <i>"now obviously most times it would be completely safe but I suppose there is just a slight risk, and even a male friend, I mean he lives here, no more than a 5 minute walk away and again he wouldn't he'd come by car at night and I just can't believe it" (Participant 6) [A6]</i> <i>"she wouldn't want to walk from here 10 minutes, just along here after 10 o'clock at night, now obviously most times it would be completely safe but I suppose there is just a slight risk (Participant 6)" [A7]</i>
	Easy	<i>"just cos its generally more attractive to work in the city where you know it's easy to get to and</i>

Categorisation	Theme	Example Quote
		<i>shops around” (Participant 5) [A8]</i>
	Annoying	<i>“say if you go to Derby by train, by train I would say it’s easy, it’s OK, it’s easy, however, to go by car its annoying” (Participant 3) [A9]</i>
	Handy	<i>“quite often I’ll walk in you know go round town to the shops and whatever and you know if I’ve got loads of shopping I can get the tram back, which is really handy” (Participant 5) [A10]</i> <i>“we had a shopping list about what should be handy and which consisted mostly of the church for my husband” (Participant 2) [A11]</i> <i>“It’s not a very nice shop, god that Asda, but it’s only a five minute walk so its kinda irresistible really, you know so I end up going” (Participant 5) [A12]</i>
	Stress	<i>“I mean my mum physically has only got so much capacity and she walks so slowly it’d be....it’s already stressful, cos I think knowing which buses go to hospitals, I’ve seen them around and I haven’t had the timetable” (Participant 9) [discussing use of car/pt for going to hospital] [A13]</i>
Symbolic	Values	<i>“I like not to drive” (Participant 1) [S1]</i> <i>“I’m trying to make an effort not to shop at the supermarket, Beeston high street, there’s loads, we’re really well supplied and so, yeah I’m trying to make an effort to shop there, greengrocers, butchers and stuff, we are spoilt only there’s just like a massive Tesco’s been built and I’m refusing to shop there because I’ve spent a lot of time filling out forms protesting against it so I think I’ve got to really really make an effort to go and support the local shops cos I’m really worried, you know I was quite worried that they’ll go and so yes, it’s time and stuff and it’s alright if you’re working part time and you’ve got time during the week where you can get and do that” (Participant 1) [S2]</i>
	Image & Identity	<i>“it’s more modern you know a bus has still got a fussy feel to them, the trams got if you like a sleek sort of modern image” (Participant 8) [S3]</i> <i>“we call it the cappuccino bus, the laminate flooring” (Participant 9) [S4]</i>
	Lifestyle Choices	<i>“...I hate the way you have to get in the car when you live in a village, all the time, and my brother in law and his wife lived in a village for a long time and there was nothing there except the church, so even if they went for a walk it would be better if they took the car, and then obviously they always had to go the same way for shopping, and that’s boring” (Participant 2) [S5]</i>

[] codes allow references in text

Transport Provision

As expected the transport provision in terms of infrastructure is an important component of accessibility. This is applicable to all modes of transport, including the quality of roads:

“I hate the road, I hate driving in that part Yorkshire, narrow steep, wall lined roads.and they have a different style of driving up there” (Participant 4)

Parking was another external constraint mentioned in relation to driving to work, where for one participant restrictions had recently been implemented.

Weather

The weather is an important influence on perceptions of accessibility at certain times and therefore is a highly dynamic factor. While the weather is continuously variable, the mere possibility of poor weather exerts a longer term constraining influence on how accessibility is perceived:

“ten minutes from the bus stop is fine, until it’s raining and you have shopping” (Participant 1)

Equally the weather can also have unexpected short term effects.

“My one wicked thing was the day I was going to walk down to there for something, I think I wanted milk, I think I wanted sausages and the heavens opened when I got to the bottom of the road and there was a bus stop there and a 36 came along and I got on the 36 wth my crumpled card, got off at John Lewis' in the centre of Nottingham crossed the road went to waitrose got the milk and the sausages and got back on the same bus to come back” (Participant 4)

In this instance the participant is discussing going (some distance) into Nottingham to get milk instead of using the corner shop because it was a way of avoiding the suddenly poor weather on this occasion. This is an example of dynamic accessibility as discussed in Section 8.4.2.

Family Responsibilities

Family, particularly children are a constraint that heavily influences some participants. For one this meant that even for short distances car is more attractive as it is hard to “ferry” the children about by walking.

Time

Surprisingly, time is rarely explicitly mentioned by participants in this study. This is in strong contrast to the quantitative work where time is a strong predictor of perceived

accessibility. Where time is mentioned it is not the absolute time that matters, but how long it is compared to a car journey or compared to what is considered acceptable. This is similar to the results in Chapter 7 suggested that time-satisfaction was more important in influencing perceptions than time itself. Further to this, this analysis adds that time-satisfaction is based on a comparison with another mode or an acceptable norm.

8.3.2 Affective Factors

Cognitive Effort

In contrast to physical effort, cognitive effort is more related to the mental or psychological energy or will required. One participant described the effort required to travel to Derby as opposed to Nottingham, but acknowledged this was only psychologically an effort, a mental barrier that had to be overcome because when she had first moved to the area, a different (long distance) bus company had operated to Derby, and she had been used to using the city buses in her previous home, so it *“was an effort to think of getting on a Barton [bus] and going in the opposite direction”* (Participant 2). The moving event she described was almost 50 years ago, yet interestingly still influences her perception of accessibility to the two places. This highlights the role that habits, and familiarity can play in creating perceived barriers to accessibility, as well as institutional factors such as different operating companies.

“I mean we can even get to Derby quite easily, it’s just because it’s outside the city area, and the bus area you have to think more about going there”
(Participant 2)

Participants also discussed certain places being worth the effort to go to, even though they were difficult to access. This reveals how the ‘values’ placed on different places can affect how cognitively accessible they are and shows the potential usefulness of weighting destinations in continuous accessibility calculations. However, what weighting places should be given may vary across individuals and it is difficult to predict how people would weight the value or importance of different places.

Two participants discussed in detail the effort required to cycle rather than drive. These two participants were both particularly keen on cycling and it was their preferred mode of transport, yet they still talked about the conscious effort required

and how sometimes they 'could not be bothered' or simply lacked energy. This shows both physical and cognitive effort involved, but the main barrier affecting their perception is the cognitive effort.

Feeling safe

Accessing certain destinations can be unsafe and dangerous, which is an instrumental attribute of the transport and land use system. However, *feeling* unsafe is an affective factor and may or may not be related to objectively safe or unsafe areas (Pain et al., 2006). It is feeling safe, or not, that affects perceptions of accessibility.

Pleasantness

Pleasantness has previously been defined as an affective factor (Anable & Gatersleben 2005) associated with transport behaviour and emerged in this analysis as influencing some participants. For example one participant discussed her liking of long distance train journeys and described this as pleasant and civilised, compared to flying.

Another described how her (work-related) bus journeys were more pleasant than having to drive:

"...get the bus and I'm gonna read and do some knitting and listen to the radio and whatever and you just get a bit more, yeah yeah.... It was a really good opportunity to find my way around so I feel like I know the city and county more than I did before that" (Participant 5)

"the bus service is really good. It's a really pleasant journey as well" (Participant 9)

Stress

Stress is often associated with travel. One participant described the difficulty of getting to the hospital by bus, saying it was much easier and less stressful to 'jump in the car' but followed this up by saying she had never investigated the bus and wasn't aware of one which suggests that some perceptions are linked to knowledge of transport options.

Convenience

Anable & Gatersleben (2005) describe convenience as an instrumental factor. However, while convenience may be a product of instrumental factors such as bus service frequency or journey length, in this analysis it appears to be more strongly related to cognitive effort involved and therefore it is included as an affective factor as

convenience is more of an emotional association with a particular trip than a tangible attribute.

8.3.3 Symbolic Factors

Symbolic factors are those linked to an individual's lifestyle or identity. Symbolic factors have been well researched in the context of car use (Steg 2005; Steg et al. 2001; Bergstad et al. 2011). In that context, a symbolic influence would be the purchasing of a car because of the image an individual feels it projects about them. Such factors are found to be influential in this analysis in understanding how people perceive their level of accessibility. From the way in which individuals described, discussed and made sense of their accessibility, less tangible factors such as habitual behaviour, attitudes to car use, the environment and travel, life values (what they want life to be like) and lifestyle decisions were revealed to be important.

The choices people make and their subjective accessibility was strongly related to how they construct their life around their self-image, social values and lifestyle decisions.

Values

One participant talked about the place she was born changing from a village to a town and moving out because *"lots of southerners moved up there and house prices rocketed"* (Participant 9). She objected to the opening of Marks and Spencer's in the 'village' and has never shopped there despite being prepared to travel further into Nottingham to go use the Marks and Spencer's. This illustrates societal values of what should be and what is acceptable in certain contexts.

Similarly, two participants, living in different areas discussed their objection to shopping in Tesco because they did not morally agree with the opening of new supermarkets. This is perhaps reflective of wider opinion, as was noted in Chapter 7 in the discussion of subjective choice sets. Tesco was mentioned by relatively few participants in Beeston compared to Sainsbury's which was more established in the local area. Certain values can therefore affect the decisions people make in terms of destinations visited. This is illustrated here in relation to supermarkets. An example relating to schools was also given, whereby a participant discussed the trade-offs between choosing a good school for her children or the nearest school.

Identity and Image

The quotations in Table 8.3.1 (S2 and S3) illustrate how certain modes of transport can fit with individuals' image. In both these examples participants discuss how they feel more comfortable with certain means of transport compared with a standard bus service.

The following example shows how symbolic factors such as identity can be related to residential self selection (Mokhtarian and Cao, 2008), but that in this instance this was traded off with a desire to be closer to services.

"I mean people were surprised that we moved here because we lived in Attenborough and Attenborough's considered much posher but this is a much nicer neighbourhood... but people would go, you moved to Chilwell? because its Chilwell really and Chilwell's [unpleasant gesture and facial expression] if you're being posh you say you live in Beeston, but its, we're much better served here than we were." (Participant 4)

The same participant talked about how she tried to be 'environmental' and felt embarrassed to have more cars than family members.

"I'm quite embarrassed we've got three cars sitting out on the drive"
(Participant 4)

This illustrates that while people may hold, or claim to hold certain values, these do not necessarily translate into their behaviour. It is also illustrative of social norms affecting perceptions; what people perceive to be acceptable in society are known as injunctive norms (Cialdini et al., 1991; Steg and Vlek, 2009). This example shows that how people think they should behave affects their perceptions of how they do behave.

Such influences also extend to longer distance travel. One participant talked about the preference of travelling further to Birmingham airport rather than using the more local East Midlands Airport because of the choice and quality of airlines on offer which meant they could travel with the kind of airline they want to fly with and not a 'no-frills' airline.

Lifestyle decisions

It is clear that lifestyle decisions, in fitting with values and identity were often important in how individuals conceptualised their accessibility and choices they made.

"and I suppose part of our decision as to where to move was that we wanted to stay within walking distance of everything" (Participant 1)

“my craft group meets in the pub so I can’t cycle there then I wouldn’t be able to have a beer” (Participant 5)

Others made it clear that they would trade off other factors in order to retain the level of accessibility that fitted their lifestyle:

“but we’d just downsize and stay within the area because I think it’s the quality of life issue and that’s strongly affected where we live” (Participant 1)

In most cases the participants valued their accessibility and had made lifestyle decisions accordingly.

8.4 Perceived accessibility and decision making

This section makes links between perceptions of accessibility and how the factors identified interact to influence travel decisions and behaviour. This was not explored in the quantitative analysis in depth. There is an assumption that behaviour will be more closely related to perceptions than objective measures (Morris et al., 1979) but this is relatively unexplored in terms of accessibility.

The analysis highlighted that travel decisions were often made based on reference points, particularly to the car. It is also necessary to highlight the dynamism of many of these factors, which do not remain static. Finally, the complex decision making processes and habits impacting travel behaviour are discussed.

8.4.1 Reference Points

The analysis highlighted that the use of reference points was influential in how accessibility is perceived. Each of the factors discussed in the previous section were only discussed in relation to a reference factor and hardly ever in isolation. For example participants did not discuss a journey being too long or too expensive, only that it was lengthy or expensive compared to an alternative.

“Beeston station’s quite far from here so yeah I would catch the bus into Nottingham rather than train” (Participant 2) [train station about 10 minutes away, compared to less than five minutes to the bus stop]

This quotation shows how the train station was described as being far away, given the proximity of the bus station. However, if there were not buses, in most cases a train station ten minutes walk away would be perceived as close.

Again, in the following example, the time taken is not of importance, rather the time compared to an alternative.

“walking to most things would be quicker than catching the bus, by the time you’ve waited and walked to a bus stop that might not even be in the direction you’re going” (Participant 1)

In the majority of cases however, the reference point was the car, as discussed in the following section.

The car as reference point, fall back and necessity

A strong theme emerging from the interviews is the car a comparator. Regardless of car ownership or car use, reference to accessibility provided by the car was frequently made, perhaps as it is seen as providing ‘perfect accessibility’, at least in terms of journey time.

For this relatively privileged sample, for whom non-car ownership or use was often a choice rather than a necessity, the car is seen as a fall back option, and its reliability and convenience something that is needed for certain trips even where strong objections to car use were expressed. This was the case for example in bad weather, for visiting distant family or carrying heavy shopping.

*“It would be a pain not to have the car to go shopping occasionally”
(Participant 1) [despite considered effort not to use the car and to shop local]*

Often, even when the will not to travel by car was evident it was seen as a fall back option, which highlights the potential difficulties encountered when this is not an available option.

The car offered spontaneity as compared to having to book trains and plan in advance, enabling participants to visit family in an emergency or go camping for the weekend.

The car was not just used as a comparison with other modes of transport but as to how long a car journey *“should”* take in traffic free conditions. One particular example was for a journey to work in Derby, which was seen as easy by train, but annoying by car, despite the fact that the participant went on to describe how the journey took longer by train, but was easy because it was *“hassle-free”*, she could get some exercise by walking to and from the station, sit and read a book on the train and arrive at work feeling relaxed. By contrast she described the drive to work as annoying and stressful because of traffic meaning it took much longer than it should. So it is interesting that despite the car journey being shorter than the train journey it was viewed more negatively because it took longer than it ‘should’ – by reference to

an ideal traffic free situation. The use of reference points to position viewpoints on accessibility compared to expectation was common throughout. Another participant described how a particular journey was difficult by car because of road-works, making it slower than normal, although the impact was not great, this divergence from the norm and from expectations is what makes the trip more difficult. The car in particular was used as a point of reference for journeys by other modes.

The car was also described as the convenient option, and less cognitive effort than other modes.

“so most places I would go by car just for the convenience really”

(Participant 3)

“they sometimes say 10 minutes from a bus stop don’t they? And 10 minutes is quite a long walk isn’t it? If you’ve got a car handy” (Participant 2)

One participant talked about ‘needing’ the car for work, but preferring to take the bus which shows conflicting needs and wants in defining their accessibility, but is also an example of preference for certain modes based on factors other than journey time.

In some cases the car was the default decision due to lack of awareness of other modes:

“to go there I’ve got to go by car. I’ve never tried the bus” (Participant 3)

In another example, the disruption of road works meant a journey took longer than it should and therefore the participant investigated alternative modes.

For the majority of car owning participants in this study the car was seen as an occasional necessity, but they also recognised its luxury.

This use of the car as a reference point might be seen to comply with Kahneman & Tversky's (1979) Prospect Theory which suggests that people make decisions based on a reference point, against which they judge losses and gains.

8.4.2 Dynamic Accessibility Needs

It was clear from the interviews that accessibility perceptions and needs are not static and change at different points in life, or different times of the day or year, dependent on factors such as family and weather which have already been discussed.

“I cycle on a Friday because my partner doesn’t work” (Participant 1)

For one participant hospital visits had at certain times dominated life but are not a consideration at other times.

The changing requirements were recognised by individuals, one who had been a keen swimmer and had plans to start swimming again mentioned the swimming pool as an example of a destination she did not use on a regular basis but thought was a valuable local destination.

“So yeah I might not be using this pool at this point in my life by in another year or less I could well be doing so” (Participant 9)

8.5 Discussion and Conclusions

In many cases accessibility is understood or described with reference to the ease, convenience or effort required. This was not necessarily related to the absolute time taken for any particular journey but a whole range of factors.

A conceptualisation of perceived accessibility, as a major influence on realised accessibility (or travel behaviour) is proposed based on the instrumental, affective and symbolic factors that influence this as well as of reference points, dynamism and habits which interact with these factors.

The conceptualisation is visualised in Figure 8.5.1. This proposed conceptualisation could be tested in further research, for example using a structural equation modelling approach, which allows theory testing of causal relationships such as those suggested here.

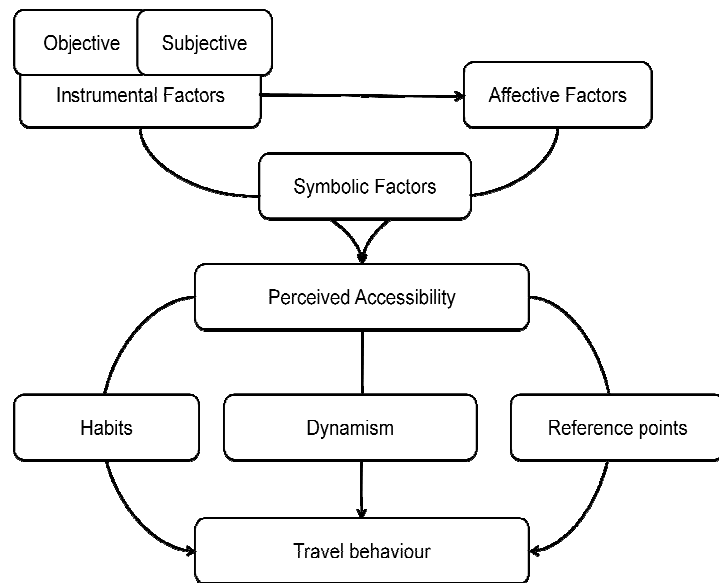


Figure 8.5.1 - A proposed conceptualisation of perceived accessibility and travel behaviour as a function of instrumental, affective and symbolic influences

Affective factors are usually a function of instrumental factors, and symbolic factors are mediating factors, influencing how an instrumental factor makes someone feel. Perceived accessibility is influenced by instrumental and affective factors. Instrumental factors can be measured and influential either objectively or subjectively. For example, as shown in Chapter 7, both objective and perceived time can influence perceived accessibility. Symbolic factors affect the lens through which people perceive their accessibility. Individuals with different attitudes or lifestyles may perceive the same level of accessibility differently.

Guiver (2007) found that people use different criteria to evaluate bus and car which means they cannot be directly compared or evaluated, for example talk about buses focuses on worst experiences, but people are more consistent in their discussion of car use.

Most participants had one or two destinations which they pin their “accessibility” around. For some this is the town centre, the church, bowls club, allotments, work or the bus station. Crucially these vary considerably, and cannot be limited to those covered in the CAI. The fact that some destinations are considered more difficult than others to access, despite them being (objectively) easier could be because of confusion between the utility of a journey and a destination (Mokhtarian & Salomon 2001) meaning that although the actual journey may be the same, the (instrumental, affective or symbolic) attributes of the destination mean that it is perceived differently.

Participants discussed preference of travel by certain modes, for example the relaxing bus journey or physical activity benefits of walking to the train station. The liking for travel by car is well researched but Mokhtarian & Salomon (2001) support the view that this liking for travel can be extended to other modes given their perceived positive attributes (e.g. quiet time, listening to music, relaxing) and that in some cases longer journey time might be seen as beneficial to an individual (Jain and Lyons, 2008).

“Because I like it, it means I will walk forty minutes more, twice forty minutes, so it’s good exercise and I don’t want to spend my time in traffic jams so I’m taking the train, but it’s quite expensive I think, its five twenty a day so for me it may be cheaper to drive” (Participant 3)

The above quotation is also illustrative of the complexities involved in many travel behaviour decisions and this is further highlighted by the quotation below:

“that is probably my main car driving activity, which is terrible, to go, to drive the car to go to the gym to do some exercise. I do an equal amount of exercise if I cycle past the gym to go to work, but, that’s cos yeah we go swimming, I take my children there because that’s the only place I can take three children swimming is the private gym” (Participant 1)

This was in the context of a local authority swimming pool requiring a ratio of one adult for every two children. For this individual, with three children this led to her joining a private gym so that she could take her children swimming and in turn this meant that she often drove to the gym on her way home from work instead of cycling to work in order to get the best value from the gym membership. Such complicated processes can only be understood through qualitative work and are very individual meaning it is difficult to translate into policy. However, this specific example, if found to be a wider issue is an example of where pressure could be applied to changes in legislation. This individual participant had the financial capability to resolve the issue, but it could be possible that others are excluded from participating in such activities due to barriers to accessibility which are nothing to do with the proximity of destinations but related to external policy or legislation.

This chapter has demonstrated that understanding accessibility from the individual perspective is based on far more than just tangible or instrumental factors which are usually studied. The analysis in Chapter 7 was heavily focused on instrumental factors of accessibility, but as shown in the final section of chapter 7 and this chapter, affective and instrumental factors play a significant role in influencing daily

accessibility. Accessibility is usually discussed in terms of barriers (SEU, 2003; Church et al. 2000) and many of the factors identified here as influencing perceptions could also be framed as barriers to accessibility. Barriers are usually instrumental, for example the SEU identified cost, travel time, availability of services, safety and travel horizons. However, as identified here, barriers could also exist for individuals due to affective and to some extent symbolic factors. The emotions, or affective factors, that are used to describe accessibility can also present barriers to individuals. Symbolic factors could also be seen as presenting barriers in the way that an individual's identity, or the way they construct their lifestyle, means that barriers to certain destinations or using modes exist. However, while being barriers, each of the factors identified can be viewed more broadly as influences on perceptions of accessibility and may also be enablers of accessibility. Focussing on influences on accessibility rather than barriers is a more inclusive approach and more in line with the social capital approach advocated by Stanley & Vella-Brodrick (2009) as opposed to a focus on exclusion.

Such attitudes are individualistic and it is difficult to capture these subtleties using statistical analyses and even harder for policy approaches to account for individual variation. However, that is not to say that qualitative approaches cannot enrich and add to understanding. Similarly to the analysis in Chapter 5, where practitioners defined accessibility as an umbrella term and as covering a wide range of factors, this analysis has demonstrated the complex interaction of a wide range of factors in determining an individual's perceived accessibility and ultimately their travel behaviour which goes beyond simple proximity to destinations and is a multi-faceted and complex concept.

Part IV: Conclusions

9. Discussion of Findings, Recommendations and Conclusions

9.1 Introduction

This thesis set out to critique current approaches to measuring accessibility, specifically within the context of Accessibility Planning in England and to draw insights regarding perceptions of accessibility and how these relate to objective measures. These aims were based on the assertion that current approaches, with their strong focus on objective measurement, were not sufficient to meet the person-centred aims of Accessibility Planning.

This chapter discusses the findings in the context of the objectives set out in Chapter 1, outlines the contributions of the thesis to both academic literature and policy debate, discusses the limitations of the research and outlines areas for future research before drawing final conclusions.

9.2 Discussion of findings related to objectives of study

The key aims of this thesis are to understand how accessibility is currently measured and applied and how this relates to the lived experience or perceptions of accessibility. These aims have been addressed through a series of core objectives whose outcomes are discussed in turn in the following sections.

9.2.1 Objective 1: To critically review the literature relating to measuring accessibility

A review of approaches to measurement of accessibility in the academic literature (Chapter 2) and policy approaches (Chapter 4) identified a gap in understanding of how objectively measured accessibility relates to subjective measures or perceptions. Traditional accessibility measures have been reviewed extensively (Geurs & van Eck 2001; Halden et al. 2000; Morris et al. 1979) and can be categorised in various ways. While attempts to measure accessibility for individuals exist (Hägerstrand, 1970; Weber and Kwan, 2003; Hsu and Hsieh, 2004), those applied practically are usually aggregate macroeconomic measures. Even when they focus on the individual, accessibility models rely on objective and quantifiable data rather than subjective or perceptual data which evidence suggests is more important for understanding behaviour (Morris et al., 1979; Gebel et al., 2011). If outcomes relating to mode shift and social inclusion are to be achieved then behaviour change needs to be effected. Given that behaviour will depend on perceptions of

accessibility, this requires an understanding of whether objective measurements are related to perceptions of accessibility. The literature review revealed examples of the relationship between objective and subjective measurement being studied in other fields, notably quality of life indicators (Pacione, 1982; Oswald, 2010) and studies of the built environment and physical activity (Ball et al., 2008; Gebel et al., 2011).

In reviewing measures of accessibility, existing categorisations of measures such as those presented by Handy & Niemeier (1997), Geurs & van Wee (2004) and Halden et al. (2000) tend to cover more traditional approaches to accessibility measurement found in the literature but do not cover broader approaches to understanding accessibility which include a range of quantitative and qualitative techniques, often used in combination to assess accessibility in a geographical area or for a specific group of people.

It has been established that accessibility is a broad term, meaning different things to different people in different places. Its breadth can be seen as a strength, but this also creates problems in translating the concept into practical and applied measures (Jones 2011; Handy & Niemeier 1997). Existing categorisations of measures were therefore broadened with a typology of approaches to measuring accessibility, consisting of the techniques used to measure accessibility and the tools and data needed to implement these. A typology of tools, techniques and data was developed in order to conceptualise approaches to measuring and assessing accessibility in the literature. This typology includes quantitative and qualitative approaches more broadly, in addition to traditional measures of accessibility. This allows a wider view of accessibility than the traditional measures and is more appropriate in relation to applied policy examples such as that of Accessibility Planning which draw on a range of techniques.

The majority of studies reviewed focused either on the objective measurement or understanding experiences of accessibility but rarely on both objective and subjective aspects of accessibility in the same study. Evidence suggests that objective and subjective measures do differ (Pacione, 1982; Lotfi and Koohsari, 2009). If the relationship between the two is not well understood in terms of accessibility measures this has implications for the implementation of Accessibility Planning which is the focus of the second objective.

9.2.2 Objective 2: To critically assess the current approach to Accessibility Planning

Accessibility Planning is one approach to applying the concept of accessibility in practice and forms a focal point of this research. The motivation for this thesis was a critique of the dominance of objective measures of accessibility in Accessibility Planning. A detailed critical review of current approaches to Accessibility Planning was therefore a crucial component of the research.

Table 9.2.1 summarises the main critiques of Accessibility Planning from these various data sources. Critiques relate mainly to objective measurement of accessibility in Accessibility Planning and draw on the literature, a review of CAI in Chapter 4 and interviews with local authority practitioners presented in Chapter 5. Insights are also drawn from the case study research in Chapters 7 and 8.

9.2.1 Objective 3: To develop understanding of the relationship between objective and subjective measures of accessibility

This objective was addressed through comparison of objective and subjective measures of accessibility, drawing on three datasets, the CAI, NTS and primary household survey data collected for this study. Firstly a comparison of subjective self-reported journey times from the NTS and objective CAI for the whole of England was undertaken (Chapter 4). Secondly the CAI was compared with a detailed household survey in Greater Nottingham to measure perceptions of accessibility.

A direct comparison of journey time accessibility to the nearest destination was undertaken with the CAI and both the NTS and household survey data. Although the subjective measures are related to the CAI, in both cases differences were found between the CAI and subjective measures. The extent of the differences varied by mode and destination.

Table 9.2.1 – Summary of main critiques of Accessibility Planning and measurement

Critique	Summary of key points
Aggregate Nature of analysis	Aggregate spatial analysis means that individual problems can be masked. Ecological fallacy in assuming that area based measures of accessibility apply to individuals within that area.
Focus on journey time barriers to accessibility	While a number of barriers to accessibility are recognised (SEU, 2003) there tends to be focus on journey time barriers. A focus on time can mean that the real barriers to accessibility are not understood and that accessibility is over-estimated for an area or population sub-group. Lack of understanding of individual level barriers, particularly non-instrumental.
Poor understanding of the link with outcomes	Improving accessibility (through Accessibility Planning) has been linked to economic development; sustainable mode shift, reduction in social inclusion and better quality of life but research evidence of the relationship between changes and the outcomes is limited.
Measures and targets not appropriate for types of interventions that will improve accessibility	Targets set in Accessibility Strategies are often arbitrarily set, may often not lead to desired outcomes and at worst may have adverse outcomes. Reducing travel times through a faster bus timetable may be the best way to achieve accessibility targets, but not the best way to improve accessibility and reduce exclusion.
National Indicators inappropriate	Assumptions in CAI are not appropriate on a national scale as expectations of accessibility vary geographically. The level of expected and possible accessibility is very different in rural and urban contexts.
Poor awareness of Core Accessibility Indicators among Local Authorities	Interviews suggested confusion and in some cases no knowledge or understanding of the CAI..
Trust in Core Accessibility Indicators is poor	Where local authorities were aware of the CAI their trust was low. In general they preferred to calculate their own measures over which they felt they had more control
Emphasis on objective measurement	The emphasis on mapping and measuring accessibility, has led to an over-reliance on objective measures. This is despite accessibility planning guidance and local authorities being aware of the need to understand perceptions and subjectivities. This is a resource issue.
Assumption that provision (of public transport) means that a place is accessible	Mapping exercises assume that potential accessibility is equal to realised accessibility. Individual perceptions accessibility will differ from this.
Emphasis on spatial accessibility	Spatial accessibility measures assume that all individuals living in the same area have the same level of accessibility
Transport focused solutions to improving accessibility	The SEU report emphasised the need for cross sector working and the cross sector benefits of improved accessibility. Despite this accessibility is seen mainly as a transport issue and responsibility lies with transport planners.
Mismatch between strategic and localised planning	Indicators and targets are useful and appropriate for strategic land use and infrastructure planning but not for the kinds of improvement to individuals' accessibility needed to reduce social exclusion
Focus on destination and mode based accessibility	Accessibility is focused on specific modes and/or destinations. In reality individuals' lifestyles are complex and not determined by one mode or destination as found in Chapter 8.

Differences between objective and subjective measures of journey time accessibility tend to be larger for public transport journey times whereas measures are more similar for car journey times. Differences are larger for supermarkets and hospitals

than other destinations which may as a result of issues of definition of these destinations or because they are usually more distant. Van Exel & Rietveld (2009) found an over-estimation of public transport journey times by 46% for non-public transport users. The analysis here was not a direct comparison of the same route, as undertaken by van Exel & Rietveld (2009) so larger discrepancies are expected to some extent. However, with differences of over 500% in some cases, it is clear that there is a large difference in survey reported and objective measures of accessibility. Most importantly, it is clear that neither objective or subjective measures are entirely accurate, the reality is somewhere between the two. This is problematic if differences are not acknowledged or if the two are assumed to be a proxy for one another.

Differences in the definition of destinations are one explanation for differences between objective and subjective journey time measures, particularly for supermarkets where largest differences in definitions of a destination occur. The CAI dataset includes local shops and it is clear that some people do not consider these in their subjective choice sets. It is also evident that when reporting the “nearest” supermarket, car users reported a longer journey time and a more distant supermarket than non-car users.

Objective measures of accessibility were also compared to satisfaction with time, choice and public transport (PT) frequency of accessibility to destinations. In general respondents are more satisfied with shorter journeys, more choice and greater frequency of PT to destinations as might be expected. However, including socio-demographic variables in the models better explained satisfaction.

Although older people report longer journey times to destinations, they do not report being less satisfied with this which suggests they may adapt expectations or be less concerned with time in general. Choice ratings are associated with objective measures of the number of destinations of a specific type but more work is needed to understand the importance of choice of destinations in understanding accessibility. The correlation between objective and subjective measures of PT frequency is high. After controlling for objective PT frequency finding PT easy to use, being satisfied with PT provision and age were significant explanatory variables for PT frequency-satisfaction.

It is concluded that there are two reasons for differences between objective and subjective measures. Firstly errors in the Core Accessibility Indicators, either in the calculation method, in not measuring what is important in framing perceptions, or if services “on the ground” differ from what is measured for example because of congestion. Secondly, variation in subjective measures, either as a result of sampling or data collection, or because of differences between how people perceive their (journey time) accessibility and reality. Reasons for this include lack of experience, information, physical mobility problems, or built environment, amongst others. In reality the difference can probably be explained by a combination of these factors, with the “real” journey time accessibility falling somewhere in between subjective and objective measures of this.

Furthermore, differences between perceived accessibility and “reality” occur for two reasons. Some demographic groups will experience longer than average journey times, for example disabled and elderly. This needs to be recognised and accounted for in planning. However, some groups such as car users who report longer PT journey times probably do so because of poor perceptions or lack of experience. This could be targeted through information and education, for example through policy measures such as Smarter Choices.

The outcomes of this work show a need to understand how different individuals’ perceive and experience accessibility and the reasons for this. This is addressed through the following objective, exploring what factors influence perceptions of accessibility more broadly, rather than focusing on specific aspects of accessibility as this objective addressed.

9.2.2 Objective 4: To understand which factors influence perceptions of accessibility

The fourth objective was to explore what factors influence perceptions of accessibility. This was addressed using statistical analysis of survey data based on a study in Greater Nottingham in Chapter 7 and probed further in Chapter 8, based on in-depth mental mapping interviews.

Hospitals and colleges were perceived to be the least accessible; at an aggregate level this is the same as the CAI. Distance to destinations added to explaining variance in perceptions of accessibility, after accounting for objective journey time.

This shows that the interaction of time and distance is important in influencing perceptions of accessibility. This can be interpreted as the time relative to expectations based on distance, or more simply the speed of travel, but suggests that time alone does not necessarily influence perceptions.

Statistical analyses suggest that time is important, with high levels of correlation between both objective and self-reported journey times and perceptions of accessibility across destinations and modes. However, in all cases time accounts for less than half the variance in perceptions of accessibility meaning that there are other factors which need to be accounted for. Just because time is significant and straightforward to measure does not mean accessibility assessment should rely on this. Furthermore, perceptions are more strongly related to self-reported time than objective measures of time. It has already been established that there are discrepancies between the two and that variation in self-reported journey time can be further explained by demographic and attitudinal variables. This means that a high correlation between self-reported journey times and perceptions of accessibility cannot necessarily be interpreted as the same thing as time being important in explaining perceptions of accessibility since self-reported time itself may be a proxy for a whole range of other influential variables. Indeed, time was rarely mentioned in interviews presented in Chapter 8, suggesting that while it may be a useful proxy for perceptions of accessibility, and as a result of measurement techniques is shown to be statistically significant in explaining perceptions, time is not necessarily a parameter upon which people actually make decisions. In fact being satisfied with time taken was more influential, and this can be affected by expectations and factors such as frequency, familiarity and speed and not the actual time taken.

Different aspects of accessibility were important for different modes. This would support work by Guiver (2007), suggesting that modes of transport cannot be directly compared using the same criteria. Evidence from Chapter 8 supports this; people sometimes chose less direct or more expensive routes because they have different benefits. One pertinent example was the participant who commuted by train despite it being more expensive and taking longer. The decision making process for this was complex, a combination of “annoying” congestion on the roads (even though the train journey takes longer than the car journey in traffic) and the exercise from walking to the train station. This shows the influence of this individual's particular lifestyle

choices in how she perceived mode based accessibility. This shows that it cannot be assumed that the same attributes will be important to different people and nor will different individuals assess them in the same way.

A general tendency of respondents to rate all measures in the same direction (positively or negatively) is evident from some of the relationships in the analyses of both quantitative and qualitative data. This demonstrates the importance of comparing self-reported measures to objective measures to identify whether some individuals are likely to have a more positive outlook in answering a questionnaire, regardless of external environmental conditions.

Although statistical analyses focused mainly on identifying instrumental aspects of accessibility important for understanding perceptions, qualitative work shows that it is not necessarily only tangible and measurable factors which are important but that emotional factors play a role. Drawing upon a framework of instrumental, affective and symbolic influences on behaviour (Dittmar, 1992), the qualitative analysis in Chapter 8 was able to highlight the importance of affective and symbolic influences on perceptions of accessibility, which need to be considered.

The importance of considering lifestyles in studies of travel behaviour has recently been emphasised (Goodwin, in press; Scheiner & Holz-Rau 2007) and this thesis echoes the importance of this. Accessibility cannot be understood as a static, measurable concept but something that varies according to an individual's needs which may change at various points in the day, and various stages of life according to particular constraints and lifestyles.

9.2.3 Objective 5: To provide recommendations for enhancing current accessibility measurement techniques

Drawing on the findings from all chapters in addressing the four objectives above, a number of recommendations can be made for improving current approaches to measuring accessibility.

The choice of CAI destinations is very subjective and the effect of the inclusion of some and exclusion of others (e.g. banks, post offices) could, if these indicators were used to determine planning requirements, have unintended consequences. While the limitations of involving only citizens' views are recognised, the results of this research would suggest that more dialogue is required to decide what is and is

not important. There needs to be more control and clarity for local authorities over which destinations are and are not included on a locally specific basis. A supermarket is very hard to define, and this has been highlighted as an issue at various stages in this research. Furthermore, definitions of destinations may be different dependent upon location. In a rural area a small grocery store is important, but may be hardly considered in an urban area.

Destination datasets could be improved through greater dialogue with local accessibility planners. However, only focusing on subjective accessibility and destinations that people currently use would not be an appropriate policy approach either. Both objectivity and subjectivity needs to be incorporated into any study. Hospitals, doctors and schools were frequently used by less than 50% of the survey sample, but are clearly important institutions for a functioning society. Moves towards open data allow greater potential for user feedback and therefore more locally relevant destination datasets could be developed through encouraging more active feedback. However, this would require a greater level of engagement of accessibility planning practitioners with the CAI. As found in Chapter 4 use of the CAI is low. However, one of the reasons for this was a lack of trust in the outputs; perhaps if local authorities were more engaged in the development of the input data their trust and therefore use of the indicators might be improved.

While there is a risk of indicator fatigue, indicators are a necessary part of social policy, if progress towards policy goals is to be measured. They must however, be relevant to achieving the outcomes of policy changes or funding. Measures incorporating more subjective viewpoints are important. Policy cannot be expected to focus on every individual yet the heterogeneous nature of society needs to be recognised. This is not to say that objective measures are not important; this research has shown that they are, but subjective measures are also important in understanding perceptions of accessibility, which are more likely to influence behaviour. In agreement with Stanley & Vella-Brodrick (2009) it is suggested that both objective and subjective measures need to be incorporated into indicators of accessibility and it cannot be assumed that one is a proxy for the other. Subjective measures can be collected on a more aggregate level through social surveys and do not need to be limited to qualitative approaches, yet in studies of accessibility this tends to be the norm. Similarly, individual objective measures can be useful,

particularly in studies of behaviour. In the context of this research, individually calculated objective measures would allow a cognitive comparison of perceived journey time accessibility with objective time taken.

Perceptions of accessibility are not absolute, but may be comparative to others living nearby or from the same social background, or in terms of accessibility by mode comparative to accessibility provided by the car. National indicators are therefore not necessarily appropriate as assumptions and expectations can differ geographically.

Journey time measures are useful and easy to understand. However they can be misinterpreted and also give an inaccurate picture of accessibility issues. The number of measures is hard to comprehend for many accessibility planners. A more robust composite indicator (such as IMD) could be of more value, despite being a relative indicator. It is suggested that the CAI are only useful in terms of showing relative differences as the journey times reported have been shown to be significantly different to self-reported journey times. However, importance of disaggregating by mode and destination should also be considered as there are clear differences between destinations, meaning they cannot be treated as equally important or have the same journey time thresholds applied.

Accessibility measures could be improved by considering the number of *options* available (not just destinations), for example in terms of modes of transport available to an individual. Interviews suggested that in a sample of relatively privileged people, who often chose to use public transport, it was this choice that is important and the availability of a car as a 'back up' was mentioned. In terms of social exclusion it might therefore be suggested that having more options is beneficial.

Some software programmes measuring accessibility allow modelling with or without interchange of public transport, although the CAI does not allow this to be determined. However, from a perceptual point of view, research shows that waiting time is weighted more negatively than in-vehicle time so the ability to reflect this in accessibility measures would be useful. Furthermore, modelling accessibility in terms of the speed of trips as opposed to absolute time may allow the way in which trips are evaluated to be better represented, although this requires further research. Some of the insights from qualitative work suggest that where time-based accessibility is important it is how time taken is perceived in relation to some benchmark that

matters most, which may be based on beliefs about how long a trip should take given the distance.

Walking is a particularly important mode of travel for a wide range of policy agendas including physical activity, sustainable travel and social exclusion. Walk based accessibility indicators would be useful to support these policy areas. Although walk times are included in the CAI at present, if the walk journey is longer than a public transport journey this makes an assumption that the shortest journey time will be most appropriate in assessing accessibility. However, as highlighted in Chapters 7 and 8, multiple factors will affect the perceived and therefore realised accessibility of individuals. Without considering the affective and symbolic influences, if a public transport journey is only slightly shorter than a walk journey, walk may be more appealing depending on the cost, frequency and perceived quality of the public transport journey and also the social norms.

The CAI are underutilised by local authorities and more could be made of them. However, the current format is not user friendly; knowledge and understanding is low. Many practitioners felt overwhelmed and lacked trust in the measures. The recent change in terminology from Core Accessibility Indicators to Accessibility Statistics is welcomed since this signifies that the dataset is not necessarily a set of indicators for performance monitoring, but a rich set of data available for manipulation to address research questions or policy issues and may therefore encourage use of the dataset in a wide range of policy areas. This change in terminology is important in recognising the role of the dataset now that there is no longer a central government requirement for reporting against indicators.

Given the more local focus in policy and less central government intervention, transport planning has become more localised. Local accessibility assessments may be of more value than national indicators but guidance and training is needed by local authorities. However, accessibility planning, as a policy approach designed to incorporate user needs and focus on local issues, fits well with ideas of localism being advocated by the current government.

There is a need for both aggregate measures but also more individual based studies on which aspects of accessibility lead to positive outcomes in terms of behaviour and wider issues such as quality of life. In the measurement of well being, much more

research has taken place into the relationship between objective and subjective measurement. This field is gaining interest, for example the UK government's recent commitment to develop well-being measures, alongside economic measures of development (ONS, 2012). However, there is still an issue of the definition and recognition of the difference between objective and subjective measures. For example the Great London Authority measures of wellbeing, released following the government recognition of the need for wellbeing to be measured are all "objective" and therefore conceptually no different from existing indices such as IMD¹.

There is a need to link daily household activity, travel patterns and behaviour with long term land use changes, but in its current form Accessibility Planning appears to be confused between the two. Clarity regarding the aims is required. Spatial measures of accessibility are appropriate for regional studies and land use and transport planning but less appropriate for addressing individual issues of behaviour and exclusion which the policy objectives suggest.

Measurement of accessibility currently presents an ecological fallacy, assuming that area based measures apply to individuals living within that area. Clarity is needed as to whether efforts should be focused on individuals or population based measures. Policy needs to be societal but if individuals' behaviour and outcomes depend on what is important to them, this presents a difficult problem for policy makers. Any measure or policy advice must be clear about what objective indicators are trying to achieve so that they can be designed accordingly. Sawicki (2002) points out the difference between measures designed to assess performance, and those designed as community indicators, but often such a distinction is not made.

Work on developing objective indicators is advanced. This is not to say this should not be continued but the fact that they represent "the truth" needs to be questioned. It should be questioned whether funding should continue to support improvements to modelling techniques without questioning whether these are an accurate reflection either of the reality they seek to represent or the perceptions of individuals.

There is also a need to consider the policy outcomes expected of Accessibility Planning. While the approach is linked to Social Exclusion (SEU 2003) the appropriateness of focusing on this as a concept in transport has been questioned

¹ <http://data.london.gov.uk/datastore/package/london-ward-well-being-scores>

(Stanley & Vella-Brodrick 2009). Indeed, many accessibility practitioners interviewed in this research were using accessibility to address a much wider range of policy issues including mode shift and sustainability.

9.3 Contributions of this research

The main contribution of this research is an empirical investigation into the relationship between objective measures and individuals' lived experiences, or perceptions of accessibility in the context of Accessibility Planning in England.

The thesis has explored several different approaches to knowledge: both objective and subjective measures of journey time accessibility, perceptions of these and practitioner viewpoints. There is a need to understand that there is not one type of accessibility (Farrington 2007) and this research has attempted to demonstrate this using an applied example of accessibility to destinations. Most existing studies focus on either objective or subjective accessibility. A comparison of the two using both primary and secondary quantitative data alongside qualitative data, is therefore a unique contribution.

The literature review drew on studies relating to the measurement of accessibility as well as social indicators research in order to demonstrate the need for subjective measurement of accessibility. A new typology of approaches to measuring accessibility was developed based on the tools, techniques and data required and broadened traditional categorisations of accessibility measures to include a range of quantitative and qualitative approaches to assessing accessibility.

An up to date review of the way in which accessibility has been measured as part of the Accessibility Planning process (Curl et al., 2011) has provided insights into the practical implementation of accessibility and provided recommendations for how this can be improved, through engagement with practitioners.

This research contributes to current research in the field of transport geography where the importance of subjectivity, perceptions and lifestyles is becoming increasingly recognised (Delbosc 2012; Stanley et al. 2011; van Acker et al. 2010; Goodwin, in press). The measurement of accessibility is an important aspect of transport studies which has traditionally been dominated by objective measurement. The approach taken here is relevant in the context of continued interest in social

aspects of transport and increasing interest in subjectivity and individual mobility. The critique has challenged the still dominant positivist approach in transport studies and demonstrated the need to ensure perceptions are considered. It also adds to understanding of how objective and subjective measures compare, which, while being researched in other fields (Kuz, 1978; Pacione, 1982) has not previously been studied for accessibility to destinations.

Results suggest that there is a relationship between objective and subjective measures and that both are important. However, there are still differences which need to be acknowledged. By adding socio-demographic variables to the analyses a better explanation of perceptions was gained. The NTS currently relies on self-reported journey times to destinations to represent an “objective” measure of accessibility to destinations (DfT, 2010a). This research has shown, by comparison with the CAI, that using self reported journey times as an objective measure is not a reasonable assumption and that if the NTS requires an objective measure of accessibility to destinations, alternative objective measures such as the CAI should be explored.

The sampling methodology is unique in drawing on both the Postcode Address File (PAF) and electoral roll for the sampling frame. This demonstrated that there may not be any advantage to using the electoral roll to personalise surveys over using the PAF alone, although it may have a greater effect among some demographic groups which warrants further research.

Methodologically there is a need to move away from the tendency to associate quantitative methods with objectivity and qualitative methods with subjectivity. Quantitative and qualitative data can be either objective or subjective, and it is only by comparing quantitatively both objective and subjective viewpoints that real progress can be made towards planning a transport system that meets the needs of individuals and can thus lead to positive outcomes.

9.4 Reflections and Future Research

The approach in this thesis relied on comparing area based objective measures to individual perceptions of accessibility. A comparison of objective and subjective measures collected at the same scale would allow stronger conclusions to be drawn.

However, despite this, the fact that difference in the mean value for a sample of individuals within a small area differs significantly from the area mean, based on an objective measure, highlights that differences exist and that further work is needed to understand how these might differ on a micro scale. Furthermore Lower Super Output Areas were matched to postcode sectors for comparison with NTS Data. The Modifiable Areal Unit Problem (MAUP), whereby the spatial unit used can affect the results, in any analyses relying on spatially aggregated data, continues to be an issue (Mitra & Buliung 2012) not unique to this analysis.

A range of factors potentially influencing perceived accessibility were explored. However, given the tendency for these all to be rated positively it might be advantageous to have been able to weight different factors, both in order of their importance to an individual and in how they perceive them in the local area. This would be possible using conjoint or discrete choice analysis.

A Structural Equation Modelling (SEM) approach could be used to test the proposed conceptualisation presented in Chapter 8 and to further explore the role of instrumental, affective and symbolic factors in affecting perceptions of accessibility, Related to this the relationships between symbolic determinants of accessibility and residential self-selection could be further explored. SEM allows the strength of causal indirect relationships, such as some of the complex relationships identified in Figure 8.5.1, to be explored in more depth. This approach has been used to address a similar issue by Weden et al (2008) who used SEM to explore objective and subjective neighbourhood characteristics and their relationship to health, finding that while both are important for health outcomes, subjective neighbourhood characteristics were more strongly related to health. Furthermore, subjective neighbourhood characteristics mediated the relationship between objective characteristics and health, highlighting how SEM can be used to explore more complex relationships. Such an approach would usually start with qualitative enquiry to conceptualise causal relationships which can then be tested quantitatively using a structural equation modelling approach.

Furthermore relationships between objective and subjective accessibility and wider outcomes such as wellbeing could have been explored, as it has been identified that accessibility is seen as a measure of quality of life. A study using behavioural or quality of life outcomes in addition to the perceptions of accessibility measured here

would be a useful addition. It may have been useful to measure perceived accessibility using more established scales such as the Satisfaction with Travel Scale (STS) proposed by Ettema et al. (2011) for comparability with other research. However, this would not have allowed detailed comparison by destination as undertaken.

An assumption that perceived accessibility relates to travel behaviour was made and evidence from studies of the link between perceived and objective measures of the built environment and behaviour suggest this is the case (e.g Gebel et al. 2011) . A more explicit focus on travel behavioural outcomes would have strengthened this research. A study focused on behavioural outcomes would add to understanding of how objective and subjective measures of accessibility interact to influence travel behaviour and wider outcomes such as quality of life and wellbeing. A longitudinal study related to a policy change or change in infrastructure, designed to improve accessibility, would be best placed to understand the relationship between changes in measured and perceived accessibility, and behavioural outcomes.

The transferability of the results is limited given the focus on a small number of areas in the case study section. In addition, the focus on England in the review section is specific to the policy of Accessibility Planning and results may not apply elsewhere. However, this study has demonstrated how perceptions may be incorporated into measures of accessibility and this can be transferred to other settings. The small survey sample also affects the ability to generalise to the population. However, given that the main purpose of the research was to explore the potential relationships between variables this is not so much of an issue.

Analysis of some questions and comments added to surveys suggested that respondents interpreted the survey to relate to public transport accessibility only which may have limited responses by those who do not feel public transport is important to them. This could be linked to wider issues identified, particularly in Chapter 8, regarding the benchmarking of accessibility against the car and the perfect accessibility it is seen to provide. If this is the case then it may be that people do not consider that accessibility by car to be a problem and therefore assume a survey to be related to public transport.

The broad approach to ask about a range of destinations was for comparison with CAI and also based on the viewpoint that a study of accessibility to one destination would not be appropriate to understand complex individual accessibility. However, a more focused survey would allow some issues to be explored in more depth. A study focused on perceptions of accessibility to one destination may have allowed more in depth analysis but this was avoided in this study as it was felt that individuals' lived accessibility is not restricted to one type of destination or mode and that a broader approach would allow a greater understanding of this lived experience. However, it may have been too ambitious in trying to cover too many destinations and modes.

Although gravity models of accessibility provide the potential for weighting destinations according to attractiveness, for example the number of jobs at an employment site, in most instances all destinations are treated equally due to challenges in deciding how destinations should be weighted. More research is needed to understand user preferences for destinations, based not only on existing travel behaviour but also latent preferences.

This research has focused heavily on the destinations included in the CAI, and although other destinations were discussed as part of the interviews in Chapter 8, many of these are rarely studied. More research should focus on '*Non-essential trips*' such as visiting family and friends which were frequently mentioned by participants in Chapters 8. Social contact is not only an often neglected or misunderstood trip generator (Axhausen 2008; Harvey & Taylor 2000) but is important in maintaining wellbeing and quality of life, particularly in old age (Hyde et al., 2003) and might therefore be seen as vitally important in reducing social exclusion by ensuring accessibility to social contacts. Furthermore, discussion in mental mapping interviews highlighted the importance of 'extra-curricular' activities which may be the first things that people stop doing if accessibility (spatial, physical or otherwise) is limited. Perhaps, in promoting an inclusive society it is such additional activities, which people struggle to participate in, which lead to exclusion but this warrants further investigation.

One of the main critiques of accessibility measurement is the usually aggregate nature of measures, leaving them open to ecological fallacy whereby it is assumed that individuals within an area will inherit the characteristics of that area. This research was limited in comparing aggregate, area based accessibility measures to

individual subjective measures. While data intensive, individually calculated objective measures would allow a more cognitive comparison between perceived and objective accessibility. Furthermore, incorporating a third dimension based on data from Geographical Positioning Systems (GPS) would fill the gap in understanding the “reality” between model-based objective measures and perceptions (although GPS data may also be open to errors). The recent trial of using GPS data in the NTS (DfT, 2012), found considerable differences between previous years based on travel diary data and GPS collected data. As a result of this the use of GPS has been abandoned in favour of maintaining a continuous dataset. This does however suggest a gulf between self-reported data and actual behaviour which is problematic and warrants further research.

As found in Chapter 5, and highlighted by Kilby & Smith (2012) a range of interventions have been implemented by local authorities as part of the Accessibility Planning process. However, accessibility planners have struggled to quantify the benefits of many of these. Transport Planners need a robust evidence base to demonstrate the benefits of improvements they implement. While this research has explored factors other than time that contribute to perceptions of accessibility, much more research is needed to understand the non-journey time impacts of a range of accessibility interventions.

Expanding on the work undertaken in this thesis to measure perceptions of accessibility across a wider range of individuals and areas would add to knowledge. This thesis presents an example of how objective measures can be compared with social survey data, which has not previously been undertaken for measures of accessibility to destinations in the UK. However, it was limited in scope and could be expanded, for example by including measures of perceived access in national subjective wellbeing surveys.

The recent increase in use and availability of open data, which is supported by the DfT, and the ability for this to be combined with user perspectives is also an area ripe for research. One potential example is highlighted by the differences between the destinations used in the CAI and user reported destinations in both the NTS and primary survey. This provides an example of how ‘official’ datasets could be verified and enhanced through user interaction, although care must be taken as to whose views are represented as user-created datasets (both official and unofficial) have

issues of provenance and validity. There are increasing examples utilising subjective viewpoints in public data sources. For example a current Ordnance Survey (OS) project¹ is attempting to build gazetteer data based on colloquial place names, which as shown by the listing of destinations in Chapter 7, is important as people attach different names to the same places. There are also examples of open data sources allowing users to contribute to improve datasets of important destinations². Therefore an open data approach to destinations included in accessibility calculations is one area where more research would be welcome.

9.5 Conclusions

This thesis opened with a definition of accessibility as a '*slippery notion*' (Gould, 1969). Following a review of the literature and engagement with both practitioners involved in delivering accessibility planning, and discussion with individuals about their lived accessibility it is evident that this remains a valid point. More recently, in citing Gould, Jones (2011) has noted the difficulty in measuring an all encompassing term and a lack of academic study into the lived experience of accessibility, both of which are emphasised by this research. This apparent breadth of accessibility as a concept in Transport Planning is recognised by Halden (2011), who asserts that this has left it open to 'abuse' by local authorities. Indeed, as highlighted in Chapter 5, views about what accessibility is and the relationship between accessibility as a concept and Accessibility Planning as a policy tool are wide ranging and this leads to problems translating the concept into an applied policy approach. That this is intentional abuse however, was not apparent from the work undertaken here. Those interviewed welcomed the multi-faceted nature of Accessibility Planning which enabled them to explore a wide range of transport issues, but struggled with measuring and therefore monitoring of changes in accessibility.

Any attempt to measure accessibility should consider the purpose of doing so and ensure the measure adopted is appropriate. If regional planning is the main imperative then spatial accessibility measures such as the CAI may be appropriate. However, if the main outcomes are related to individuals and issues of travel behaviour and exclusion then perceptual based measures need to be developed. There is a need for development of appropriate models, focusing on individual

¹ <http://www.yourplacenames.com/>

² <http://greatbritishpublictoiletmap.rca.ac.uk/>

variation and 'borrowing' from the behavioural sciences (McFadden, 2007) where appropriate, in line with current trends towards more individualistic and behavioural transport studies.

In a discussion of lifestyles it has been noted that *"all inclusiveness may seem like a conceptual strength in reminding us that the world is complex, but it is a practical weakness in failing to tell us how to simplify it"* (Goodwin, in press) and such an understanding can also be applied to accessibility as a concept in transport planning.

Indeed, accessibility as a real world issue is by its nature complex and one study cannot expect to explain accessibility for all individuals to all destinations. Rather, this research has focused on understanding if and how objective and subjective measures vary and exploring the wide ranging factors that might explain perceptions of accessibility and ultimately travel behaviour but it is not exhaustive.

Despite the aspiration to reflect individual needs, the measures and targets which have dominated Accessibility Planning in practice may not be best placed to address individuals' accessibility issues. This is not to say that these issues are not understood or addressed by the process but that ultimately quantitative measures against which progress is measured rely on objective time-based approaches, which may not lead to the outcomes desired. If objective measures are not a good reflection of perceptions which ultimately influence behaviour then this is problematic for achieving desired outcomes from any policy measures.

The recent release of the national wellbeing dataset (ONS, 2012) and the use of a Minimum Income Standard (MIS) (Davis et al., 2012) based on user needs in different geographical areas, rather than a definitive poverty line, shows policy recognition of the importance of subjective as well as objective indicators. However, in order to improve such measures through policy interventions, an understanding of the objective conditions is also necessary and this requires data available at a much finer scale; not aggregated by geographical region.

This research has shown the importance of geographical variation in shaping perceptions of accessibility. This highlights the need for social research to consider the geography, and the environmental condition in which research takes place. Many social surveys do not consider how their results relate to the objective conditions. For example council wellbeing surveys and often large national scale surveys do not

record a detailed enough level of geography to understand whether individuals' responses relate to the actual conditions. This research has shown that objective conditions are important in shaping perceptions and so should be included.

Since this research began in 2008 the policy and political climate has changed dramatically. Local Transport Plans are no longer the primary means of funding for local transport and budgets are now more localised rather than being dependent on block grants from central government. A change in the UK government in 2010 led to a number of changes, including the streamlining of reporting against national indicators (LTT, 2011). Despite this, accessibility remains an important topical issue as evidenced by recent policy interest, for example, from the environmental audit committee¹ and the DfT (Lloyd & Moyce 2012; Kilby & Smith 2012), alongside continued academic debate (Halden 2011; Jones 2011). Kilby & Smith (2012) suggest that in a changing economic climate, the links between economic growth and accessibility have been highlighted by recent government policy. It is however important that the wider non-economic benefits are not forgotten. If there is a renewed emphasis on economic growth then there is a danger that accessibility will continue to be measured in terms of time savings and monetary benefits and the individual and social impacts will be neglected.

Accurate objective measurement is important in policy making but blind pursuit of representing "the truth" should be questioned. In a world where increasing emphasis is placed on changing individual behaviour and improving quality of life, both of individuals and society, it is important that accessibility, a key indicator of quality of life, as experienced and perceived by individuals, is well understood. Crucially an understanding of how this "lived" accessibility relates to the objective environmental conditions will inform a clearer understanding of how infrastructure and land-use changes can promote behaviour change and social inclusion.

¹ <http://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news/new-inquiry-transport-and-the-accessibility-of-public-services/>

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Appendices

Appendix A: Publications

Journal Publications

Curl, A; Nelson, J & Anable, J (2011) "Does Accessibility Planning Address What Matters? A review of current Practice and Practitioner Perspectives" Research in Transportation Business & Management 2 (3-11)

Conference Papers presented

January 2012 '*The Lived Experience of Accessibility: The Importance of Perceptions in Measuring Accessibility*' UTSG, Aberdeen

April 2011 '*Comparing objective & subjective measures of Accessibility*' RGS-IBG Postgraduate Mid-Term Forum, Durham

October 2010 - '*Comparing the lived experience to measures of Accessibility*' - Travel Demand Management Symposium, University of Aberdeen

September 2010 - '*Comparing objective and subjective measures of journey time accessibility*' - RGS-IBG Annual International Conference, London

August 2010 - '*Comparing objective and subjective measures of journey time accessibility*' - ERSA Congress Jönköping, Sweden

January 2010 - '*Do Current approaches to Accessibility Planning address what matters? An initial assessment of tools and techniques*' - UTSG, Plymouth

March 2009 - '*What is important in Accessibility Planning? Comparing the lived experience to objective measures of accessibility*' RGS-IBG Postgraduate Mid-Term Forum, Plymouth

Appendix B: UTSG Paper 2010 – Review of Measures

DO CURRENT APPROACHES TO ACCESSIBILITY PLANNING ADDRESS WHAT MATTERS? AN INITIAL ASSESSMENT OF TOOLS AND TECHNIQUES

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Abstract

This paper presents the outcomes of the first year of PhD research into how currently used measures of accessibility relate to individual perceptions, or the “lived experience” of accessibility. Accessibility has been framed in the context of social exclusion within UK Transport Planning, focussing on the ability of people to participate fully in society, which is seen as being limited by poor accessibility. Despite the policy recognition of multiple barriers to accessibility such as information, cost, safety and security, travel horizons, provision of services and journey times, measures used in accessibility planning are dominated by “easily” quantifiable time/distance measures, and therefore do not necessarily reflect the complex interactions, perceptions and behaviours of individuals which influence travel and ultimately the ability of people to access destinations. If measures used do not accurately reflect individuals’ perceptions of their accessibility then the cross sector, social inclusion objectives of Accessibility Planning, such as reduction of unemployment, missed appointments or those not in education or training, may not be realised.

For the first stage of this research, a categorisation of tools used and techniques applied to accessibility problems has been developed. This characterises international approaches, both theoretical and applied, to measurement in terms of their practicality, geographical coverage, data requirements and relation to desired outcomes, in order to understand the current application of accessibility in transport planning and where there are gaps in understanding and measuring the aspects of accessibility that are important to individuals in their everyday mobility. This paper presents this categorisation of tools, techniques and data available to accessibility planning and areas for future research are outlined in terms of understanding the difference between current, often time based objective measures and individual perceptions or the “lived experience” of accessibility.

Introduction

This paper takes a broad overview of both theoretical approaches to measuring and evaluating accessibility, and the practical application of these in transport planning. The aim is to explore the international literature relating to accessibility, its measurement and different applications and in doing so to develop a deeper insight into: understandings and approaches to measuring accessibility; the development of accessibility in transport planning in the UK and elsewhere; and the importance of understanding individual perceptions of accessibility and how these may be at variance with objectively measured accessibility.

The paper begins with an overview of definitions and approaches to measuring accessibility, before discussing a categorisation of data, tools and techniques employed in understanding it. The next section then looks at how accessibility has been incorporated into transport planning practices in the UK and elsewhere, and then the final section highlights areas of further research and proposes a methodology for future work.

Definitions and Measurement of Accessibility

There is no universal agreement regarding the definition of accessibility in transport studies and the concept has been understood and applied differently by people at different times and in different places. To take the dictionary definition, accessibility is “*The quality of being accessible, or of admitting approach*”; and accessible is defined as 1) “*capable of being used as an access; affording entrance; open, practicable*” or 2). “*capable of being entered or reached; ease of access; such as one can go to, come into the presence of, reach, or lay hold of; get-at-able.*” (Oxford English Dictionary) In this sense then, accessibility might be interpreted as the extent to which something is accessible. In the context of transport planning it has generally been understood more specifically as the ability of people to access places, with transport as the main means by which this accessibility is provided, though virtual mobility may mean that transport is no longer always necessary. Geurs and Ritsema van Eck (2001) define accessibility as “*the extent to which the land-use transport system enables (groups of) individuals or goods to reach activities or destinations by means of a (combination of) transport mode(s)*”. The Social Exclusion Unit (SEU) defines accessibility as the “ease with which

people can access goods and services” and asking “can people get to key services at reasonable cost, in reasonable time and with reasonable ease?” (SEU, 2003) Defining accessibility in this way makes it more difficult to measure as „ease” and „reasonable” will be interpreted differently depending upon the individual context.

In order to develop a practical application there is a need to develop an appropriate and meaningful measure of accessibility that can be utilised in planning and policy decisions and measure variation both temporally and spatially. This raises a number of issues, including what do we want to measure? What can be measured? and, what are the theoretical and technical implications of applying these measures? The answer to most of these questions will be dependent upon the adopted definition of accessibility. Given the wide ranging definitions of which exist, it is no surprise that there are various approaches to measurement.

Vandenbulcke et al (2009) suggest that the concept of accessibility is determined by four interdependent components: A *transport* component (transport system); A *land-use* component (the magnitude, quality and characteristics of activities found at each destination); A *temporal* component (availability of activities); An *individual* component (needs, abilities and opportunities of individuals). It would therefore follow that any measurement of the concept should include each of these four aspects. However, as is highlighted later, few measures incorporate all of these four components, with there often being trade-offs between which of the above aspects are included and the practical application of a technique.

Classical approaches to measuring accessibility include Hansen (1959) and the time-space geography of Hägerstrand (1970). Hansen developed a measurement of accessibility to be used in development control and town planning based on a definition of accessibility as the potential of opportunities for interaction. His formula was based on “*accessibility at point 1 to a particular type of activity at area 2 (say employment) is directly proportional to the size of the activity at area 2 (number of jobs) and inversely proportional to some function of the distance separating point 1 from area. The total accessibility to employment at point 1 is the summation of the accessibility to each of the individual areas around point 1. Therefore as more and more jobs are created nearer to point 1 the accessibility to employment at point 1 will increase.*” (Hansen, 1959)

Hägerstrand (1970) introduced the concept of time-geography and space time. This is based on individual travel spaces and takes into account daily scheduling. Extensive work has been undertaken, particularly utilising travel diary data in the US, and such an approach provides a much greater insight into the individual constraints and difficulties faced in day to day travel. However, there is limited evidence of this approach being applied in practice, perhaps due to the data requirements and the difficulty of developing policy to address individuals’ issues. More recently, however, this approach has been somewhat revived with advances in GIS technology and processor capabilities which mean that much more data can be handled (Kwan & Weber, 2003).

Various papers have provided summaries and classifications of accessibility measures and these are detailed in the following section. However, as explained in the review of techniques below, analysis of accessibility should not be limited solely to such measures, as often simplifying the concept into a measure means that some issues are not fully represented.

Categorisation of approaches to Accessibility Planning and Analysis

The aim of this section is to understand current applications and approaches to accessibility analysis, the tools available for this and techniques applied to measure and understand the problem as well as the datasets currently used. A categorisation was developed as follows: Empirical studies relating to assessing accessibility have been found from reviewing academic and policy literature. From this initial review, techniques used in accessibility assessment and analysis were identified, as well as the tools used to support these techniques and the various data inputs required.

Techniques are defined as measures, or methods applied to understanding accessibility and consist of measures such as gravity and activity based measures, as well as approaches such as statistical analysis, interviews, questionnaires or focus groups.

Tools are software packages or policy tools available to researchers and practitioners to measure and understand accessibility, and include generic tools such as GIS and more bespoke tools developed for specific purposes.

Data relates to the various data types and sources used in and required by the tools and techniques and includes specific data sets and generic data types.

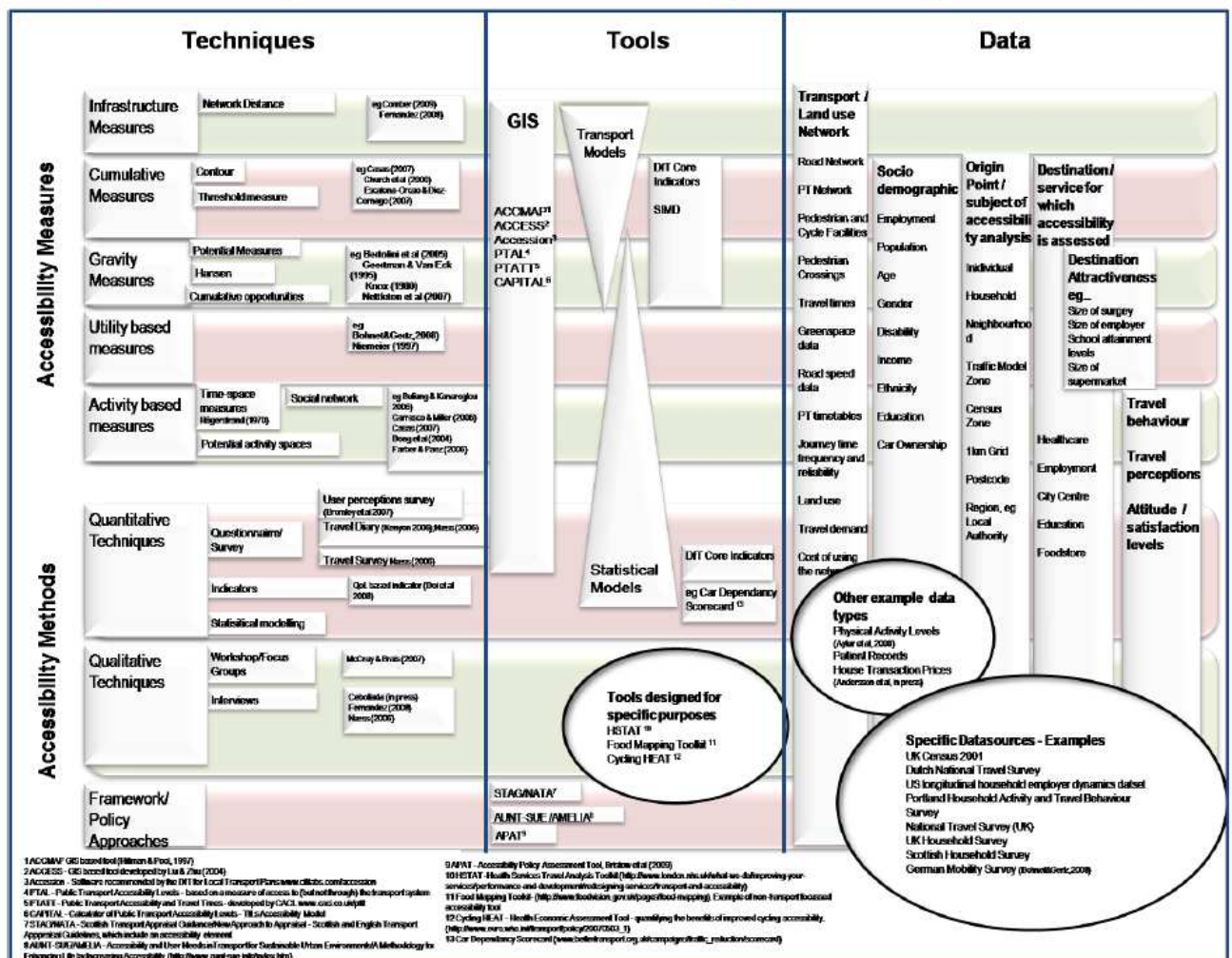
Techniques require tools in order to be operationalised, and tools require a technique, method or theoretical underpinning on which to be based. Both tools and techniques require data inputs. The studies found in the literature both fed into developing the categorisation, and also provide example applications of tools and techniques. It should be noted that the examples chosen from the literature

are by no means exhaustive but have been chosen based on an initial literature review and to cover as wide a range of applications, measurement types and approaches as possible, internationally. Studies found in the literature were reviewed based on the following criteria;

- Geographical Location (Continent and Country)
- Geographical coverage of study (eg city/region/neighbourhood)
- Scale of analysis used (eg individual/household/neighbourhood)
- Type of technique (measure or method of analysis used)
- Tools used
- Data requirements
- Availability of data (cost/time series/age)
- Socio-demographic categories used
- Service specific/destination type (eg employment/healthcare)
- Theoretical or applied study
- Outputs
- Relation to desired outcomes
- Limitations

Figure 1 shows the categorisation and links between techniques, the tools used and data requirements and availability, and the relationships between these. The following sections discuss these in more detail.

Figure 1 - Techniques, tools and data that have been applied to the analysis of Accessibility



Techniques

This section reviews the various techniques applied to accessibility analyses. As shown by Figure 1 these comprise both accessibility measures and methods. Measures are explained below and have been categorised in various ways. However, what this review has identified is that approaches to analysing accessibility are not limited to the use of such measures, and that various other techniques are also employed. These are termed “accessibility methods” and are split into quantitative and qualitative approaches.

Vandenbulcke et al (2009) categorise approaches to measuring accessibility into four main types: *infrastructure* based measures; *activity* based measures; *person* based measures; and utility based measures. Handy & Niemeier (1997) classified measures as follows: *cumulative* measures; *gravity* based measures; and *random utility* theory. Geurs & van Eck (2003) provide a detailed overview of accessibility measures, classifying these into *infrastructure* based, *utility* based, and *activity* based. Geurs & van Wee (2004) add *personbased* measures to this earlier classification. Baradaran & Ramjerdi (2001) categorise measures into: *travel-cost*, *gravity*, *constraints-based*, *utility-based* and; *composite*. In a review of accessibility measuring techniques Halden et al (2000) categorised measures into *simple* measures, *opportunity* measures and *value based* measures. It can be seen that not only are there considerable different approaches to measuring accessibility, but also that these have been categorised and defined in numerous ways.

The various approaches differ in their level of complexity and ease of practical application as summarised here;

- *Infrastructure* based measures relate to the performance of the network and therefore might include measures used in transport modelling such as capacity, or in terms of public transport frequency or reliability.
- *Cumulative* measures which represent the accessibility at a location (origin) to another (destination) and are the most easily understood measures. These are often also described as contour measures, due to the contour maps produced.
- *Gravity* based measures are an extension of cumulative measures, but weight opportunities by an impedance factor and the attractiveness of the destination (e.g. Hansen’s measure), and may also be called opportunity or potential measures.
- *Utility* based measures consider travel behaviour in terms of selecting the location based on economic principles of diminishing return and the likelihood of an individual making a certain choice is based on the attractiveness of that choice in relation to all options.
- *Activity* based measures relate to the level of access to spatially distributed activities, and so considers travel through the network. Time space measures fall into this category.

While activity and utility based measures provide a better theoretical underpinning and reflect behaviour, they are rarely used in practical applications due to the data intensity of such measures. As a result of this, cumulative or contour measures are much more common in practical applications (Geurs & van Eck 2003). In addition to the five categories of accessibility measure outlined, Figure 1 shows that there are other methods applied to analysing accessibility that do not fall within the existing categories of accessibility measures.

- *Quantitative* Techniques. These include the use of indicators, statistical modelling and surveys.
- *Qualitative* Techniques include for example focus groups, workshops and interviews and the resulting analysis which allow problems of accessibility to be understood.

The majority of studies reviewed that use some kind of accessibility measure are based on cumulative opportunity, potential, gravity measures, following Hansen (1959) or focus on individual time-space measures of accessibility following the time-space geography of Hägerstrand (1970). Which measure is utilised clearly relates to the aims and objectives of the study, with strategic, destination based studies using cumulative or contour measures, origin based studies of accessibility using potential or gravity based measures, and more individual level studies using activity based measures. In addition to accessibility measures, social indicators, such as Indices of Multiple Deprivation (IMD) are often used to assess accessibility. These are useful where data availability is limited, and an accessibility measure specific to the research problem cannot be calculated, therefore substitute or proxy datasets are often used.

It must be noted that there is some overlap here, and that such indices may be based upon accessibility indicators (eg Scottish Indices of Multiple Deprivation), or indeed an index may feed into an accessibility measure. Additionally techniques such as travel diaries and associated statistical

analysis may be seen as techniques in their own right but may also feed into, or include within them some measure of accessibility. The categories are not therefore mutually exclusive.

Qualitative assessments of accessibility include those based upon interviews, focus groups or workshops, amongst others. These provide an important dimension to understanding individual accessibility. As suggested by Handy & Clifton (2001) often the best approach is a combination of techniques with an initial accessibility assessment, which is enriched by local case studies. Similar to techniques based on time space geography, qualitative methods are best placed to understand detailed accessibility requirements, but the tools for implementation are less developed in a practical sense. Framework and policy approaches as outlined in Figure 1 include those that incorporate more than one technique, for example combining accessibility measures and quantitative statistical analysis to form policy decisions. These are discussed in the tools sections below.

Tools

Tools are used to enable an accessibility technique to be operationalised, and therefore require some form of theoretical underpinning. A variety of tools have been developed to enable analysis of accessibility problems, as shown in Figure 1. One of the most commonly used tools is some form of Geographical Information System (GIS), and the majority of studies covered by this review utilised GIS to implement accessibility techniques. Standard GIS packages such as ArcGIS are commonly used, as well as there being a number of specifically developed packages as shown. Those commonly used in the UK include Accession (www.citilabs.com/accession) PTAL (Public Transport Accessibility Level) and CAPITAL (Calculator for measuring Public Transport Accessibility in London, Church et al, 2000)

Transport Models can be used to provide an understanding of the level of accessibility provided by the transport system, and therefore are most suited to calculate infrastructure measures such as congestion levels or network distances. The coarse scale of analysis of such models means they are more likely to be used to assess high level strategic accessibility rather than understand individual's accessibility problems, and therefore have less influence on more disaggregate measures as shown in the diagram. Likewise statistical models based on individual level data and techniques such as multilevel modelling are used more frequently in quantitative studies and more complex measures such as activity utility based measures.

The National Core Accessibility Indicators (DfT, 2008) and tools such as Accession are useful in the UK as they provide public transport accessibility calculations based upon timetables. As can be seen from Figure 1 these indicators are based upon cumulative and gravity measures, as well as falling into the indicators category, showing that there is some overlap in types of tool. Another example of the use of statistical indicators is the „Car Dependency Scorecard“ developed by the Campaign for Better Transport, which used a variety of data sources to develop an index of the level of non-car accessibility in English regions. In addition, there are often tools developed for specific purposes, such as the Health Services Transport Analysis Toolkit (HSTAT) developed by NHS London (2008) which is designed to analyse the effects of health service re-design on people's travel options and times, and a number of Primary Care Trusts (PCTs) have begun to utilise location planning software which accounts for public transport accessibility. The Food Mapping Toolkit provides the tools to identify areas with access to poor food and appraise the impact of new food projects (Foodvision, 2009). Such examples show the consideration of accessibility in non-transport sectors.

There are also tools such as transport appraisal frameworks (STAG/NATA) and the AMELIA tool developed as part of the AUNT-SUE project, as well as Accessibility Policy Appraisal Tool, which are more wide ranging and allow a variety of techniques to be combined to evaluate the impact of proposed transport schemes or policies on accessibility. In order to be effective such tools need to be based on robust assumptions and datasets.

Data

The types of data used in accessibility studies are wide ranging. These have been categorised into main types shown in Figure 1. It must be recognised that these categories and examples of data are not exhaustive but show the range of studies covered in this review and data found to be typically used for studies into accessibility, or which have the potential to be used. Types of data used vary in terms of their level of detail, availability, coverage and recentness. The type of data required is dictated by the type of measures being applied and the tools used, but also that the reverse is often true, whereby the data availability drives the decision regarding the tools and techniques to be employed. If this is the case it is vital to ensure that the data that is being used is appropriate to the research questions and desired outcomes, otherwise there is potential for inappropriate conclusions based on limited available data.

There are a number of national data sets that are periodically updated and which provide data useful for analysing accessibility (eg National Travel Surveys, Censuses). However, given that such datasets

are rarely designed for this specific purpose and are reported at quite coarse scales they are not always particularly appropriate, and data is often used as proxies for required information (eg car ownership used for low income and poor accessibility). However the advantage is their ease of availability and low cost. On the other hand, specialist data sets such as the 1994 Portland Household Activity and Travel Behaviour Survey (e.g. Farber and Páez, Buliung and Kanaroglou, 2006) have provided for many detailed studies into accessibility, with the disadvantage that they are expensive to conduct and as a result not regularly updated, so that the data is often quite old when it is used. Use of GPS in conjunction with GIS offers the potential for collection of such data to become more commonplace and there have been some studies using such data (Schönfelder & Axhausen 2003). Liu & Zhu (2004) suggest an accessibility measure may include seven aspects: definition of a spatial unit for analysis; definition of socio-economic groups; Type of opportunities; Mode of travel; definition of origins and destinations; measurement of attractiveness and; travel impedance. This is reflected in the range of data inputs used in accessibility studies in this review, in that the range of aspects that make up a measure relate to its data requirements. It is important to consider the appropriateness of the data sets being used, both to the type of technique and also the desired outcomes of a study. Figure 1 shows that time-space measures are the most data intensive, requiring detailed travel diary data, whereas infrastructure and cumulative measures are the least data intensive and can often be calculated using existing datasets such as GIS layers of road networks and destination types. Although not included in the diagram, there are a number of other datasets that have potential to be used in studies of Accessibility, but for which no examples have been found. For example, crime, noise, environmental, street condition and street lighting data, all are identified to impact on people's accessibility levels.

Summary of review of accessibility studies

A wide range of international studies were reviewed, covering Europe, North America, Asia and Australasia. However, the vast majority of studies included in the review were from Europe (50%) and North America (38%), partly as a result of language and possibly publishing practices but also reflective of the quality of data available for such studies in these regions and the consideration of accessibility issues in transport planning. While academic literature is internationally available, sourcing "grey" policy literature from outside the western, English speaking world is more difficult. 30% of those reviewed were studies in the USA and 24% in the UK, with Germany, the Netherlands, Sweden and Norway also being important in European Studies. It is important that this bias in terms of geographical location is remembered when considering conclusions.

The scale of measurement is important in any study of accessibility and can affect the outcomes significantly. The studies covered in this review vary in scale from the individual household level, through neighbourhood, census zones to the whole city/region scale. A popular scale of analysis is the census zone or traffic model zone due to the relatively easy availability of secondary data at these scales, particularly in the USA and UK where many of the studies are undertaken. Activity based and qualitative approaches are able to consider the individual level of accessibility, but are more difficult to transform into policy applications than more aggregate measures based on quantitative techniques or cumulative measures.

Where analysis is undertaken for sub-sections of society the focus is on groups seen as being at risk of experiencing poor accessibility or exclusion from accessing facilities. Analysis has been undertaken for socio-demographic groups based on criteria such as ethnicity, income, disability, employment, education, age (elderly and young adults), gender and no car households. However, it is important to note that there may not be noticeable differences in spatially measured accessibility of different socio-demographic groups, particularly if they are not geographically concentrated (Hine and Grieco, 2003) and also that not all people within a certain group will experience the same levels of accessibility.

Interestingly, despite work being undertaken to understand how attitudes and perceptions affect transport decisions (Anable 2005, Rajé 2007) limited evidence has been found of such an approach to understanding people's perceived levels of access to facilities. In other words, accessibility analyses tend to be based on analysing pre-determined social grouping, rather than examining levels of accessibility, subjective or objective, prior to drawing conclusions about the likely outcomes.

Examples of accessibility to a wide range of destination types has been found in the studies reviewed, including: employment; city centres; greenspace; health (GP, pharmacy, hospital, primary care); social activities; retail; education (schools); and post offices. Similarly much analysis undertaken as part of the Local Transport Planning process in England has focussed on specific facilities, such as healthcare, education or employment (Atkins & CRSP, 2008) However, it must be recognised that individual's perceived accessibility and daily travel patterns are not likely to be influenced by the levels of access to one particular type of facility, but of all the facilities they need to access. This is considered by activity based, individual accessibility measures based on time-space geography which

consider daily activity patterns, trip chaining and potential path areas. However, such measures are much more difficult to operationalise into a practical measure useful in planning applications due to the heavy and costly data demands, as well as the difficulty of translating understanding of individual accessibility needs into strategic planning decisions.

The mode of travel considered by studies also varies, with many studies investigating accessibility by car, public transport or walking in isolation from other modes. Interestingly the US focussed studies are heavily car-centric, with transit (public transport) based accessibility only being considered in the case of studies focussing on groups with low car availability. More advanced GIS techniques mean that there are techniques which allow assessment of multi-modal accessibility (Kwan & Weber, 2003) although on the whole it is deemed more appropriate to consider car and public transport separately due to the differing nature of mobility and accessibility provided by the two modes. Likewise, walking is usually only considered in small scale local studies or as part of a public transport journey.

Throughout the literature various applications of accessibility assessments and measures have been found. These are predominantly in transport appraisal, land-use planning/allocations, understanding transport behaviour, policy evaluation and as social indicators. The research question and type of application often defines and drives the decision regarding the type of measure to be used, the scale of analysis and the data inputs. However, it is also true that often the data and tools available dictate the way in which accessibility is understood and applied. It is therefore necessary to understand the ways in which these interactions work and identify gaps in data availability and ways of measuring, and therefore how outcomes can be improved.

There are some measures, such as time-space measures and utility measures, which while having a good theoretical underpinning, and arguably more appropriate for analysing some accessibility problems are less used in practical application, possibly because the tools do not exist to implement them and the data requirements are too heavy. Following the criteria outlined by (Vandenbulcke et al. 2009) and discussed in the first section, most measures used include a transport component and a land use component, but fewer include a temporal component and even fewer an individual component. This highlights the tension between developing a theoretically robust measure and one which can be applied in practice. The review of tools shows that tools are often developed for a specific purpose and it is therefore important that tools appropriate to desired outcomes are available.

Use of data, tools and techniques in Accessibility Planning

The above section has reviewed the use of data tools and techniques in empirical studies of accessibility in the literature. However, in order to address the original aim of this paper, the usefulness and relevance of these to Accessibility Planning needs to be understood.

The advent of Accessibility Planning as a formal requirement in the UK came about as a result of New Labour's social exclusion agenda. This has resulted in the inclusion of Accessibility Strategies within Local Transport Plans in England, and greater consideration of accessibility and inclusion issues with Scotland's Transport Appraisal Guidance (STAG). This has brought about a more people focussed accessibility agenda, focussing on the ability of people to participate in society, and using accessibility planning as a mechanism for promoting social inclusion, with the aim of ensuring barriers to accessing key facilities are reduced, especially for those most at risk of social exclusion

The FIA Foundation (2007) examined the consideration of social exclusion issues in transport across seven nations: USA; Canada; France; UK; Germany; Japan and Italy. It suggests that the UK is unique and ahead of other nations in considering access to a range of services, such as healthcare, education and healthy food in the context of social exclusion. In the other nations, only access to employment was usually considered in the context of promoting inclusion, and France and the USA were seen to be most advanced in this area, through the Transport Equity Act and welfare to work schemes in the US.

Many studies relating to the Netherlands are heavily land use focussed, suggesting accessibility is considered more in the context of sustainable land use planning, and the accessibility of destination, rather than people. The same is true in South East Asia, where Light Rapid Transit schemes have been justified on the basis of improving the accessibility of a city centre. In North America and Australia, accessibility measures have tended to be car focussed. However, more recently work has been undertaken focussing on the public transport and social inclusion aspects of accessibility, drawing more similarities with work in the UK. For example, a study of women and low income group's use of public transport in Quebec City (McCray and Brais, 2007).

„Making the connections“ (SEU 2003) highlighted five key barriers to access that might be considered when assessing accessibility. These are; *Journey time, cost, physical availability of services, safety and security, and travel horizons*. An evaluation (Atkins & CRSP, 2008) of all English Accessibility Strategies submitted as part of the 2006 LTP process in England found that the majority of targets were time threshold based. Such threshold based measures do not assess the complex social

interactions, perceptions and behaviours which influence travel and ultimately the accessibility of individuals. For example, there is an assumption that because a public transport service exists then it can be used, but as noted by (Weber & Kwan, 2003) *“individual household measures, or individual characteristics such as gender, age, income and number of households are more important than the urban environment and differences between individuals can have vast impacts on their personal accessibility.”* Hine & Grieco (2003) suggested that much of the evidence on which Accessibility Planning in the SEU report is based was anecdotal. While accessibility audits, and use of tools such as GIS are useful in identifying accessibility problems, and raising awareness with stakeholders, it is however important that these do not lead to the kind of „black box“ approach feared by (Lucas 2006) who highlighted that *„however sophisticated the model, it will be unable to identify people’s actually activity patterns, or other „softer“ barriers to access such as low travel horizons, cognitive and mental mapping abilities, which can often be more of a barrier than the availability and timing of transport services ,”* and aggregate analysis of problems that are often not spatially or socially concentrated (Preston & Rajé 2007). However, with the time consuming use of such tools it is all too easy for them to be seen as providing the answer, rather than placed in context.

It is important to remember that *„an accessibility measure is only appropriate as a performance measure if it is consistent with how residents perceive and evaluate their community “* (Handy & Niemeier 1997). This highlights the need to incorporate perceptions and subjectivity into accessibility measures, because while accessibility is a geographical problem, it is also a social one, so two people in the same place may experience different “accessibilities” (Handy & Niemeier 1997) and equally the same person will experience different accessibility dependent upon the place they are in at any given time. Rajé (2007) identified a major consultation gap between users of the transport system and planners, and suggested that that existing methodologies under-record and under-represent the barriers to mobility experienced in everyday life. There is therefore a need for transport policy and practice to be informed by local experience.

Straatemeier (2008) recognises that accessibility is a theory not well applied in practice and looks at ways of using it in practice in the Netherlands. Also in the context of the Netherlands Bertolini et al. (2005) describe the challenge to find the balance between theoretical concepts of accessibility and one that can be applied in practice, in the Dutch context of accessibility in transport and land use planning. Furthermore, Handy & Niemeier (1997), point out that concepts of accessibility have rarely been translated into performance measures by which policies are evaluated and thus have had little practical impact on policies. While there has been progress since this observation in 1997, it is debatable whether the concepts of accessibility have directly translated into the performance measures by which they are evaluated. Often the measures used to assess accessibility interventions are not related to the outcomes they seek to achieve.

Conclusions and Future Work

The above section has highlighted issues with current policy approaches to analysing accessibility in that they do not reflect the experience and perceptions of individuals, or what is important to them in making travel choices. It is important to understand local level, household and individual accessibilities in addition to the aggregate, national or regional picture if we are to properly understand the relationship between accessibility and associated outcomes, and therefore target interventions appropriately. This idea is not new. Morris et al. (1979) wrote that *“perceived accessibility and perceived mobility – the real determinants of behaviour – will be at variance with “objective” indicators of accessibility and mobility.”* Despite this there is still little practical understanding of how they vary. Differing accessibility needs, requirements and expectations should inform how we understand accessibility. While there is a normative view that accessibility is always good (Ross, 2000) for some people rurality and tranquillity may be more important and valuable than accessibility.

While recognising the importance of subjective measures, it is also necessary to remember the value of objective measurements, and their importance in policy development. Stanley & Vella-Brodrick (2009), explain that; *“while the subjective perspective is important, such measures do not account for value-based social policy social justice principles....an individual may be personally satisfied with their circumstances if they have diminished capabilities, social justice dictates that they should be offered the choice to be able to participate fully in society. This position subsumes the value judgement that it is not sufficient to allow people to simply adjust or accommodate to adverse circumstances”* (Stanley & Vella-Brodrick 2009). This suggests that simply using subjective measurements would not be an appropriate policy response due to the tendency of people to adjust to adverse circumstances, and perhaps under-assess their need. In addition objective measurements, against which progress can be monitored is a requirement of government policy. A method incorporating both objective and

subjective measures would therefore be best placed to deepen our understanding of accessibility and enable interventions to be appropriately targeted.

From the review work to date it seems that while there is a considerable body of work attempting to develop objective measures of accessibility and equally those that seek to understand people's perceptions and experiences of travel, there is limited work that directly compares the two approaches to understanding accessibility for the same people or places. Exceptions include Lotfi & Koohsari (2009) and van Exel & Rietveld (2009). Lotfi & Koohsari (2009) use three objective measures (Infrastructure, Activity and Utility based) and compare these with a subjective approach based on interview and questionnaire data. What they find is that those areas with the highest "measures" of accessibility are not perceived as such by residents (in terms of satisfaction with access to facilities) due to issues of safety and security. van Exel & Rietveld (2009) investigate transport choice sets for commuters, and found that the ratio of perceived to objective travel times strongly influenced modal choice. Car users over-estimated objective public transport times by 46%. This shows that if more can be done to understand the difference between perceived and policy measured accessibility, then improvements in perceived, and therefore realised accessibility, may be achieved.

It is therefore proposed to undertake a mixed methods, case study approach to understand how perceived or "lived" accessibility differs from currently used objective measures. Current approaches have been reviewed based on their practicality, data requirements, outcomes. However, a greater understanding of links to policy outcomes will be gained following engagement with practitioners. This will feed into development of an objective measure and fieldwork to ascertain individual perceptions and subjective accessibilities. The factors accounting for differences between the two approaches will then be investigated.

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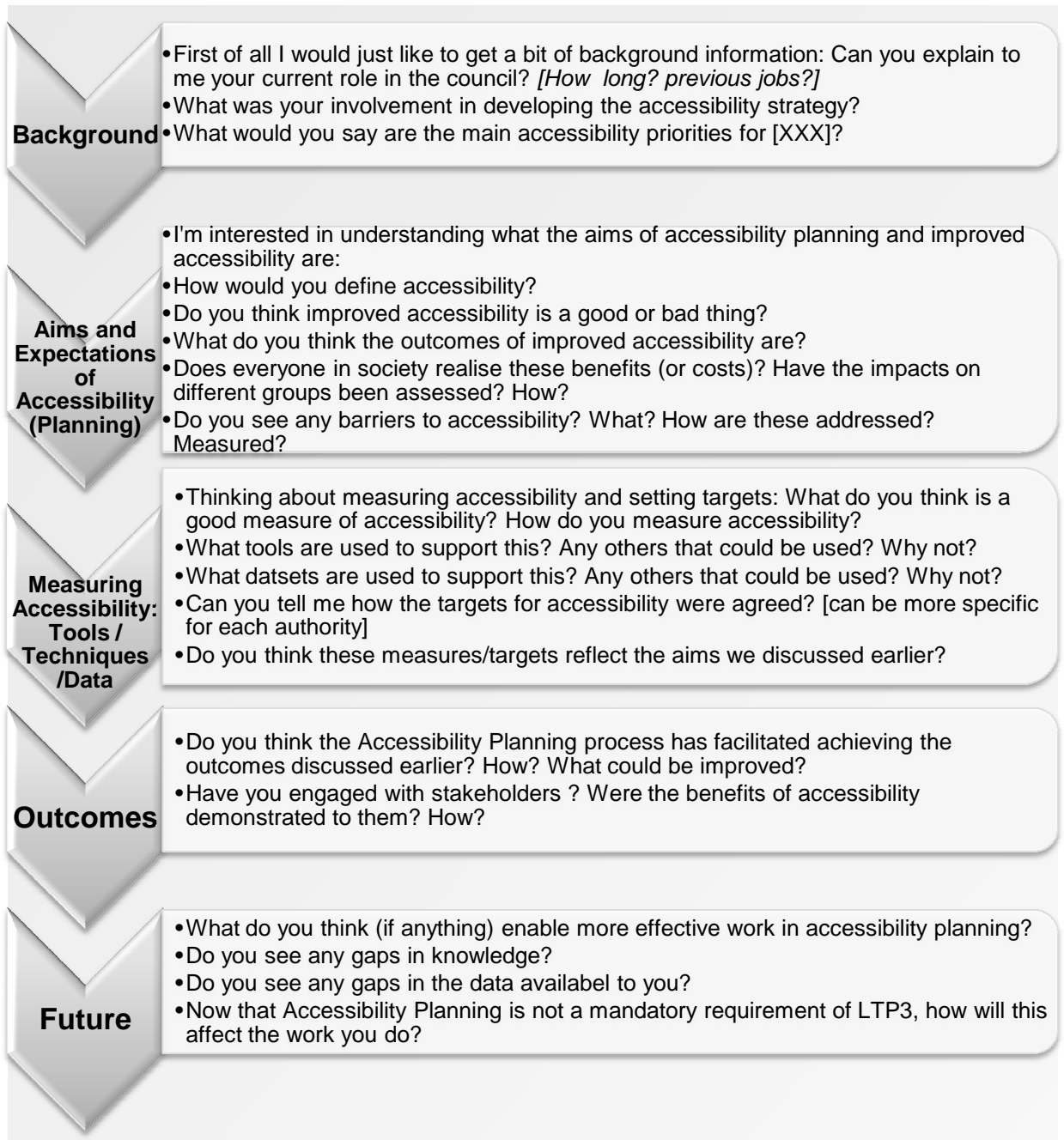
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Appendix C: Practitioner Interview Guide



Appendix D: Household Survey Questionnaire



Survey of Access to Local Services

Dear Householder,

The Centre for Transport Research at the University of Aberdeen is undertaking this survey to better understand how people perceive their ability to access important destinations. As a thank you for taking part there is an opportunity to enter a **prize draw** to win one of 3 gift cards for the Victoria Shopping Centre, Nottingham - just in time for Christmas. More information is on the last page.

We are particularly interested in what you have to say because your household is located within a carefully selected sample area. We would therefore very much appreciate your time and effort in filling out this questionnaire. This should take about **15-20 minutes** of your time.

It is important for us to understand how you travel to and access certain destinations so that facilities and transport can be planned to better meet your needs. We are interested in your opinions and observations - there are no 'right' or 'wrong' answers so don't worry about spending too long on any question, often your first impression is best. If you don't feel you can answer a particular question or it is not relevant to you leave it blank.

Any adult member of the household can complete the survey. If more than one member of your household would like to complete this survey they can do so online (www.abdn.ac.uk/~r01amc8) or by requesting an additional copy to be posted to your address using the contact details below.

Any information you provide will be used only by the Research Team and only for the purposes of this research. The data you give us about the identity of individuals and their personal and sensitive personal data, will be held securely in terms of the Data Protection Act 1998 by the University of Aberdeen (the Data Controller) for the purposes only of this research and will be destroyed when the research conclusions and results are finished. Any publication of the research results will be anonymised and will not be able to be used to identify you or to be linked to you or your family in any way.

Please post the completed questionnaire back to us by **Friday 17th December**. Stick the enclosed pre-printed freepost address label over your address on the envelope we posted the survey out in to help reduce wasted paper. If you prefer to fill it in online please go to www.abdn.ac.uk/~r01amc8/survey and enter the number in the top right of this page when prompted for a code. This code only identifies the area you live in for analysis purposes and not your household.

Thank you in advance for your help - it is very much appreciated.

If you have any questions or want to request another paper copy of the survey please contact:
Angela Curt by telephoning 01224 273772 or email: angelacurt@abdn.ac.uk
Centre for Transport Research, Department for Geography & Environment, St Mary's, Edgemont Road, Aberdeen, AB24 3UF

Complete this survey online www.abdn.ac.uk/~r01amc8/survey - Enter the code at the top right of this page

Section 1 - How do you get around?

This section is to help us understand how often you travel, the places you need to get to and how you get there.

Do you hold a driving licence?

 Yes

 No

Do you have a car available for your personal use as driver or passenger on a daily basis?

 Yes

 No

How many cars are available for use by members of your household?

 None

 1

 2

 3+

Thinking about your typical travel habits over the last year, how often do you travel by?

	1-7 days a week	2-4 days a week	About once a week	1-3 days a month	Less than once a month	Never
Walking to/from a destination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car as driver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car as passenger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Train	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tram	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Taxi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Please State)

Thinking of your typical travel habits over the last year, how often did you travel to?

	1-7 days a week	2-4 days a week	About once a week	1-3 days a month	Less than once a month	Never
Doctor's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hospital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supermarket	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nottingham City Centre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Primary School	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Secondary School	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
College	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How would you usually travel to each of the following places?
 (Think about the main mode. The main mode is the mode that covers the greatest distance, so for example if you cycle to the station, catch a train, then walk to work, the main mode would be train)

	Walk	Cycle	Train	Bus	Taxi	Car as driver	Car as passenger	Taxi	Never get there
Doctor's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hospital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supermarket	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nottingham City Centre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Primary School	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Secondary School	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
College	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have anything else to say about the topics raised in this section?

Section 2 - How easy is it for you to get to places?

This section is to help us understand how easy it is for you to get to local services and how satisfied you are with transport in general. We know from Section 1 how often you go to each place and what modes of transport you use, so please try to answer even for places or transport modes you don't use often or at all.

How satisfied are you with the following?

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Ease of getting to places I need to get to	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provision of Public Transport in your local area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The range of local facilities available to suit your needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
It is easy for me to get to.....					
the doctor's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
the hospital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
the supermarket	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nottingham City Centre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
the primary school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
the secondary school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
college	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
In general, it is easy to get to places I need to go to by..... public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
car	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
walking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
cycling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have anything else to say about the topics raised in this section?

Section 3 - What do you think about the trips you make?

This section is to help us understand how you feel about the way you travel to your local services. It would be helpful to have your opinion even if you don't often use a mode of transport or destination.

First of all how would you describe WALKING to local destinations?
Indicate your position by circling a number between the two viewpoints.

Unenjoyable	1	2	3	4	5	Enjoyable
Dangerous	1	2	3	4	5	Safe & Secure
Unreliable	1	2	3	4	5	Reliable
Expensive	1	2	3	4	5	Cheap
Inconvenient	1	2	3	4	5	Convenient
Slow	1	2	3	4	5	Quick

What about PUBLIC TRANSPORT to local destinations?

Unenjoyable	1	2	3	4	5	Enjoyable
Dangerous	1	2	3	4	5	Safe & Secure
Unreliable	1	2	3	4	5	Reliable
Expensive	1	2	3	4	5	Cheap
Infrequent	1	2	3	4	5	Frequent
Inconvenient	1	2	3	4	5	Convenient
Slow	1	2	3	4	5	Quick

And how do you feel about travelling by CAR to local destinations?

Unenjoyable	1	2	3	4	5	Enjoyable
Dangerous	1	2	3	4	5	Safe & Secure
Unreliable	1	2	3	4	5	Reliable
Expensive	1	2	3	4	5	Cheap
Inconvenient	1	2	3	4	5	Convenient
Slow	1	2	3	4	5	Quick

We'd like to get a feeling for how long you think certain journeys might take. For example, Joe needs to arrive by 9am, he knows it take 5 minutes on the bus, but might allow 15 minutes for the journey in total because the bus might be late and he has to walk for a few minutes at either end of the journey. He knows it usually takes about 10 minutes in the car and as he isn't sure about walking he guesses 25. Joe's answers would look like this

	walking	Public Transport	By car
10 GP	25	15	10

How many MINUTES would each of these journeys take you if you had to arrive at 9am? Try to estimate how long you would allow for each journey even if you don't usually go there or use that particular mode of transport. Leave blank, if, for example it is not possible to get there using public transport.

	walking	Public Transport	By car
Doctor's	<input type="text"/>	<input type="text"/>	<input type="text"/>
Hospital	<input type="text"/>	<input type="text"/>	<input type="text"/>
Supermarket	<input type="text"/>	<input type="text"/>	<input type="text"/>
Nottingham City Centre	<input type="text"/>	<input type="text"/>	<input type="text"/>
Primary School	<input type="text"/>	<input type="text"/>	<input type="text"/>
Secondary School	<input type="text"/>	<input type="text"/>	<input type="text"/>
College	<input type="text"/>	<input type="text"/>	<input type="text"/>

Just so we know where you were thinking of can you tell us the name, street-name or neighbourhood you were thinking about for each of the destinations.....

Doctor's	<input type="text"/>
Hospital	<input type="text"/>
Supermarket	<input type="text"/>
Primary School	<input type="text"/>
Secondary School	<input type="text"/>
College	<input type="text"/>

Are the places you listed above the ones nearest to you, ones you usually use, or both? If you don't use your nearest it would be helpful if you could write a few words to help us understand why - reasons for this might be travel or non-travel related.

	Is this the one you usually use? (Y/N)	Is it your nearest? (Y/N)	I don't use my nearest because.....
Doctor	<input type="text"/>	<input type="text"/>	<input type="text"/>
Hospital	<input type="text"/>	<input type="text"/>	<input type="text"/>
Supermarket	<input type="text"/>	<input type="text"/>	<input type="text"/>
Primary School	<input type="text"/>	<input type="text"/>	<input type="text"/>
Secondary School	<input type="text"/>	<input type="text"/>	<input type="text"/>
College	<input type="text"/>	<input type="text"/>	<input type="text"/>

Thinking about travelling from your home, how accessible do you consider the following to be in general, even if you don't use them often?

	Difficult to access (1)	(2)	(3)	(4)	Easy to access (5)
Places you need to get to on a regular basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doctors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Your place of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hospitals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supermarkets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Primary Schools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Secondary Schools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colleges	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nottingham City Centre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The job market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How far do you agree with the following statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I need a car to do most of the things I do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would travel further each day if it meant I could live in a nicer area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I like my neighbourhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I care about the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
People without a car are at a disadvantage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I know my neighbours well	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can reach important places by foot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The buildings, streets and public spaces in my neighbourhood make it a pleasant place to live	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is a good sense of community in my neighbourhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall, I can easily access goods and services essential to my needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have anything else to say? Use this space if you have any further comments about this section.

Section 4 - Finally, just a few questions about you....

This section will help us understand a little bit about you so that we can understand if particular types of people have similar views.

Are you...?

 Male

 Female

What year were you born?

Are you?

- | | | |
|--|--|---|
| <input type="checkbox"/> Employed full time | <input type="checkbox"/> Looking after family or home/not seeking work | <input type="checkbox"/> Part time education |
| <input type="checkbox"/> Employed part time | <input type="checkbox"/> Retired | <input type="checkbox"/> Long term sick or disabled |
| <input type="checkbox"/> Unemployed and seeking work | <input type="checkbox"/> In full time education | <input type="checkbox"/> Other |

Please tell us your highest educational qualification

- | | |
|---|--|
| <input type="checkbox"/> Postgraduate Degree | <input type="checkbox"/> Secondary School (eg. Standard Grade/GCSE/CSE/O-level/GNVQ or equivalent) |
| <input type="checkbox"/> First Degree | <input type="checkbox"/> None of these qualifications |
| <input type="checkbox"/> Post 16/College study (eg. Highers/Advanced Highers/A level/Advanced GNVQ or equivalent) | |

What is your total annual household income from all sources before tax?

- | | | |
|--|--|--|
| <input type="checkbox"/> £0 - £14,999 | <input type="checkbox"/> £15,000 - £29,999 | <input type="checkbox"/> £30,000 - £44,999 |
| <input type="checkbox"/> £45,000 - £59,999 | <input type="checkbox"/> £60,000 - £74,999 | <input type="checkbox"/> £75,000 + |

How many children under the age of 18 live in your house?

- None 1 2 3+

Including yourself, how many adults aged 18 or over live in your house?

- 1 2 3 4 5+

Do you consider yourself to have an illness or disability which affects your ability to travel independently?

- Yes No

Anything else to say? Use this space if you have any further comments about this questionnaire

Thank you for completing this questionnaire, your input is valued. Please use the pre-paid label to post it back to us by **Friday 17th December**. As a thank you for taking part we will be giving **gift vouchers for the Victoria Shopping Centre to the value of £75, £50 or £25** to three randomly selected respondents. If you wish to enter for the prize draw please enter your details below.

Once we have the results from this survey we will be looking to undertake more in depth discussions about your opinions on travelling by different modes of transport in your local area. We would like to speak to a range of people and would be pleased if you could join us. If you would be interested in attending a short workshop please write your name and address below

This section will be separated from your survey responses and your name and details will in no way be matched to the answers provided.

Please tick if you would like to.....

- Enter Prize Draw Attend a workshop

Name and Address:

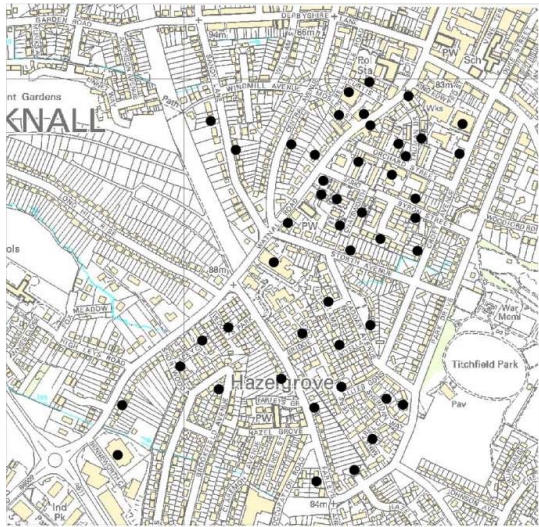
Phone:
e-mail:

Preferred method of contact

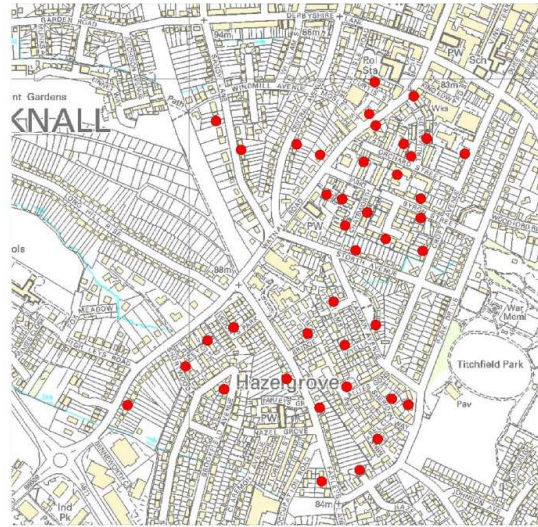
- Phone Email Post

Appendix E: Survey Sampling and Response Maps

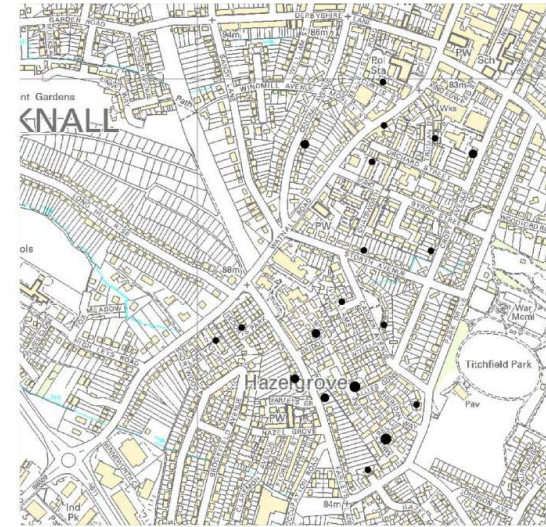
Hucknall (Area A)



All postcodes in sample area

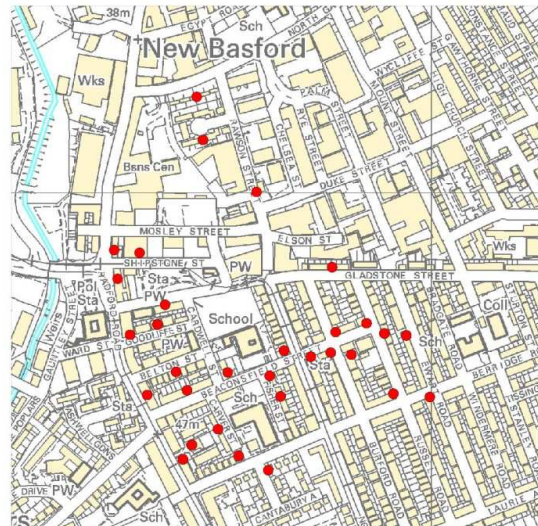
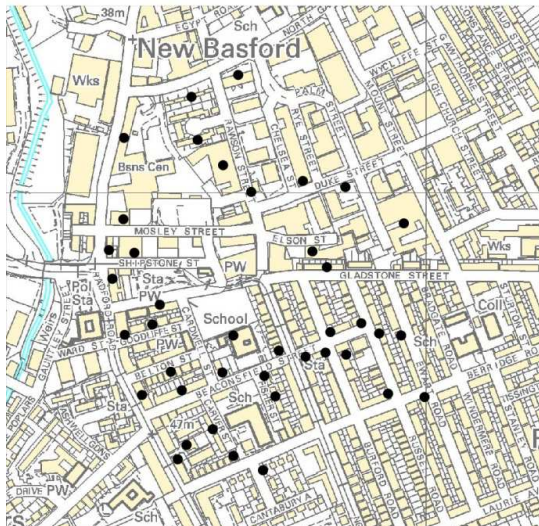


Sample Frame

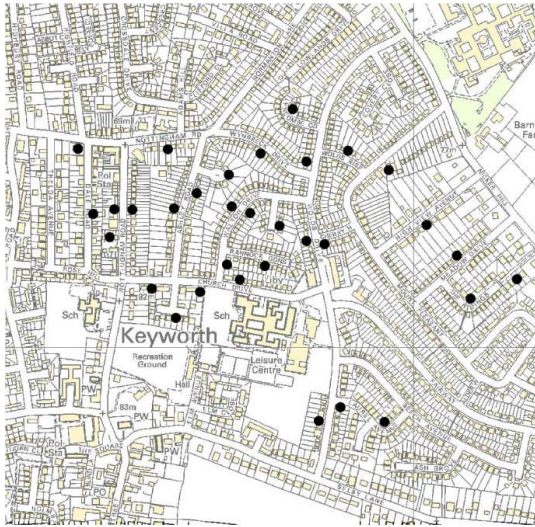


Response rate

Hyson Green (Area B)



Keyworth (Area C)



All postcodes in sample area

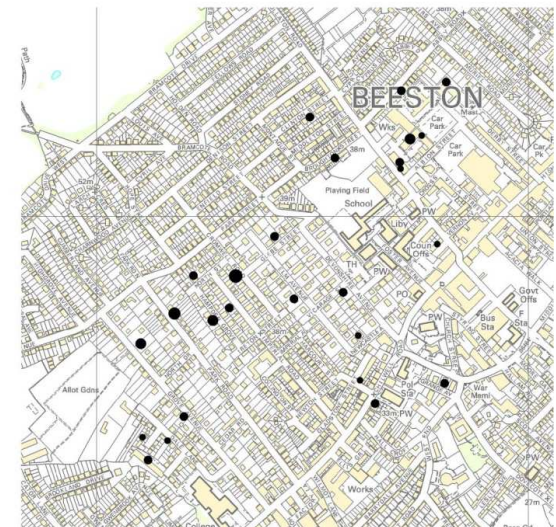
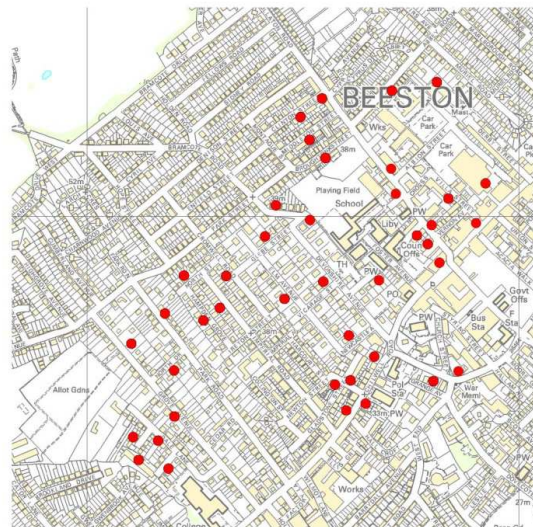
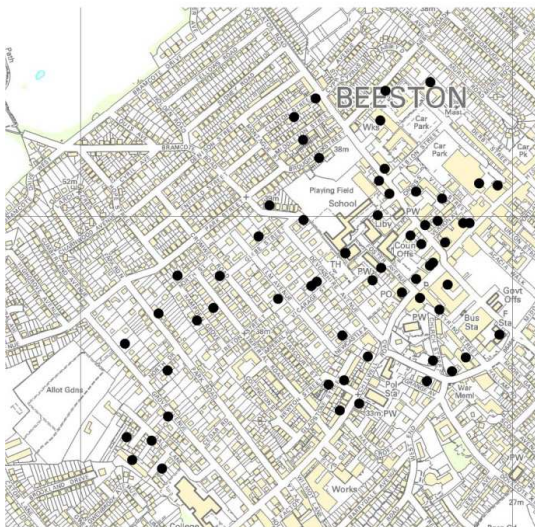


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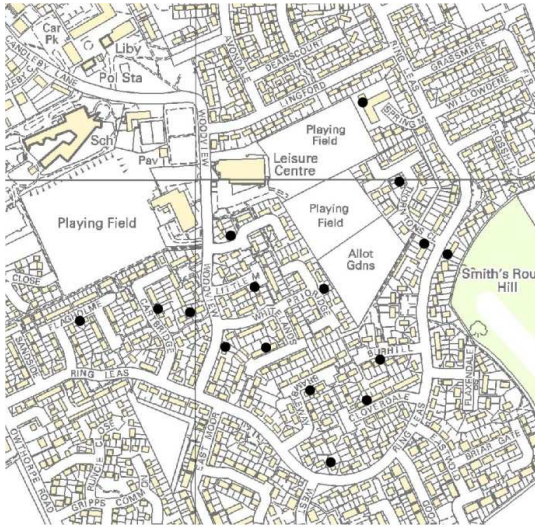


Response rate

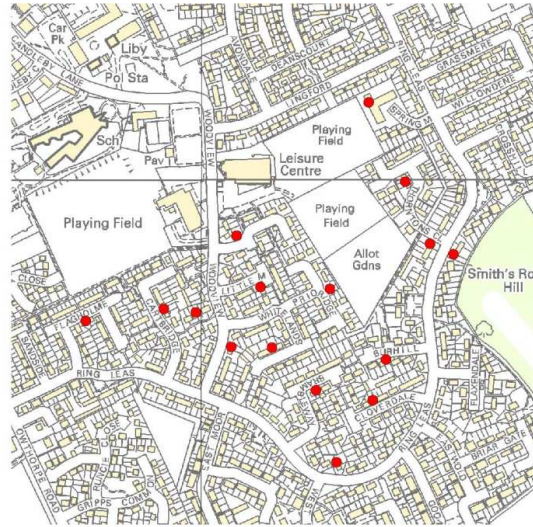
Beeston (Area D)



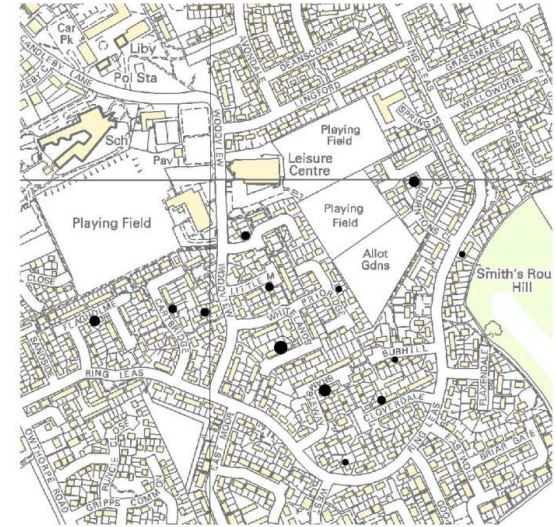
Cotrave (Area E)



All postcodes in sample area

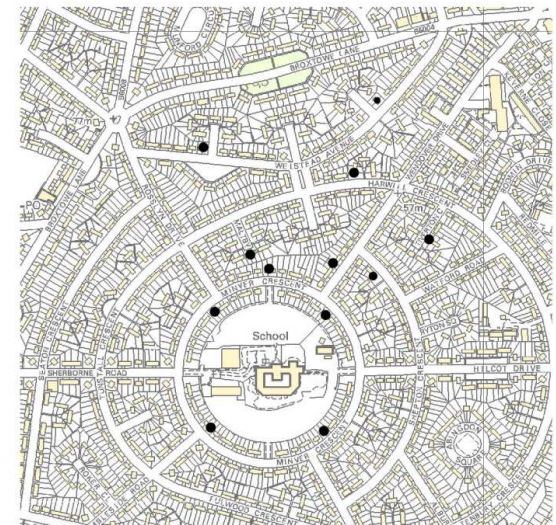
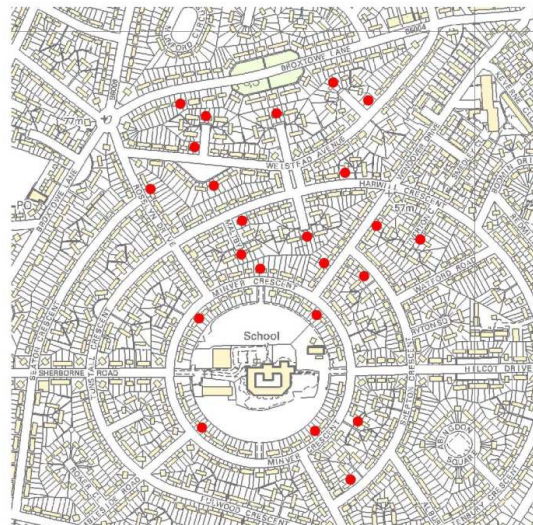
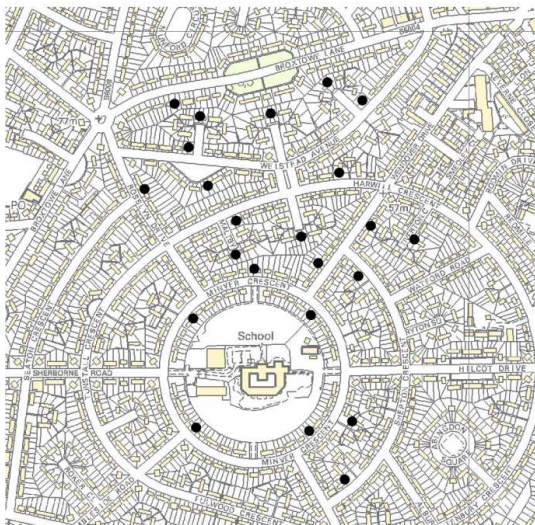


Sample Frame

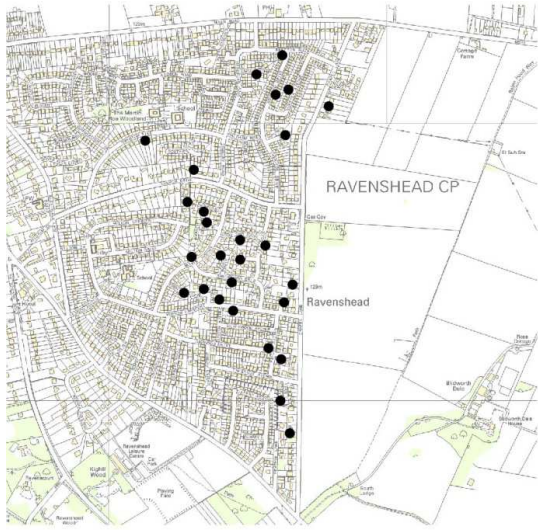


Response rate

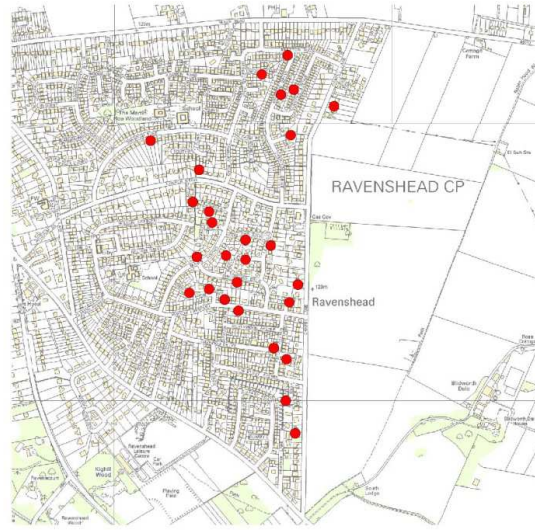
Aspley (Area F)



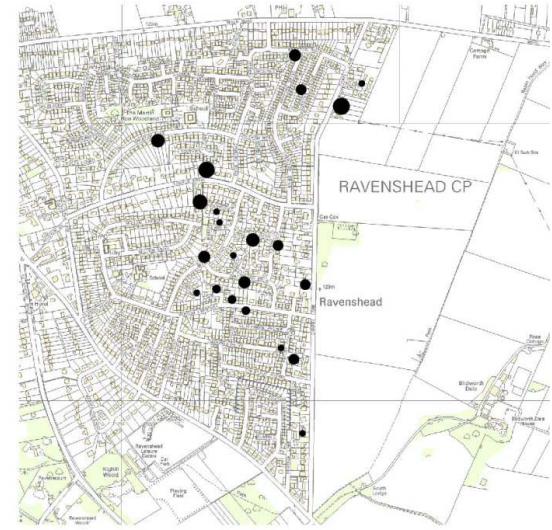
Ravenshead (Area G)



All postcodes in sample area

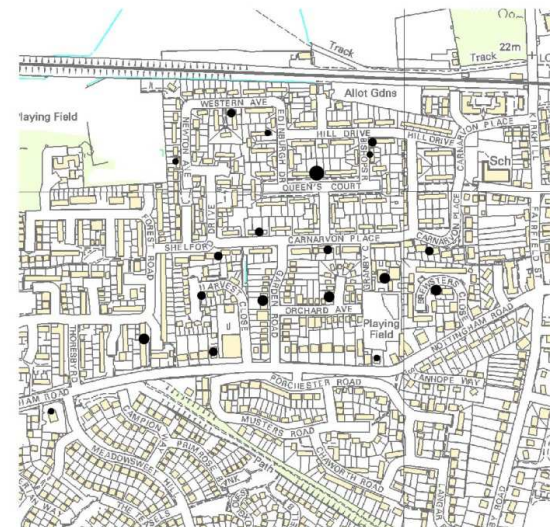
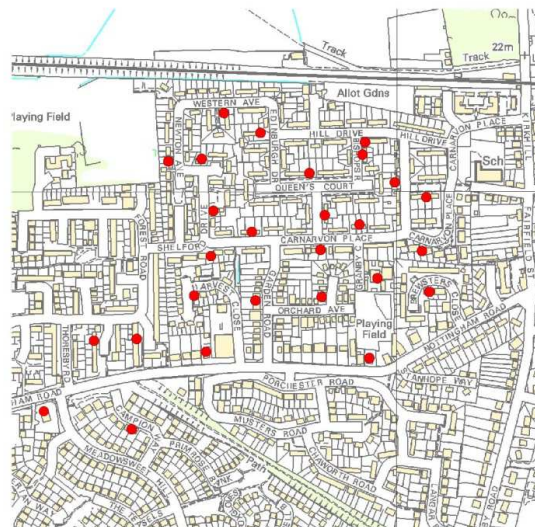


Sample Frame



Response rate

Bingham (Area H)



Appendix F: Destination Mapping

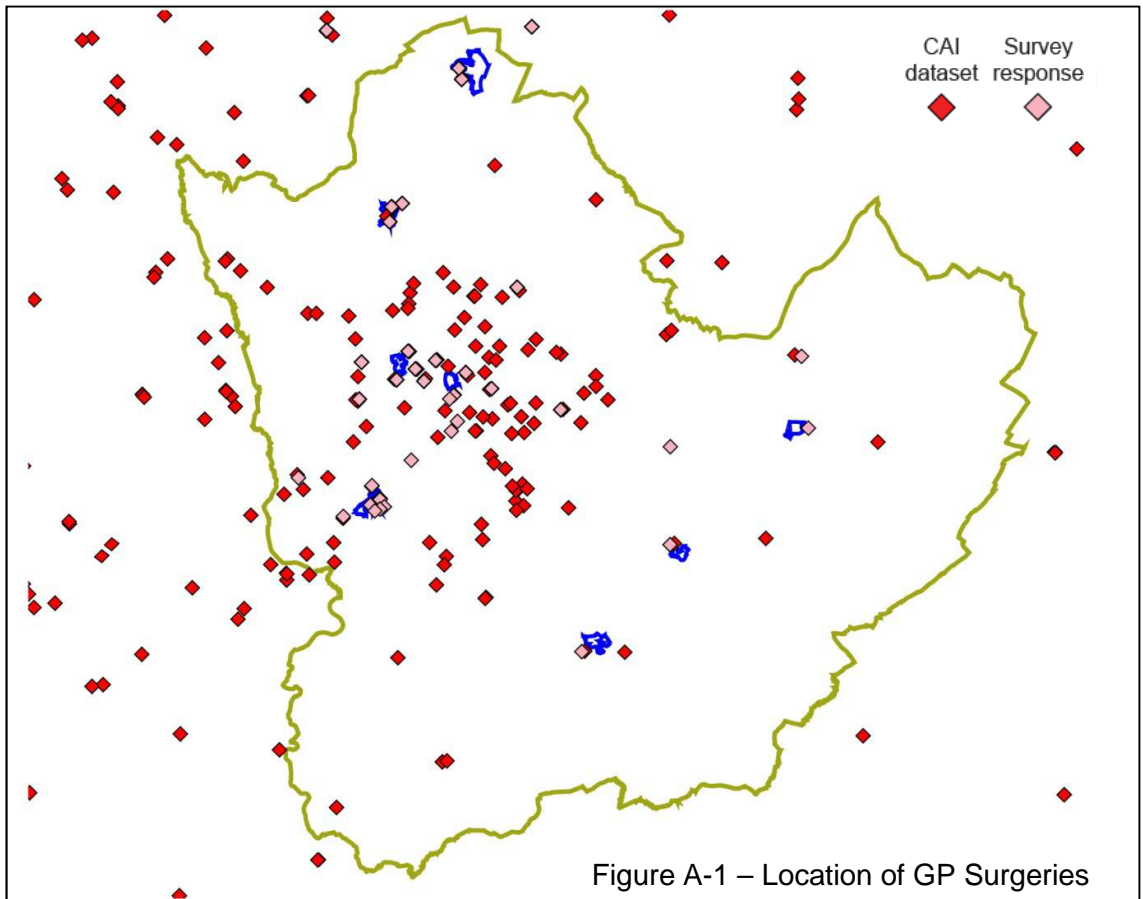


Figure A-1 – Location of GP Surgeries

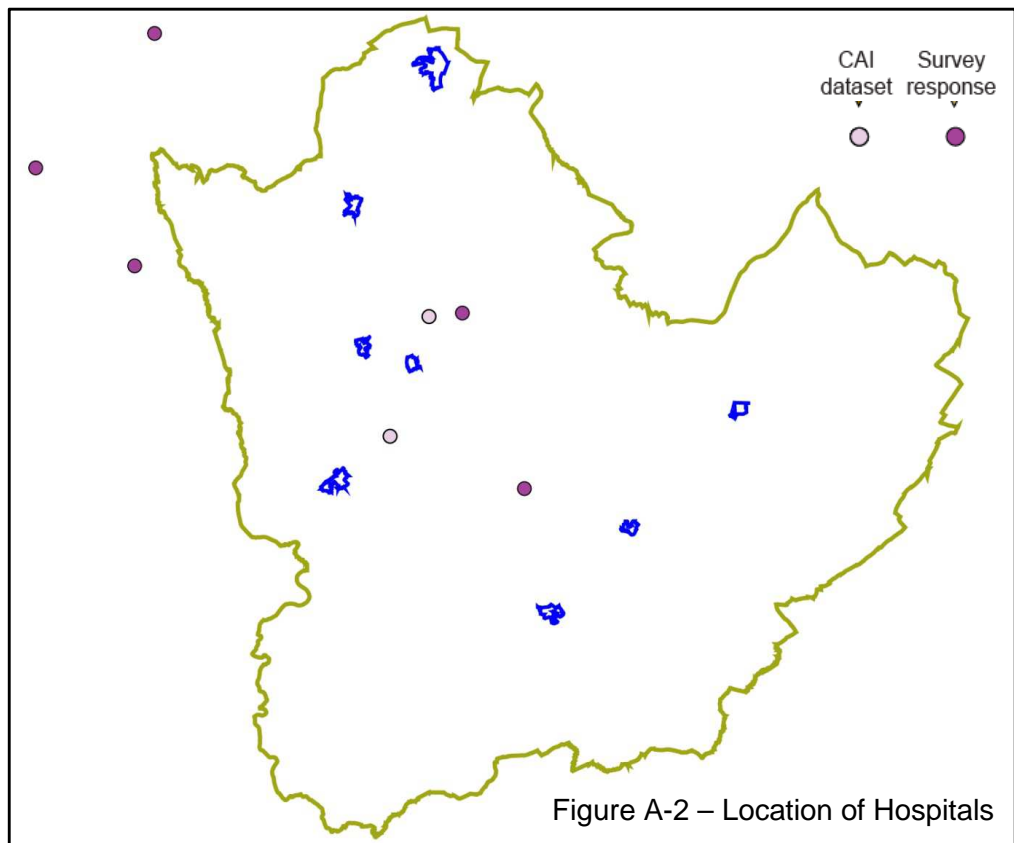


Figure A-2 – Location of Hospitals

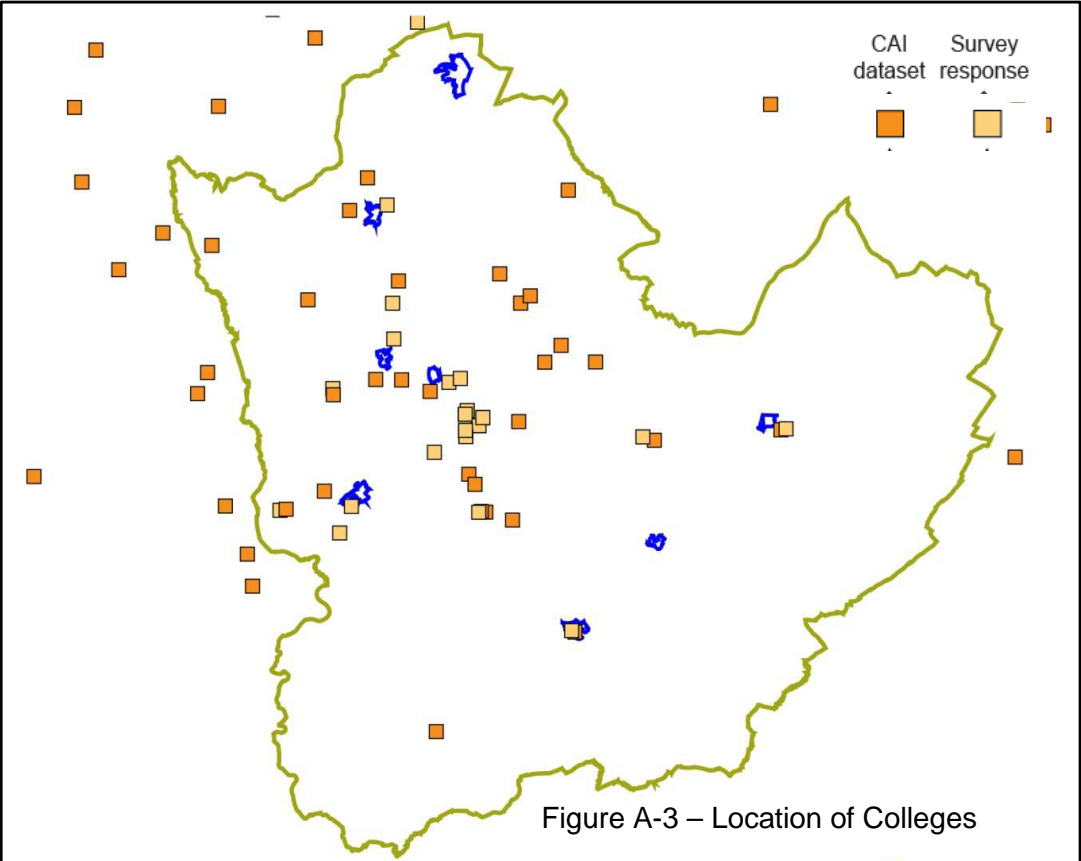


Figure A-3 – Location of Colleges

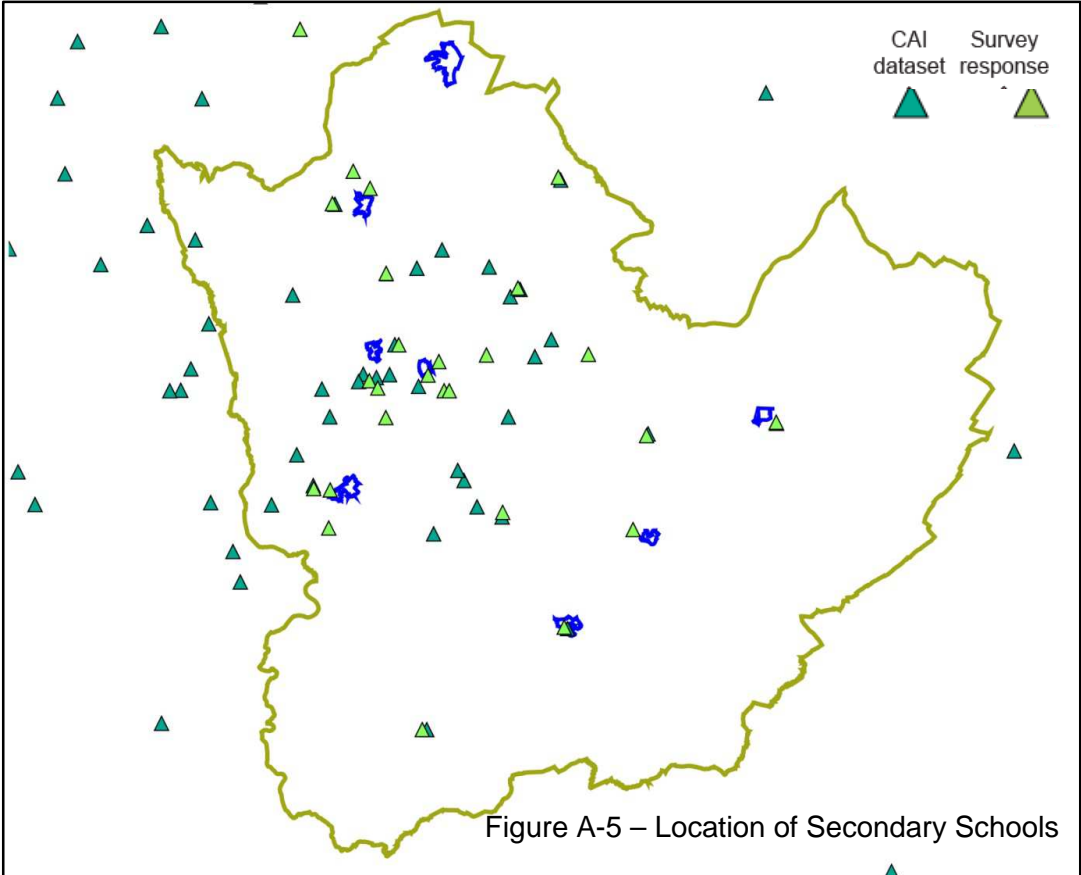
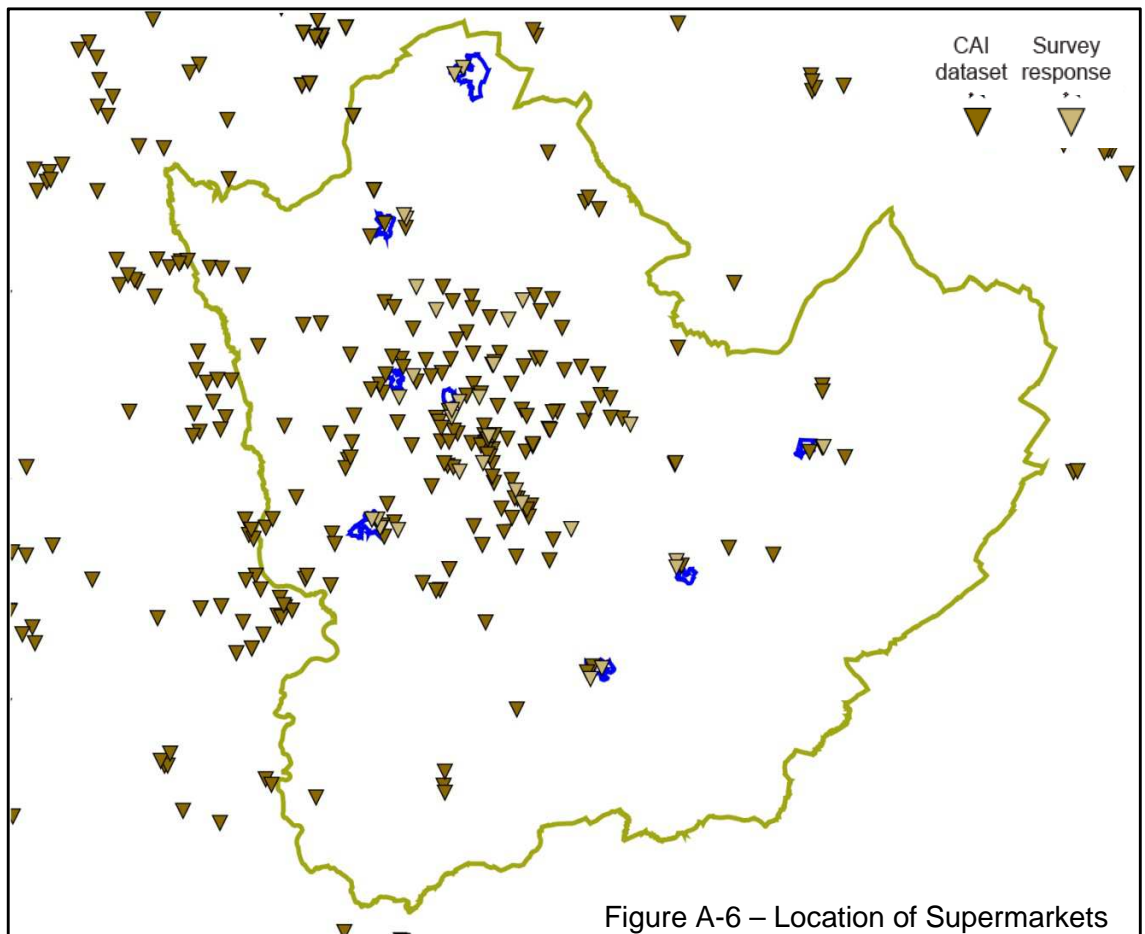
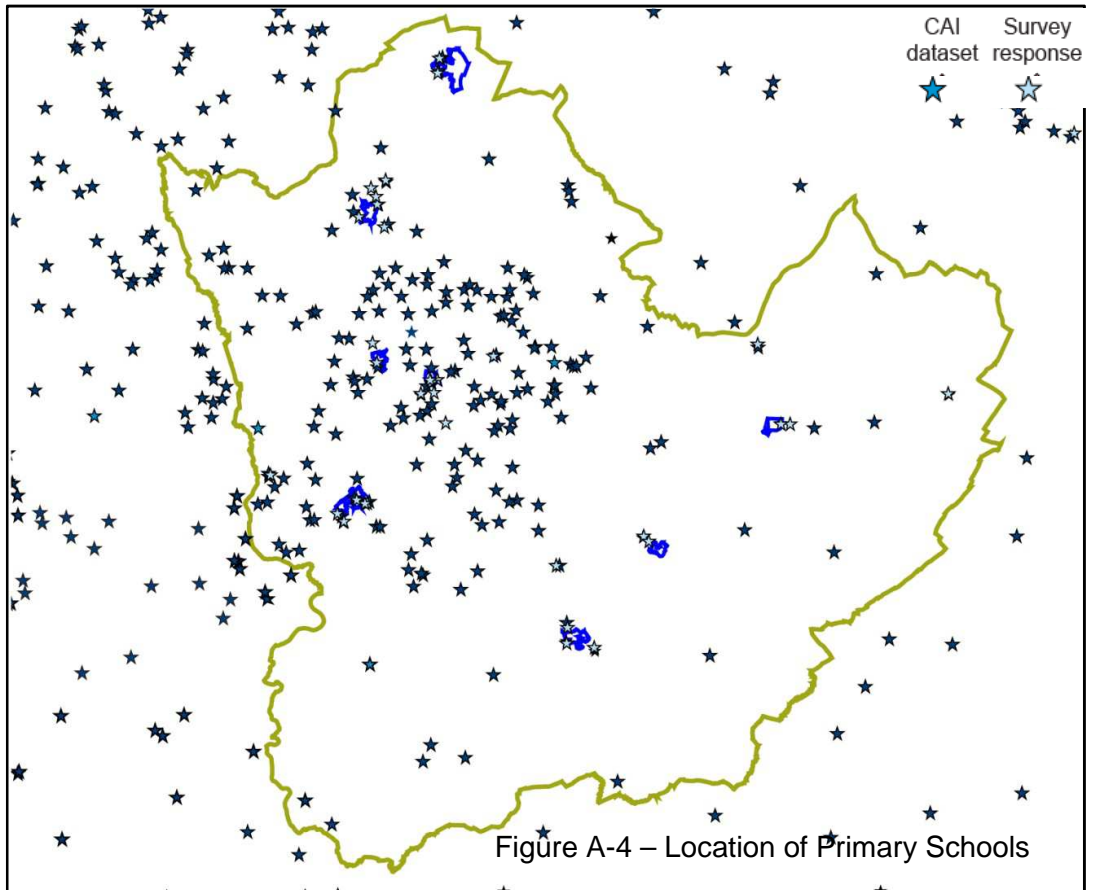
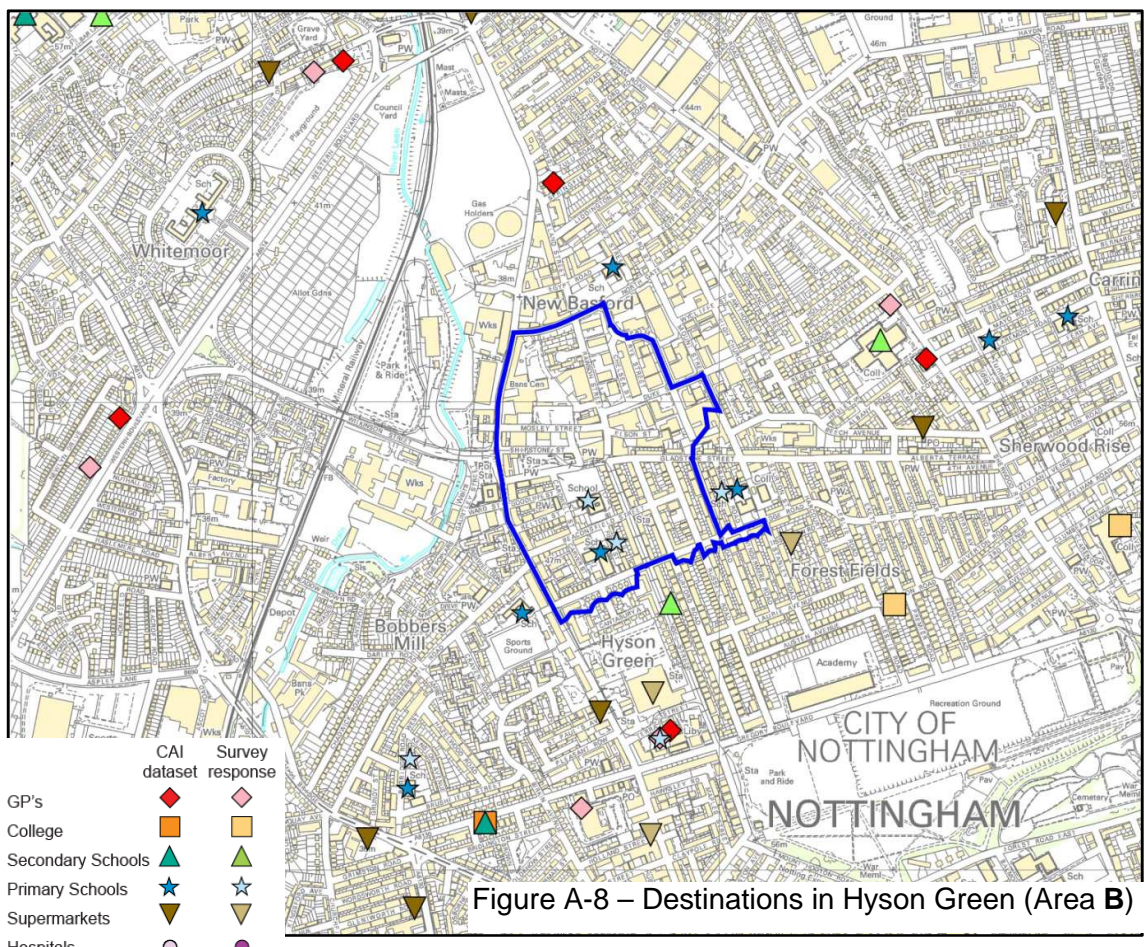
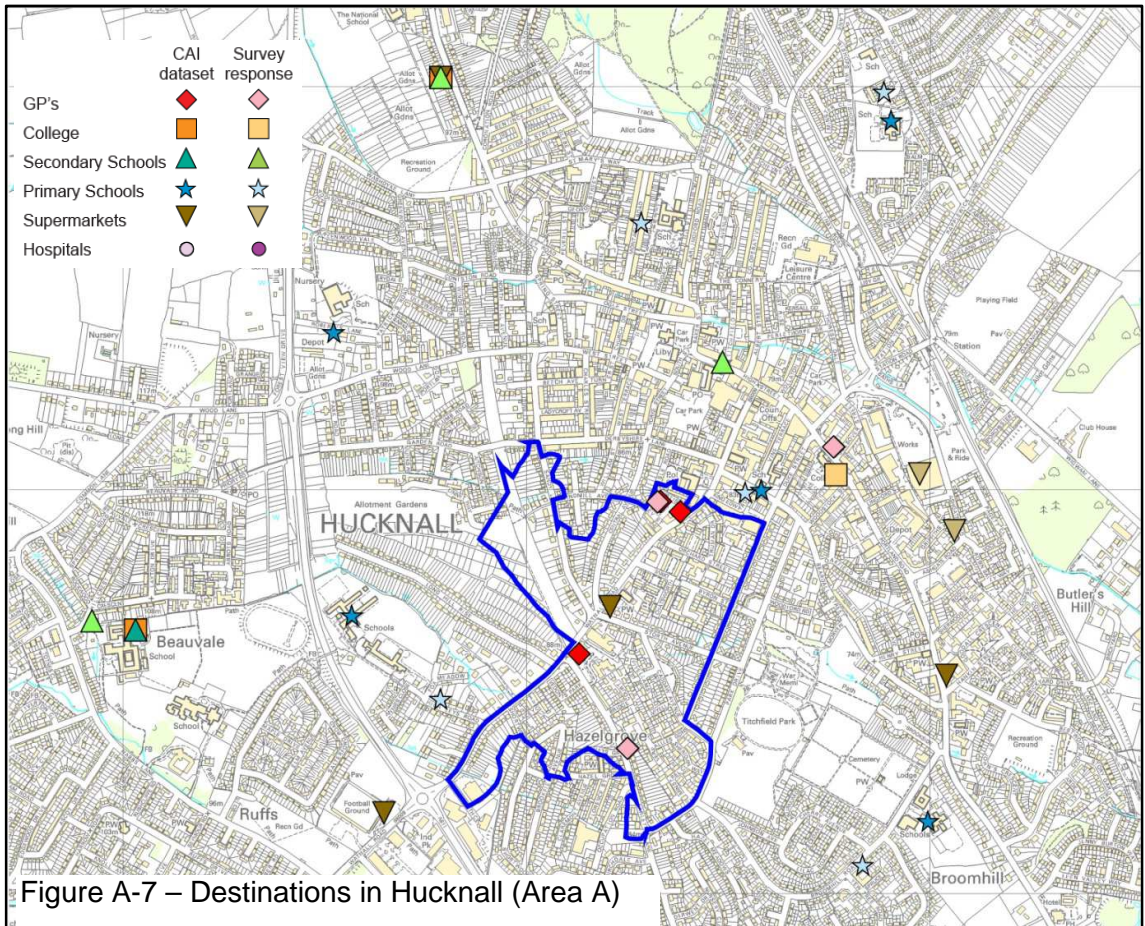


Figure A-5 – Location of Secondary Schools





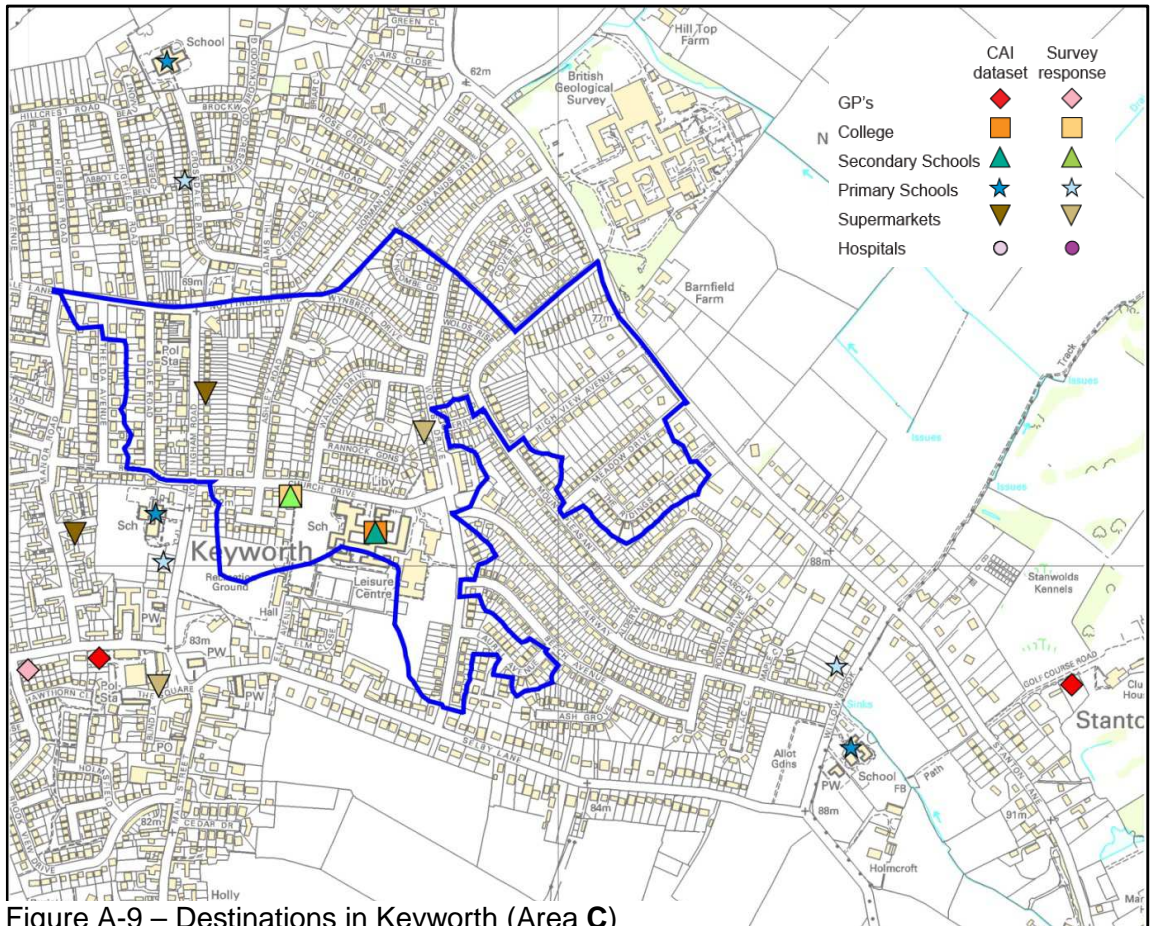


Figure A-9 – Destinations in Keyworth (Area C)

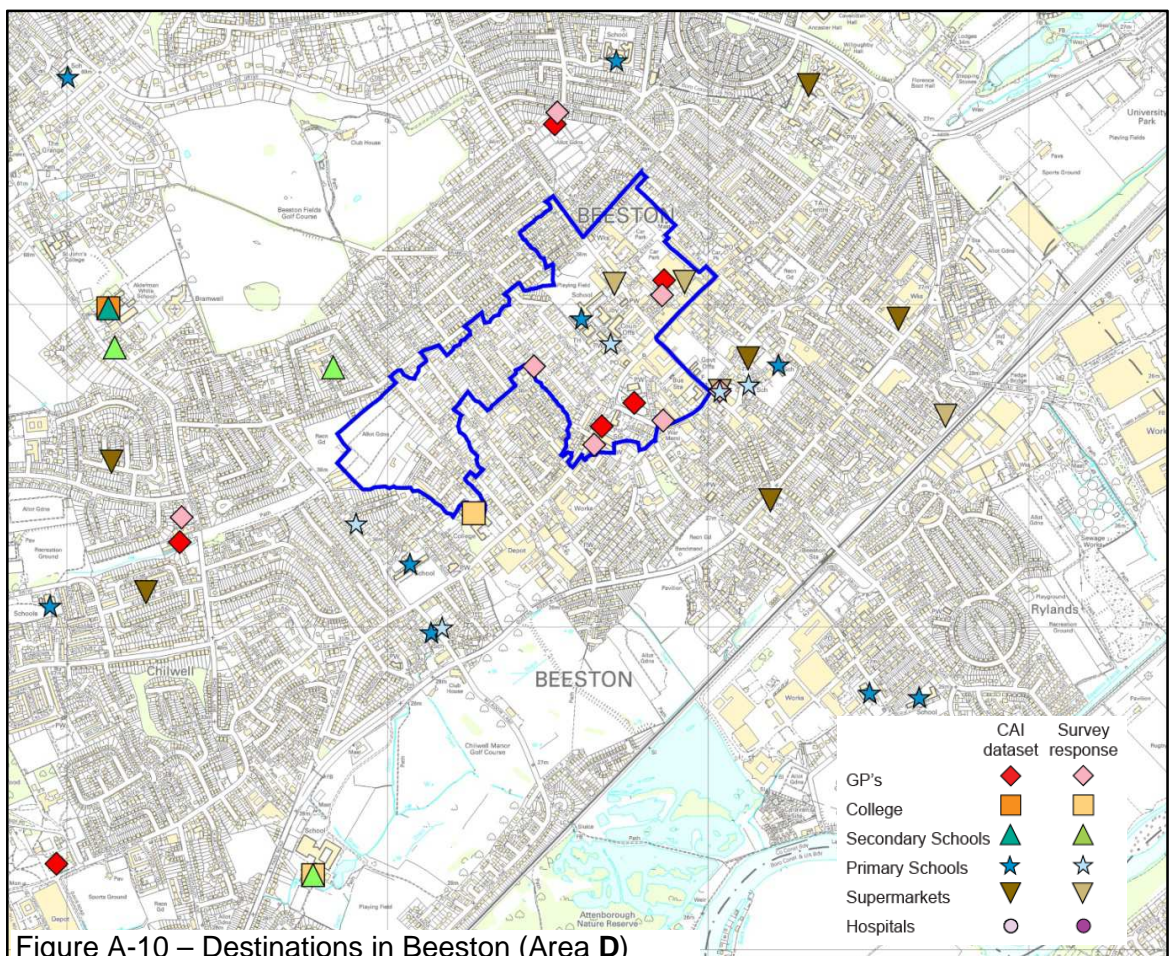


Figure A-10 – Destinations in Beeston (Area D)

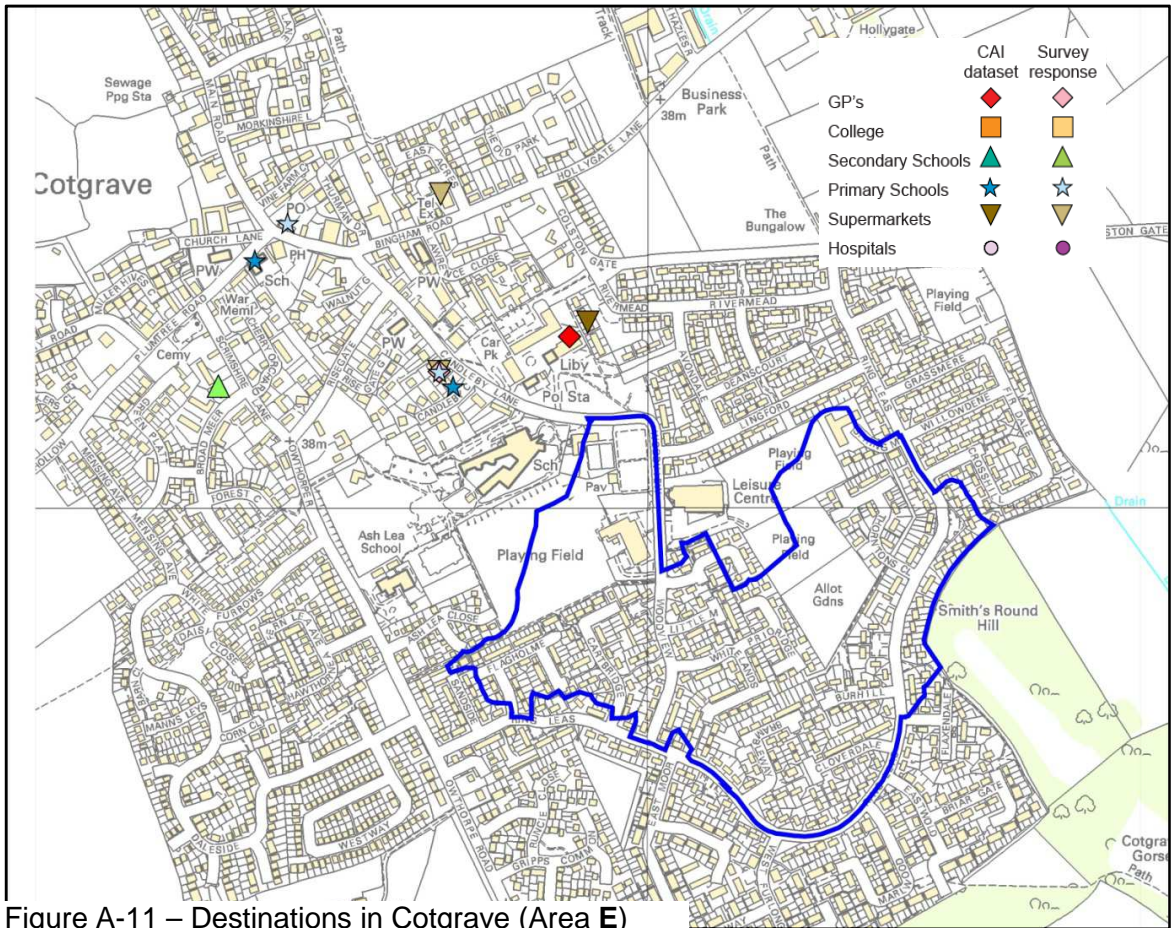


Figure A-11 – Destinations in Cotgrave (Area E)

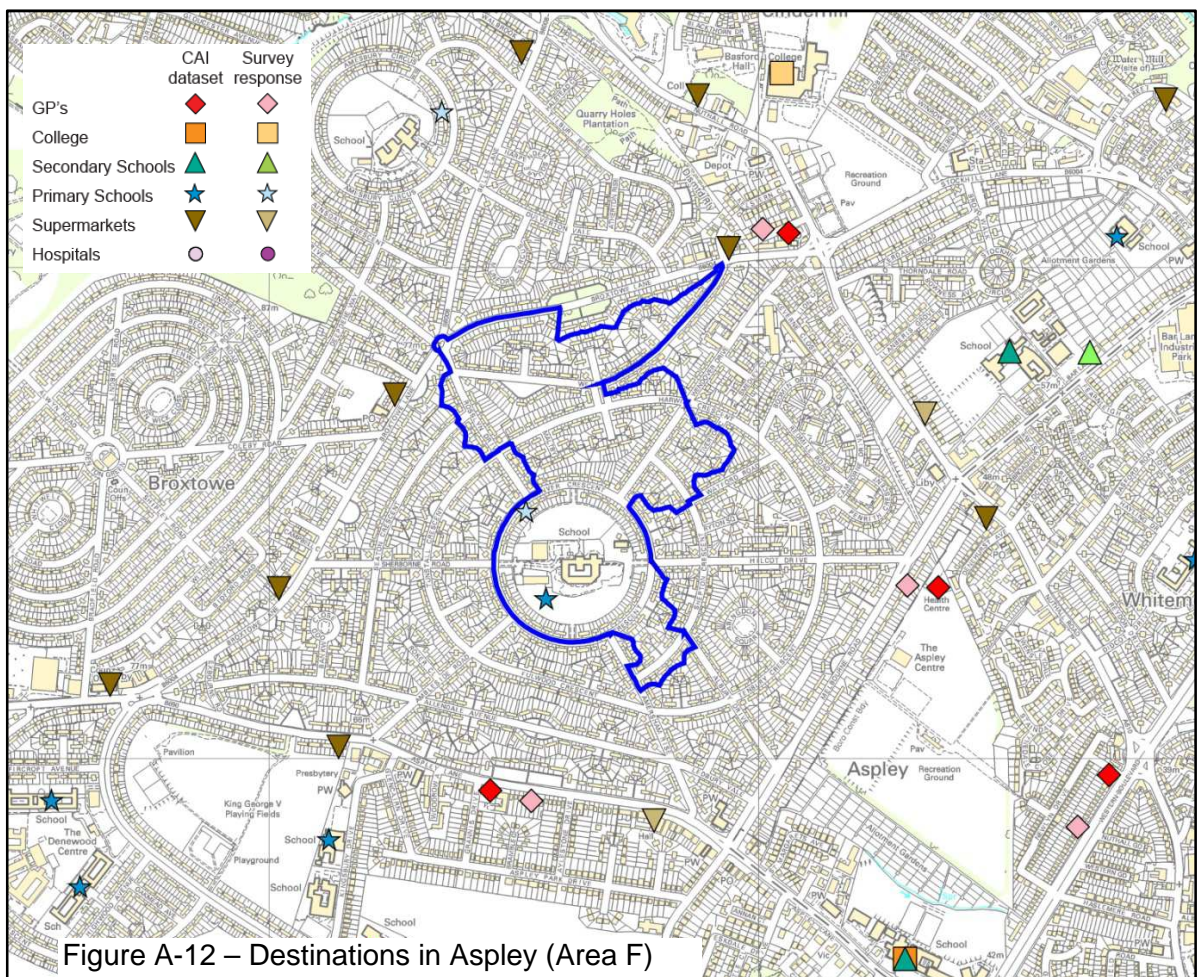
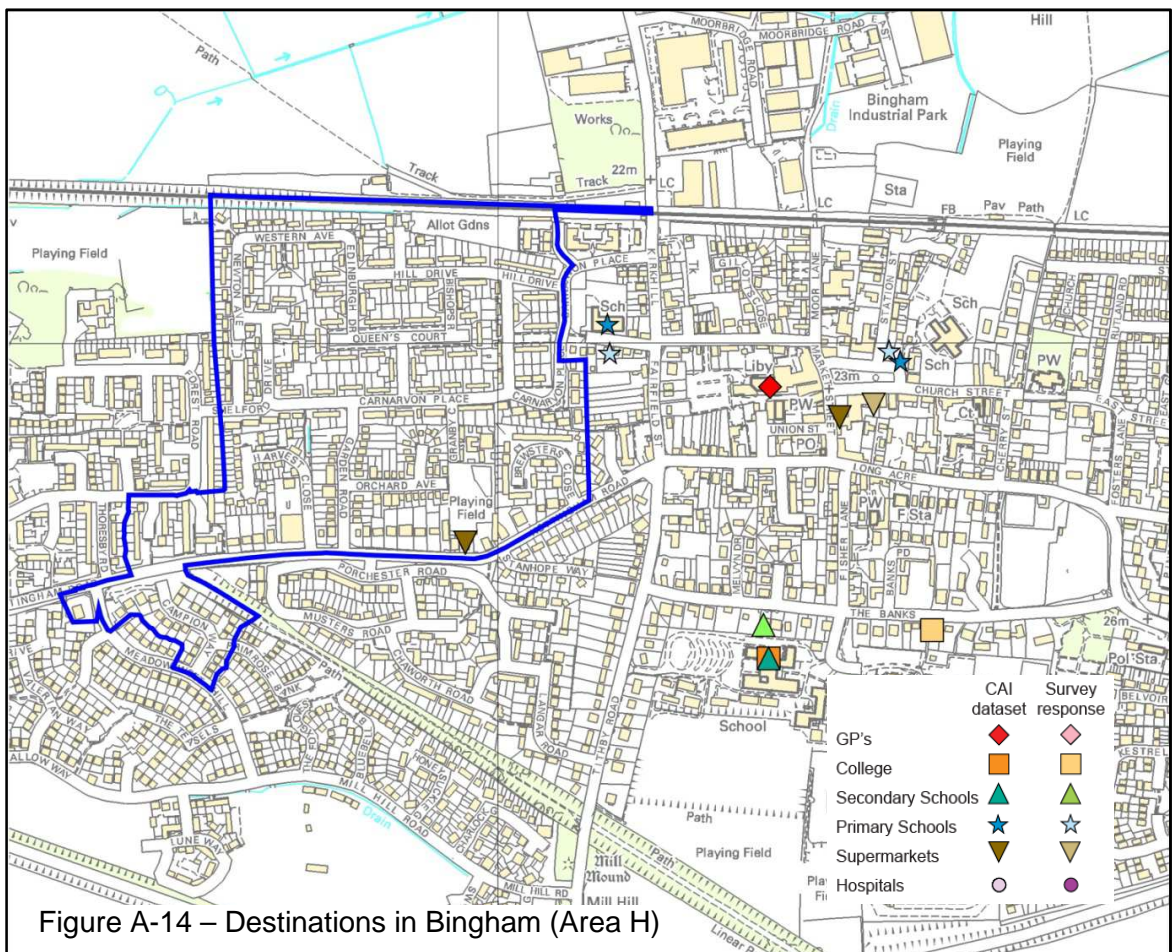
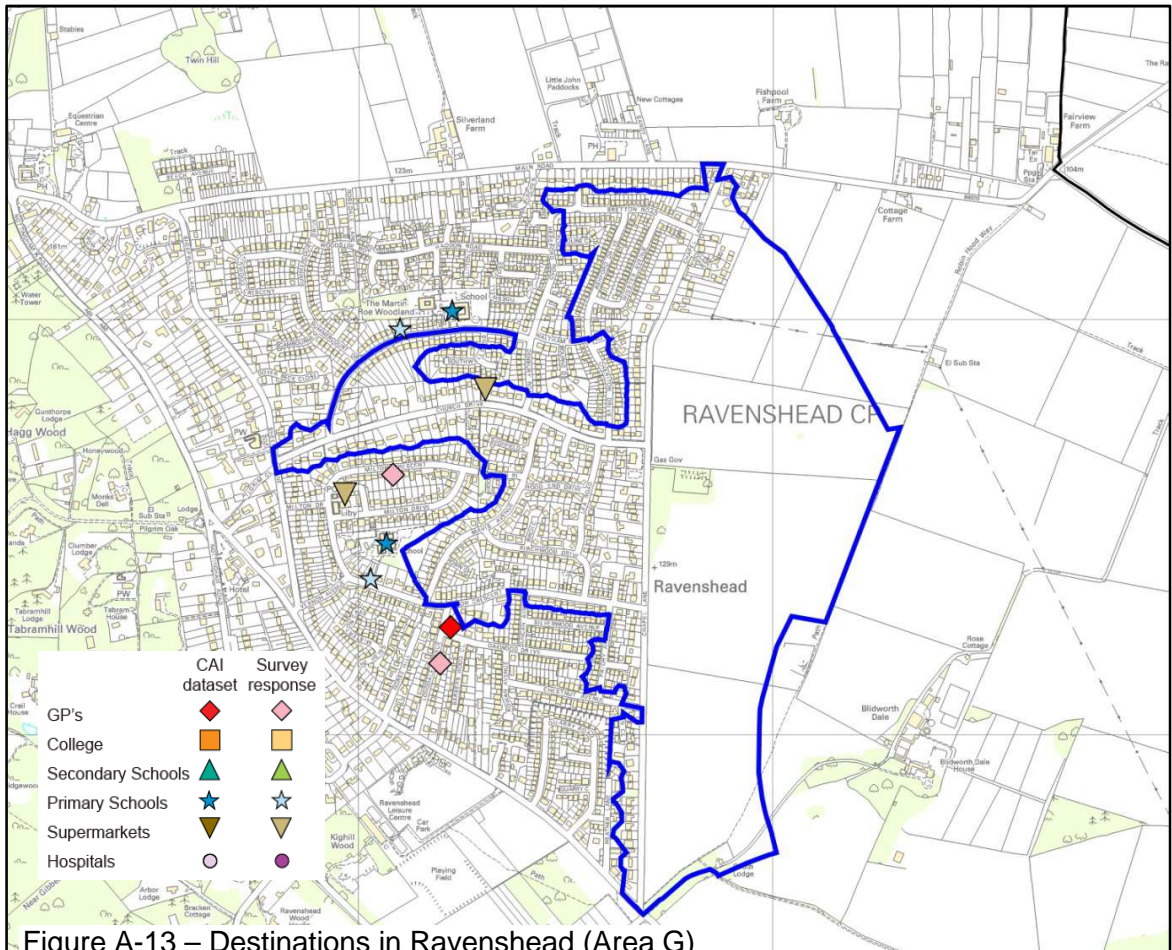


Figure A-12 – Destinations in Aspley (Area F)



Appendix G: Glossary of Variables

This Appendix describes the variables from the household survey used in the analysis in Chapter 7. Given the number of modes and destinations assessed the variables fall into a number of 'variable sets' used in the analysis and summarised below:

Variables Set	Variable Name
Frequency of Travel by mode	Frequency: Walking to/from a destination Frequency: Car as driver Frequency: Car as passenger Frequency: Bus Frequency: Train Frequency: Tram Frequency: Bicycle Frequency: Taxi Frequency: Other
Frequency of travelling to a destination	Frequency: Doctor's Frequency: Work Frequency: Hospital Frequency: Supermarket Frequency: Nottingham City Centre Frequency: Primary School Frequency: Secondary School Frequency: College
Mode used to destination	Mode: Doctor's Mode: Work Mode: Hospital Mode: Supermarket Mode: Nottingham City Centre Mode: Primary School Mode: Secondary School Mode: College
Perceived ease of access to destination	Ease: Doctors Ease: work Ease: the hospital Ease: the supermarket Ease: Nottingham City Centre Ease: the primary school Ease: the secondary school Ease: college
Perceived ease of using modes	Ease: public transport Ease: car Ease: walking Ease: cycling
Mode related attributes	Walking: Unenjoyable - Enjoyable Walking: Dangerous - Safe&Secure Walking: Unreliable - Reliable Walking: Expensive - Cheap Walking: Inconvenient - Convenient Walking: Slow - Quick PT: Unenjoyable - Enjoyable PT: Dangerous - Safe&Secure PT: Unreliable - Reliable PT: Expensive - Cheap PT: Infrequent - Frequent PT: Inconvenient - Convenient PT: Slow - Quick Car: Unenjoyable - Enjoyable Car: Dangerous - Safe&Secure Car: Unreliable - Reliable

	Car::Expensive - Cheap Car::Inconvenient - Convenient Car:Slow - Quick
Satisfaction with destinations	Satisfaction: Doctors Satisfaction:Hospitals Satisfaction:Supermarkets Satisfaction:Primary Schools Satisfaction:Secondary Schools Satisfaction:Colleges Satisfaction:A range of opportunities for work
Choice-satisfaction rating	Choice: Doctors Choice: Hospitals Choice: Supermarkets Choice: Primary Schools Choice: Secondary Schools Choice: Colleges Choice: A range of opportunities for work
Time-satisfaction rating	time rating:Doctors time rating:Work time rating:Hospital time rating:Supermarket time rating:City Centre time rating:Primary School time rating:Secondary School time rating:College
Self-reported journey time	Walk time:Doctors/GP Walk time:Hospital Walk time:Supermarket Walk time:Nottingham City Centre Walk time:Primary School Walk time:Secondary School Walk time:College PT time: doctors PT time: hospital PT time: supermarket PT time: nottingham city centre PT time: primary school PT time: secondary school PT time: college Car time: doctors Car time: hospital Car time: supermarket Car time: nottingham city centre Car time: primary school Car time: secondary school Car time: college
Perceived accessibility of destinations	Accessible: Doctors Accessible:Your place of work Accessible:Hospitals Accessible:Supermarkets Accessible:Primary Schools Accessible:Secondary Schools Accessible:Colleges Accessible:Nottingham City Centre Accessible:The job market
Overall perceptions of accessibility	Ease of getting to places I need to get to Provision of Public Transport in your local area The range of local facilities available to suit your needs Accessible: Places you need to get to on a regular basis
Attitudes to the environment, car use	I need a car to do most of the things I do

and neighbourhood

I would travel further each day if it meant I could live in a nicer area
I like my neighbourhood
I care about the environment
People without a car are at a disadvantage
I know my neighbours well
I can reach important places by foot
The buildings, streets and public spaces in my neighbourhood make it a pleasant place to live
There is a good sense of community in my neighbourhood
Overall, I can easily access goods and services essential to my needs

Socio-demographic variables

Gender
Age
Employment Status
Level of education
Disability
Household income
Children in household
Adults in household
Household car ownership
Personal car availability
Driving licence

Appendix H: Results of multicollinearity diagnostic tests

This appendix contains Variance Inflation Factors (VIF) for all regression analyses reported in Chapter 7 in order to identify if there may be issues of multi-collinearity. According to Field (2009) a VIF above 10 is problematic, although a value above 1 indicates that there is some level of bias in the model. Results here are above 1 but not as high as 10. This would suggest that while there is some level of multi-collinearity among variables, this is not particularly great and given the blocked approach to regression, which has allowed the unique contribution of variables to be identified, this is not considered problematic.

Predictors	Supermarket			Hospital			Doctors		
	PT	Car	Walk	PT	Car	Walk	PT	Car	Walk
Objective JT Accessibility (CAI)	1.07	1.04	1.04	1.05	1.03	1.03	1.02	1.04	1.04
Age	1.15	1.15	1.13	1.12	1.14	1.11	1.11	1.14	1.11
Frequency of going to destination	1.06	1.03	1.03	1.01		1.01	1.09	1.09	1.08
PT user (to destination) ^a	1.09			1.06	1.17		1.06		
Car user (to destination) ^a		1.19						1.19	
Walks to destination ^a			1.11			1.12			1.11
Gender ^b	1.09	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Disability ^c	1.10	1.10	1.10	1.10	1.09	1.10	1.15	1.15	1.15
Car Availability ^d	1.10	1.16	1.12	1.09	1.15	1.11	1.11	1.17	1.13

Predictors	Primary School			Secondary School			College		
	PT	Car	Walk	PT	Car	Walk	PT	Car	Walk
CAI journey time	1.10	1.04	1.04	1.03	1.03	1.04	1.02	1.03	1.04
Age	1.34	1.32	1.29	1.12	1.15	1.13	1.12	1.15	1.13
Frequency of going to destination	1.19	1.82	1.12	1.03	1.03	1.04	1.03	1.03	1.03
PT user (to destination) ^a	1.06			1.08			1.07		
Car user (to destination) ^a		1.19			1.17			1.17	
Walks to destination ^a			1.11			1.24			1.11
Gender ^b	1.09	1.07	1.07	1.07	1.09	1.07	1.07	1.09	1.07
Disability ^c	1.10	1.09	1.09	1.09	1.09	1.10	1.09	1.09	1.09
Car Availability ^d	1.13	1.16	1.12	1.10	1.15	1.12	1.10	1.16	1.13

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.3.2

	PT	Car	Walk
Predictors	Nottingham City Centre		
Objective JT Accessibility (CAI)	1.15	1.27	1.26
Age	1.21	1.29	1.24
Frequency of going to destination	1.13	1.13	1.13
PT user (to destination) ^a	1.08		
Car user (to destination) ^a		1.22	
Walks to destination ^a			1.13
Gender ^b	1.07	1.08	1.07
Disability ^c	1.10	1.09	1.09
Car Availability ^d	1.18	1.26	1.22

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.3.3

Predictors	<i>Doctors</i>	<i>Hospital</i>	<i>Supermarket</i>	<i>Primary School</i>	<i>Secondary School</i>	<i>College</i>	<i>Nottingham City Centre</i>
Objective JT Accessibility	1.037	1.184	1.348	1.045	1.302	1.139	1.077
Subjective JT Accessibility	1.201	1.113	1.568	1.060	1.354	1.301	1.092
Walk to destination	3.169	1.148	3.332	3.894	1.198	1.349	1.380
PT to destination	1.341	2.145	2.247	1.026	1.195	1.709	2.816
Car to destination	3.012	2.284	4.585	1.742		1.917	2.906
Frequency of using destination	1.042	1.116	1.152	4.373		2.721	1.145
Gender	1.080	1.088	1.085	1.091	1.082	1.094	1.105
Household Income	1.350	1.369	1.368	1.338	1.349	1.377	1.352
Age	1.163	1.164	1.195	1.334	1.190	1.202	1.267
Car Availability	1.398	1.492	2.007	1.228	1.211	1.309	1.379

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.4.3

Predictors	<i>Rating of Public Transport Frequency</i>
Objective Frequency (CAI)	1.389
Age	1.232
Gender ^a	1.332
Perceived ease of using public transport	1.257
Frequency of using public transport	1.485
Satisfaction with provision of public transport	1.219
Car Availability ^b	1.414

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.4.5

Predictors	<i>Doctors</i>	<i>Hospital</i>	<i>Supermarket</i>	<i>Primary School</i>	<i>Secondary School</i>	<i>College</i>	<i>Nottingham</i>
Objective JT Accessibility	1.268	1.305	1.434	1.169	1.504	1.177	1.142
Subjective JT Accessibility	1.246	1.154	1.872	1.134	1.577	1.447	1.104
Straight line distance to destination	1.131	1.127	1.770	1.437	1.668	1.305	
Walk to destination	3.203	1.157	3.359	4.057	1.321	1.392	1.390
PT to destination	1.387	2.124	2.263	1.049		1.729	2.987
Car to destination	3.031	2.295	4.689	1.972		1.956	2.976
Frequency of using destination	1.110	1.157	1.198	4.693	1.377	2.813	1.292
Age	1.117	1.079	1.110	1.242	1.098	1.081	1.145
Car availability	1.234	1.340	1.976	1.090	1.079	1.190	1.228
Importance of destination	1.110	1.125	1.080	2.004	1.486	1.487	1.437
Satisfaction with destination	1.375	1.637	1.559	2.287	1.896	1.639	
Choice of destination	1.323	1.406	1.511	1.277	1.269	1.347	
Time-satisfaction to destination	1.504	1.699	1.715	1.908	1.964	1.680	1.341

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.5.1

Predictors	<i>Public Transport</i>	<i>Car</i>	<i>Walking</i>
Objective Accessibility	1.448	1.041	1.059
Frequency of using Mode	1.445	1.228	1.283
Objective frequency of PT	1.930		
Gender	1.136	1.095	1.097
Household Income	1.283	1.323	1.231
Age	1.528	1.192	1.191
Enjoyable	2.616	2.200	2.178
Safe&Secure	1.768	2.001	1.800
Reliable	2.633	2.407	2.204
Cheap	1.641	1.211	1.328
Frequent (PT)	3.871		
Convenient	4.271	1.968	2.543
Quick	3.156	2.069	1.911

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.5.2

	<i>Overall Perceived Accessibility</i>
Predictors	
Objective JT Accessibility	1.224
Subjective JT Accessibility	1.302
Age	1.157
Gender	1.098
Car Availability	1.111
Perception of walking	1.271
Perception of PT	1.520
Perception of car	1.146
Overall satisfaction with destinations	1.306
Overall satisfaction with choice of destinations	1.468
Overall time satisfaction	1.736

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.5.3

Predictors	<i>Pleasant neighbourhood / community</i>			<i>Accessible</i>	<i>Car Dependency</i>
	Objective accessibility ^a	1.108	1.108	1.108	1.108
IMD ^b	1.266	1.266	1.266	1.266	
TTW ^c	1.249	1.249	1.249	1.249	
Car availability	2.827	2.827	2.827	2.827	
Frequency of driving	3.186	3.186	3.186	3.186	
Frequency of using PT	1.619	1.619	1.619	1.619	
Gender	1.132	1.132	1.132	1.132	
Household Income	1.340	1.340	1.340	1.340	
Age	1.279	1.279	1.279	1.279	

Variance Inflation Factors (VIF) for variables included in the regression models presented in Table 7.5.5

Appendix I: Mental Maps of Accessibility

