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An investigation into the factors affecting urban travel needs in later life

by

Carlo Luiu

A thesis submitted to the University of Birmingham for the degree of
DOCTOR OF PHILOSOPHY

Supervised by

Professor Miles Tight

Dr Michael Burrow

School of Engineering
Department of Civil Engineering
University of Birmingham
July 2018

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ABSTRACT

As the population in Western countries becomes older, providing transportation able to meet travel needs during later life will become more challenging, especially due to the heterogeneity characterising older people (identified as those aged 60 years old and above). Given the importance between the ability to be mobile and use transportation with individuals' wellbeing, this doctoral research aims at investigating which are the factors influencing travel needs during later life, with a focus at the English urban context. A mixed method approach of quantitative and qualitative data is employed to analyse first travel behaviour and changes over time according to an age, period and cohort analysis. Then, a framework is developed to assess which factors have to be considered when investigating travel needs during later life. A survey is undertaken to deploy the framework, with a focus on both realised and unfulfilled mobility. The results from the age, period and cohort analysis indicate that older people have been travelling more in terms of trip frequency and distance, particularly by car. Age effects are shown in all the six aspects analysed (trip frequency, distance travelled, mode share, travel purpose, access to the car and driving licence), stressing the fact that mobility decreases while ageing, with 80 years old as turning point in this sense. Similarly, cohort effects are found regarding the two Baby Boom groups, highlighting how the newer generations of older people differ from their older counterparts. Gender differences in travel patterns seems also to be reducing by time, with older women showing converging trends. Health and wellbeing conditions and access to the car, particularly driving a car, were found to be in the survey the two main factors affecting travel needs' fulfilment with regard to both realised mobility and unmet travel needs. Around one-third of the respondents reported the need to undertake more out-of-home activities than they do, particularly older women. Activities reported more in this sense were those related to the discretionary domain such as visiting other people and undertaking social and leisure

activities. This was found particularly true for those suffering health impairments and lack of availability of transport options.

To Linda

Acknowledgment

I would like to sincerely thank my supervisors, Professor Miles Tight and Dr Michael Burrow, for their continuous guidance, support, advice and inspiration during the journey of this research project.

I wish to acknowledge the progress reviewers, Dr Dexter Hunt and Dr Fiona Rajé, for their most useful comments and suggestions that helped the development of this research.

Special thanks go to my fellow colleagues, especially to Valeria, Mehran, José, and those from the research office F55.

I would like to thank my mother, for the great life lessons she taught me and for having made this possible with her great support and sacrifices.

Finally, I wish to thank the College of Engineering and Physical Sciences of the University of Birmingham for funding this research through a Post-Graduate Teaching Assistantship Scholarship.

Table of Contents

List of Figures

List of Tables

Abbreviations

APC	Age, Period and Cohort
AV	Autonomous Vehicles
CAPI	Computer Assisted Personal Interviewing
FTS	Flexible Transport Services
ICT	Information and Communication Technology
ITS	Intelligent Transport Systems
NTS	National Travel Survey
ONS	Office for National Statistics
PAF	Postcode Address File
UK	United Kingdom

1 INTRODUCTION

1.1 Background of the research

The growth of the Baby boom generation, in addition to the increased longevity and declining birth rates, is going to determine a considerable demographic change in developed countries over the coming decades (OECD, 2001). The Eurostat population growth projections (Lanzieri, 2011) highlight the fact that the European countries are steadily ageing, even if with different patterns (Lanzieri, 2011). In 1990 the median age of EU-27 countries was 35.2 years, while in 2010 it was 40.9. By 2040, the median age is forecast to increase by over 5 years, reaching the value of 46.3 years. Similar trends are shown for the population aged 65 years and above. Over the period between 1990 and 2010 the percentage of older people grew in all the EU-27 countries, with the average percentage raised from 12.9 to 16. By 2040 the portion of older population is projected to almost double, reaching 25.6%. A comparison between the United Kingdom (UK) and the EU-27 countries' trends reveals that UK population is getting older, but with a slow growth. In 1990 the UK had 15.7% of population aged 65 years and above, second only to Sweden with 17.8%. In 2010 the percentage increased to 16.4%, but the growth was not as significant as in other countries. By 2040, 23.2% will be aged more than 65 years, making the UK one of the least aged countries in the EU-27 (Table 1-1). This trend of ageing can be found also in other countries, such as Sweden and Denmark. Indeed, while at the end of the 20th century Nordic and Western Europe countries were the ones with the biggest portion of older population, by 2040 it is expected to shift to Southern and Central-Eastern countries (Lanzieri, 2011), as shown in Figure 1-1.

Table 1-1. Median age on 1 January of selected years (left) and percentage of population with 65 years and over on 1 January of selected years (right) (Lanzieri, 2011)

	1990	2000	2010	2020	2030	2040
BE	36,2	38,7	40,9	41,7	42,6	43,5
BG	36,5	39,1	41,4	44,1	47,6	50,0
CZ	35,1	37,3	39,4	42,7	45,8	47,8
DK	37,0	38,2	40,5	42,3	42,4	43,2
DE	37,6	39,8	44,2	47,8	48,8	50,4
EE	34,2	37,8	39,5	41,3	44,4	47,5
IE	29,1	32,4	34,3	37,8	38,8	38,5
EL	36,0	38,1	41,7	44,8	48,0	49,4
ES	33,4	37,4	39,9	43,8	47,4	48,7
FR	34,7	37,3	39,8	41,4	42,7	43,6
IT	36,9	40,1	43,1	46,2	48,4	49,3
CY	30,5	33,3	36,2	38,6	41,5	44,1
LV	34,6	37,9	40,0	42,6	45,9	50,2
LT	32,4	35,8	39,2	41,3	44,1	47,6
LU	36,3	37,3	38,9	40,4	42,3	43,9
HU	36,1	38,5	39,8	42,7	45,7	48,2
MT	32,8	36,3	39,2	41,6	44,4	47,2
NL	34,4	37,3	40,6	42,9	43,8	44,8
AT	35,6	37,9	41,7	44,4	45,5	46,9
PL	32,2	35,1	37,7	40,9	45,3	49,3
PT	33,9	37,6	40,7	44,2	47,4	49,0
RO	32,6	34,4	38,3	41,8	45,7	49,8
SI	34,0	37,8	41,4	43,7	47,0	49,4
SK	31,2	33,9	36,9	40,8	45,1	48,8
FI	36,3	39,2	42,0	42,7	43,9	44,8
SE	38,4	39,3	40,7	41,2	42,0	43,5
UK	**35,8**	**37,5**	**39,5**	**39,9**	**40,9**	**41,8**
Average	34,6	37,2	39,9	42,4	44,7	46,7

	1990	2000	2010	2020	2030	2040
BE	14,8	16,8	17,2	19,2	22,3	24,3
BG	13,0	16,2	17,5	20,9	24,2	27,4
CZ	12,5	13,8	15,2	19,6	22,0	24,8
DK	15,6	14,8	16,3	19,9	22,5	24,6
DE	14,9	16,2	20,7	23,0	28,1	31,7
EE	11,6	15,0	17,1	19,1	22,3	24,8
IE	11,4	11,2	11,3	14,4	17,6	20,2
EL	13,7	16,5	18,9	20,9	23,7	28,1
ES	13,4	16,7	16,8	19,1	22,8	27,8
FR	13,9	15,8	16,6	20,2	23,2	25,6
IT	14,7	18,1	20,2	22,3	25,5	29,8
CY	10,8	11,2	13,1	16,5	19,6	21,3
LV	11,8	14,8	17,4	19,0	23,1	26,6
LT	10,8	13,7	16,1	17,6	22,1	25,6
LU	13,4	14,3	14,0	15,7	19,3	22,9
HU	13,2	15,0	16,6	19,7	21,8	24,8
MT	10,4	12,1	14,8	20,5	24,2	25,0
NL	12,8	13,6	15,3	19,7	24,1	27,0
AT	14,9	15,4	17,6	19,8	24,1	27,6
PL	10,0	12,1	13,5	17,9	22,5	25,1
PT	13,2	16,0	17,9	20,6	24,0	27,9
RO	10,3	13,2	14,9	17,4	20,2	25,4
SI	10,6	13,9	16,5	19,8	24,2	27,5
SK	10,3	11,4	12,3	16,1	20,5	24,1
FI	13,3	14,8	17,0	22,1	25,0	25,5
SE	17,8	17,3	18,1	20,6	22,3	24,0
UK	**15,7**	**15,8**	**16,4**	**18,7**	**21,2**	**23,2**
Average	12,9	14,7	16,3	19,3	22,7	25,7

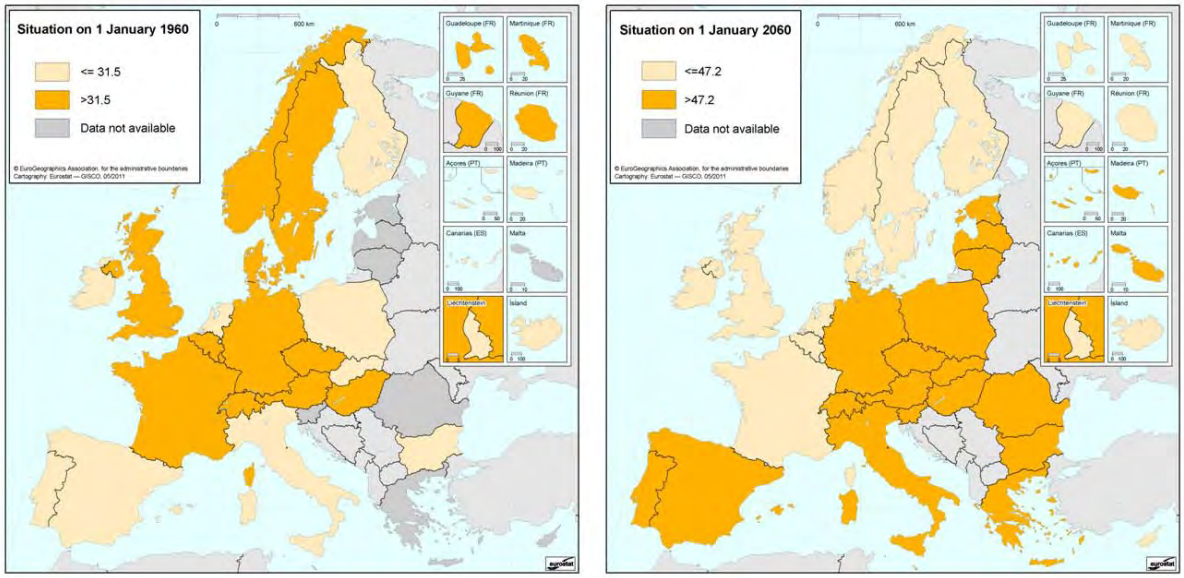

Figure 1-1 - Countries above or below the average of the median age in selected years (Lanzieri, 2011)

Looking more specifically at the UK context, the National Census from 2011 (Office for National Statistics, 2013) shows that in 2011 9.2 million of the population of England and Wales were aged 65 years old and above, 1 million more compared to the National Census 2001. This accounts for 16% of the total population of England and Wales. A further look into the forecast trends (Figure 1-2) reveals that by 2031 the amount of people aged 65 years and above is expected to grow from 10 to 16 million. This means that over a period of time of fifty years (1971-2031) the UK older population is expected to double. According to the Office for National Statistics (ONS), this shift towards ageing is happening due to two main reasons. Firstly, the constant increase in life expectancy over the last decades. Secondly, the changes in birth trends following World War II that are influencing the ageing trends now and are going to last for the next decades (House of Lords, 2013).

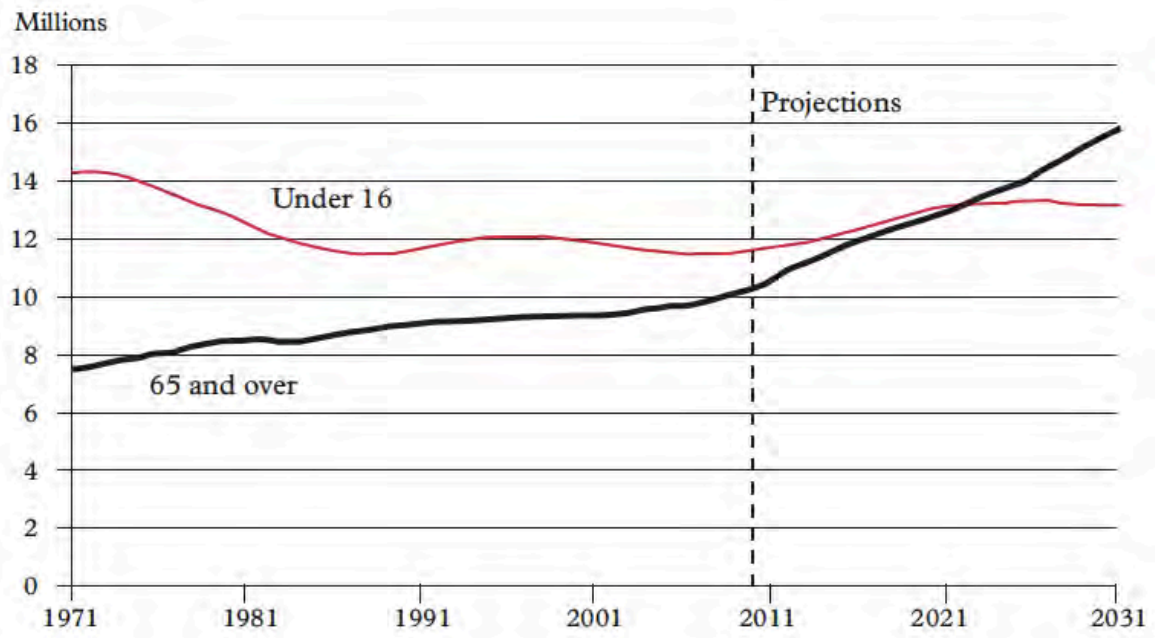

Figure 1-2. Population aged under 16 and 65 and over, United Kingdom (House of Lords, 2013)

The concept of ageing have been various and not straightforward, with consequent issues in defining and measuring the older population (Dannefer and Shura, 2009, Shergold et al., 2016). From a gerontological point of view, ageing is considered as a process associated with the physical implications of advancing age, and consequently, in terms of increases of likelihood of death (Rose, 1991). Comfort (1964) describes ageing as *"a progressive increase throughout life, or after a given stadium, in the likelihood that a given individual will die, during the next succeeding unit of time, from randomly distributed causes"*. Similarly, Rose (1991) defines ageing as *"a persistent decline in the age-specific fitness components of an organism due to internal physiological deteriorations"*. Another common approach used as cut-off for ageing is the association with changes in life-events. A typical example in this sense is using retirement from work as a starting point of later life (e.g. in the UK 65 and 60 years old for men and women, respectively). However, as the pensionable age is increasing and it has become more flexible and transitionary, using retirement as key marker might be not appropriate anymore (Shergold et al., 2016). Similarly, the right of

accessing some benefits such as public transport concessions or housing benefits is another way to identify older people (Tilley, 2013). Nonetheless, these approaches are criticised by scholars due to two main reasons. Firstly, a dichotomous differentiation of young and older people does not take into account the heterogeneity that older people have with regard to health, demographic characteristics and travel behaviour. This is particularly valid considering also the fact that there is more heterogeneity within the older population than in the other age groups of society (Dannefer and Shura, 2009, Andrews, 2012). Secondly, the fact that those approaches identify ageing as an end-state rather than a dynamic process (Baltes and Carstensen, 1996), especially due to the fact that ageing is more a personal experience that tends to differ between individuals than a cut- off life stage (Wilson, 2000).

A consequence of this demographic shift towards an ageing population is the effect that it is likely to have on the transport system. The ability to be mobile and use transport are considered fundamental factors to increase an individuals' independence during later life and contribute to personal wellbeing while ageing (Farquhar, 1995, Gabriel and Bowling, 2004, Nordbakke and Schwanen, 2014, Musselwhite et al., 2015). However, the heterogeneity characterising the older population in terms of socio-demographic background, health and mobility patterns presents a challenge to fulfil their travel needs. Research on transport gerontology show that travel patterns related to outdoor activities tend to decrease with advancing age, due to deterioration in health and consequent reduced access to transportation (Haustein et al., 2013, Siren and Hakamies-Blomqvist, 2004, Hjorthol, 2013a). At the same time, the future generation of older people will be wealthier and healthier, with different and higher mobility expectations in terms of car access and usage and active and diverse lifestyles, especially for discretionary activities (Coughlin, 2009, Siren and Haustein, 2015). Therefore, taking into account these differences and potential inequalities, understanding which are the factors influencing travel needs and their fulfilment

during later life should have a high importance for policy makers and service providers.

Transportation research traditionally relies heavily on realised mobility to investigate travel patterns. Although this approach might be sufficient when investigating the overall population, it might not be as appropriate when looking specifically at the older population. Retirement and advancing age affect individuals' lifestyle and travel behaviour, especially in terms of reduction of travel patterns (Coughlin, 2009, Haustein et al., 2013). In this sense, a reduction in travel might automatically suggest unfulfilled mobility (Hough et al., 2008) but at the same time, might result from lack of transport options and circumstance (Kim et al., 2014).

Therefore, the purpose of this doctoral research is to fill this gap in knowledge, by creating a framework that investigates which aspects have to be taking into account when assessing out-of-home mobility in later life and which are the factors influencing the fulfilment of travel needs amongst the older population in terms of both realised and unfulfilled mobility.

1.2 Definitions of older population and out-of-home mobility for this research

Starting from the insight related to the conceptual definition of ageing, this research defines the older population as those people aged 60 years and above. In spite of several studies using retirement age to define the older population (usually 65 years old), here 60 years old is used as the baseline age for two main reasons: the British National Travel Survey (NTS) uses this age to identify the older population and; 60 years old is the eligibility age for claiming several benefits available for older people, including the National Concessionary bus pass or Senior Railcard, which allow older people a one-third off fare for travelling with trains.

With regard to out-of-home mobility, taking into consideration the significance of the

relationship with wellbeing highlighted in Section 2.2.1, in this study mobility is not considered only as a derived demand, but as a more comprehensive concept involving wellbeing and satisfaction of travel needs. Therefore, mobility is identified as the set of potential benefits proposed by Metz (2000), namely: 1) the ability to gain access to desired places, 2) the ability to meet with other people; 2) the physiological and psychological benefits of movement related to getting out and about; 3) the benefits from involvement in social and local community and 5) the benefits from traveling itself.

1.3 Aim and objectives of the research

The research is aimed at investigating which are the factors affecting and influencing the fulfilment of travel needs of the older population.

In order to meet this aim, five main objectives have been set:

- *Research Objective 1* - To analyse current and past travel patterns of older people in order to understand how and why they travel and if it is possible to forecast future patterns;
- *Research Objective 2* - To investigate if different age and cohorts groups of older people show peculiarity and different characteristics in terms of travel behaviour during the ageing process;
- *Research Objective 3* - To develop a conceptual framework in order to assess travel needs fulfilment of the older population;
- *Research Objective 4* - To investigate which are the factors affecting the fulfilment of travel needs during later life;
- *Research Objective 5* - To develop a segmentation of older people based on the

fulfilment of their travel needs.

1.4 Outline of the research

In order to achieve the objectives listed above, this thesis is structured according to eight chapters. Chapter 1 introduces the subject of the thesis and puts into context the scope of the research undertaken, in addition to illustrating the research aim and objectives. Chapter 2 provides a theoretical background and a critical review of the literature related to travel needs of the older population. It investigates the implications of the relationship between quality of life and out-of-home mobility during later life and the factors affecting modal choice amongst the older populations. The chapter concludes with the identification of the research gaps and the research question behind the research. Chapter 3 describes and justifies the key research methods that were conducted throughout the research. In addition, it outlines the three distinct research methods for the data collections and analyses employed to identify the older people travel patterns, the development of a conceptual framework to assess travel needs in later life and the identification of the factors affecting the fulfilment of travel needs amongst the older population. Chapter 4 illustrates the findings of the analysis aimed at understanding the travel patterns of the older population within the English context. The investigation is based on an Age, Period and Cohort (APC) analysis of the National Travel Survey (NTS) and it explores data related to trip frequency, distance travelled, mode share access to the car, driving licence ownership and travel purpose with regard to four different age groups and six cohorts. Chapter 5 outlines the findings related to the development of a conceptual framework to assess travel needs in later life. The chapter illustrates the process that led to the development of the framework and its components. Chapter 6 reports the findings from a case study aimed at investigating the factors affecting the fulfilment of travel needs during later life. The case study employs the conceptual framework described in

Chapter 5 as a base for a survey questionnaire and an innovative travel diary aimed at recording both realised and unfulfilled mobility. Chapter 7 provides a critical interpretation of the findings related to the three studies composing this research, in addition to highlighting the main limitations behind both methods and findings. Finally, Chapter 8 concludes the thesis by describing the contribution of this research to existing knowledge and by providing a summary of the key findings, in addition to potential avenues for future research.

2 LITERATURE REVIEW

2.1 Introduction

This chapter provides a theoretical background and a critical review of the literature related to travel needs of the older population. The chapter comprises of two main parts. It commences with a focus on the implication associated with out-of-home mobility and ageing by investigating the relationship between wellbeing and out-of-home mobility during later life (Section 2.2.1), the factors leading to unmet travel needs (Section 2.2.2) and social exclusion (Section 2.2.3) and finally how older people have been segmented in transport studies (Section 2.2.4). Then the focus shift to the description of positives and negatives associated with the use of cars (Section 2.3.1), public transport (Section 2.3.2), Flexible Transport Services (FTS)[1] (Section 2.3.3), taxis (Section 2.3.4), walking and cycling (Section 2.3.5) amongst the older population. Finally, the chapter concludes with the identification of the research gaps and questions behind this research (Section 2.4).

2.2 Out-of-home mobility in later life

2.2.1 Ageing, out-of-home mobility and quality of life

Out-of-home mobility is considered a fundamental contributor to the wellbeing of the older population. The ability to be mobile and use transport modes has been recognised as crucial for independence and for ageing well (Farquhar, 1995, Gabriel and Bowling, 2004). It allows older people to access services and facilities they need and places and people they desire (Metz, 2000). Moreover, it provides the potential psychological and physical benefits of

[1] FTS comprises of transport modes including demand responsive transport; dial-a-ride services; special transport service; shared taxis/taxi buses; car sharing; carpooling and community transport.

movement (Metz, 2000), fulfils social and leisure needs and generates a sense of being in control of one's life (Hjorthol, 2013a, Knight et al., 2007, Mollenkopf et al., 2011, Musselwhite and Haddad, 2010b, Nordbakke and Schwanen, 2015).

Several studies on mobility and wellbeing relate to the extent to which travel needs are satisfied. Much research in this area originates from the motivational hierarchy of human needs developed by Maslow (1968). In this theory, Maslow points out that people satisfy certain needs over others and that once basic needs related to biology and survival are met, the necessity of satisfying psychological and self-fulfilment needs emerge. A common categorisation of mobility needs that follows this approach is to classify them into utilitarian/serious and discretionary ones (Davey, 2007, Ahern and Hine, 2012, Siren et al., 2015). In this sense, utilitarian/serious needs are identified as travel necessary to achieve access to basic needs such as medical appointments and emergencies, shopping or financial services. On the other hand, discretionary needs are associated with travel related to the social, leisure and cultural realm, such as visiting other people, desired places and more generally as a means of achieving pleasure. A more elaborate hierarchy of needs based on Maslow's theory is the one proposed by Musselwhite and Haddad (2010b) (Figure 2-1). They developed a three-tier hierarchical framework based on utilitarian, affective and aesthetic needs to define motivation for mobility and travel amongst the older population. The primary level of the framework is characterised by travelling in order to fulfil practical and utilitarian needs such as access to services and shopping facilities, medical appointments and visiting other people. Once practical needs are met, psychological needs follow. At this secondary level, older people are motivated by the need to find their identity, independence and sense of control over their life. Finally, aesthetic needs are associated with the feelings obtained by the experience of the travel itself.

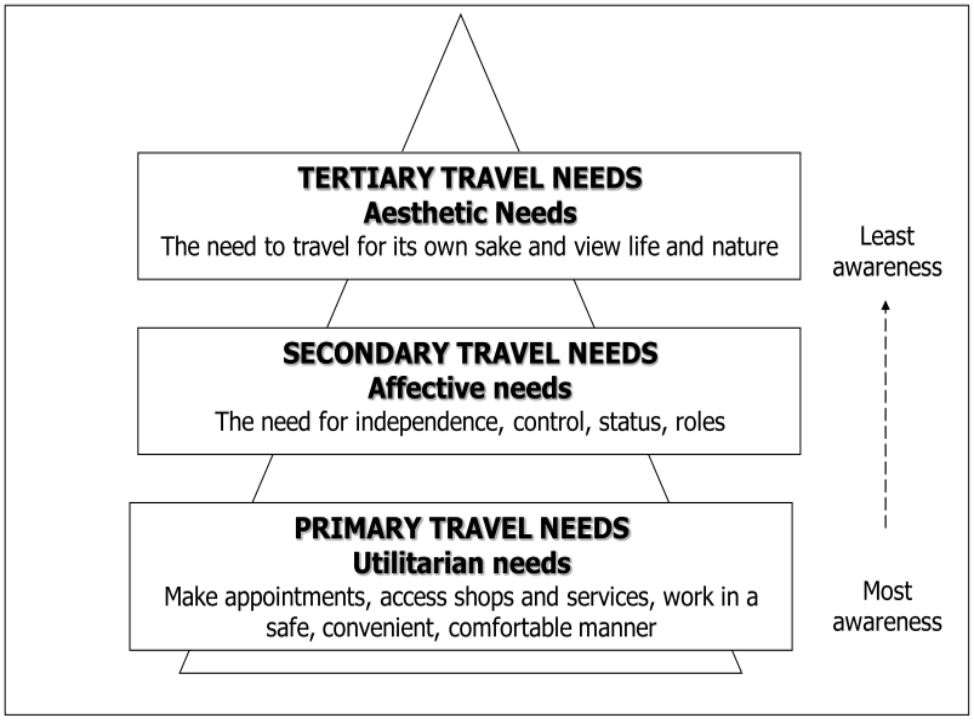

Figure 2-1. The three levels of mobility needs by self-awareness of the need (Musselwhite and Haddad, 2010b)

Another perspective in terms of needs satisfaction, used particularly in Scandinavian research, is connected to the integral needs approach developed by Allardt (1993). This approach identifies wellbeing not only as a matter of fulfilling basic needs, but also highlights the importance of non-material aspects of life that allow individuals to flourish (Nordbakke and Schwanen, 2015). Moreover, individuals are not considered merely as receptacles for resource inputs but play an active role in controlling and managing their resources. In this theory, wellbeing is considered in terms of needs satisfaction in the context of three different conditions of life:

- *having* - income, household, employment, health and education;
- *loving* - relations with family, friends and other social relationships;
- *being* - self-esteem, leisure activities, social reputation and political resources.

An example of the adjustment of the integral needs approach to explain the relationship between mobility and wellbeing of older people can be found in Hjorthol (2013a) and Nordbakke and Schwanen (2015). In their studies, journeys for shopping, health, services and commuting can be associated with the *having* aspects of life; social activities, such as trips to visit other people, and chauffeuring with *loving;* and journeys related to leisure activities with the *being* condition. However, an important element of this approach is that, contrary to Maslow's theory, activities do not belong to pre-fixed categories. Therefore, some activities can help to fulfil needs in more than one aspect of life (e.g. shopping as a primary need as well as a social or leisure need).

The active role of individuals in terms of how to manage resources is also central in the capability approach developed by Sen (1993). According to Sen, focusing only on resources is not enough to describe wellbeing, since the ability to manage resources differ according to individuals and social, temporal and spatial contexts (Nordbakke and Schwanen, 2014). Therefore, wellbeing is identified as the freedom of choosing what type of life individuals want to live and how they use personal resources. This theory hinges upon the concepts of functionings and capabilities, where the first are the states of being and doing and the latter the combination of potential functionings that an individual can achieve. In this sense, functionings can be considered not only as achievements, but also as part of individual capabilities to relate on attaining new functionings (Nordbakke, 2013, Nordbakke and Schwanen, 2014). Starting from this approach, Nordbakke (2013) developed a framework to assess opportunities for mobility, namely personal resources and both opportunities and barriers related to the context, during later life. More precisely, the framework is aimed at investigating active participation and choices, i.e. action strategies based on the opportunities for mobility that individuals have.

2.2.2 Unmet travel needs

Mobility is traditionally assessed as a derived demand by taking into account travel behaviour and preferences based on realised journeys and activities (Hjorthol, 2013a). As highlighted by Siren and Hakamies-Blomqvist (2004), these approaches are often insufficient to explain mobility in later life. Low travel demand patterns do not automatically imply unmet travel needs (Hough et al., 2008), but at the same time, unmet travel needs might be a consequence of inadequate transport options and environment (Kim et al., 2014). Therefore, a better understanding of older people's mobility needs requires taking into account unmet travel needs in addition to those realised.

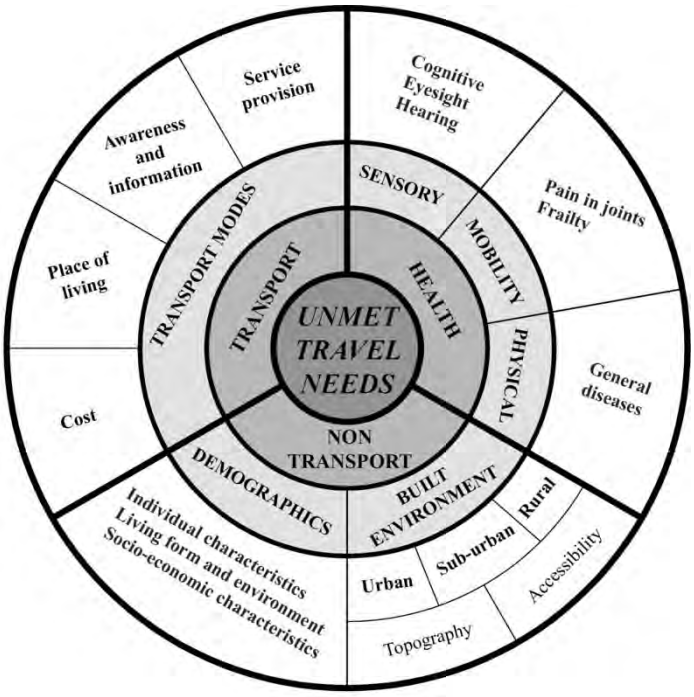

Figure 2-2. Conceptual framework for the analysis of the literature focused on unmet travel needs

Unmet travel needs can be identified as mobility needs that remain unfulfilled due to the inability to accomplish needed or desired journeys and activities Starting from the

classification of barriers proposed by WS Atkins (2001), factors influencing the fulfilment of travel needs were analysed according to three main categories of potential barriers, namely health, transport and non-transport barriers (Figure 2-2).

Health issues were classified in terms of physical, sensory and mobility impairments. This category includes general physical problems due to disease; personal mobility problems such as frailty, reduced mobility and sensory problems related to limited eyesight and hearing or cognitive impairments. Transport issues are the focus of much of the literature particularly the relationship between mobility and unmet travel needs. The developed framework disaggregates transport issues related to different modes (car, public transport, FTS, taxi, walking and cycling) in terms of accessibility, service provision, cost, information and awareness and place of living. Non-transport issues are characterised in the model in terms of socio-demographic characteristics of individuals and built environment. The first category includes characteristics such as age, gender, income, employment status, education, marital status, household structure, social network and caring duties. The second is characterised by context (urban, sub-urban/rural), topography and accessibility to transport and activities.

Due to the heterogeneity of older people and differences in research approaches, the analysis of the literature was found to be inconclusive in terms of identifying the real impact of the analysed variables on unrealised mobility. Nonetheless, of the studies analysed, on average at least one-third of older people reported unmet travel needs, with older women and people aged 75 years old and above the most affected groups. Leisure activities, in particular visiting friends and family, were found to be the activity most associated with unmet travel needs.

A more exhaustive review of the literature has been published in an article entitled “The unmet travel needs of the older population: a review of the literature” (see Appendix A). Moreover, Section 5.2 provides a more detailed overview of some of the studies presented

in this section with regard to aim(s) and hypotheses behind each study, approaches, variables investigated and findings.

2.2.2.1 Health issues

Looking more specifically at the impact of barriers leading to unmet travel needs, the literature suggests that health issues seem to be the ones that most significantly affect travel needs among older people. Such issues are consistently reported across all of the studies investigating unmet travel needs among older people. In general, people self-reporting good health conditions show an increased desire to do more activities (Hjorthol, 2013a). Not surprisingly, health problems are most reported by the oldest population (75 years old and above) and women as a significant barrier for the fulfilment of travel needs. This is in line with other research showing that health impairment levels rise with advancing age (Haustein et al., 2013). Health impairments affect mobility in different ways. For example, reduced ability to move often leads to an individual undertaking less diverse activities. Scheiner (2006) found that more than activity frequency, health impairments or disabilities reduce the range of activities undertaken, due to the prioritization and selection of activities. Physical and mobility impairments affect also the use of transport modes. Older people face problems in using public transport due to difficulties in boarding and alighting and also where stops are more than a critical distance from home or destination (Hjorthol, 2013a, Buys et al., 2012, Davey, 2007, Gilhooly et al., 2002, Wretstrand et al., 2009). Moreover health problems are considered as the main predictor for driving cessation (Haustein et al., 2013, Hjorthol, 2013a, Haustein and Siren, 2014), especially due to deterioration of vision and physical, cognitive and hearing impairment (Adler and Rottunda, 2006, Brown and Ott, 2004, Ragland et al., 2004, Seiler et al., 2012). Finally, health problems may lead to unmet travel needs in indirect ways. Knight et al. (2007) and Siren et al. (2015) both report that

participants explained how poor health conditions of relatives or friends reduced their travel activities due to a lack of travel companions.

2.2.2.2 Non-transport issues

Non-transport barriers were characterised with conflicting findings, especially for the effect of the place of living and household characteristics. With regard to the former, three studies (Hjorthol, 2013a, Nordbakke and Schwanen, 2015, Scheiner, 2006) show the influence of the built environment is limited, since living either in urban, sub-urban or rural environment is not shown to affect travel needs fulfilment when other variables are controlled for. In contrast, Kim (2011a) reports older people living in suburban areas mention more unmet travel needs compared to those in urban areas, while Nordbakke (2013) shows that some participants had previously decided to move from the outskirts to the centre of a city in order to benefit from better public transport service supply and shorter distances. Moreover, the topography of the built environment was found to affect travel needs not least if many hills and gradients are present (Kim et al., 2014), particularly to reach public transport stops (Buys et al., 2012).

In terms of demographic variables, due to differences in sampling and country of investigation, the impact of background socio-demographic variables varies significantly among studies reviewed. On average, evidence shows that age, gender, income and education do not appear to be significant in several studies. Marital status and living in households with more than two people are probably the most controversial among non-transport related variables. With regard to marital status, living alone increases leisure and social needs due to the necessity of satisfying these needs outside the home (Nordbakke and Schwanen, 2015). This is especially valid for widows (Hjorthol, 2013a). In contrast, living together with a partner reduces the likelihood of unfulfilled travel needs. Social contacts

could be satisfied inside the home and the chances of getting a lift are higher (Haustein and Siren, 2014, Kim et al., 2014). However, living with a partner might also be a cause of unmet travel needs. This is the case when a partner has to take care of his/her spouse due to health impairment, with consequent reduced frequency of other activities (Scheiner, 2006, Mollenkopf et al., 2011, Knight et al., 2007). This is valid also when older people live in a household of more than two people. Both Kim (2011a) and Kim et al. (2014) found older people living with one or more children under 18 years were more likely to report unmet travel needs due to caregiving duties.

2.2.2.3 Transport issues

Looking at the transport barriers, the literature suggests that having access to the car, and especially holding a driving licence, are necessary to fulfil travel needs in later life. Musselwhite and Haddad (2010b) showed that driving a car helps to meet practical needs and to realise both social and aesthetic needs. Conversely, former drivers report numerous difficulties in achieving satisfactory levels for all three needs. Practical needs are influenced by the burden of not being able to travel without spending large amounts of time planning the journey. Social needs are particularly affected and can lead to psychological issues. Feelings of anxiety, depression and annoyance are the most commonly reported, especially for those seniors who were forcibly prevented from driving and who had not planned for their future without a car. Finally, the research shows that once older people stop driving they rarely achieve their aesthetic needs. Such needs are often seen as unnecessary and so older people find it is difficult to ask relatives or friends for a lift. At the same time, destinations associated with meeting aesthetic needs are often expensive and difficult destinations to reach with alternative transport modes. Haustein and Siren (2014) showed that possessing a driving license was very important to meet personal travel needs.

Unlicensed older people (especially women and the oldest older groups) report more unmet travel needs and greater dependence on others. Overall, they concluded that "a *more positive attitude towards, more experience with better access to alternative transport cannot sufficiently compensate for mobility problems due to lack of option to drive*" (Haustein and Siren, 2014). Siren and Haustein (2014) found that those not renewing their driving licence had more unmet travel needs compared to those renewing it, especially for leisure activities such as visiting other people, pursuing a hobby and going out with a specific purpose. Wasfi et al. (2012) suggest the main reasons for unrealised mobility were no availability of a car or people available to ask for a lift, together with weather conditions. Similar findings about impact of driving licence possession, car availability and evidence that non-drivers have more limitations in achieving activities are also found in Kim et al. (2014), Haustein et al. (2013), Kim (2011a), Mollenkopf et al. (2002) and WS Atkins (2001).

The importance of access to private transport is confirmed by Davey (2007) and Kim (2011b). Both studies focused on driving cessation and showed that the car remains the preferred transport option after stopping driving and that lifts from other people were the best alternative to using one's own car. Davey (2007) found that almost one-third of the participants asked for lifts from relatives or friends in order to fulfil all their transport needs, with two-thirds having lifts on a weekly basis and a quarter on a daily-basis.

The importance of the car seems to be particularly relevant in a sub-urban and rural context. Zeitler and Buys (2015) focused on the suburbs of Australia and identified two important reasons for continued car use. First, low-density environments are characterised by trip-chaining, because of the necessity of organising activities due to longer travel distances to reach desired destinations. The second aspect that emerged from this study is the importance of the car not only to satisfy personal needs, but also to provide assistance and support to

family, friends and other people in a community. Moreover, five studies found that asking for a lift was considered the preferred option for people who cannot drive even in sub-urban and rural environments, not only due to the characteristics that make car the preferred option, but also because of being positively evaluated for the social interaction involved (Glasgow and Blakely, 2000, Shergold et al., 2012, Ward et al., 2013, Zeitler and Buys, 2015, Hanson and Hildebrand, 2011).

Despite the findings illustrating the importance of the car to fulfil travel needs amongst older people, two studies challenge this evidence and raise a significant question about the real impact of the car and its connection to circumstances in life requiring travel. Kasper and Scheiner (2002) found that, in contrast to most evidence, older people holding a driving licence and having access to a car in the household report more unfulfilled wishes than people with no car availability. Comparing the effects of car and season tickets for public transport, Scheiner (2006) argued that it is not car availability that allows people to keep a high level of mobility and consequently to satisfy their needs, but rather it is a healthier and more mobile lifestyle that leads older people to more frequently use the car for their trips. This study critiqued other research for not controlling for other variables when comparing drivers and non-drivers. It shows that the influence of cars decreases and becomes irrelevant when other background variables, such as health, employment and gender are introduced into the statistical models used to infer correlation.

The point of view of these two studies is partially supported by Nordbakke (2013). Her study recognises the importance of the car to compensate for physical impairments and the effect of car availability to fulfil travel needs for specific situations, such as travelling during the night or when public transport services are difficult to use. However, using Sen's capability approach to wellbeing (Sen, 1993), Nordbakke's study shows that it is more the ability to

manage opportunities and develop strategies for mobility than the ability to drive that allows older people to meet their travel needs. In order to be mobility independent, three conditions are needed to be satisfied: experience in using alternative transport modes, high quality of the transport system and accessible activities in terms of both time and space.

Moreover, despite the fact that moving from being a driver to a passenger is often considered the preferred option to private transport, it may be problematic. Many people feel reluctant to ask relatives or friends for a lift, due to the fact that they cannot reciprocate, and also because of concerns about other drivers' skills and behaviours or gaining access to the back of a car (Davey, 2007, Siren et al., 2015). Nordbakke and Schwanen (2015) affirm also that due to pride and guilt, older people self-censor themselves and reduce the amount of help they need. WS Atkins (2001) point out that in addition to reluctance to ask for lifts, other problems are related to the feeling of maintaining independence, lack of spontaneity involved in adapting their plans to another driver's schedule and difficulties in offering some form of payment to the people providing the lift.

2.2.3 Social exclusion

A potential consequence of reporting unmet travel needs is the association with experiencing social exclusion. Social exclusion is a topic that has received particular attention in recent decades with regard to the transport field, as several studies found that there is a connection between poor transport and difficulties in societal participation (Delbosc and Currie, 2011, Preston and Rajé, 2007, Hine and Mitchell, 2003). In this regard, the issues related to social exclusion are particularly significant for the older population, as this group is considered one of the most at risk of experiencing transport disadvantages (Evans, 2001).

Despite the amount of studies investigating the topic, there is a no commonly recognised definition of the concept of social exclusion. However, it is generally acknowledged that

more than an end-state, social exclusion can be identified as a process preventing individuals or groups from accessing and taking part into the activities of the society they are part of (Hine and Mitchell, 2003, Preston and Rajé, 2007). In this sense, Burkhardt et al. (2000) identified four main dimension of exclusion, namely: 1) Consumption (the inability to consume at least a minimum level of goods and services); 2) Production (not being engaged in a socially valued activity); 3) Political engagement (the inability to vote or take part in civic organisation or activity) and 4) Social interaction (inability to engage in social interaction with other people).

Social exclusion has been often associated with the concept of poverty, as people with lack of financial resources are more likely to have lower access to private transport (Lucas, 2004) and experience transport disadvantages and consequent lack of access to services and goods if living in deprived areas (Hine and Mitchell, 2003). Nonetheless, poor income is only a component leading to social exclusion, since other issues can affect access to activities. In this sense, Delbosc and Currie (2011) found that people reporting more social exclusion and transport disadvantages were those unemployed, a lone parent, receiving a disability pension and not owning a car, highlighting the fact that it is not just poverty leading to social exclusion, but more a combination of different factors. Similarly, Church et al. (2000) found seven potential categories of mobility that might affect social inclusion:

- Physical exclusion (the physical nature of the transport system that create barriers to access by impaired people);
- Geographical isolation (the dispersion of a locations that reduce the ability to undertake activities in specific areas);
- Exclusion from facilities (the distance of services and facilities from dwellings);
- Economic exclusion (the issues related to travel cost that limit the extension of

work travel patterns and job search);

- Time-based exclusion (the constraint of organising commitments to allow time for travelling);
- Fear-based exclusion (the problems related to personal security when travelling in public spaces);
- Space exclusion (the management of security or space preventing the access to public and quasi-public transport spaces).

2.2.4 Segmentation of older people in transport studies

As the older population is characterised by being a heterogeneous group (OECD, 2001, Alsnih and Hensher, 2003) a common approach used in transport studies is to analyse this heterogeneity by segmenting older adults (Haustein et al., 2013). As found in Haustein and Siren (2015)'s review, segmentations in the transport field are diverse and built upon different variable sets, but usually based on background demographic characteristics, attitudinal variables, spatial variables and travel behaviour. In this sense, Hildebrand (2003) used socio-demographic background characteristics to segment the older population and identified six different groups: 1) Workers, 2) Disabled drivers, 3) Affluent Males, 4) Mobile widows, 5) Mobility impaired and 6) Granny Flats. Similarly, Bell et al. (2010b) used demographic characteristics, in addition to health conditions, and found three main segments according to mobility levels: 1) Mobile people, 2) Slightly restricted mobiles and 3) Highly restricted mobiles. Mollenkopf et al. (2004) focused on trip frequency, variety of transport options, activity variety, and mobility satisfaction to cluster older people. They identified four different subgroups going from high outdoor mobility and mobility satisfaction to low mobility and satisfaction. Aigner-Breuss et al. (2010) segmented older people according access to the car and use of different transport modes and identified three groups: older

people predominantly using private car, selective car user and those without car access.

Car availability and specific attitude towards mobility were used by Haustein et al. (2008), which identified six clusters: 1) Mobile car-oriented, 2) Mobility impaired; 3) Self-determined mobiles; 4) Ecology-minded public transport-user; 5) Pragmatic public transport-oriented and 6) Bike-oriented. A subsequent study from Haustein (2012) based on socio-demographics, infrastructure, mobility-related attitudes identified four groups: 1) Captive car user; 2) Affluent Mobiles; 3) Self-determined Mobiles and 4) Captive Public Transport Users. In their review Haustein and Siren (2015) concluded that older people can be grouped into four main segments: 1) Affluent mobile drivers (predominant car users with high mobility engagement); 2) Car dependent seniors (predominant car users with low mobility engagement); 3) Mobile multi-modal seniors (use of all modes with high/medium mobility engagement) and 4) transport service dependent seniors (walking, public transport users and car passenger with low mobility engagement) (Table 2-1).

Table 2-1. Overview of different segmentations of older people and the relation between the resulting segments (adapted from Haustein et al., 2013)

	Aigner-Breuss et al., 2010	Hildebrand, 2003	Bell et al., 2010	Haustein et al., 2008	Haustein, 2012
Variables / *Segments*	*Car use*	*Socio-demographic and household variables (e.g. driving licence, head of the household)*	*Health, household structure, occupation*	*Socio-demographic, infrastructure, mobility-related attitudes*	*Socio-demographic, infrastructure, mobility-related attitudes*
Car-oriented but restricted in mobility	Older people who predominantly use car	Disabled drivers		Restricted Mobiles	Captive car user
Car-oriented highly mobile		Affluent Males	Mobile person	Mobile car-oriented	Affluent Mobiles
		Mobile Widows			
Open to all transport modes	Selective car users		Slightly restricted mobiles	Self-determined mobiles	Self-determined Mobiles
Captive public transport users	Older people w/o access to a private car	Mobility impaired	Highly restricted mobiles	Pragmatic Public Transport-oriented	Captive Public Transport Users

2.3 Older people within a car-oriented society

2.3.1 Cars

Studies of transport gerontology attribute a significant importance to the role that access to the car has in later life. Cars meet the majority of transport needs of older people by fulfilling most of the conditions that Metz (2000) describes as defining mobility (i.e. access to desired places; psychological benefits of travel; benefits of physical movement; maintaining social networks and maintaining potential travel). Cars also provide autonomy, flexibility and

independence (Glasgow and Blakely, 2000, Musselwhite and Haddad, 2007) are available at any hour and allow desired destinations to be reached conveniently (Davey, 2007) and it creates a sense of control over individuals' life (Musselwhite and Haddad, 2017). Moreover, they can compensate for health impairments, allowing older people to be independent when undertaking daily activities (Siren and Hakamies-Blomqvist, 2004).

Various studies have found access to the car necessary to fulfil travel needs in later life (Haustein and Siren, 2014, Hjorthol, 2013a, Kim et al., 2014, Kim, 2011a, Siren and Hakamies-Blomqvist, 2004, Siren and Haustein, 2014, Musselwhite and Haddad, 2010b). In these studies, older people who had stopped driving or who had never previously driven were found to report more unmet travel needs compared to those still driving. Most reported unmet travel needs were those associated with social and leisure activities, such as visiting friends or family, or travelling to the countryside.

In general, older people without car access were found to have a lower quality of life (Gilhooly et al., 2002) and were considered "*among the least mobile, among those most at risk for social isolation and inadequate service availability*" (Evans, 2001). The importance of the car is also confirmed by studies on driving cessation. Stopping driving is perceived as a loss of independence (Adler and Rottunda, 2006, Davey, 2007) and is strongly associated with symptoms of depression (Marottoli et al., 1997, Whitehead et al., 2006). Furthermore, the car remains the preferred mode of transport even once driving has been given up, since asking for a lift from family or friends is considered the first option for people who cannot drive (Glasgow and Blakely, 2000, Shergold et al., 2012, Ward et al., 2013, Zeitler and Buys, 2015, Hanson and Hildebrand, 2011, Davey, 2007, Taylor and Tripodes, 2001).

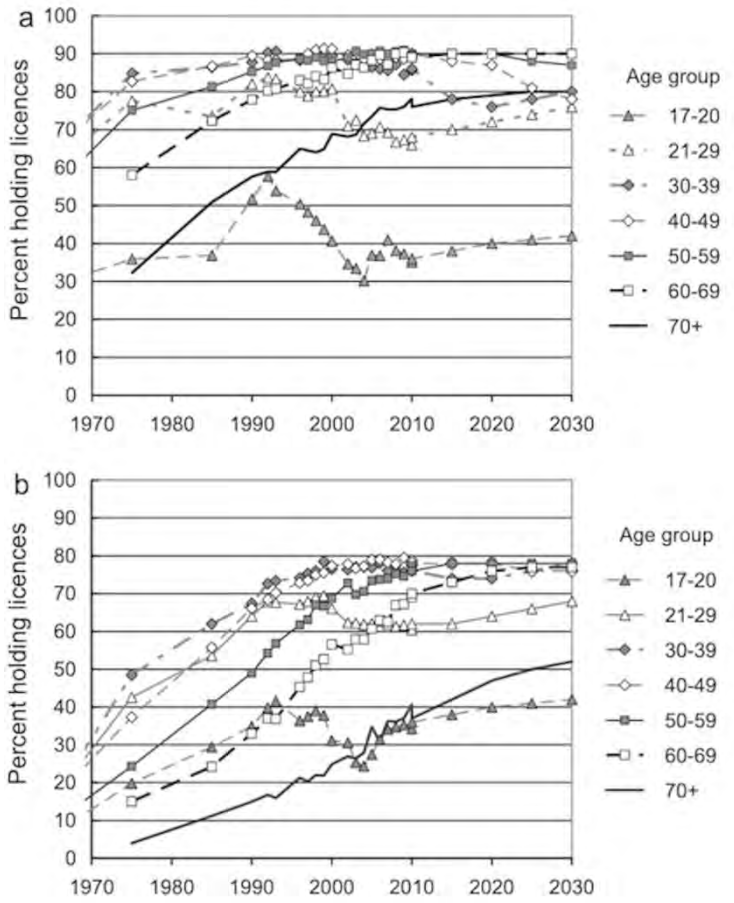

Figure 2-3. (a) Forecast percent of men holding car driving licences in Great Britain. (b) Forecast percent of women holding car driving licences in Great Britain (Mitchell, 2013)

It is commonly presumed that as people age they are more likely to face mobility problems, will stop driving and consequently will switch to using public transport services or special demand-responsive transport services (Rosenbloom, 2001). This perception may be based on patterns which show that older people rely more on public transport compared to younger people. However, there is no published evidence to support this assertion (Rosenbloom, 2009). Contrary to this, data show that as the size of the older population increases, so does the percentage of car licence holders in the older population. An example in this sense is provided in Figure 2-3, showing that by 2030 approximately 90% of the British male population aged between 60-69, and approximately 80% of those aged 70 and over will be licence holders. For the female population, the corresponding percentages are 80% and 50%

(Mitchell, 2013).

Great Britain's licence holding trends and forecasts of licence holding rates are similar to other countries, such as Germany, the Netherlands (Rosenbloom, 2001), Scandinavian countries (Hakamies-Blomqvist and Peters, 2000, Hjorthol et al., 2010, Rosenbloom, 2001), the U.S.A. (Rosenbloom, 2001), Australia (Buys et al., 2012, Rosenbloom, 2001) and New Zealand (Rosenbloom, 2001, Davey, 2007). Therefore, it may be postulated that the ageing population in developed countries is becoming increasingly car dependent and less likely to use alternative transport (Rosenbloom, 2009). This reliance seems to be particularly evident in suburban (Zeitler and Buys, 2015, Rosenbloom, 2004a) and rural environments (Ahern and Hine, 2012, Hanson and Hildebrand, 2011, Shergold et al., 2012). Tacken (1998) highlighted that "*mobility behaviour follows the general rule that people stay as long as possible with the type of behaviour they are used to*". Considering these facts, it seems that car dependence trends are unlikely to decrease (Buys et al., 2012) for the foreseeable future.

It is commonly agreed that older people, while ageing, are more likely to be affected by physical impairments, which might have repercussions on their driving skills, decreasing their driving performances and modifying travel behaviour. As highlighted by Mitchell (2017), older drivers are exposed to increased risks of injuries and death due to their fragility associated with advancing age. Psychological matters due to safety concerns play an important role in behavioural changes. Older drivers tend to avoid particular travel situations in which they may find difficulties and have bad experiences. Indicative in this sense is the "longer but safer" dimension. Opposite lane turns at unsafe intersections are often avoided, and older drivers prefer to make the trip longer and wait to find a turn in same lane to go back and reach their destination. In the same way, due to concerns about traffic levels (e.g. speed and volumes), faster and more direct trips by highway are frequently bypassed and

substituted with slower and longer routes by local streets (Banister and Bowling, 2004, Rosenbloom, 2001, Musselwhite and Haddad, 2010a). Experiences of navigation problem situations are another clear example of changes in this sense. Older drivers are more likely to get lost and make way-finding errors in their trips, giving origin to what Burns (1998) identifies as "wasted trips". Related to this phenomenon is the "scouting a trip" dimension. In order to avoid duplicate trips, older people often travel to a predicted destination in advance, so as to find best routes for their travel and availability of facilities and parking (Rosenbloom, 2001).

Car dependence trends surely pose a number of sustainability implications. As Rosenbloom (2001) highlights, increased access and use of private vehicles is strictly associated with increment of trips taken and length among the ageing population. This increment and also changes in travel behaviour have clear environmental impacts. More car usage and more trips taken mean more air pollution emissions and more traffic congestion rates on road networks. Evidence from several studies focused on older people's mobility reveal that with ageing, older drivers tend to make shorter trips (Hakamies-Blomqvist and Peters, 2000, Su and Bell, 2009, Tacken, 1998). Such behaviour can cause more pollution emissions due to the so-called "cold-start" problem. In order to make pollution control devices work properly, car engines need to be warmed enough, which may be difficult with short trips (Rosenbloom, 2001). It is also true that some of these changes lead also to positive implications. Driving slowly and avoiding potential stressful situations such as during night-time, bad weather conditions (in fog or rainy days e.g.), peak traffic times or heavy traffic, and finding car parking contribute to reduce traffic congestion and decrease pollution emissions rates (Lyman et al., 2001, Marottoli and Richardson, 1998, Rosenbloom, 2001). Another significant direct problem raised by the almost complete reliance on car to travel is the less marginal role public transport services are taking as a means of transport among the ageing

population. It looks clear that these patterns, if confirmed, will have as consequence that public transit will be less and less likely to be used by the next generations of old people (Rosenbloom, 2001).

Driving reduction or cessation may have significant consequences on older people's daily life and affect considerably their quality of life (Musselwhite, 2011). As Adler and Rottunda (2006) highlight, decisions to continue or cease driving may be determined by a variety of factors. Main reasons can be identified in:

- deterioration in health conditions - due to vision, physical, cognitive and hearing impairment (Adler and Rottunda, 2006, Brown and Ott, 2004, Ragland et al., 2004, Seiler et al., 2012);
- psychological problems - caused by responsibilities associated with driving (e.g. risks of injuring themselves or others), experienced bad situations (e.g. get lost or have already had driving cessation cases in family), lack of comfort and confidence in driving abilities, experience of stress and avoid particular situations in traffic (Adler and Rottunda, 2006, Hakamies-Blomqvist and Peters, 2000);
- lack of valid alternatives to private vehicles - since mainstream public transport is perceived by older people as "*inconvenient, inadequate, unsafe, and generally non responsive to older people needs*" (McKnight, 2003). Significant in this sense is the fact that the first option old drivers choose after stopping driving still remain car, switching from being a driver to a passenger (Oxley, 2000, Taylor and Tripodes, 2001, Davey, 2007).

Other reasons that may entail driving cessation are temporary license suspension or failing

license renewal, financial problems (e.g. costs of running a car), physician recommendation and availability of car lifts (Adler and Rottunda, 2006, Dellinger et al., 2001).

Several studies have investigated driving cessation circumstances and their implications, especially from a medical point of view (mainly geriatric), with similar findings. Older people who had experienced driving cessation can be categorised in three main categories. Adler and Rottunda (2006) define as "proactive" people who decide to stop driving on their own, "reluctant accepters" people with realistic perspectives of their driving skills and reluctantly decide to stop driving, and "resisters" people being not realistic about their driving skills and who will continue to drive until they are forced to cease doing it. The lack of self-awareness of this latter group is considered a significant factor that increases their vulnerability within the road environment (Mifsud et al., 2017).

In the vast majority of the cases analysed, driving cessation causes an overwhelming loss of independence, which has as consequence a "dependence career". Access to social connection and leisure activities are notably reduced (Eisenhandler, 1990) and more generally driving cessation impose dramatic restrictions on older people's daily life. One of the main findings in this sense is the strong relationship between driving cessation and depression symptoms (Marottoli et al., 1997). For example, failure in car license renewal is perceived as a shocking experience, which commonly leads to feelings of being hopeless, useless, worthless and unwanted. Some answers given by those interviewed are quite emblematic in this sense: *"it was like a death sentence"; "now my life is over"; "it is as your whole world had been collapsed around you"* (Whitehead et al., 2006). In the Western society, possession of car license and consequently driving, is considered a granted habit, and for older drivers access to car avoids the feeling to be categorised as old (Eisenhandler, 1990), while not driving or not using the car for travel driving must be due related to unusualness (Musselwhite and

Haddad, 2017).

Overall, despite transport usage depends on several factors (e.g. access to transport resources, socio-economic characteristics and health conditions), statistics suggest that almost half of the journeys older people undertake in several European countries are made by car (OECD, 2001, European Commission, 2011, Bell et al., 2013). The percentage is even higher in Australia at 70% (OECD, 2001), and in the USA, with more than 80%, both as a driver and passenger (Rosenbloom, 2004a). A lack of valid alternative transport modes to the car is often reported by older people as one of the main reasons for car reliance. Despite the importance of promoting transport policies to incentivise the switch from private vehicle to more sustainable forms of transportation, alternatives to the car are still underused by the older population.

The following sections explain the main factors affecting the use of public transport services, FTS, taxis, walking and cycling amongst older people identified within the literature. More specifically, transport modes have been analysed according to built environment, health, personal security, service provision, affordability, comfort, attitude, information and awareness issues. Table 2-2 summarises the main issues for each identified barrier. It is important to highlight that when analysing the mobility of older people, it is always necessary to take into account the heterogeneity in terms of demographic background characteristics, health conditions and transport resources they have, and therefore not all older people might be affected by these barriers.

Table 2-2. Overview of identified barriers per transport mode of alternatives to the car

Barrier	*Transport mode*	*Issue*
Service provision	Public transport	Unsuitable routes and timetable
		Poor service provision during off-peak time
		Poor punctuality and connectivity with other buses or modes
		Stop/station location
		Awaiting times
	FTS	Booking issues
		Lack of spontaneity for leisure activities
	Taxi	Lack of provision in specific contexts (e.g. rural)
		Awaiting times
		Taxi driver behaviour
Health	Public transport	Boarding operation
		Standing of moving bus
		Walking distance to/from stop/station
	Walking & Cycling	Risk of falling due to sensory/cognitive/physical impairment
Safety and personal security	Public transport	Driver/operators' behaviour
		Other passengers' behaviour
		Overcrowded modes
	Walking & Cycling	Travelling at particular times due to inadequate lighting and users behaviour
		Conflict with road users
		Conflict cyclists-pedestrian in shared environment
Comfort	Public transport	Unsuitable bus shelter
		Lack of toilet facilities on buses
		Personal space and overcrowding conditions
Information and awareness	Public transport	Ticketing options
		Understanding timetables and maps
		Understanding directions of buses
		Identification of approaching buses
		Lack of familiarity with services
	FTS	Confusion about available schemes
		Confusion about service provision
		Lack of awareness about available services
Attitude	FTS	Stigma of specialised mode for impaired/disadvantaged people
Affordability	Public transport	Concessionary fares outside municipal boundaries
		High fares when no concessionary schemes are provided
	Taxi	High fares
Built environment	Walking & Cycling	Crossing street operations
		Poor design and quality of walking-cycling infrastructure/environment
		Presence of obstacles along the pathways

2.3.2 Public Transport

Public transport has been advocated as a low cost and low emissions alternative to the car,

allowing passengers to avoid the stress associated with driving in congested traffic, to enjoy interaction with other people and to relax by reading, listening to music or by admiring the passing scenery while travelling (Currie and Delbosc, 2010, Fiedler, 2007, Beirão and Sarsfield Cabral, 2007, Gatersleben and Uzzell, 2007). However, public transport is perceived by older people as unresponsive to their travel needs (McKnight, 2003, Risser et al., 2010). The transport barriers affecting public transport usage among the older population can be grouped into six main categories: (1) reliability and availability of service provision; (2) health and mobility issues; (3) comfort; (4) personal safety; (5) information and awareness and (6) affordability.

Reliability and availability of service provision significantly affect modal choice. Unsuitable routes, timetables and scheduling are one of the most reported issues among public transport usage by older adults. Older people seek more flexibility for their trips than is provided for by fixed-route services (Alsnih and Hensher, 2003). Moreover, while rail-based services tend to be provided mainly on corridors of high-demand, road-based services tend to be affected by the so-called vicious cycles of public transport decline (Brake and Nelson, 2007, Enoch et al., 2004). In cases of low demand, service providers tend to reduce frequency of provision in order to reduce costs. As a consequence, this might lead to a reduction of customers since some might reduce their usage or change transport options by preferring alternative modes. Therefore, this decline in demand can generate an additional decrease in frequency, which results in only captive customers using the service (Mohring, 1970, Bar-Yosef et al., 2013). These cycles usually affect most the vulnerable members of society, such as older and younger people, as well as disabled and low income earners, which are deprived of access to services and goods (Brake and Nelson, 2007).

Serious trips (Davey, 2007), such as to medical appointments, are usually well-served by

public transport, although they might be problematic in rural areas, due to inconvenient schedules and infrequent services (Mattson, 2011). Moreover, older people report dissatisfaction with public transport services for discretionary trips. Indeed, spontaneous travel for leisure, social and shopping activities is often unachievable (Siren et al., 2015, Musselwhite and Haddad, 2010b, Davey, 2007). Several studies have shown that older people have more time to spend than younger people and to some extent they can adjust their schedules around public transport availability (Su and Bell, 2009, Nordbakke, 2013). Nonetheless, public transport services are considered unreliable due to lack of provision during off-peak times (e.g., weekend or holidays). Moreover, older people report dissatisfaction with the locations of stops, punctuality and waiting times and poor connectivity with other buses and/or transport modes (Broome et al., 2010a, Buys et al., 2012, Gilhooly et al., 2002, Su and Bell, 2009, Fiedler, 2007, WS Atkins, 2001, Broome et al., 2013, Ahern and Hine, 2012, Odufuwa, 2006, Olawole and Aloba, 2014, Ipingbemi, 2010, Mattson, 2010). This was found particularly valid for suburban or rural areas (Ahern and Hine, 2012, Hanson and Hildebrand, 2011, Glasgow and Blakely, 2000).

Public transport usage is particularly influenced by the health and mobility problems faced by older people, since the ageing process is associated with a variety of changes in mobility and ability. The main problems identified by the older population are linked to boarding and alighting from vehicles (Aceves-Gonzalez et al., 2016). The ability to get on and off, as well as sometimes having to stand, are seen as key reasons for the lack of public transport usage (Wretstrand et al., 2009, Broome et al., 2010a, Broome et al., 2013, Odufuwa, 2006, Olawole and Aloba, 2014, Ipingbemi, 2010, Kim et al., 2014, Ramachandran and D'Souza, 2016, Chang and Wu, 2010). Despite improvements to accessibility including the introduction of low-floor buses, there are a variety of obstacles that hinder the less mobile. These include cycle ways that can conflict with the pedestrian environment at bus stops, the narrowness of

bus entrances, and the presence of many buses at the same time and the gaps between the bus and the curb (Broome et al., 2010b, Carlsson, 2002). Similarly, keeping balance while standing, particularly during acceleration and deceleration operations, can be physically challenging and increase the risk of falling when the transport mode is moving (Chang and Wu, 2010). Bus stop density and locations also affect mobility problems. Inappropriate locations as well as the distance of stops from both home and destination may require an amount of walking that could deter older people from using public transport (Davey, 2007, Su and Bell, 2009, Wretstrand et al., 2009, Broome et al., 2010a, Hjorthol, 2013b, Peck, 2010, Broome et al., 2010b, OECD, 2001, WS Atkins, 2001, Odufuwa, 2006, Kim et al., 2014).

Older adults are especially sensitive about safety and security, particularly when travelling at night or at peak-times when buses and trains are likely to be less full, when travelling alone or due to the presence or behaviour of other passengers (Gilhooly et al., 2002, Peck, 2010, Broome et al., 2010b, Odufuwa, 2006, Ipingbemi, 2010, Risser et al., 2010). An additional element, often underrated in transport research, is driver behaviour (Aceves-Gonzalez et al., 2016). Unfriendly and unhelpful drivers, who do not stop close to the curb, wait until passengers are seated prior to pulling away, drive erratically, fail to lower the bus during entry and exit operations and fail to provide assistance and information to passengers, are often reported by the older population as a safety concern (Gilhooly et al., 2002, Buys et al., 2012, Broome et al., 2010a, Fiedler, 2007, Shiau and Huang, 2014, Odufuwa, 2006, Olawole and Aloba, 2014, Ipingbemi, 2010, Aceves-Gonzalez et al., 2016).

Comfort also plays an important role. Poor vehicular design leading to overcrowding as well as lack of personal space, toilet facilities, room for heavy shopping and amount and position of handrails are frequently mentioned as factors affecting comfort (Gilhooly et al., 2002,

Buys et al., 2012, Broome et al., 2010a, Fiedler, 2007, Peck, 2010, Broome et al., 2010b, Vine et al., 2012, Ipingbemi, 2010, Ramachandran and D'Souza, 2016, Aceves-Gonzalez, 2014, Risser et al., 2010). Similarly, lack of or unsuitable bus shelters that do not provide adequate seating and shelter from adverse weather conditions at all times are factors affecting public transport usage (Broome et al., 2010a, Peck, 2010, Broome et al., 2010b, Shiau and Huang, 2014, Olawole and Aloba, 2014, Ipingbemi, 2010, Mattson, 2010).

As highlighted by Fiedler (2007), accessibility to public transport is not only a matter of physical access to the service, but also access to information plays an important role in public transport usage. Lack or difficulties in getting information can prevent older users from using public transport. Principal issues in this sense include understanding ticketing options, timetables, maps and directions both at stops/station and on-board, in addition to finding bus stops and locations or recognizing approaching buses (Broome et al., 2010a, Buys et al., 2012, Gilhooly et al., 2002, Wretstrand et al., 2009, Davey, 2007, Su and Bell, 2009, Broome et al., 2011, Vine et al., 2012, Haustein and Møller, 2016, Mattson, 2010, Mattson, 2011). Lack of awareness and low familiarity with available transport modes also influence travel activities in later life (Kim et al., 2014), particularly in suburban (Zeitler and Buys, 2015, Vine et al., 2012) and rural areas (Shergold et al., 2015) due to the high reliance on the car in such areas.

Finally, older people might experience affordability issues. Providing older people with concessionary schemes is a common policy in several countries, allowing them to travel for free or with discounted fares (Metz, 2010). Nonetheless, some schemes might create affordability problems if provided only locally when travelling beyond the municipal boundaries (Metz, 2010) or if they are valid for some modes instead of others (e.g., tube vs buses in Seoul) (Kim et al., 2014). Moreover, in contexts where concessionary schemes are

not provided, cost of travel can be considerable. A few African studies (Ipingbemi, 2010, Olawole and Aloba, 2014) have shown the significance of the cost of travelling with public transport due to high fares. This was found particularly valid for long distance journeys, since fares were based on modal choice and distance between origin and destination (Olawole and Aloba, 2014).

2.3.3 Flexible Transport Service (FTS)

FTS are a form of public transport that is considered to be between a bus operating a regular service and the bespoke service offered by a taxi (Brake et al., 2004). Thanks to the variety of modes and the flexibility in routes and timing, FTS have been advocated as a suitable alternative to private vehicles or mainstream public transport services and are seen as being better positioned to compete with the private transport market for passengers (Finn, 2012). The main characteristics of FTS are improved accessibility and flexibility through door-to-door services and booking and routing facilities. Mulley et al. (2012) suggest that FTS can address several negative issues associated with conventional public transport, namely: spatial (due to lack of services), physical (inaccessible vehicles), time (lack of services at required times and journey take long time), information (users do not have proper information about journeys), economic (high costs of services) and cultural (cultural and attitudinal issues about usage of public transport services).

Due to their characteristics FTS have the potential to play a key role in social inclusion for specific mobility needs (e.g., older or disabled people) or where there are situations of low-demand provision, such as in suburbs and rural areas (Currie, 2010). Moreover, the developments in Information and Communication Technology (ICT) and Intelligent Transport Systems (ITS) have generated significant opportunities for improvements in FTS provision (Nelson et al., 2010). However, improvements in technologies have not been

followed by adequate enhancements in business models and organizational frameworks by service providers (Mulley et al., 2012, Finn, 2012). Despite the potential of this transport option, evidence shows that the FTS concept is still not well received and services provided are generally small-scale, fragmented and informal (Finn, 2012). Barriers concerning the uptake of FTS can be associated with: (1) service provision; (2) information and awareness; (3) attitude.

Service provision issues are mainly associated with funding and costs to service users. Key issues are related to the high cost of service provision and the need for pump priming at an early stage. As Brake et al. (2007) highlight, FTS providers have shown significant difficulties in achieving financial sustainability over the long-term. FTS schemes usually receive public funding at launch, but due to the high costs of provision and low-demand from users, operators face problems to make sufficient revenue. This can lead to providers, once funding is finished, adapting their service to fixed routes and competing within the public transport market segment in order to achieve economic sustainability. The conditions required to receive funding may also be a cause of problems. For conventional public transport, the amount of subsidy is usually linked to the distance travelled by the service, which is difficult to forecast for FTS due to their flexible nature. As a consequence, to meet requirements in order to receive subsidies as a form of public transport, FTS are often forced to modify service provision, such as having fixed stops or fixed timing points (Mulley et al., 2012). Economic issues are not the only ones affecting FTS service provision. Both Glasgow and Blakely (2000) and WS Atkins (2001) found that the necessity of booking a journey with these type of services is a barrier to spontaneous trips. Some schemes also prioritize certain activities (e.g., medical trips), reducing the type of activities older people can undertake. Other schemes are designed to reach specific destinations, such as shopping or senior centres, or are provided for special occasions, but they are not available on a daily

basis.

Information and awareness barriers concern the level of awareness FTS customers have about the service, with regard to available schemes and how these are provided. Confusion about the kind of FTS schemes available, when and where they travel is the most reported barrier in this sense (Broome et al., 2012, Ward et al., 2013, Knight et al., 2007, Davey, 2007, Su and Bell, 2009). The presence of more than one scheme or provision with different modes was also a factor increasing lack of awareness. Other examples include difficulties in understanding the concept of sharing any transport mode apart from buses (e.g., shared taxis) (Daniels and Mulley, 2012), or that FTS operate as conventional taxis due to the availability of booking services (Nelson and Phonphitakchai, 2012). Furthermore, the high level of flexibility offered can lead to identification problems, since the more flexible the service is, the less visible it becomes to potential users. Absence of landmarks such as bus stops, a lack of an indicative logo, brand or promotional advertisements, may reduce awareness among users. Attitude barriers are related to culture and perception of FTS. Ahern and Hine (2012) found that community transport in Irish rural areas was recognized as a "feminized" transport mode by male participants and therefore not used to meet their transport needs. While mainstream fixed-route public transport is regarded as normal, FTS can be perceived as a specialised service for impaired or generally disadvantaged people (Daniels and Mulley, 2012, Knight et al., 2007), despite acknowledging the potential benefit from using it (Musselwhite, 2017b, Musselwhite, 2017c). Glasgow and Blakely (2000) found that the "young-older" (60–74 years old) reported low consideration of FTS due to the stigma associated with using these transport modes, while Kim (2011b) found a correlation between modal choice preference and age, with the older cohorts reporting more usage of FTS. Modifications to travel habits take time to build both patronage and acknowledgement of the service, therefore, customer attitudes are also affected by the time needed to change travel

behaviour (Mulley et al., 2012, Daniels and Mulley, 2012).

2.3.4 Taxis

Taxis are regarded as an important transport option for those people who do not have access to a car or are unable to use public transport due to health impairment (WS Atkins, 2001). Studies by Knight et al. (2007) and Oxley (2000) found that older people using taxis were predominantly women, those with health impairments (especially mobility ones), those of low income, without access to a car and living in town. Taxis are seen as a fast and direct transport mode (Haustein et al., 2013), available at any time (Trudel, 1992) and are perceived as a safer mode compared to public transport (Haustein et al., 2013, Knight et al., 2007), allowing older people to travel at any time of the day, such as during the night (Knight et al., 2007). Moreover, taxis provide independence for those who have stopped driving and have to rely on family or friends for their journeys (Buys et al., 2012) and are not associated with the stigma of impairment unlike other modes (e.g. FTS) (Trudel, 1992). Nonetheless taxis are an underused transport mode among the older population. Two main reasons can be identified for this: service affordability and service provision.

Despite the convenience offered by taxis their usage is limited by affordability. Taxis have been found to be the most expensive transport mode in both the UK (WS Atkins, 2001) and Australia (Harris and Tapsas, 2006), and this has been identified as the main disincentive to their use by older people (Davey, 2007). Affordability problems emerged especially when taxis are compared with other transport modes. Taxis are perceived as more expensive than cars and public transport services, particularly when concessionary fare schemes for older people are available (WS Atkins, 2001, Knight et al., 2007). Therefore, taxis are not regarded as a valid option for regular transportation, but mainly as an occasional mode, or in some cases as a last resource (Knight et al., 2007, Glasgow and Blakely, 2000). Accordingly, taxi

usage has been found to be mainly associated with trips to hospitals and medical appointments or for special occasions (Ahern and Hine, 2012, Knight et al., 2007). As a consequence, discretionary and spontaneous travel, as well as recreational journeys to the countryside, are considered "unacceptably extravagant" to do by taxi (Davey, 2007).

Service provision issues are generally related to the reliability and the availability of the service. Older people report issues about late arrival after booking (Davey, 2007), lack of information about the final cost of the journey and not being able to see the taxi meter (WS Atkins, 2001). The behaviour of taxi drivers was also found to be a barrier to taxi usage, due to rudeness (Glasgow and Blakely, 2000), dishonesty in route taking (WS Atkins, 2001) and unwillingness to provide a service for short trips (Harris and Tapsas, 2006, NCST, 2011) or help with impaired people (NCST, 2011, Shiau and Huang, 2014). The nature of vehicles was also identified as an issue. Purpose-designed vehicles that guarantee a high level of accessibility are common in some countries, but rare elsewhere (Oxley, 2000, NCST, 2011). In the United Kingdom Hackney Carriages (black cabs) are wheelchair accessible by law, but this is not the case with most private hire taxi services (WS Atkins, 2001). Rural areas are characterized by a lack of service availability (Glasgow and Blakely, 2000, NCST, 2011). While small towns are usually covered by taxi services, older people living in rural villages report low taxi usage due to scarcity or no availability. Often, when there is a need to hire a taxi in a rural area, due to a lack of public transport provision, taxis have to come from the closest town, with significant additional cost involved (Glasgow and Blakely, 2000).

2.3.5 Walking and cycling

Walking and cycling are often promoted as a valid solution to mitigate the variety of problems raised by the modern car-oriented society. Indeed, both are green transport modes (no air and noise pollution), more affordable and reliable, and useful to reduce traffic

congestion and parking problems (Jones et al., 2012, Ryan et al., 2016, Tight, 2016). For older people, walking and cycling are often regarded as more feasible and faster travel options to accomplish everyday activities compared to the car or public transport. This was found to be true especially for short journeys in denser cities or congested urban centres (Mindell et al., 2011, Buys et al., 2012, Ryan et al., 2016). Both modes have the characteristic of being a transport option as well as a recreational activity and provide physical exercise, with consequent benefits to health and wellbeing (Mindell et al., 2011, Ryan et al., 2016, Zander et al., 2013, Winters et al., 2015). However, walking and cycling are not always easy activities for older people to undertake. Very little research has been carried out on walking and cycling in later life from the transportation point of view, especially in terms of barriers affecting the use of these two modes, since researchers have focused mainly on safety of older drivers (Tournier et al., 2016). Nonetheless, three main issues can be identified: health, safety and the built environment.

It is recognised that mobility in later life is influenced by progressive changes to and deterioration of health (OECD, 2001). Unlike other transport modes (e.g., car) that can compensate for health impairments (Siren and Hakamies-Blomqvist, 2004), walking and cycling can be more directly affected by health problems. In their review, Tournier et al. (2016) identified health barriers affecting older pedestrians according to sensory, cognitive and physical impairments. Sensory impairments are associated with the risk of falling, reduced perception of fixed and moving objects, problems in detecting approaching vehicles and difficulties in distinguishing vehicles from other aspects of the road environment. Cognitive impairments were found to affect multi-tasking processes and information, with consequent problems in spatial navigation and orientation (especially in new environments), learning new routes, increased time to make decisions to cross the street, slower walking speeds and higher risks of falling. Physical impairments are associated with changes in

muscles and joints. Loss of strength in muscles can lead to reduced walking speed and risk of falling, while pain in joints was found to create problems in walking and climbing stairs. Other issues related to motor skills such as loss of agility, flexibility and endurance were associated with reductions in walking speed and in maintaining balance (OECD, 2001).

In general, risk and fear of falling were found to be the most reported barriers across the three categories analysed. Older pedestrians tend to self-regulate their behaviour due to the awareness of falling and report increased attention to their footsteps and the pavement, in addition to walking slower, especially in bad weather conditions (Tournier et al., 2016). Cognitive impairments were found to be more significant than a decline in physical condition for cycling cessation. Fear of not being able to quickly evaluate potential situations as well as a decline in reactions, memory and balance skills were identified as main health issues (Ryan et al., 2016). Finally, temporary stops due to injuries or illness was correlated with permanent cycling cessation, due to loss of familiarity with the activity (Ryan et al., 2016).

The form of the built environment can also significantly affect mobility among older adults. Many modern cities are designed for vehicles rather than human mobility (Matan and Newman, 2012, Oxley et al., 2004), leading to problems of urban sprawl and community severance. The former produces a dispersion of services and activities beyond a reasonable walking and cycling distance (OECD, 2001), the latter a divisive effect on residential areas (Mindell and Karlsen, 2012). Crossing the road in later life is particularly affected by community severance and road traffic issues, due to traffic volumes, speed, noise and pollutant emissions (Asher et al., 2012, Mindell et al., 2011, Rantakokko et al., 2010, Wang et al., 2016, Amosun et al., 2007, Ramachandran and D'Souza, 2016). Asher et al. (2012) found that 84% of older men and 93% of older women were not able to cross streets safely as their walking speed was not fast enough to cross the road in time. A similar result was

found in both Amosun et al. (2007) and Loo and Tsui (2016). The design of pedestrian/cycling environments was also identified as a barrier for walking and cycling. Poor quality of footpaths, (size, width and presence of steps), broken or uneven pavements, lack of footpath networks and resting places (e.g., benches), toilets in public spaces, cars and scooter parked on, or obstructing, sidewalks and shared walking/cycling environments were found to be the most reported issues (Winters et al., 2015, Rosenbloom, 2009, Ryan et al., 2016, Eronen et al., 2014, Vine et al., 2012, Mitra et al., 2015, Rantakokko et al., 2010, Wang et al., 2016, OECD, 2001, Ramachandran and D'Souza, 2016, Mattson, 2012, Chen et al., 2015, Risser et al., 2010, Musselwhite, 2017a). In this sense, an additional barrier found in studies from Northern countries is the presence of snow or ice along the pathway during the winter season (Hjorthol, 2013b). The presence of obstacles and cleanliness of footpaths were found to be associated with problems in obstacle negotiation and the risk of falling. Under such conditions, older pedestrians reported reducing their walking speed, keeping a large distance between them and other pedestrians and spending more time looking at their footsteps rather than straight ahead (Tournier et al., 2016).

As previously discussed for public transport, older people tend to be sensitive about their safety and personal security. Walking and cycling during particular times, such as during the night, or in some less salubrious areas of cities are perceived as dangerous (Ryan et al., 2016, Eronen et al., 2014, Wang et al., 2016). A lack of adequate street lighting, the presence of dark areas as well as of people, either groups or individuals, “hanging out” are also seen as a deterrent to walking or cycling (Mitra et al., 2015). Older pedestrians and cyclists are considered vulnerable road users and have the highest rates of fatal and serious casualties. This is generally related to the fact that while ageing, their walking speeds reduce, and their decision-making is impaired due to cognitive problems (Asher et al., 2012, Mindell et al., 2011, OECD, 2001). The safety of older pedestrians and cyclists is also compromised by

fear of sharing roads with other users (Musselwhite, 2017a). Apart from the fear of being involved in accidents, older people complain about the behaviour of other road users (Ramachandran and D'Souza, 2016). Oxley et al. (2004) highlight the fact that roads are mainly designed for car traffic and driver attitudes fail to acknowledge the rights of other users. Older cyclists report feeling safer on quiet roads or on cycle lanes separated from the road in order to avoid accidents, especially those related to car doors opening (Ryan et al., 2016, Winters et al., 2015, Zander et al., 2013, Velasco et al., 2015). Another reported concern was found to be the lack of respect of road rules, not only from drivers, but also from other cyclists and pedestrians, especially younger ones (Ryan et al., 2016, Winters et al., 2015). Continuity of cycle lanes and footpaths and problems of mutual space invasion between pedestrians and cyclists, and the speed of other cyclists were also found to be of concern (Rosenbloom, 2009, Winters et al., 2015, Ryan et al., 2016, Velasco et al., 2015, Vine et al., 2012). Interestingly, the fear of falling off a bicycle was not found to be a safety issue (Zander et al., 2013).

2.4 Conclusions and identification of research questions

This chapter provided an overview and a critical review of the literature related to travel needs of the older population. Despite the recognised key-role that out-of-home mobility plays for wellbeing during later life, the review shows the presence of issues related to the identification of which are the factors and barriers affecting the travel needs during the ageing process. In this sense, main problems were identified with the main reliance on only realised mobility and the differences in approaches, samples and contexts of investigation.

As this research project is aimed at investigating which are the factors affecting and influencing the fulfilment of travel needs during later life, a necessary requirements is the need to identify the travel patterns of the older population. In this sense, it is fundamental to

understand which are the preferred modes that older people use for travelling and the main purposes for doing it. Moreover, if they are travelling more compared to the past and more in general which are the most significant trends and changes over time with regard to their travel patterns. Existing studies lack of up-to-date investigation regarding travel trends of the older population over an extended period of time, since they tend to focus on a single point in time (Tilley, 2013). Furthermore, these studies often tend to consider the older population as a single group. As the heterogeneity of the older people poses the challenge of understanding differences in subgroups composing it, there is a need to investigate if advancing with age and belonging to different cohort groups shows peculiarity and different characteristics in travel behaviour.

The inconclusive findings about the real impact of analysed variables on unfulfilled mobility raises the issue of which are the aspects that have to be taken into account when addressing the mobility of the older population. The review highlighted that the main focus has been put on transportation, and more specifically on assessing the impact of accessing the car. Therefore, a more inclusive approach to identify what shapes and influences mobility in later life is needed, as transportation alone is not fully sufficient to explain this process. Only once this is done, would it be possible to investigate the factors affecting the travel needs fulfilment amongst the older people. The review of the literature revealed how relying only on realised journeys and activities is insufficient to explain mobility in later life. Therefore, travel needs have to be investigated from the twofold perspective of realised and unfulfilled mobility.

Finally, up-to-date segmentations of older people in transport studies have been developed mainly by taking into account travel behaviours and/or socio-demographic backgrounds characteristics. Again, the reliance of these approaches on only realised mobility to explain

mobility attitude and the lack of consideration of other domains mobility during ageing implies the need of a segmentation approach based on travel needs fulfilment.

Table 2-3 summarises the main gaps identified from the literature and the associated research question and objectives stated in Section 1.2. The next chapter illustrates the methodology undertaken to address the above illustrated research questions and the research aim and objectives highlighted in Section 1.2.

Table 2-3. Overview of research gaps, questions and objectives

Research gaps	**Research questions**	**Research objectives**	
There is a lack of up-to-date investigation of travel patterns over an extended period of time regarding the older population.	1. Are older people travelling more compared to the past? 2. How and why older people travel? 3. Are there any gender differences with regard to travel patters?	*R. OBJ 1*	To analyse current and past travel pattern of the older people in order to understand how and why they travel and if it is possible to forecast future patterns.
There is a lack of up-to-date investigation of travel patterns in terms of differences regarding age and cohort groups.	1. Does ageing affect travel patterns? 2. Do different cohort groups display differences in travel patterns?	*R. OBJ 2*	To investigate if different age and cohorts groups of older people show peculiarity and different characteristics in terms of travel behaviour during the ageing process.
Studies on travel needs lack of an inclusive approach regarding what influence mobility in later life and rely mainly on realised mobility, with consequent ambiguity in which factors affect travel needs fulfilment.	1. Which are the factors that should be taken into account when investigating travel needs in later life?	*R. OBJ 3*	To develop a conceptual framework in order to assess travel needs fulfilment of the older population.
	1. Which are the factors affecting the fulfilment of travel needs during later life? 2. Which are the factors affecting activity frequency? 3. Which are the factors leading to unmet travel needs? 4. What is the relationship amongst the investigated variables?	*R. OBJ 4*	To investigate which are the factors affecting the fulfilment of travel needs during later life.
As based only on realised mobility, current segmentation approaches do not take into account unfulfilled travel needs.	1. How can older people be segmented with regard to the fulfilment of their travel needs?	*R. OBJ 5*	To develop a segmentation of older people based on the fulfilment of their travel needs.

3 METHODOLOGY

3.1 Introduction

This chapter describes and evaluates the key stages of the research, how they are connected and how the research objectives stated in Section 1.2 are addressed. The chapter consists of two main parts. First, a methodology overview (Section 3.2) is provided by broadly describing the methodological approach and the framework behind this study. Then, the Research methods section (Section 3.3) provides a detailed description of the methods used for the data collection and analysis related to the three main studies used to identify the factors influencing the fulfilment of travel needs in later life. Finally, a summary of the chapter is provided in Section 3.4.

3.2 Methodology overview

In line with aim and objectives stated in Section 1.2, the research methodology proposed is an integrative mixed method approach of quantitative and qualitative analysis. The reason behind this choice is related to the idea that, if well developed and integrated, this kind of approach can produce a more robust and significant understanding of the travel needs of the older population, thanks to the overcoming and filling the gaps of each single method (Castro et al., 2010).

Figure 3-1 illustrates the framework of this research project. As the figure shows, the research is structured with three main stages, namely: 1) preliminary analysis, 2) data collection and analysis and, 3) research outputs.

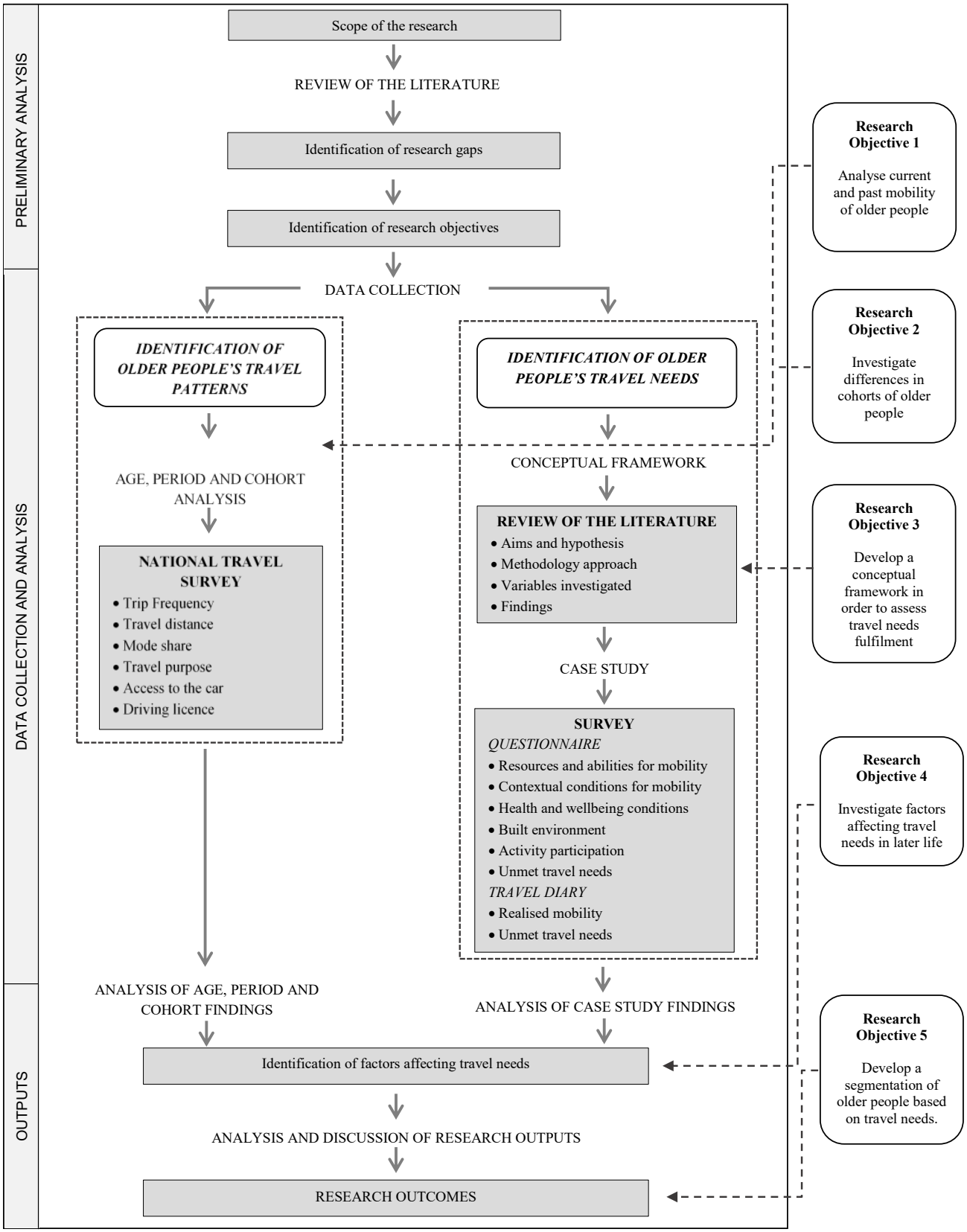

Figure 3-1. Methodology framework of the research

In the preliminary analysis the literature was investigated with the twofold aim of understanding the relationship between out-of-home mobility and wellbeing in later life and usage of transportation modes amongst older people and identifying the main research gaps in the existing literature.

The second and core part of the research framework is related to data collection and analysis. Two main topics are investigated through the development of three studies. The first study examines the travel patterns of the English older population by investigating the NTS according to an APC analysis. This study is aimed at investigating three main aspects:

- historical analysis of trends in older people's travel;
- how and if travel patterns of older people change as a result of their ageing; and
- how and if it is possible to identify differences in travel patterns of older people when age groups, cohorts and gender variables are taken into account.

This study addresses the Research Objectives 1 and 2 and its analysis is described in Section 4.2.

The second topic investigated is the one related to the identification of the travel needs of the older population. The topic is aimed at addressing Research Objectives 3 and 4 and it involves two different studies. In the first, a conceptual framework to assess the fulfilment of travel needs in later life is developed by the means of methodological assessment of aims, approaches, variables used and findings of studies related to travel needs fulfilment in later life. The development of the framework is outlined in Section 5.2. The framework is subsequently employed for the development of a case study based on a survey. The case study is aimed at investigating the factors affecting the fulfilment of travel needs amongst the older population. It comprises of questionnaire survey and an innovative travel diary

recording both realised and unfulfilled travel. The development of the case study is outlined in Section 6.2.

The third and final stage relates to the outcome of the research. In this stage, the findings from the three studies are critically assessed in order to identify which are the factors affecting and influencing the fulfilment of travel needs during later life and associated potential outcomes in terms of future research recommendations.

3.3 Research methods

This section provides the identification of the concepts of older population and mobility behind this research and it describes the methodological approach, data collection, measures and analysis used for the three main studies comprising this research.

3.3.1 Understanding mobility trends of the older population

This section describes the methodological approach related to the investigation of current and past mobility trends of the older population and the potential differences in terms of travel behaviour for different cohorts during the ageing process, in order to address Research Objectives 1 and 2.

3.3.1.1 Age, Period and Cohort analysis

The APC analysis is a common approach used in several disciplines, such as demography, sociology, epidemiology and social science, to explain changes in society over time (Yang and Land, 2008). As the name suggests, this type of analysis is based on three different types of time-effects. Age effects consist of the changes displayed by different age groups in terms of behaviour and physiology, accumulation of social experience and status due to the ageing process. Period effects are related to the variation in external factors over time affecting all

age groups at the same time such as social, cultural, physical or financial events. Cohort effects are associated with changes across groups of people experiencing an initial event (e.g. birth year, marriage, retirement) at the same time (Yang and Land, 2008).

As highlighted by Hjorthol (2013a), the older population is characterised by significant heterogeneity. This heterogeneity makes it more difficult to fully understand older people's mobility patterns and needs and consequently the extent to which their transport needs are satisfied is not clearly explained by the existing literature. Given its characteristics, the APC analysis can be regarded as a useful approach to explain and differentiate characteristics and changes over time within the ranks of the older population. Therefore, the current research employs the APC analysis to understand if and how the mobility of older people changes in terms of travel behaviour, particularly as they age.

3.3.1.2 Data and methods

In order to understand and analyse mobility patterns and trends of the older population in England, the key data source used is the NTS. The NTS is a cross-sectional government survey that collects information about travel within English households. It is a survey carried out by the Department for Transport in order to monitor individuals travel behaviour and changes in travel patterns, assessing the potential equality impacts of transport policies, contributing to evaluation of the impact of policies and providing inputs for transport modelling and appraisal guidance (Department for Transport, 2016a). Moreover, this information is used by a variety of other organisations, such as other government departments, local authorities, research institutions and voluntary sector organisations (Lepanjuuri et al., 2016). Figure 3-2 shows some examples of the uses of NTS data.

• Build up a picture of changes in personal travel over time
• Examine travel among different groups, such as children, elderly people and people with mobility difficulties
• Understand the circumstances in which people will tend to use cars or public transport
• Understand how people travel to the shops and the impact of home deliveries
• Assess the take-up of concessionary passes and the impact on bus use
• Understand how increased car ownership and licence holding has led to increased driving among women
• Study how children travel to school and how this has changed
• Monitor accident rates amongst different types of road users
• Understand the 'distributional' impact of Spending Review proposals on different groups of people
• Measure the contribution to total transport CO_2 emissions of different trip purposes and lengths
• Examine the uptake of sustainable transport modes, e.g. walking and cycling
• Understand how travel patterns vary according to area type, e.g. in urban or rural areas
• Produce research reports by academics, consultants, charities and others.

Figure 3-2. Uses of NTS data (Lepanjuuri et al., 2016)

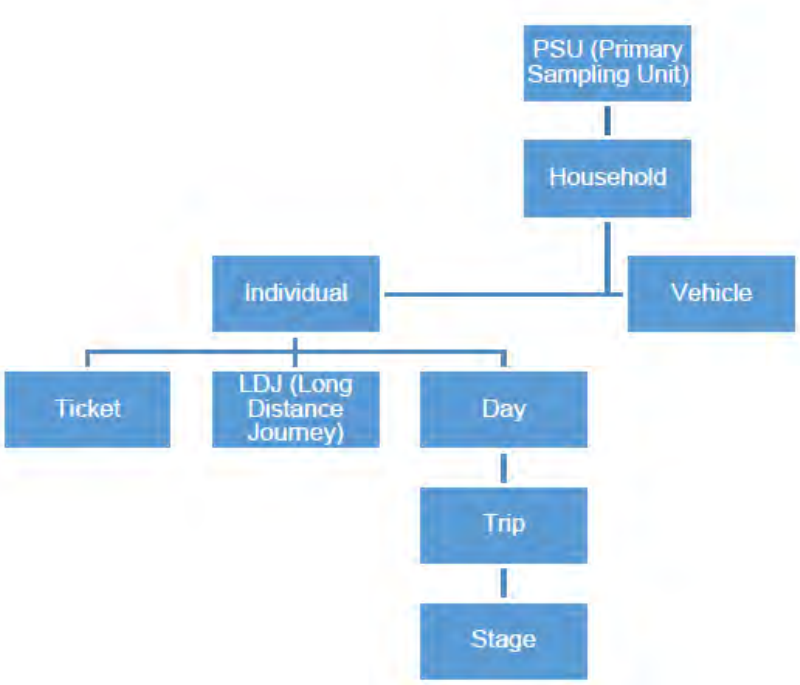

Figure 3-3. Levels in the NTS database (Department for Transport, 2016b)

The first NTS was conducted in 1965-1966 and then repeated in 1972/1973, 1975/1976, 1978/1979 and 1985/1986. Starting from 1988 the NTS has been conducted on annual basis, with a sample size that increased from 5,040 households in 1988 to the 7,000 households and 16,000 individuals in 2015 (Lepanjuuri et al., 2016). As Figure 3-3 shows, the NTS collects exhaustive data at different levels: household, individual, vehicle, tickets, long-

distance journey, day, trip and stage.

The NTS data are gathered from two different sources: face-to-face placement interview and pick-up interviews using the Computer Assisted Personal Interviewing (CAPI) method and a self-completed travel diary recording journeys for seven days. The sample for the data collection is randomly drawn from the Postcode Address File (PAF) and accounts for around 17,000 households (Lepanjuuri et al., 2016). The placement interview takes place before the completion of the travel diary week and collects information about the household, individuals and vehicles within the household (Table 3-1).

Table 3-1. NTS 2015 placement interview topics (Lepanjuuri et al., 2016)

HOUSEHOLD	INDIVIDUAL	VEHICLE
Household grid	Disabilities that affect travel	Registration number
Accommodation	Methods of transport used	Make and model
Tenure	Walk of 20 minutes or more	Vehicle details
Length of residence	Cycling	Parking
Shopping and home deliveries	Driving licences	Vehicle use outside of GB
Attitude to local services	Education, paid work and journey planning	Mileage
Children's travel to school	Transport barriers to work	SatNav
Household vehicles	Job details	
	Income	
	Location of work	
	Travel to work	
	Working at home	
	Ease / difficulty of travelling to work	
	Transport difficulties	
	Road accidents involving adults	
	Road accidents involving children	
	Special tickets / passes	
	Long-distance journeys	
	Permission for recontact for follow up	

Next, each household member has to complete a seven-day travel diary, in which they record their travel activities. The travel diary is provided in two versions, one for adults and one for people under 16 years old. The information collected in this stage is related to origin and destination, purpose, mode, distance and time travelled, number travelling in their party, vehicles used, tickets used and cost. Participants are also asked to record details about long-

distance journeys, which are defined as journeys of 50 miles or more. Finally, a pick-up interview is conducted within one week after the completion of the travel diary to collect the diaries and check if the information provided during the placement session has changed (Lepanjuuri et al., 2016).

The data for the APC analysis have been collected from the UK Data Service database. Data were structured within two separate folders, one for the years 1995-2001 and one the years 2002-2015. Each folder contained information regarding the dataset shown in Figure 3-3. Descriptive analysis comprising frequencies, cross tabulations and means are used to analyse the travel patterns of both age and cohort groups over 1995 to 2015 through IBM SPSS Statistics 24. In order to facilitate the analysis of the available data, information from each dataset were combined on the basis of a three years difference, namely: 1) 1995-1997; 2) 1998-2000; 3) 2001-2003; 4) 2004-2006; 5) 2007-2009; 6) 2010-2012 and 7) 2013-2015.

In order to investigate the travel patterns of the older population, different aspects of everyday mobility have been taken into account, namely: (1) trip frequency; (2) distance travelled; (3) mode share; (4) travel purpose; (5) access to the car and (6) type of driving licence. Trip frequency has been analysed in terms of average number of trips undertaken during a week. Distance travelled was analysed as average number of miles travelled per week. Mode share and travel purpose have been analysed in terms of changes in percentage of transport modes used and main reason to travel, respectively. Access to the car has been analysed in terms of changes in percentage accessing a transport mode as main driver, other drivers, passenger or no access to it. Finally, type of driving license has been analysed in terms of number of people holding a full driving licence, provisional or none at all.

Instruction from the NTS data extraction user guide (Department for Transport, 2016b) were followed for the analysis. Weighting procedures were applied in order to account for

weighting and grossing-up for short walks trip frequency and distance travelled. This has to be done due to the fact the short walks less than 1 mile have been recorded only on the seventh day of the travel diary week. Therefore, a weight factor is applied to the data to reduce the effect of non-response and drop-off bias while recording the travel diary, so that the weighted total number of journeys made on a particular day of the travel diary always equals the number reported for the first day of the travel diary. The weight is provided within the NTS dataset and it is calibrated and adjusted so that the weighted sample matches with the population estimates of household residents and are representative of the population (Department for Transport, 2016b, Lepanjuuri et al., 2016).

The development of the APC analysis requires the identification of age and cohort groups. Both have been outlined based on a ten year period, as suggested by Frey (2011). With regard to the age analysis, the groups have been identified by taking as reference the starting age identifying older people for this research, namely 60 years old. Therefore, the four age groups for the APC analysis are as follows: 1) 60-69 years old; 2) 70-79 years old; 3) 80-89 years old, and 4) 90 years old and above (90+).

Looking at the cohort groups, this study follows the classification of cohorts proposed by Tilley and Houston (2016), although by selecting only the cohorts related to those aged 60 years old and above. Six cohort groups are identified for the APC analysis, namely: 1) Grandparents of the Boomers; 2) Parents of the Boomers; 3) Great depression; 4) World War II; 5) Post-War Boomers and 6) 1960's Boomers. Table 3-2 illustrates the six identified cohort groups in relation to year of birth and age of each at different years throughout the period of investigation.

Table 3-2. Cohort groups and associated years of birth and age at different years

Cohort name	*YOB*	*1995*	*1998*	*2001*	*2004*	*2007*	*2010*	*2013*
Grandparents of the Boomers	*1906–1915*	80-89	83-92	86-95	89-98	92-101	95-104	98-107
Parents of the Boomers	*1916–1925*	70-79	73-82	76-85	79-88	82-91	85-94	88-97
Great depression	*1926–1935*	60-69	63-72	66-75	69-78	72-81	75-84	78-87
World War II	*1936–1945*	50-59	53-62	56-65	59-68	62-71	65-74	68-77
Post-War Boomers	*1946–1955*	40-49	43-52	46-55	49-58	52-61	55-64	58-67
1960 's Boomers	*1956–1965*	30-39	33-42	36-45	39-48	42-51	45-54	48-57

3.3.2 The conceptual framework to assess travel needs in later life

The review of the literature showed that due to the heterogeneity of older people investigated and the differences in research approaches it was not possible to determine the real effect on which the variables affect fulfilment of travel needs. Therefore, this study proposes a conceptual framework aimed at defining which are the factors necessary to be investigated while assessing travel needs' fulfilment in later life.

3.3.2.1 Data and methods

The development of the proposed conceptual framework is delineated by three different stages, as shown in Figure 3-4. The first stage consisted of mapping studies on travel needs fulfilment during later life. In this stage the set of studies selected belongs to those identified in Section 2.2.2, but considered only those studies directly addressing factors affecting travel needs fulfilment. Then, a methodology assessment was used to analyse firstly the aim(s) and hypotheses behind each study, then the approaches, variables used and finally findings from each study. Lastly, a content analysis was undertaken to categorise the information from the previous stages and identify themes that influence mobility in later life.

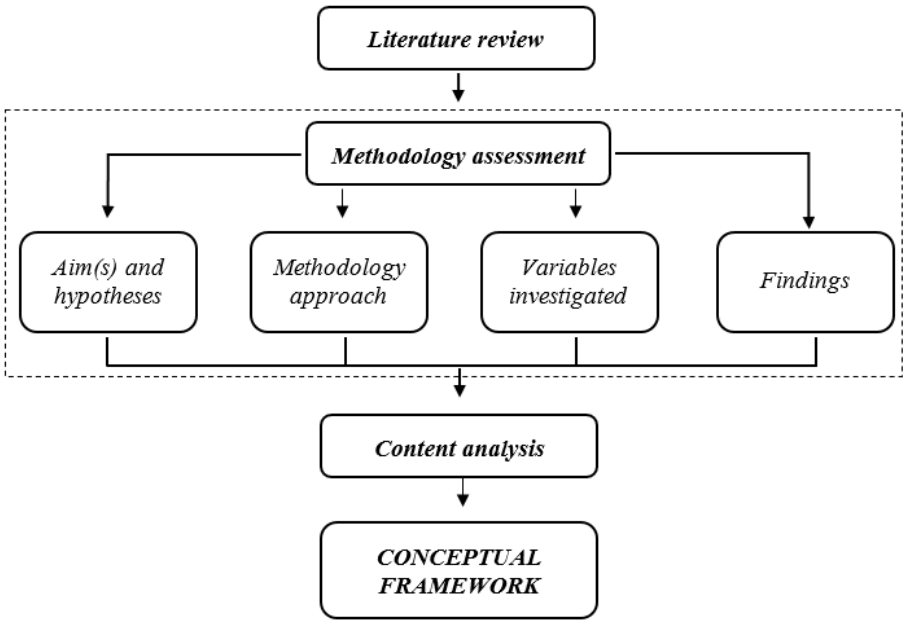

Figure 3-4. Methodology stages for the development of the conceptual framework

3.3.3 The travel needs of the older population: a case study

This section describes the methodological approach related to the development of a case study aimed at employing the conceptual framework to assess mobility in later life and investigate which are the factors influencing the fulfilment of travel needs of the older population.

3.3.3.1 Study area for the case study

The study area identified for the case study is the city of Birmingham, UK. Birmingham is a metropolitan borough located in the West Midlands. It is the second British city after London in terms of population, with an estimated 1,101,360 inhabitants in 2014 (Birmingham City Council, 2015). With regard to the older population, Birmingham presented in 2014 a total population of 189,978 people aged 60 years old and above (17% of the total population). Table 3-3 illustrates the distribution of the older population in Birmingham by age groups and gender in terms of both number and percentage.

Table 3-3. Birmingham older population by age groups and gender in 2014 (Birmingham City Council, 2015)

		Age group							
		60-64	**65-69**	**70-74**	**75-79**	**80-84**	**85-89**	**90+**	**TOT**
Male	N	22890	19680	15229	12674	9236	4888	2094	86,691
	%	*4%*	*4%*	*3%*	*2%*	*2%*	*1%*	*0%*	*16%*
Female	N	23197	21207	17375	15725	12389	8133	5261	103,287
	%	*4%*	*4%*	*3%*	*3%*	*2%*	*1%*	*1%*	*19%*
Total	N	46087	40887	32604	28399	21625	13021	7355	189,978
	%	*4%*	*4%*	*3%*	*3%*	*2%*	*1%*	*1%*	*17%*

3.3.3.2 Participants

Before conducting the survey process, ethical approval for both questionnaire and travel diary was sought and obtained from the University of Birmingham on 22 July 2015 with reference number ERN_14-1277. Once obtained the ethical approval to conduct the case study, 12 pilot survey packages were conducted with people aged 60 years old and above in order to test the proposed questionnaire and the travel diary. The main feedback received from the participants was to make the survey less complex and easier to complete. Two main measures were adopted to address this issue. First, the amount of open-ended questions was reduced significantly and replaced by ticking-boxes options. Then, the recording of the travel diary was reduced from seven days to only one, with date selected for recording identified in the following one after receiving the survey package.

Following the revision of both questionnaire and travel diary, and receiving positive feedback from the pilot participants, 2000 survey packages were distributed in the period between 1st March 2016 and 31st March 2017. In total 288 survey packages were returned, with a 14% response rate. A detailed description of the respondents' characteristics is provided in Section 6.2.1. Potential participants for this study have been recruited amongst people aged 60 years and above. More precisely, the participants belong to two main sources,

namely the Birmingham 1000 Elders Group and the Age UK centres located in Birmingham. The Birmingham 1000 Elders Group is a group of volunteers formed in Birmingham in the early 1980s by Professor Bernard Isaacs, a professor of Geriatric Medicine at the University of Birmingham, with the aim of involving local people in research activities. The group is composed of people aged 65 years old who have agreed to collaborate with the University of Birmingham in research relevant to older people. Participants from this group were first recruited at the Agewell 2015 workshop and then through a mail sent to all members. Age UK is a registered charity operating in the UK to support people aged 50 years old and above. Born in 2009 from the merger of two charities, Age Concern and Help the Aged, it is nowadays considered one of the biggest charities in the UK related to later life. Age UK has currently three centres located in Birmingham: the Onneley Centre (Harborne), the Seymour Centre (New Oscott) and the Old Oscott Community Centre (Great Barr). Participants were recruited at the three centres through a face-to-face visit. Additional participants were recruited amongst random citizens within the Birmingham area.

3.3.3.3 Data and methods

The survey design for this study contains qualitative and quantitative data obtained through a survey questionnaire and travel diary. The questionnaire is aimed at understanding the factors and variables which influence and shape mobility and mode choice during later life. Moreover, it is aimed at identifying existing relationship amongst the variables investigated, similarly to the example shown in Figure 3-5.

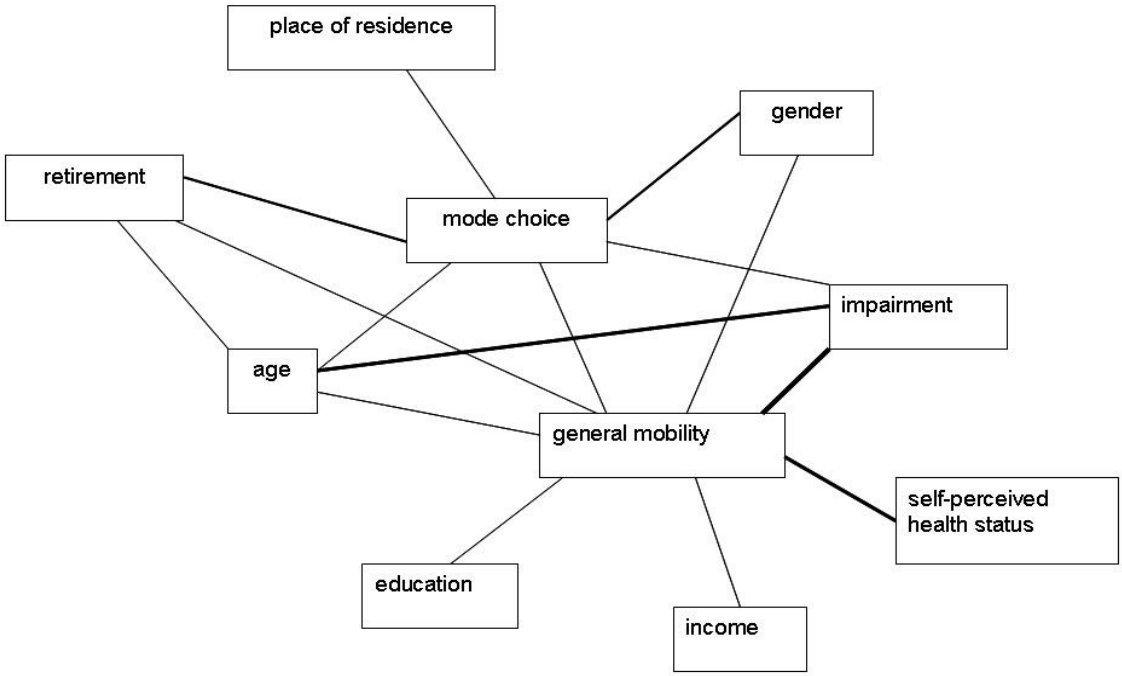

Figure 3-5. Factors influencing mobility and mode choice of the older people (effects strength indicated by width) (Bell et al., 2010a)

The questionnaire consists of fifty-three questions including multiple-choice, rating scale and open-ended questions. In order to facilitate completion and reduce participant stress, the questionnaire design is largely tick-box based. The questionnaire has four main sections.

The first relates to experiences of everyday mobility. Questions about this topic involve importance of transport in everyday life and overall mobility satisfaction; frequency of travel activities and modes used to undertake them; unrealised mobility; access to transport options; barriers affecting the use of selected modes and trip planning activity.

The second part concerns participant's place of living. More specifically, it covers their level of satisfaction regarding the area they live and accessibility to transport, goods and service facilities, in terms of availability of services and distance to reach them.

The third part is related to health conditions, in terms of self-perceived health status, type of impairments and how these impairments create difficulties using transport modes.

Finally, the last section involves individual's information regarding participants' socio-demographic background characteristics. The analysis of the questionnaire is outlined in Chapter 6, sections 1 to 5.

Together with the questionnaire, participants are required to complete a travel diary. Travel diaries are traditionally used to gather data regarding individuals' travel activities and behaviour based on realised journeys. However, as mentioned in Section 2.4, one of the gaps identified in this research project relates to the fact that the amount of travel that older people need or wish to do, but they are not able to do, is not usually taken into consideration when assessing travel behaviours and needs. Therefore, the provided travel diary consists of an innovative tool that combines these two dimensions of the travel, in order to gather not only detailed information about realised mobility, but also the reasons preventing them from achieving these. The travel diary was used to collect data to assess travel behaviour, trip-chain complexity and unmet travel needs of participants. The travel diary for realised mobility draws on the traditional standards used by previous studies and it is designed for recording data about travel destination, start and arrival time, travel purpose, travel mode used, and estimated distance travelled. Similarly, information needed for unrealised mobility travel diary consists of time, travel destination, importance of travel (need or wish), travel purpose and reason for not being able to fulfil travel activity (see Section 6.2.7).

Both questionnaire and travel diary were sent inside a survey package consisting of other parts, namely: recruitment letter, participant information sheet and instructions for completing the survey. The recruitment letter was provided in order to inform potential participants about the aim of and context for the research project and who was involved in it. Through the participant information sheet, participants were informed about their right in taking part in the project, confidentiality issues, cost, reimbursement and compensation, and

risks and disadvantages involved in completing the survey. Finally, instructions were provided about how to complete the questionnaire and the travel diary, in addition to information about the date in which the travel diary should have been completed, definitions about what counts or not as a trip and details about the components of the travel diary, as shown in Figure 3-6 and Figure 3-7. Finally, a second class prepaid envelop was given together with the survey package to return the questionnaire and the travel diary once completed. The completed version of the survey package is available in Appendix B.

3.3.3.4 Measures

In this section, the variables identified for the questionnaire are described in detail. Measures to analyse the mobility needs of the older population relate to five main domains identified in the conceptual framework developed for this research, namely: 1) Demographic characteristics; 2) Transportation; 3) Activity patterns; 4) Health and wellbeing and 5) Built environment. Demographic characteristics draws on the standards used by previous studies of this type and are analysed in order to outline a background profile of the participants. The selected variables are presented according to the classification provided by Haustein and Siren (2015), namely individual characteristics, socio-economic factors, living form and environment. Individual characteristics comprise age, gender and ethnic background. Socio-economic factors are identified as income *(less than £9,999; £10,000 to £14,999; £15,000 to £24,999; £25,000 to £44,999 and more than £45,000)* education *(primary education; secondary education; higher education and other)* and employment status *(retired; full-time employed; part-time employed; unemployed and other)*. Living form and built environment characteristics include marital status *(single; living with a partner; married; living with other family members; widowed; separated/divorced, other)*, place of living *(postcode)*, number of people living in the household, presence of dependent people in the household and amount

of years living in the local community.

Health and wellbeing variables comprise of both objective and subjective information. With regard to health issues, participants were first asked to specify whether or not they suffered any health problem, disability or general physical frailty that might have affected their ability to use any kind of transport mode. Then, a list of 20 diseases and illnesses was presented to specify which type of health issue they suffered in the 5 years before the survey. The list is derived from previous studies on transport field investigating older people's mobility (Siren and Hakamies-Blomqvist, 2004, Haustein and Siren, 2014, Siren and Haustein, 2014). The list is as follows: (i) Anemia; (ii) Arthritis; (iii) Cancer; (iv) Mild cognitive impairments; (v) Dementia; (vi) Depression; (vii) Epilepsy; (viii) Hearth impairments; (ix) High blood pressure; (x) Hyperthyroidism; (xi) Obesity; (xii) Osteoporosis; (xiii) Pain in joints; (xiv) Parkinson's disease; (xv) Reduced eyesight; (xvi) Reduced hearing; (xvii) Reduced mobility in legs or feet; (xviii) Respiratory diseases; (xix) Stroke; (xx) Other. Moreover, participants were asked to rate the extent to which health issue made it difficult to use each of the seven

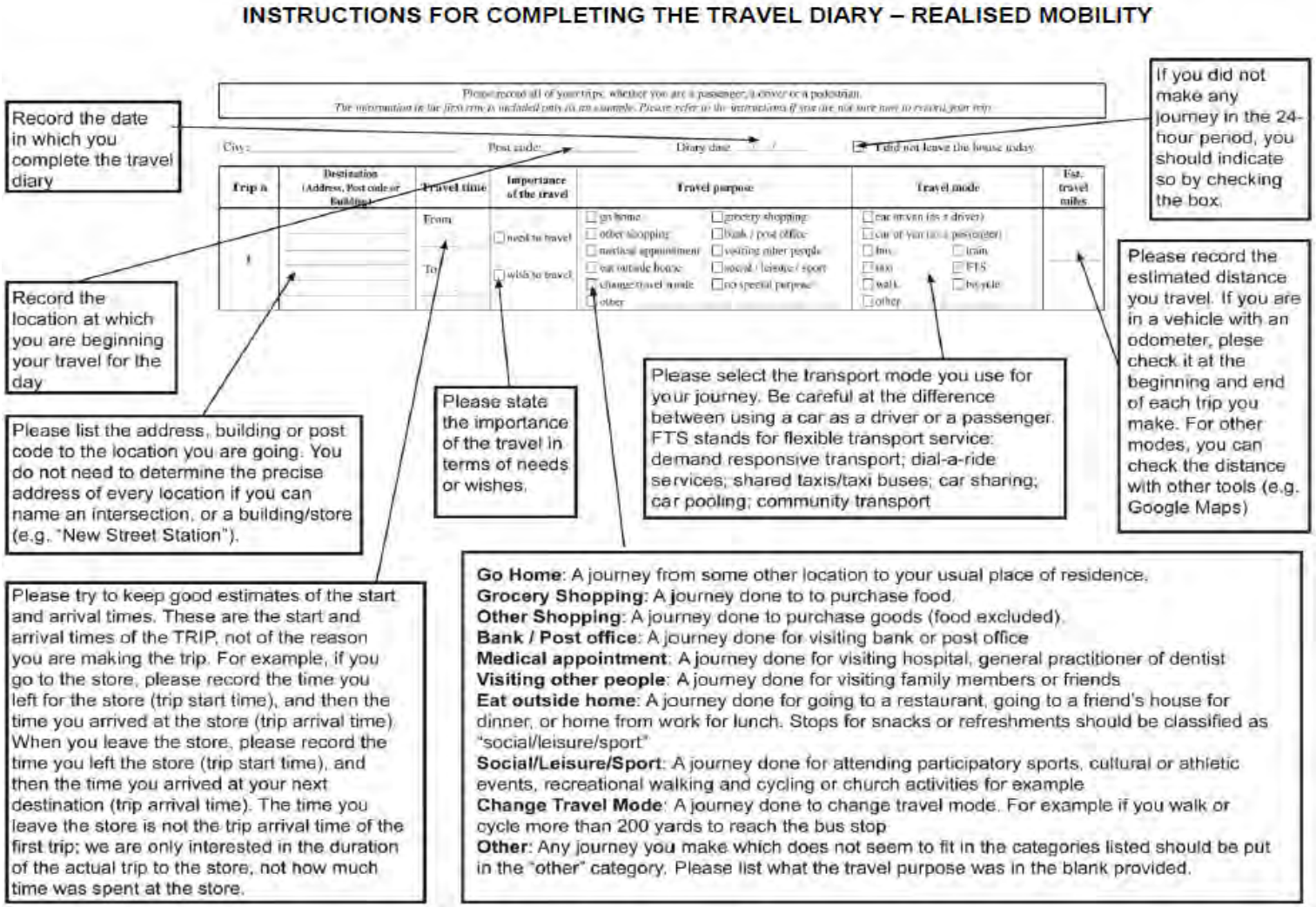

Figure 3-6. Instruction for completing the travel diary - realised mobility

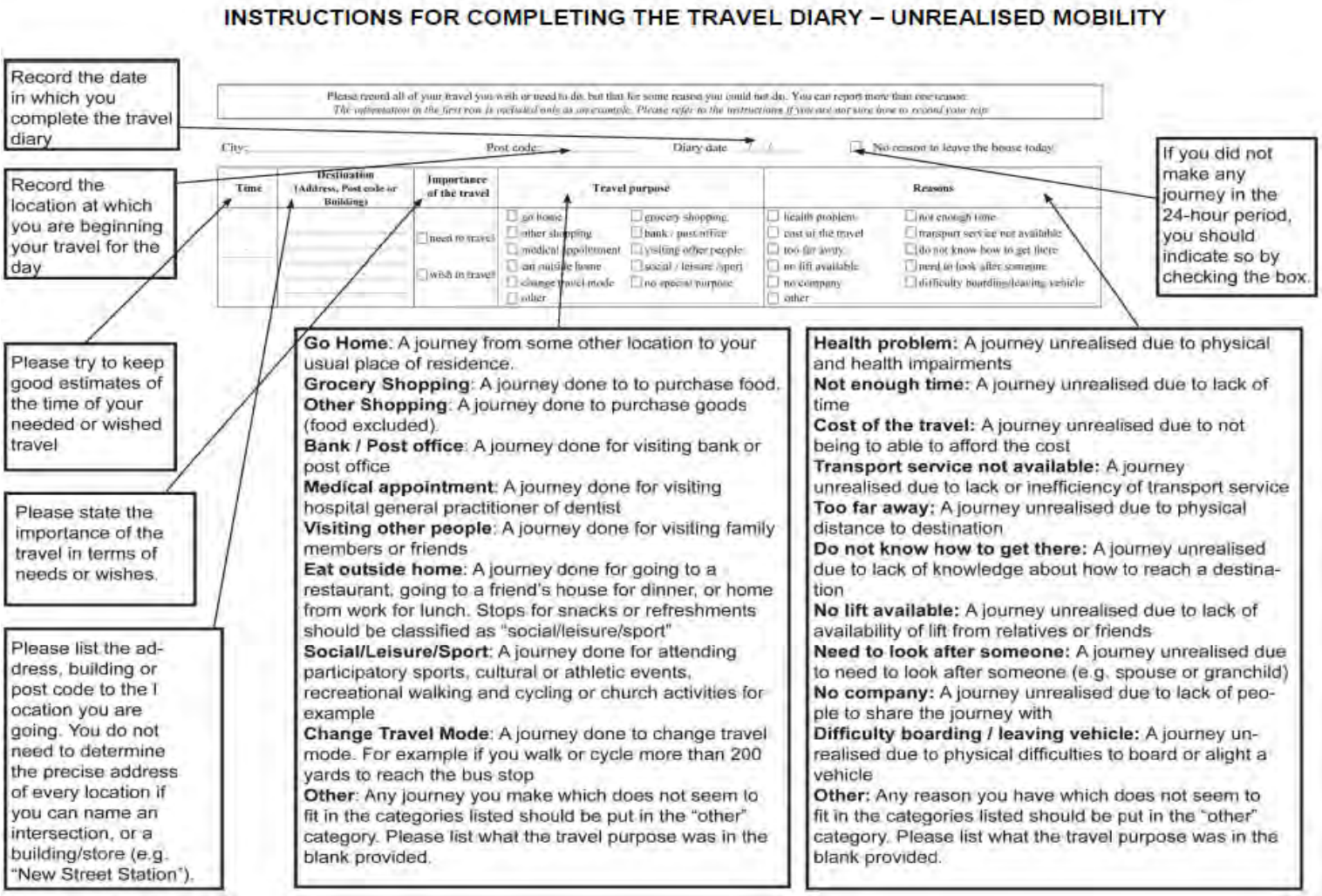

Figure 3-7. Instructions for completing the travel diary - unrealised mobility

transport modes identified in this study on a five-point rating scale *(not difficult at all; not very difficult; difficult; very difficult; impossible)*. Individual wellbeing was measured by asking participants to rate their subjective satisfaction with regard to three aspects: out-of-home mobility, health and place of living. Rate satisfaction was based on a five-point rating scale *(not very satisfied; not satisfied; neither satisfied or not satisfied; satisfied and very satisfied)*.

Transportation variables were measured on the basis of three main criteria: importance of transport in everyday life; mode usage and planning activities. Importance of transport was assessed by asking participants to rate the role of transportation overall and of specific modes (Car / van; Bus; Train; Walking; Cycling; Taxi and FTS) in their everyday life on a five-point rating scale *(Not very important; not important; neither important or not important; important and very important).* With regard to transport mode usage, participants were asked to provide information about access to the car in terms of number of car available in their household, whether or not they hold a driving licence and, in case of negative answer, the reason why they stopped driving (*never had a licence, licence not renewed and voluntarily stopped driving)*. Moreover, participants were asked how often they drove a car or how often they were able to get a lift if they stopped driving, based on a five-point rating scale *(rarely; not often; sometimes; often and always)*. The transport usage related to the alternatives to the car was measured on the basis of a five-point rating scale about how often participants used public transport *(never or hardly ever; about once or twice a month; once a week; twice a week and more than twice a week)*, walking and cycling *(never; twice a month or less; once a week; two to four times a week and five or more times per week)*, taxis *(never or hardly ever; about once or twice a month; once a week; twice a week and more than twice a week),* FTS *(rarely; not often; sometimes; often and always).*

Transport barriers were measured for public transport, taxis and FTS. Participants were asked to specify which were the main factors preventing the use of public transport according to the following list:

- Unsuitable routes and timetables;
- Service infrequent and unreliable;
- Service not available where I live;
- Bus stop too far from my house;
- Difficulties boarding / alighting vehicle;
- Being afraid to travel alone;
- Driver's behaviour;
- Other users' behaviour;
- Overcrowding;
- Inadequate bus shelter;
- Lack of space for shopping loads;
- Cost of the travel;
- Difficulties in getting information;
- Difficulties in understanding timetables;
- Difficulties in purchasing ticket;
- Lack of comfort on board;
- Other (specify).

The list is derived from the issues highlighted in Section 2.3.2. With regard to taxis and FTS, participants were asked to state up to three factors they disliked preventing the use of these two transport modes in an open-ended question.

The last of the four criteria concerns the planning activity related to the journey experience. Participants were asked whether they planned their journeys and in case of positive answer the average amount of time spent planning *(less than one hour; less than ten hours; one day; more than two days and more than a week).* Moreover, participants were asked to specify which tools they used for their planning activities based on the following list:

- AA route planner;
- Cyclestreets;
- Google maps;
- National Rail enquires;
- RAC route planner;
- Traveline;
- Walkit;
- Mobile app (specify);
- Other (specify).

Finally, participants were asked to state up to three reasons preventing the use of planning tools for their travel activities in an open question.

Built environment was measured in terms of place of living (city centre, inner and outer suburbs) and accessibility with regard to public transport provision and facilities, services

and goods availability. Participants were asked to specify whether or not both public transport services and facility services or shops were available in the area where they live (*yes, no, I do not know)* and to rate how far it was to reach them based on a five-point rating scale *(too distant; distant; neither distant or close; close and very close)*.

Activity patterns were measured in terms of both realised and unrealised mobility. With regard to the former, participants were asked to specify the average frequency *(at least twice a week; once a week; twice a month; once a month or less and never)* of the following activities: 1) Grocery shopping; 2) Other shopping; 3) Bank / post office; 4) Medical appointment; 5) Visit other people; 6) Eat outside home; 7) Social / leisure / sport; 8) Have a walk; 9) Other. Furthermore, participants were asked which travel mode they mainly used to carry out the above listed *(Car / van as driver; Car / van as passenger; Bus; Train; Walking; Cycling; Taxi and FTS)*. In terms of unrealised mobility, participants were asked whether or not there are times they cannot make trips they want. In case of affirmative answer, participants were asked to specify the missed activities *(have a walk; grocery shopping; other shopping; bank / post office; medical appointment; visiting other people; eat outside home; social/leisure/sport and other)* and which were the main reasons preventing them to undertaking these activities *(health problems; not enough time; cost of the travel; too far away; do not know how to get there; transport service not available; no lift available; need to look after someone; no company; difficulties in boarding/leaving the vehicle and other)*.

3.3.3.5 Data analysis

Data collected from the questionnaire survey have been analysed using the software IBM SPSS Statistics 24. The analysis comprises of two different typologies. Firstly, data have been analysed according to descriptive statistics including frequency and cross tabulation.

As a second stage, logistic regression analyses have been employed to test the impact and the relationship of the investigated variables regarding both realised and unfulfilled mobility of the older population. The dependent variables used for the analyses consisted of the frequency of the activities for realised mobility and if respondents reported unmet travel needs. The independent variables were selected on the basis of the conceptual framework outlined in Section 5.3. Furthermore, in order to gain a deeper insight and see the differences in significance when other variables are introduced, the independent variables were investigated according to multiple models, namely:

- Model 1: Transportation resources and abilities variables;
- Model 2: Model 1 and demographics variables;
- Model 3: Model 2 and health and wellbeing variables;
- Model 4: Model 3 and built environment variables
- Model 5: Model 4 and activity frequency (only for unfulfilled mobility analyses).

The development of the logistic regression analyses is outlined in Section 6.2.6 and illustrated in Table 6-5 to 6-9.

3.4 Summary

This chapter has illustrated the outline of the methods used to undertake this research. The chapter provides a definition of the main subject of investigation, which is identified as people aged 60 years old and above. Moreover, it defines the concept of mobility employed in this research, which is established as the set of potential benefits associated with out-of-home mobility developed by Metz (2000). In order to address the scope of this research, three studies were developed to investigate two main topics, namely: the travel patterns and

travel needs of those aged 60 years old and above. The chapter provides a detailed explanation and justification for the methodology employed for each of the studies, which comprises of the use of an APC analysis to assess travel patterns, and the development of a conceptual framework and the employment of this in a case study to understand which are the travel needs of the older population.

The application of the illustrated research methods to this research is depicted in the following three chapters of the thesis (Chapters 4 to 6).

4 UNDERSTANDING THE MOBILITY PATTERNS OF THE OLDER POPULATION

4.1 Introduction

This chapter presents the findings of the analysis related to understanding the travel behaviour of the older population within the English context. Several studies found that mobility patterns change with age and findings from the literature seem to suggest that on average older people travel less compared to young people with regard to trip frequency, distance travelled and time spent while travelling (Haustein et al., 2013). Indeed, while ageing, older people are likely to be affected by physical impairments and/or disabilities that can gradually lead to a reduction or loss of mobility, due to difficulties in using transport modes (OECD, 2001). At the same time mobility patterns during later life can be influenced by life events related to ageing such as retirement, driving cessation or loss of a partner (Tacken, 1998). Moreover, the older population present a considerable heterogeneity within its ranks, with regard to age, gender, health conditions, household income and residential area of living. As the Baby Boomer generation is starting to age, this heterogeneity is expected to be more relevant due to their characteristics. Therefore, this investigation of the mobility patterns amongst older people is aimed at exploring: 1) how older people have travelled over time; 2) how travel behaviour changes over time as older people age; 3) if and how different are the travel patterns of older people when age groups, cohorts and gender variables are taken into account.

By employing the APC analysis approach and using the data from the NTS covering a period of time from 1995 to 2015, this chapter investigates the mobility patterns during later life by exploring trip frequency (Section 4.2.1), distance travelled (Section 4.2.2), mode share (Section 4.2.3) access to the car and driving licence (Section 4.2.4), and travel purpose

(Section 4.2.5). Finally, a summary of the chapter is provided in Section 4.5.

4.2 Results and findings

4.2.1 Number of trips

This section investigates the trip frequency of the older population. Trip frequency has been analysed in terms of average number of journeys undertaken per week. Figure 4-1 illustrates the trends of the overall ageing population. Trends show that weekly number of trips done has gradually increased from 1995 to 2015. More specifically, it is possible to notice a steady rise from 1995 to 2005, followed by a drop in 2010 and a stabilization until 2015. Looking at the gender differentiation, Figure 4-1 shows that the male and female population present differences in terms of trip frequency. On the one hand, the male group trends display a decrease from 1995 to 2015. From 1995 to 2006, trends show a fluctuating tendency, with a drop from 19 to 17.8 trips per week between 2006 and 2007, followed by a steady trend around 18 trips. On the other hand, the female group show a gradual rise from 13.4 to 15 trips.

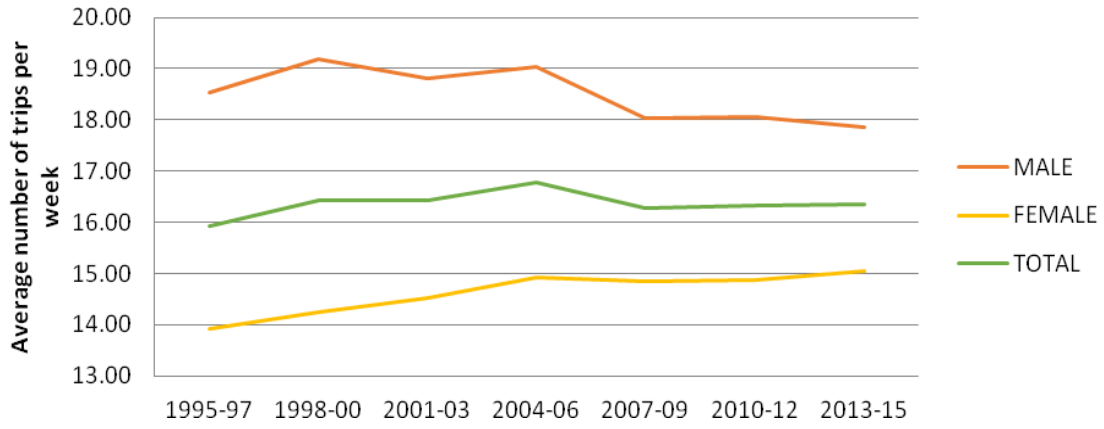

Figure 4-1. Average number of trips of population aged 60 years old and above

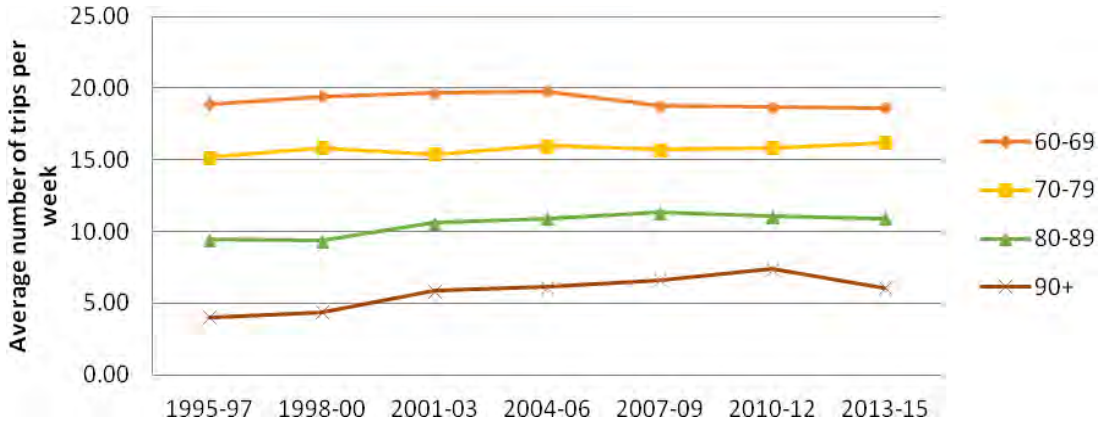

Figure 4-2. Average number of trips by age groups

Figure 4-2 plots the average number of trips by age group. The graph shows levelled trends for each of the age groups in the period between 1995 and 2015, with the exception of the 90+ one, which displays a gradual uplift from an average of 4 to 7 trips per week. The 60-69 age group presents an average of slightly less than 20 trips per week. The number decreases of around 3 and 9 trips per week for the 70-79 and 80-89 age groups, respectively.

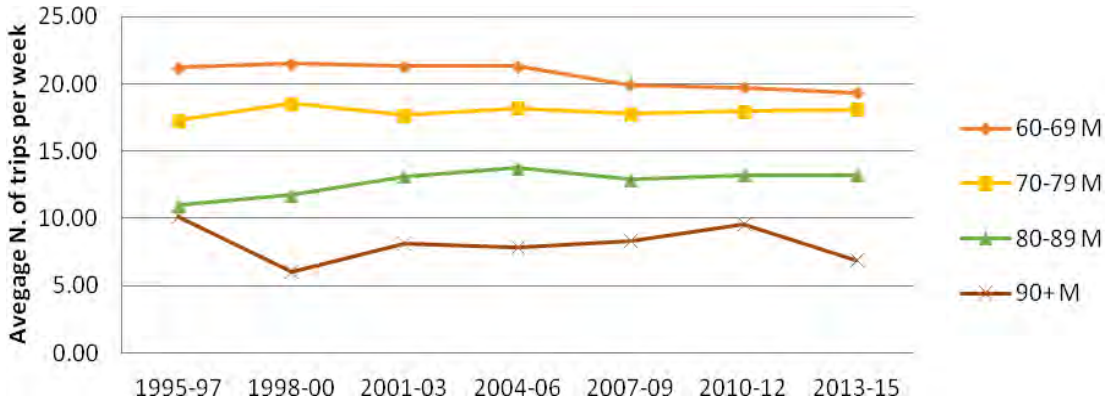

Figure 4-3. Average number of trips by age groups and gender - Male

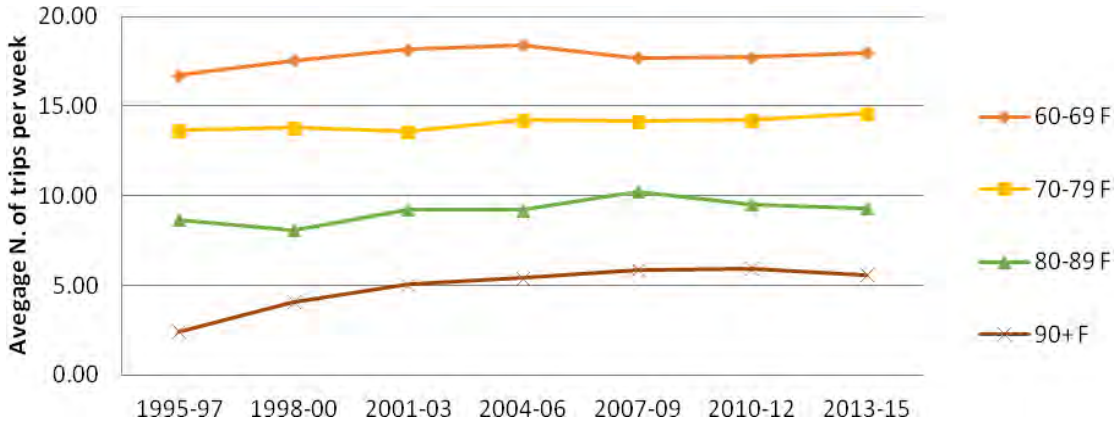

Figure 4-4. Average number of trips by age groups and gender – Female

Figure 4-3 and Figure 4-4 plot the average number of trips by age groups and gender. The analysis shows similar trends for all male and female age groups, with a moderate growth over the year of investigation, with the male 60-69 and 90+ aged groups, show a fall of 2 and 3.5 trips, respectively.

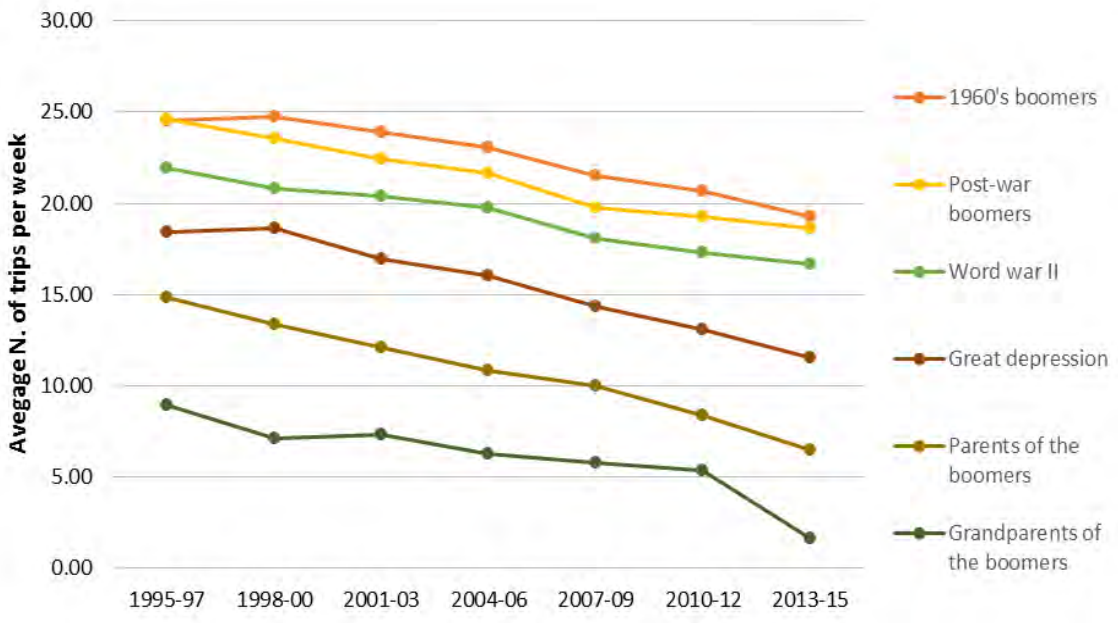

Figure 4-5. Average number of trips per week by cohort groups

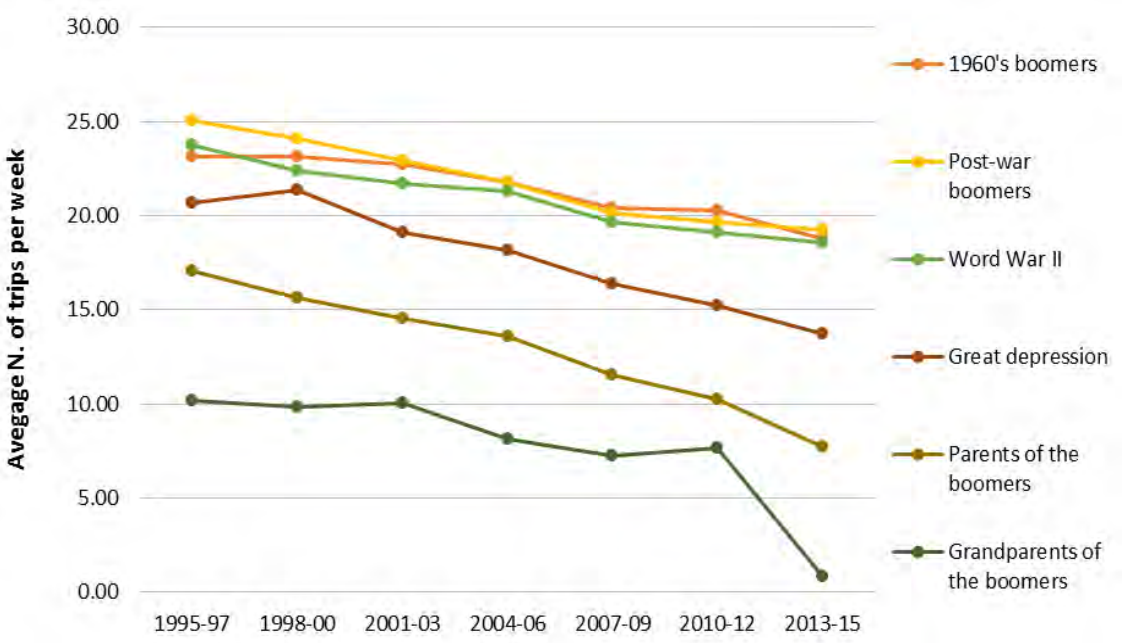

Figure 4-6. Average number of trips per week by cohort groups and gender - Male

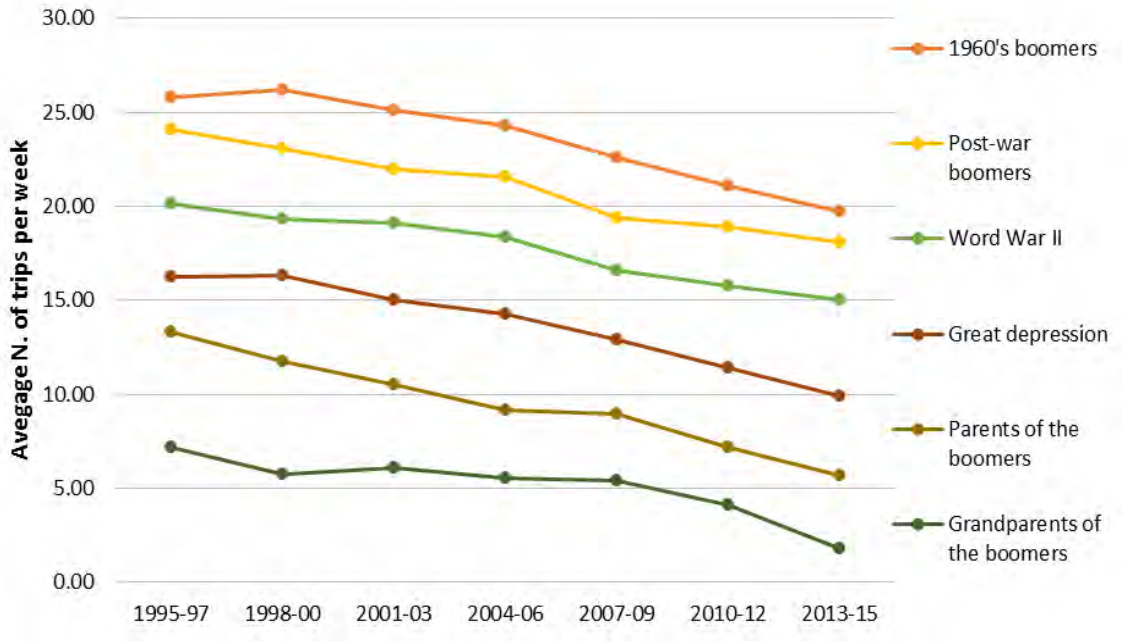

Figure 4-7. Average number of trips per week by cohort groups and gender - Female

Figure 4-5 displays the average number of trips per cohort group. All the six cohort groups present similar trends, having a steadily decreasing trip frequency over the investigated

years. The three younger cohort groups display a fall of 5 trips per week between 2005 and 2015. More precisely, the two Boomers group steadily decreased their trip frequency from 24 to around 19 trips per week, while the World War II cohort group trends declined from slightly less than 22 trips per week to around 17. The decreasing trends appear to be even more accentuated for the remaining three cohort groups, with a fall of around 8 trips during the twenty years of investigation. Both the Great Depression and the Parents of the Boomers groups show declining trends from around 18 and 15 trips per week to 11.5 and 6.5, respectively. Finally, the Grandparents of the Boomers cohort again display declining trends, but less accentuated compared to the other cohort groups, since between 1995 and 2012 the average number of trips decreased from around 9 to 5, with a significant drop to 1.5 in the remaining three years of investigation. This is likely due to the advanced age of the cohort members. Figure 4-6 and Figure 4-7 show the average number of trips per week by cohort groups and gender. Just like for the overall older population, all the male and female cohort groups present gradual falling trends between 2002 and 2015. Particularly, the male Grandparents of the Boomers cohort fell by around 7.5 to less than 1 trip in the period between 2012 and 2015, showing a significant reduction in mobility with increasing age.

4.2.2 Distance travelled

This section investigates the distance travelled by the English older population. Distance travelled has been analysed in terms of average miles travelled per week. Figure 4-8 shows the trends of the overall ageing population. Trends show that the average weekly distance travelled has gradually increased from 1995 to 2015 by around 30 miles, rising from slightly more than 84 to around 114.5 miles per week. Both male and female older population present similar rising trends in distance travelled, but the former group travelled for an average of 33 miles more per week during the period of investigation.

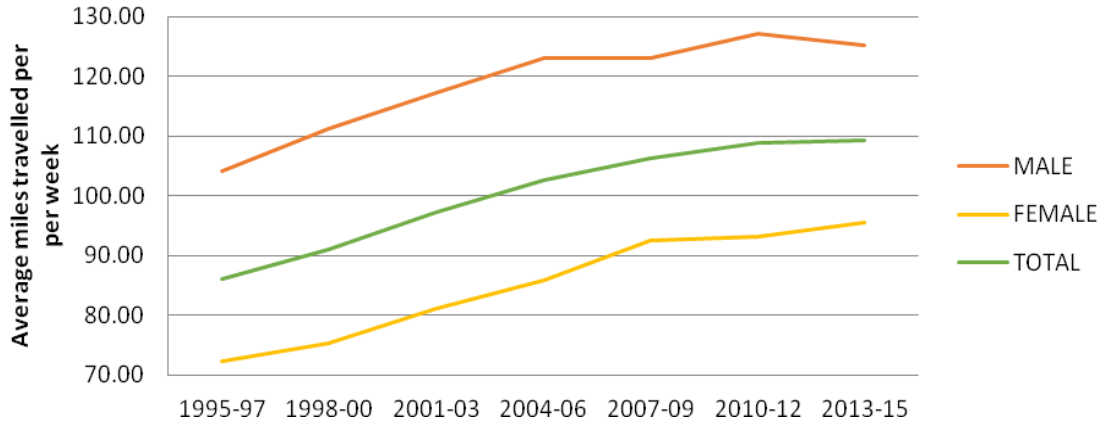

Figure 4-8. Average miles travelled by 60+ years old

Looking at the average miles travelled by age group (Figure 4-9), the graph illustrates that all the age groups steadily increased their distance travelled over the period of investigation, although both the 80-89 and 90+ groups presented a fall of around 10 miles travelled between 2012 and 2015. Figure 4-10 and Figure 4-11 plot the average miles by age groups and gender. Similarly, to the trip frequency, all male and female age groups display similar rising trends, with the exception of the 90+ male group. All female groups increased their average distance travelled by around 15 miles, with only the 90+ one increasing by 10. In the male group both 70-79 and 80-89 gradually increased their trends of around 30 and 20 miles, respectively, while the 60-69 group showed a fall of slightly less than 10 miles between 2012 and 2015. Finally, the 90+ group trends fluctuated considerably throughout the period, with a significant drop of 25 miles travelled between 1995 and 2003, followed by a peak of 27 miles in 2006 and again a fall of 18 miles between 2012 and 2015. Overall, the trends show an upward trajectory with a plateau occurring after 2004.

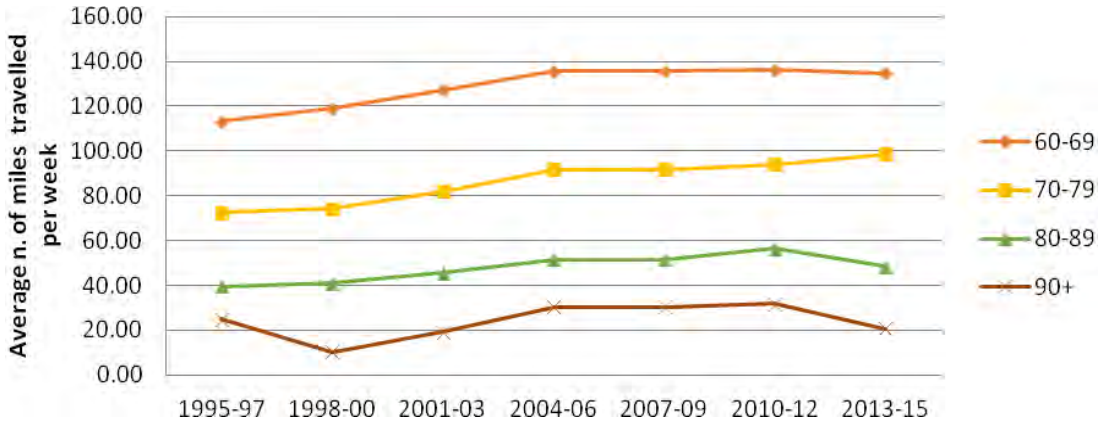

Figure 4-9. Average miles travelled by age groups

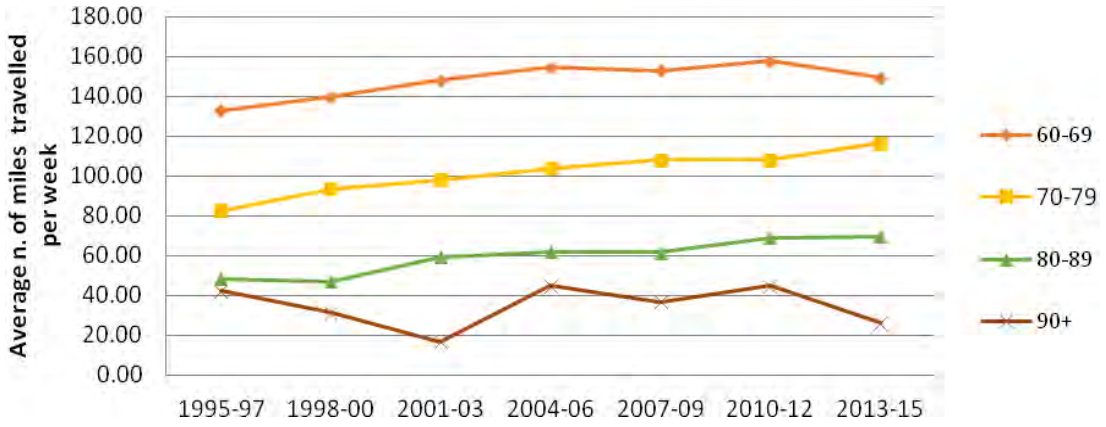

Figure 4-10. Average miles travelled by age groups and gender – Male

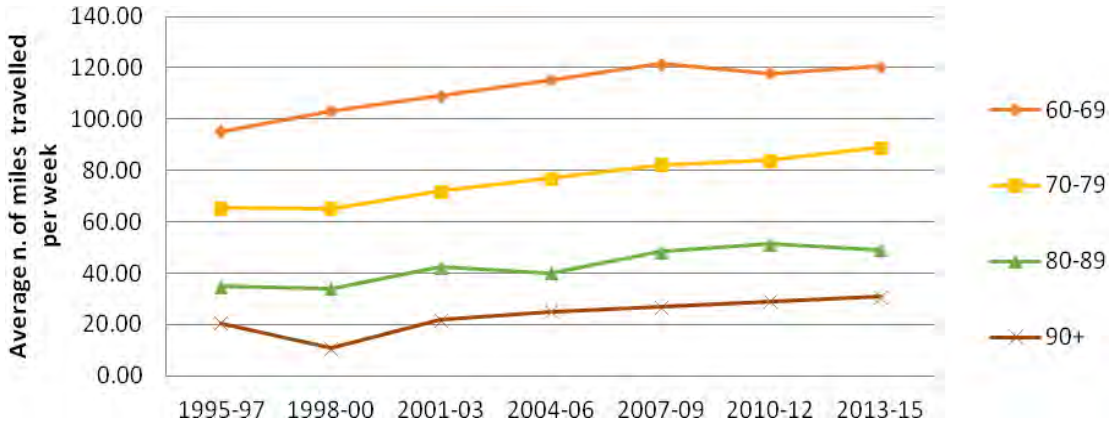

Figure 4-11. Average miles travelled by age groups and gender – Female

Figure 4-12 shows the average miles travelled per week by cohort groups. As for trip frequency, all the six cohort groups present similar declining trends. While the 1960's Boomers and the Grandparents of the Boomers slightly decreased by 17 and 25 miles, the other four cohorts groups present a more steeply falling trend, with a drop of around 50 miles for the Post-War Boomers and World War II cohorts, 45 and 38 miles for the Great depression and Parents of the Boomers cohorts, respectively. These declining trends in average distance travelled are also repeated for both male and female cohort groups, with the exception of the female 1960's Boomers cohort that presents rising trends (Figure 4-13and Figure 4-14). Again, male cohorts travelled more miles throughout the period of investigation, but the drops in the trends are significantly more compared to the female cohorts. The difference is particularly considerable for the three younger cohort groups, with a difference of more than 45 miles per week drop.

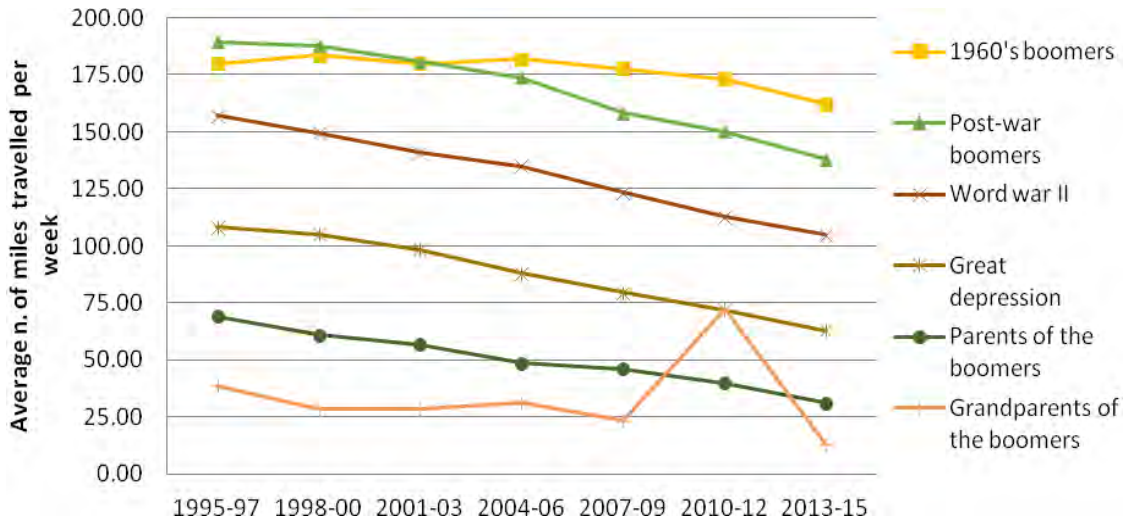

Figure 4-12. Average miles travelled by cohort groups

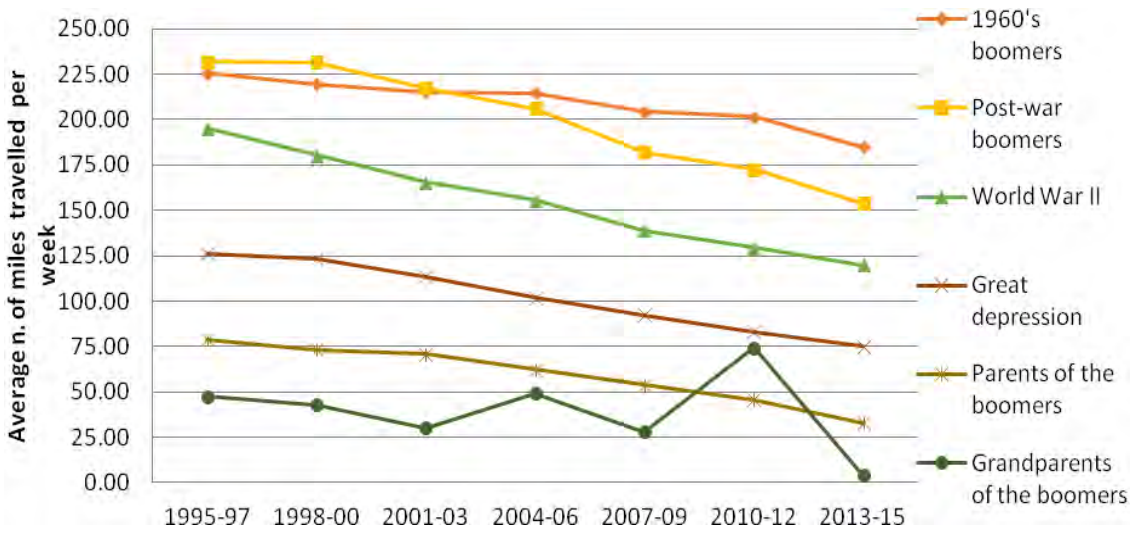

Figure 4-13. Average miles travelled by cohort groups and gender – Male

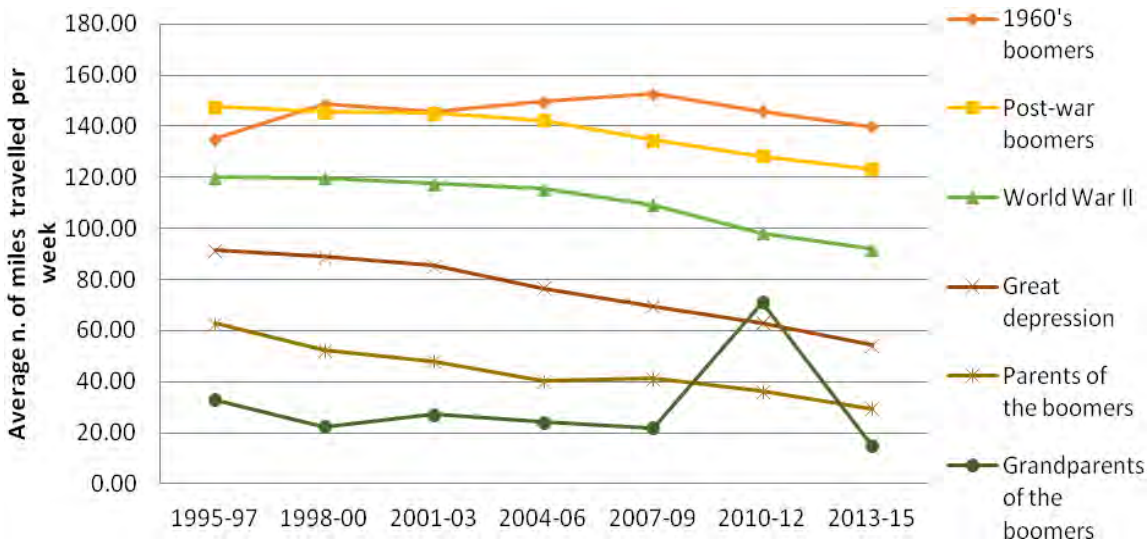

Figure 4-14. Average miles travelled by cohort groups and gender – Female

4.2.3 Mode share

This section investigates the mode share of the English older population. Mode share has been analysed as the percentage of transport mode used for travel in terms of journeys undertaken. Transport modes identified for the analysis are the following:

- Walk;

- Bicycle;
- Car/van as driver;
- Car/van as passenger;
- Other private transport;
- Bus;
- Rail;
- Taxi/Minicab;
- Other public transport.

Figure 4-15 shows the mode share of the overall ageing population. The graph highlights that private transport modes accounted for around 90% of the share throughout the period between 2002 and 2015. Particularly, the car (both as driver and passenger) was the most used mode, being used for at least half of the journeys undertaken. Moreover, car use shows increasing trends, growing from 54% in 1995-97 to 68% in 2013-15. This is particularly due to the increase of the share of the drivers group. Indeed, while the car passenger group's percentage remained stable between 18% and 20%, the car drivers' one steadily increased from 36% to almost 50%. Moreover, the data suggest that walking trips are mainly replaced by car trips. Indeed, despite remaining the second mode used, trips by walking present steadily declining trends falling from 32% to 19% throughout the period of investigation. This is particularly significant when taking into account the inversely proportional trends regarding car drivers.

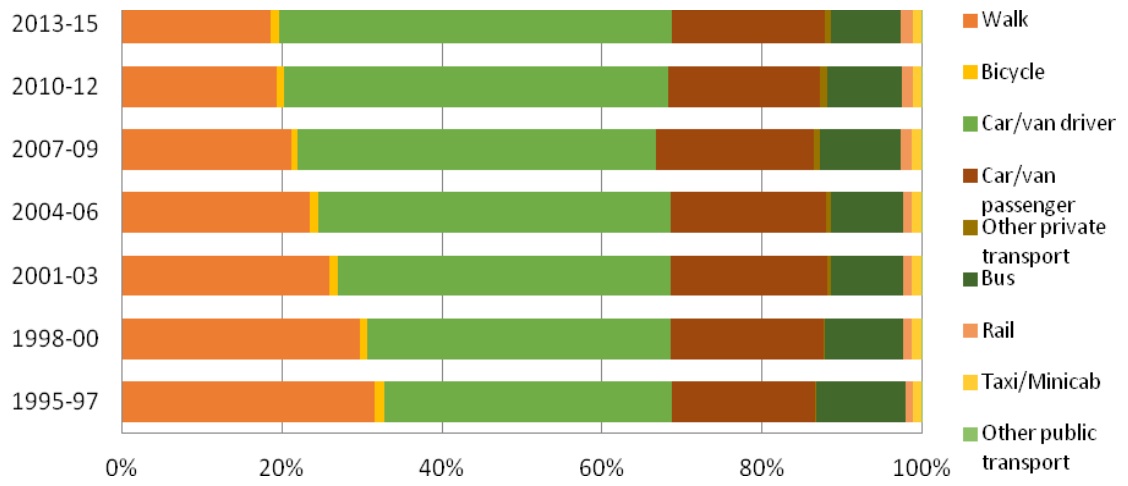

Figure 4-15. Mode share of people aged 60 years old and above

Table 4-1 describes the mode share by age groups. Similar to what is shown in Figure 4-15, the table highlights that the car remains the most used transport mode amongst all age groups, accounting for around of half of the journeys undertaken by older people as both driver and passenger. In this sense, it is possible to highlight three main trends regarding car usage. First, driving a car increased by 11%, 16% and 20% throughout the time of investigation for the 60-69, 70-79 and 80-89 age groups, respectively. Moreover, it surged from 2% to 20% for the 90+ group. Second, using a car as a passenger shows fluctuating trends for all the age groups, but usage as a passenger is more common amongst the older groups. Finally, it is possible from Table 4-1 to notice that the percentage of drivers is inversely proportional to the percentage of passengers while ageing. Walking trends, again, show declining trends. This is particularly valid for the 70-79 and 80-89 age groups, showing a drop of 16% and 19%, respectively. Public transport (buses and trains) display small decreasing trends. Data show, just like for the car passengers, that the percentage of public transport mode share increases with age, since it almost doubles when comparing the 60-69 group with both 80-89 and 90+ ones, particularly for bus usage. Similar trends in this sense are shown by taxi and minicab use, although with considerable smaller percentages.

Table 4-1. Mode share by age groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
60-69	*Walk*	29%	27%	24%	22%	20%	19%	19%
	Bicycle	1%	1%	1%	1%	1%	1%	1%
	Car/van driver	42%	44%	47%	50%	50%	52%	53%
	Car/van passenger	17%	18%	18%	17%	18%	17%	17%
	Other private transport	0%	0%	0%	0%	1%	1%	1%
	Bus	8%	7%	7%	7%	8%	8%	6%
	Rail	1%	1%	1%	1%	2%	2%	2%
	Taxi/Minicab	1%	1%	1%	1%	1%	1%	1%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
70-79	*Walk*	34%	33%	27%	24%	21%	21%	18%
	Bicycle	1%	1%	1%	1%	1%	1%	1%
	Car/van driver	31%	33%	38%	40%	42%	44%	47%
	Car/van passenger	17%	19%	20%	21%	21%	20%	21%
	Other private transport	0%	0%	1%	1%	1%	1%	1%
	Bus	14%	12%	11%	11%	11%	11%	11%
	Rail	1%	1%	1%	1%	1%	1%	1%
	Taxi/Minicab	1%	2%	1%	1%	1%	1%	1%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
80-89	*Walk*	38%	32%	30%	27%	24%	19%	19%
	Bicycle	1%	1%	1%	1%	1%	1%	0%
	Car/van driver	18%	19%	25%	28%	29%	37%	38%
	Car/van passenger	22%	28%	24%	23%	23%	26%	24%
	Other private transport	0%	0%	1%	1%	2%	1%	1%
	Bus	17%	16%	15%	15%	16%	14%	14%
	Rail	1%	1%	1%	1%	1%	1%	1%
	Taxi/Minicab	2%	3%	3%	3%	3%	2%	2%
	Other public transport	0%	1%	0%	0%	0%	0%	0%
90+	*Walk*	26%	39%	30%	31%	18%	21%	19%
	Bicycle	6%	0%	0%	0%	0%	0%	0%
	Car/van driver	2%	8%	4%	13%	19%	20%	20%
	Car/van passenger	43%	32%	42%	39%	37%	36%	39%
	Other private transport	0%	0%	1%	2%	5%	2%	3%
	Bus	18%	10%	15%	12%	17%	15%	14%
	Rail	0%	4%	1%	0%	1%	1%	0%
	Taxi/Minicab	4%	8%	4%	3%	3%	4%	4%
	Other public transport	1%	0%	2%	1%	1%	1%	1%

Table 4-2. Mode share by cohort groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
1960's boomers	*Walk*	22%	19%	18%	18%	17%	17%	17%
	Bycicle	2%	1%	2%	1%	2%	2%	2%
	Car/van driver	57%	60%	62%	61%	61%	60%	59%
	Car/van passenger	12%	12%	11%	11%	12%	12%	13%
	Other private transport	0%	1%	1%	1%	1%	1%	1%
	Bus	4%	3%	4%	4%	4%	4%	5%
	Rail	2%	3%	2%	2%	3%	3%	3%
	Taxi/Minicab	1%	1%	1%	1%	1%	1%	1%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
Post-war boomers	*Walk*	21%	19%	19%	19%	19%	18%	19%
	Bycicle	1%	2%	2%	1%	1%	1%	1%
	Car/van driver	58%	60%	59%	57%	56%	55%	54%
	Car/van passenger	13%	13%	14%	14%	15%	15%	17%
	Other private transport	0%	0%	1%	1%	1%	1%	1%
	Bus	4%	4%	4%	4%	5%	6%	6%
	Rail	2%	2%	2%	2%	2%	2%	2%
	Taxi/Minicab	1%	1%	1%	1%	1%	1%	1%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
Word war II	*Walk*	23%	23%	23%	22%	21%	20%	18%
	Bycicle	1%	2%	1%	1%	1%	1%	1%
	Car/van driver	53%	51%	50%	50%	48%	47%	48%
	Car/van passenger	15%	17%	18%	17%	19%	19%	20%
	Other private transport	0%	0%	0%	0%	1%	1%	1%
	Bus	5%	5%	6%	7%	9%	9%	10%
	Rail	1%	1%	1%	1%	1%	1%	1%
	Taxi/Minicab	1%	1%	1%	1%	1%	1%	1%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
Great depression	*Walk*	30%	30%	26%	25%	22%	19%	19%
	Bycicle	1%	1%	1%	1%	1%	0%	1%
	Car/van driver	41%	40%	42%	40%	39%	41%	39%
	Car/van passenger	17%	18%	19%	20%	22%	23%	24%
	Other private transport	0%	0%	0%	1%	1%	1%	1%
	Bus	9%	9%	9%	11%	13%	12%	13%
	Rail	1%	1%	1%	1%	1%	1%	1%
	Taxi/Minicab	1%	1%	1%	1%	2%	2%	2%
	Other public transport	0%	0%	0%	0%	0%	0%	0%
Parents of the boomers	*Walk*	35%	34%	24%	26%	25%	20%	19%
	Bycicle	1%	1%	1%	1%	1%	1%	0%
	Car/van driver	30%	29%	24%	28%	25%	26%	24%
	Car/van passenger	18%	20%	19%	24%	26%	30%	34%
	Other private transport	0%	0%	2%	1%	2%	2%	3%
	Bus	14%	13%	10%	15%	16%	16%	15%
	Rail	1%	1%	1%	1%	1%	1%	1%
	Taxi/Minicab	1%	2%	2%	3%	3%	4%	4%
	Other public transport	0%	0%	17%	0%	1%	1%	1%
. Grandparents of the boomers	*Walk*	38%	33%	32%	31%	15%	18%	
	Bycicle	1%	0%	0%	0%	0%	0%	
	Car/van driver	17%	17%	9%	14%	20%	12%	
	Car/van passenger	22%	30%	35%	38%	39%	57%	
	Other private transport	0%	0%	1%	1%	7%	1%	
	Bus	17%	15%	16%	11%	15%	9%	
	Rail	1%	1%	1%	0%	0%	0%	
	Taxi/Minicab	2%	3%	4%	3%	4%	3%	
	Other public transport	0%	0%	2%	1%	1%	0%	

Table 4-2 illustrates the mode share by cohort groups. Again, the car is the most used transport mode. The cohort analysis presents similar trends to the age one, with car drivers' share higher amongst younger cohorts, and passenger rates increasing with age. This is particularly evident in the Parents of Boomers and Grandparents of the Boomers cohorts, showing an increase of 18% and 35% throughout the period of investigation. Consequently, it seems that car users tend to switch from driving to being passengers as they age.

Walking trends display decreasing trends for all cohort groups. While for the three younger cohorts the fall is limited to between 2% and 5%, the trends are more extreme for the remaining cohorts steadily dropping from 30%, 35% and 28% to 19%, 19% and 18%, respectively. Public transport use shows rising trends for all cohort groups. Although the increasing percentage is modest for both Boomers cohorts (1-2%), the trends are larger for the remaining four cohort groups. In this sense, it is also possible to notice that the older the cohort is, the higher the percentage share becomes. Taxis and minicabs present similar trends to public transport, despite a smaller share of use. Again, it is possible to notice a correlation between advancing age and mode usage, with increasing trends for both the Parents and Grandparents of the Boomers of at least three times higher compared to the younger cohort groups.

4.2.4 Access to car and type of driving license

The previous section highlighted that car is the most used mode for travelling by the older population, either as a driver or passenger. Therefore, this section further investigates the relationship between the older population and car use by analysing access to this transport mode and trends in driving license during later life.

Access to the car has been analysed in terms of percentage regarding the following characteristics (Department for Transport, 2016b):

- As main driver - household member that drives the furthest in that car in the course of a year;
- As other driver - people in car-owning households, who have a full driving licence to drive a car, but are not main drivers of a household car;
- As passenger - all other people in car-owning households that do not drive;
- No access to the car/van - people with no access to the car/van in their household.

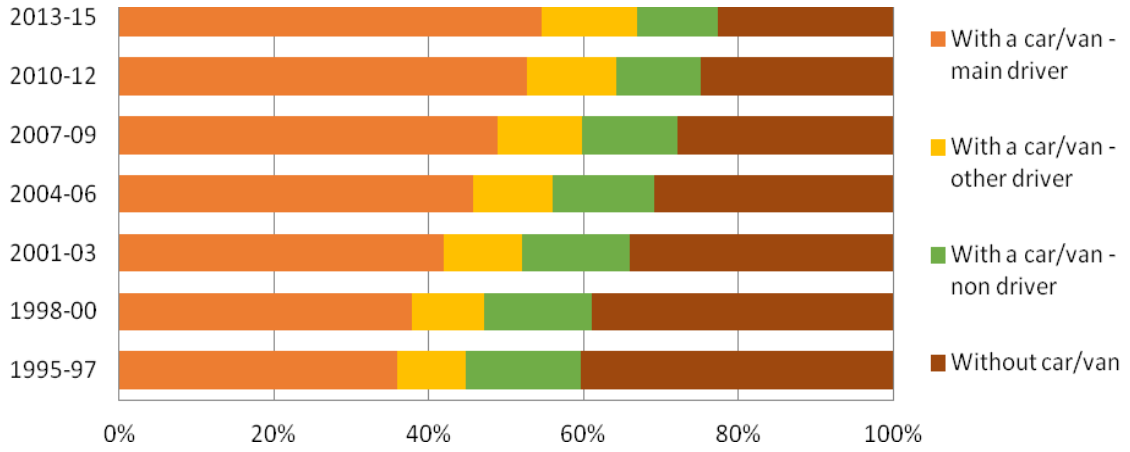

Figure 4-16. Access to the car for the overall English older population

Figure 4-16 shows that access to the car by the older population presents increasing trends in the period between 1995 and 2015. Indeed, the percentage related to access to this transport mode grew by almost 20%. This is particularly due to the rising trends of people reporting access to the car as main driver and the inversely decreasing trend of those older people without access to car (+19% and -18% throughout the period of investigation, respectively). In a similar way, trends regarding older people having access to the car as other driver slightly increased from 9% to 12%, while those having access as passenger decreased from 15% to 10%.

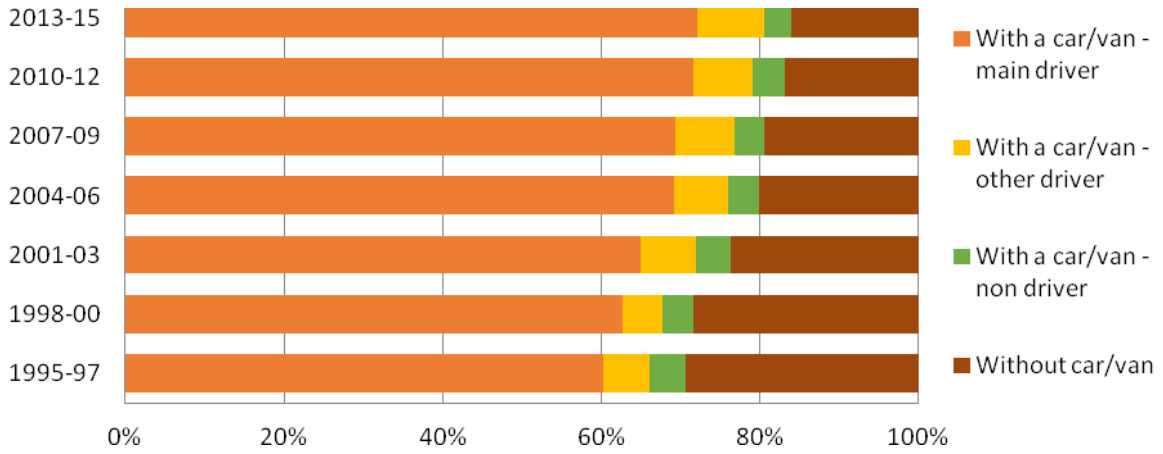

Figure 4-17. Access to the car by the male older population

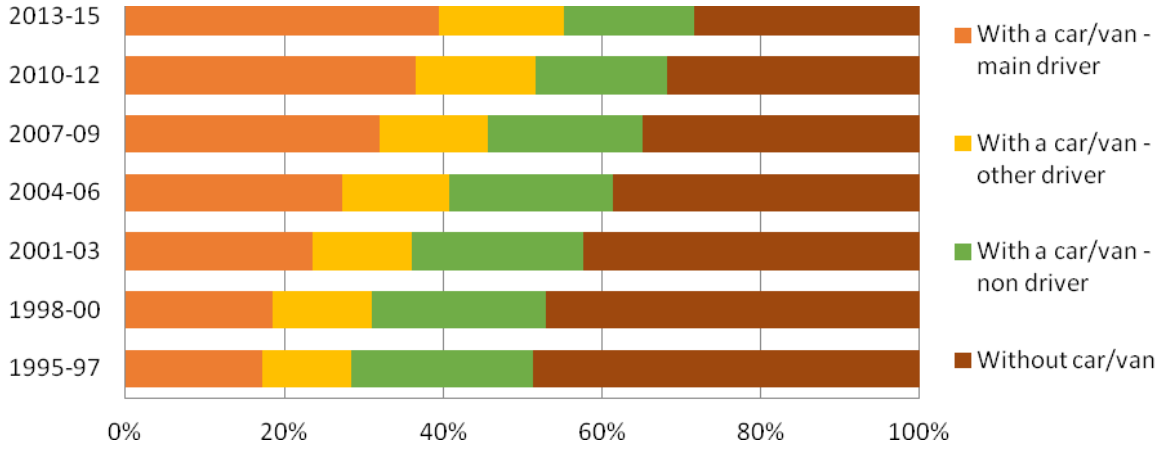

Figure 4-18. Access to the car by the female older population

Looking at the gender differentiation, Figure 4-17 and Figure 4-18 depict access to the car by male and female older population, respectively. Access to the car as a main driver for the male group is almost twice as much as for females. Both groups show growing trends, although female car use is growing faster than males (17% to 40% compared to 60% to 72%). The predominance of the male group as main driver is also highlighted by data on access to the car for the female group as other driver and passenger. The female group shows moderate increasing trends for the other driver category, by growing from around 11% to 14% and the passenger trends decreased by around 6.5%. However, a comparison in

percentages between the two gender groups illustrates a significant difference, with the female one being twofold (other driver) and five-fold (passenger) as much as the male older population. Looking at those older people without access to the car, both groups depict decreasing trends, with the men displaying a fall of 13% and women 20% throughout the period of investigation. A comparison in percentages show that the female group presents a bigger share of population without access to the car, having more than double compared to males.

Table 4-3 illustrates access to the car by age groups. Data show that access to the car as main driver is increasing for all the four age groups, with the 60-69, 70-79 and 80-89 showing a growth of around 20% and the 90+ group of 13% throughout the period of investigation. Inversely, trends related to no access to the car highlight a fall for the age groups, particularly for the 70-79 and 80-89 groups, with a drop of 24% for each. Similarly, accessing the car as a passenger reveals decreasing trends for the four categories, especially for the 60-69 (-7%) and 90+ (-6%) groups. Finally, data regarding accessing the car as other driver show fluctuating trends for the 60-69 and 90+ groups, with percentages oscillating between 13% and 15% and 0% and 4%, respectively. On the other hand, the 70-79 and 80-89 groups depict increasing trends, with both growing by 6% during the period of investigation.

Table 4-3. Access to the car by age groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
60-69	With a car - main driver	46%	49%	52%	60%	50%	62%	63%
	With a car - other driver	13%	14%	14%	13%	15%	13%	14%
	With a car - non driver	16%	14%	14%	11%	14%	10%	9%
	Without car	26%	24%	20%	16%	22%	15%	14%
70-79	With a car - main driver	33%	35%	40%	46%	37%	49%	54%
	With a car - other driver	7%	7%	8%	10%	7%	12%	13%
	With a car - non driver	14%	13%	15%	14%	13%	12%	11%
	Without car	46%	45%	38%	29%	43%	27%	22%
80-89	With a car - main driver	16%	16%	23%	29%	19%	35%	35%
	With a car - other driver	2%	3%	4%	5%	3%	7%	8%
	With a car - non driver	14%	15%	13%	12%	15%	12%	12%
	Without car	69%	66%	61%	54%	63%	47%	45%
90+	With a car - main driver	2%	4%	6%	12%	2%	15%	15%
	With a car - other driver	1%	0%	1%	3%	1%	4%	2%
	With a car - non driver	18%	12%	15%	16%	11%	16%	12%
	Without car	78%	84%	78%	69%	85%	66%	71%

Table 4-4 describes the access to the car by cohort groups. From the table, it is possible to notice that access to the car as both main driver and other driver show similar patterns, with the three younger cohorts having fluctuating trends and the older cohorts decreasing ones. Data highlights that the younger the cohort is, the higher is the percentage of accessing the car as main driver, with the two Boomers cohorts showing around two-thirds of the share, and the World War II more than half for the entire period of investigation. Looking at accessing the car as a passenger, all the cohort groups show slight decreasing patterns, with the exception for the Grandparent of the Boomers, who showed an increase of 2% between 1995 and 2012, followed by a further rise of 6% in the last segment of investigation. Having no access to a car reveals moderate increasing trends for all the cohort groups, with again the exception of the Grandparent of the Boomers, which dropped from 71% to 58%. From the table, it is possible to notice that that the older the cohort is, the higher the rise in no accessing the car is, highlighting a potential relationship between advanced age and access

to the car.

Table 4-4. Access to the car by cohort groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
1960's Boomers	With a car - main driver	61%	67%	68%	69%	69%	69%	69%
	With a car - other driver	15%	13%	12%	11%	11%	10%	11%
	With a car - non driver	9%	8%	8%	8%	8%	8%	7%
	Without car	15%	12%	12%	12%	12%	13%	13%
Post-War Boomers	With a car - main driver	63%	66%	66%	67%	66%	65%	64%
	With a car - other driver	14%	13%	12%	11%	12%	12%	14%
	With a car - non driver	10%	9%	10%	10%	9%	9%	9%
	Without car	13%	12%	11%	12%	13%	14%	14%
World War II	With a car - main driver	57%	57%	56%	57%	55%	54%	55%
	With a car - other driver	13%	14%	14%	14%	13%	14%	13%
	With a car - non driver	14%	14%	13%	12%	12%	12%	11%
	Without car	16%	15%	17%	17%	19%	21%	21%
Great depression	With a car - main driver	45%	43%	44%	43%	42%	42%	37%
	With a car - other driver	12%	11%	10%	9%	9%	9%	9%
	With a car - non driver	16%	13%	15%	14%	14%	12%	12%
	Without car	27%	33%	31%	33%	36%	38%	42%
Parents of the Boomers	With a car - main driver	31%	29%	28%	25%	23%	22%	19%
	With a car - other driver	6%	5%	5%	5%	4%	4%	3%
	With a car - non driver	14%	13%	13%	12%	12%	13%	12%
	Without car	49%	53%	54%	58%	61%	61%	67%
Grandparents of the Boomers	With a car - main driver	13%	10%	9%	10%	10%	17%	0%
	With a car - other driver	2%	2%	1%	2%	2%	4%	10%
	With a car - non driver	14%	15%	14%	19%	19%	20%	32%
	Without car	71%	73%	76%	68%	69%	59%	58%

Trends in driving licence have been analysed in terms of number of people holding a full driving licence and provisional or no driving licence. Figure 4-19 shows an increase in holding a full driving licence in the period between 1998 and 2012, with the percentage of licence holders increasing by more than three and half times, and followed by a small drop in the following years. Other types of licence or no licence shows, after a small decrease in the first four years of investigation, an increase leading to double the percentage of

other/non-holder people in the period between 2000 and 2003, followed by a steady decline to 2015.

Figure 4-20 describes the trends in holding a driving license by the overall older population and gender. From the graph, it is possible to see that both male and female groups present similarly growing trends starting from 1998 to 2012, with a three-fold and four-fold growth, respectively, followed by a slight drop in the following years. Moreover, data show that the gap between male and female licence holders has been reduced significantly in the last year. This is also highlighted from the trends of the other or no licence female group, which displays steady declining trends in the last 15 years, while the male group displayed very limited changes in number over the same period of investigation.

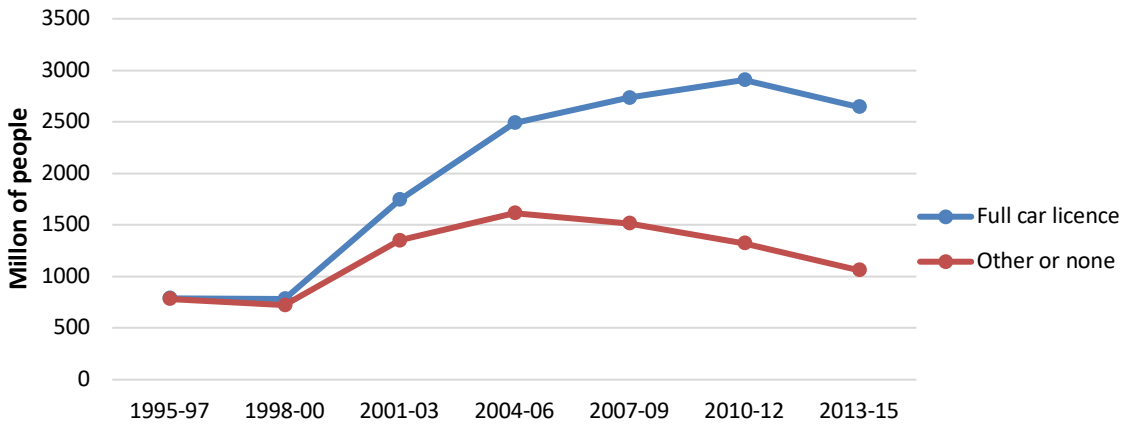

Figure 4-19. Type of driving license held by the overall English older population

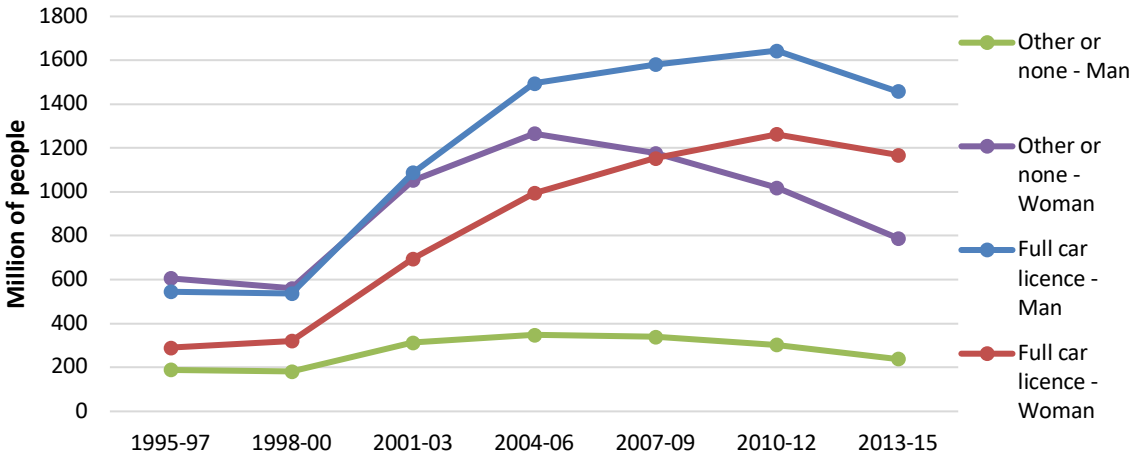

Figure 4-20. Type of driving license held by the overall English older population and gender

Table 4-5 describes the type of driving license held by different age groups. All four age groups show steadily increasing trends regarding holding a full licence. This is particularly valid for the 70-79 and 80-89 groups, which grew by 25% and 28%, respectively, while the 60-69 (18%) and 90+ (15%) show less accentuated percentages. Consequently, the other or no licence category presents declining trends with inverse percentages to the full car license group. Looking at a cohort differentiation, Table 4-6 shows that the three younger cohorts display level trends in terms of holding a full license, with small overall variation in percentages of 1% for the Boomers cohorts and 2% for the World War II one throughout the period of investigation. On the other hand, the remaining cohorts present falling trends in holding a full driving licence, with both Great depression and Grandparents of the Boomers decreasing by 9% and the Parents of the Boomers by 16%. Consequently, these cohort groups show inverse trends with regard to the other or no licence category.

Table 4-5. Type of driving licence held by age groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
60-69	*Full car licence*	64%	67%	71%	74%	77%	79%	81%
	Other or none	36%	33%	29%	26%	23%	21%	19%
70-79	*Full car licence*	46%	46%	51%	57%	61%	65%	71%
	Other or none	54%	53%	49%	43%	39%	35%	29%
80-89	*Full car licence*	22%	23%	31%	35%	41%	48%	51%
	Other or none	78%	77%	69%	65%	59%	52%	49%
90-120	*Full car licence*	9%	9%	12%	16%	18%	26%	23%
	Other or none	91%	91%	88%	84%	82%	74%	77%

Table 4-6. Type of driving licence held by cohort groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
1960's Boomers	*Full car licence*	81%	84%	84%	84%	83%	83%	84%
	Other or none	19%	16%	16%	16%	17%	17%	16%
Post-War Boomers	*Full car licence*	81%	82%	81%	82%	82%	81%	82%
	Other or none	19%	18%	19%	18%	18%	19%	18%
World War II	*Full car licence*	74%	74%	74%	74%	73%	72%	73%
	Other or none	26%	26%	26%	26%	27%	28%	27%
Great Depression	*Full car licence*	62%	59%	58%	57%	55%	55%	53%
	Other or none	38%	41%	42%	43%	45%	45%	47%
Parents of the Boomers	*Full car licence*	44%	38%	37%	36%	34%	34%	28%
	Other or none	56%	62%	63%	64%	66%	66%	72%
Grandparents of the Boomers	*Full car licence*	19%	16%	17%	17%	14%	32%	10%
	Other or none	81%	84%	83%	83%	86%	68%	90%

4.2.5 Travel purpose

This section investigates the travel purpose of the English older population. Journeys investigated are related to the following activities, as specified by Department for Transport (2016b):

- Commuting - trips to a usual place of work from home, or from work to home;
- Business - personal trips in course of work, including a trip in course of work

back to work. This includes all work trips by people with no usual place of work (e.g. site workers) and those who work at or from home;

- Education/escort education - trips to school or college, etc. by full time students, students on day-release and part time students following vocational courses;
- Shopping - all trips to shops or from shops to home, even if there was no intention to buy;
- Other escort - used when the traveller has no purpose of his or her own, other than to escort or accompany another person (e.g. taking a child to school);
- Personal business - trips to services, medical or consultation;
- Leisure - visits to meet friends, relatives, or acquaintances, both at someone's home or at a pub, restaurant, etc.; all types of entertainment or sport, clubs, and voluntary work, non-vocational evening classes, political meetings, etc.;
- Other including just walk - other activities including walking trips for pleasure or exercise along public highways, including taking the dog for a walk and jogging.

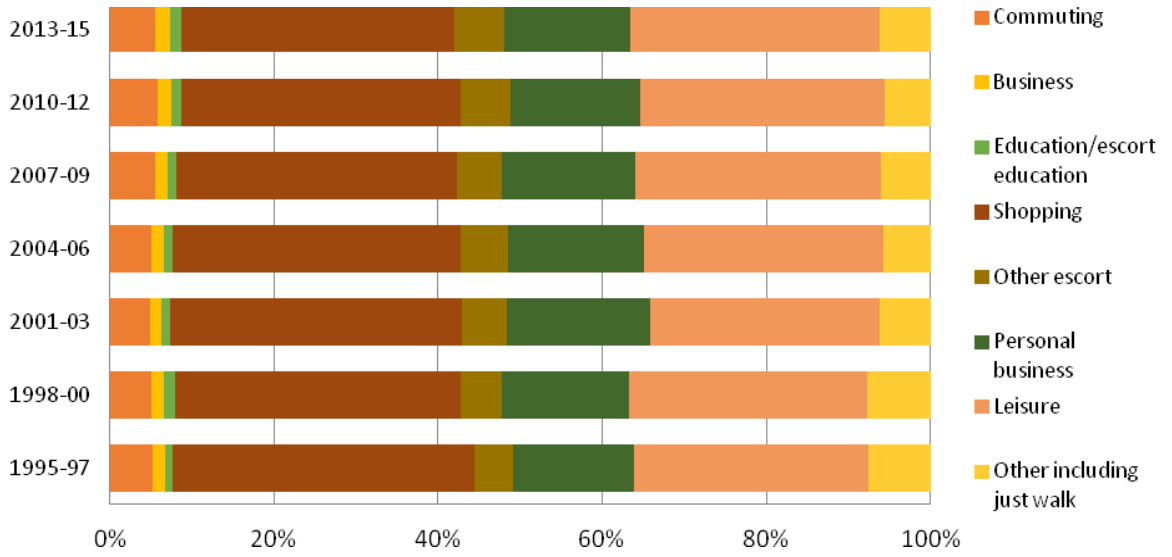

Figure 4-21. Travel purpose of people aged 60 years old and above in England

Figure 4-21 shows the travel purpose of those aged 60 years and above in England. The figure highlights that two-third of journeys have been undertaken for shopping and leisure purposes. Shopping is the most common reason for travelling during later life throughout the period of investigation, being more than one-third of the share. However, data show that shopping journeys present modest declining trends, decreasing from 37% to 33%. Leisure is the second main reason for travelling, with a percentage of around 30% in the period between 1995 and 2015. Personal business accounts for approximately one-sixth of the share and shows fluctuating trends, increasing from 15% to 17% between 2001 and 2006 and then falling again to 15% in the following years. With regard to the other reasons for travelling, commuting, other escort and other (including just walk) account together for almost one quarter of the share, with an average of 6% each throughout the period of investigation. However, while the first two travel purposes show similar trends by slightly growing from 5% to 6%, the latter one displays a decreasing trend, with a fall from 8% to 6%. Finally, business and education account for the remaining 3% of the share, with the former slightly rising from 1% to 2% and the latter remaining stable at 1% throughout the period of

investigation.

Table 4-7. Travel purpose by age groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
60-69	*Commuting*	8%	8%	8%	8%	9%	9%	9%
	Business	3%	2%	2%	3%	2%	3%	3%
	Education/escort education	1%	2%	1%	1%	1%	2%	2%
	Shopping	34%	32%	32%	32%	31%	30%	29%
	Other escort	6%	6%	7%	7%	7%	7%	7%
	Personal business	13%	13%	15%	15%	14%	14%	13%
	Leisure	28%	29%	28%	29%	30%	30%	31%
	Other including just walk	7%	7%	6%	6%	6%	6%	6%
70-79	*Commuting*	2%	1%	1%	1%	1%	1%	1%
	Business	0%	0%	0%	1%	1%	0%	1%
	Education/escort education	1%	1%	1%	1%	1%	1%	1%
	Shopping	40%	38%	39%	39%	37%	38%	37%
	Other escort	4%	4%	5%	5%	5%	5%	5%
	Personal business	17%	18%	19%	18%	18%	17%	17%
	Leisure	29%	29%	29%	30%	31%	30%	31%
	Other including just walk	8%	8%	6%	6%	6%	6%	6%
80-89	*Commuting*	1%	0%	0%	0%	1%	0%	1%
	Business	0%	0%	0%	0%	0%	0%	0%
	Education/escort education	0%	0%	0%	0%	0%	0%	0%
	Shopping	43%	39%	41%	40%	42%	41%	41%
	Other escort	2%	2%	3%	3%	3%	3%	4%
	Personal business	18%	21%	24%	23%	22%	22%	22%
	Leisure	30%	30%	26%	28%	27%	28%	28%
	Other including just walk	6%	7%	6%	5%	5%	4%	5%
90+	*Commuting*	0%	0%	0%	0%	1%	0%	0%
	Business	0%	0%	0%	0%	0%	0%	0%
	Education/escort education	0%	0%	0%	0%	0%	0%	0%
	Shopping	34%	36%	40%	39%	39%	33%	37%
	Other escort	2%	0%	0%	2%	3%	2%	1%
	Personal business	20%	21%	22%	27%	25%	23%	29%
	Leisure	42%	36%	34%	28%	29%	37%	28%
	Other including just walk	3%	8%	4%	3%	3%	4%	5%

Table 4-7 displays the travel purpose by age group. Journeys related to shopping and leisure

activities account for almost two-thirds of the trips for the four age groups. Similarly to Figure 4-21, shopping is the most common reason for travelling and it presents slight declining trends for all the age groups, except the 90+ one. Indeed, while the 60-69, 70-79, and the 80-89 groups show a fall of 5%, 3% and 2%, respectively, the 90+ group shows a fluctuating trend, growing from 34% to 40% between 1995 and 2003, falling to 33% in 2010-2012, and rising again to 37% in 2013-2015. Leisure journeys present increasing trends for the 60-69 (+3%) and 70-79 (+2%) groups, but declining ones for the other two groups, with the 80-89 group falling by 2% and the 90+ plummeting by 14%. Personal business is the third main reason for travelling. For all the four age groups, this travel purpose illustrates similar fluctuating trends, with a rise in the period between 2001 and 2003, followed by a modest decline in the following years. Looking at the other reasons for travelling, significant are the high percentage of commuting and business journeys for the 60-69 group (around 12% altogether), compared to the other age groups. This is likely due to the percentage of older people belonging to this group still in work force.

Table 4-8 illustrates travel purpose by cohort groups. In the same way as the previous analysis, shopping and leisure activities are the most common reasons for travelling. From the data, it is possible to see that the older the cohorts are, the higher is the percentage related to these two purposes. Indeed, the Great depression, Parents of the Boomers and Grandparents of the Boomers cohorts display an average percentage of around 40% of shopping journeys, almost twice of the 1960's Boomers. Moreover, this tendency is confirmed by the data related to the three younger cohort groups, showing growing trends of shopping activities and highlighting that shopping activity seem to increase with age. Travelling to leisure outlines increasing trends for the three younger cohorts, particularly for the Post-War Boomers (+9%), and shows stable trends for the remaining cohorts. However, it is possible to notice a drop of 4% for the Parents of the Boomers between 2012 and 2015,

while the Grandparents of the Boomers surged from 30% to 41% between 2009 and 2012. Personal business is the third main travel purpose for all the cohort groups, except the two Boomers groups. As illustrated in the age group analysis, data related to the two younger cohort groups delineate that commuting journeys are still significant in the earlier stages of older age. However, the two cohorts present different trends for commuting, with the 1960's Boomers slightly increasing from 22% to 24%, while the Post-War Boomers slumped from 24% to 11%, likely due to retirement characteristics. Looking at the other reasons for travelling during later life, other purposes (including just walk) show modest rising trends for the two Boomers cohorts, steady trends at 6% for the Word War II cohort, but declining ones for the remaining cohorts. Travelling for other escort purposes present similar fluctuating trends for the 1960's Boomers, Word War II and Grandparents of the Boomers cohorts, while the remaining groups show a drop of 2% during the period of investigation. Finally, journeys related to education and business journeys illustrate similar declining trends associated with ageing with the exception of the 1960's Boomers regarding business journeys, which remained stable around 5-6%. The trends are particularly low with regard to the three oldest cohorts, revealing a 0% of share in the last two segments of investigation and with both Parents and Grandparents of the Boomers having a 0% throughout the entire period of investigation for business journeys.

Table 4-8. Travel purpose by cohort groups

		1995-1997	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015
1960's boomers	*Commuting*	22%	22%	22%	23%	24%	23%	24%
	Business	5%	6%	5%	6%	6%	6%	6%
	Education/escort education	10%	10%	9%	7%	6%	4%	3%
	Shopping	20%	20%	19%	20%	20%	21%	21%
	Other escort	9%	10%	11%	11%	10%	9%	8%
	Personal business	9%	9%	9%	9%	9%	9%	10%
	Leisure	22%	21%	20%	20%	21%	21%	23%
	Other including just walk	3%	3%	3%	4%	4%	5%	5%
Post-War boomers	*Commuting*	24%	23%	23%	22%	19%	16%	11%
	Business	6%	6%	6%	6%	5%	4%	3%
	Education/escort education	4%	4%	3%	2%	1%	2%	2%
	Shopping	21%	22%	23%	23%	25%	27%	29%
	Other escort	9%	8%	8%	8%	7%	7%	7%
	Personal business	10%	10%	11%	11%	11%	12%	13%
	Leisure	21%	21%	21%	23%	25%	27%	30%
	Other including just walk	4%	5%	5%	5%	6%	6%	6%
World War II	*Commuting*	21%	18%	13%	8%	5%	3%	2%
	Business	6%	4%	3%	2%	2%	1%	1%
	Education/escort education	2%	1%	1%	1%	1%	1%	1%
	Shopping	25%	27%	29%	32%	33%	35%	36%
	Other escort	6%	6%	7%	7%	6%	6%	6%
	Personal business	10%	11%	14%	15%	16%	16%	16%
	Leisure	24%	25%	27%	29%	31%	31%	31%
	Other including just walk	6%	6%	6%	6%	6%	6%	6%
Great depression	*Commuting*	7%	4%	2%	1%	1%	1%	1%
	Business	2%	1%	1%	1%	0%	0%	0%
	Education/escort education	1%	2%	1%	1%	1%	0%	0%
	Shopping	35%	35%	38%	39%	39%	41%	41%
	Other escort	5%	5%	5%	5%	4%	4%	3%
	Personal business	14%	15%	18%	18%	19%	20%	21%
	Leisure	28%	30%	29%	30%	30%	28%	28%
	Other including just walk	8%	8%	6%	6%	5%	4%	5%
Parents of the boomers	*Commuting*	1%	1%	0%	0%	1%	0%	0.0064
	Business	0%	0%	0%	0%	0%	0%	0.0007
	Education/escort education	1%	1%	1%	0%	0%	0%	0.0034
	Shopping	40%	39%	41%	40%	41%	41%	39%
	Other escort	4%	3%	4%	3%	3%	2%	2%
	Personal business	16%	19%	22%	23%	23%	24%	29%
	Leisure	29%	28%	27%	28%	28%	29%	25%
	Other including just walk	8%	9%	6%	5%	5%	4%	4%
Grandparents of the boomers	*Commuting*	1%	0%	0%	0%	2%	5%	-
	Business	0%	0%	0%	0%	0%	0%	-
	Education/escort education	0%	0%	0%	0%	0%	3%	-
	Shopping	42%	37%	41%	39%	32%	26%	-
	Other escort	2%	2%	1%	3%	6%	2%	-
	Personal business	19%	23%	21%	26%	24%	14%	-
	Leisure	30%	31%	30%	28%	30%	41%	-
	Other including just walk	6%	6%	7%	4%	6%	9%	-

4.3 Summary

This chapter presented an analysis investigating the travel patterns of older population within the English context. The analysis was aimed at explaining how older people travel during later life, how their travel patterns changed over time and how these patterns changed when age, cohorts and gender variables were taken into account. The investigation is built upon descriptive analysis of data from the NTS in the period between 1995 and 2015 and it is undertaken by using an APC approach. Four age groups and six cohorts are identified based on a ten years period to investigate patterns and changes with regard to trip frequency, distance travelled, mode share, travel purpose, access to the car and driving license.

The overall results from the analysis indicate that throughout the period of investigation the older population have been travelling more in terms of both number of trips undertaken and that the average distance travelled increased by around 30 miles per week. The car is the main transport mode used for travelling, accounting for almost two-thirds of the journeys undertaken, both as driver and passenger. Moreover, both access to the car and driving licence has also shown steadily increasing trends over time. Shopping and leisure activities were found to be the most common reasons for travelling. Age effects can be recognised in all the six aspects analysed, highlighting the fact that mobility decreases while ageing, with 80 years old as turning point in this sense. The cohort analysis reveals substantial differences in patterns between the two Boomers groups and the rest of the cohorts, by showing these cohorts to be more mobile in terms of number of trips undertaken, distance travelled and relying significantly on the car for their journeys. Gender differences in travel patterns seems also to be reducing by time, with older women showing converging trends. Despite older men are still travelling more in terms of both trip frequency and distance, older women are showing faster rates of increase in both. The age analysis show that differences in numbers

of trips for all the age groups is reducing, while the cohort analysis reveals that the Boomers cohorts present significant similar trends to their male counterparts. Furthermore, data related to access to the car and driving licence reveals that the percentage of older women without access to this transport mode has been steadily decreasing in the last 20 years.

5 A CONCEPTUAL FRAMEWORK TO ASSESS THE FULFILMENT OF TRAVEL NEEDS IN LATER LIFE

5.1 Introduction

The conceptual framework to assess the fulfilment of travel needs in later life was developed in order to improve the evaluation of the travel needs amongst the older population. As highlighted in Section 2.2.2, studies investigating the relationship between ageing and out-of-home mobility are generally characterised by being focused on realised journeys and activities. However, very little has been investigated so far in terms of unfulfilled mobility and often, where it has been investigated, with different approaches and results. In this chapter, the process that led to the development of the framework is outlined in detail. The chapter comprises of two main parts. Firstly, Section 5.2 illustrates the analytic approach behind the development of the framework. Then, the components of the framework are described in Section 5.3. Finally, a summary of the chapter is provided in Section 5.4.

5.2 Analytic approach

This section illustrates the analytic approach behind the development of the conceptual framework to assess the fulfilment of travel needs amongst older populations. As stated in Section 3.3.3.1, the analytic approach comprises three main stages. First, studies investigating fulfilment of travel needs have been mapped and identified from the literature. Then, a methodology assessment related to the aim and hypotheses, approaches, variables used and findings from each identified study was undertaken to analyse the identified studies. Finally, a content analysis from the findings of the methodology assessment was undertaken to categorise the information from the previous stages and identify themes that influence mobility in later life and consequently the components comprising the framework.

The first stage consisted of mapping the literature related to studies investigating fulfilment of travel needs amongst the older population. For this stage a set of studies, identified in review of the literature undertaken in Section 2.2.2, was used but considered only those studies directly addressing factors affecting travel needs. Out of the twenty-nine studies addressing unmet travel needs, fifteen have been identified as addressing in a direct way the issue of travel needs fulfilment during later life. An overview of the identified studies, their sampling strategies, data collection and analysis approaches, and geographical context is provided in Table 5-1.

From the table, it is possible to notice that the majority of the studies employed a quantitative approach, with a combination of descriptive statistics, mainly cross tabulation, and regression analysis (ordinal or logistic), the most common statistical analysis methods. Looking at the aims and findings of the identified studies, it is possible to state that the main focus to date has been to understand the impact of car access during later life.

Musselwhite and Haddad (2010b) investigated the effect of driving cessation in fulfilling travel needs by comparing older drivers and ex-drivers. They found that people who had stopped driving reported more unmet travel needs compared to drivers, particularly for social and spontaneous trips which were very difficult without car access. Siren and Haustein (2014) looked at the effect of not renewing a driving licence with regard to mobility patterns, unfulfilled mobility needs and physical and psychological wellbeing. Again, older people not renewing their driving licence were found to report more unmet travel needs. Health conditions and physical and mental wellbeing were also found to be factors affecting mobility fulfilment. Leisure activities, such as visiting family and friends, pursuing hobbies and spontaneous trips, were the ones participants report missing the most.

Table 5-1. Overview of identified studies

Author(s)	*Year*	*Age group*	*Sample and data collection approach*	*Analysis method(s)*	*Study location*
WS Atkins	2000	60+	1445 face-to-face interviews and 6 focus group with 7-10 respondents	Content analysis	England and Wales
Kasper and Scheiner	2002	60+	1911 questionnaire respondents	Cross-tabulation	Germany
Siren and Hakamies-Blomqvist	2004	65+	1522 questionnaire respondents	ANOVA test Cross-tabulation	Finland
Scheiner	2006	60+	4500 interview respondents	Logistic regression	Germany
Davey	2007	60+	99 face-to-face semi-structured interview respondents	Cross-tabulation Content analysis	New Zealand
Musselwhite and Haddad	2010	65+	26 individuals in 3 focus groups and telephone interviews plus 31 telephone interview respondents	Content analysis	England
Kim	2011	65+	603 telephone interview respondents	Z-test Logistic regression	U.S.A.
Wasfi et al.	2012	55+	854 questionnaires plus 775 travel diaries respondents	Cross-tabulation	U.S.A.
Hjorthol	2013	67+	1889 questionnaires respondents	Cross-tabulation Logistic regression	Norway

Table 5-1. Overview of identified studies (Continued)

Author(s)	*Year*	*Age group*	*Sample and data collection approach*	*Analysis approach*	*Study location*
Nordbakke	2013	67+	4 focus groups with 31 female respondents	Content analysis	Norway
Haustein and Siren	2014	70+	1508 telephone interviews plus 1161 telephone interview respondents	Cross-tabulation ANOVA test Chi-squared test K-W H-test Ordinal regression	Denmark
Nordbakke and Schwanen	2014	67+	4723 questionnaires respondents	Cross-tabulation Chi-squared test Ordinal regression	Norway
Siren and Haustein	2014	70+	1792 telephone interview respondents plus 863 telephone interview respondents	Cross-tabulation Chi-squared test Linear regression U-test T-test	Denmark
Kim et al.	2014	65+	812 questionnaire respondents	Cross-tabulation Logistic regression Principal component analysis	The Republic of Korea
Musselwhite	2017	63+	60 semi-structured interview respondents	Content analysis	Wales

Haustein and Siren (2014) analysed the impact of car access on older drivers, former drivers and people who never drove. Their study shows that lack of having a driving licence and health impairments increase the chance of experiencing unmet travel needs, particularly visiting other people. Former drivers and people who had never driven presented similar patterns, but the latter reported more unfulfilled needs, particularly for shopping activities. Davey (2007) identified experiences and preferences of former drivers with respect to how

they meet their mobility needs. Access to the car was found to be significant in terms of reducing unmet travel needs and the car remains the preferred option either as a passenger or driver, since lifts were reported by almost two-thirds of participants as their first option after driving cessation (especially women). Moreover, car unavailability was found to reduce spontaneous trips and the ability to attend special occasions, due to lack of alternatives for these types of activities. Musselwhite (2017b) examined fulfilment of discretionary activities amongst drivers, community transport users and older people who do not drive and rely on lifts from others for their travel. Discretionary travel was found to be associated with positive health and wellbeing status. Cars were identified as the best way to meet these travel needs, especially for older drivers. Older people relying on lifts reported feelings of strain due to the burden they place on others, while community transport was associated with loss of control and spontaneity, despite meeting their travel needs. Likewise, Scheiner (2006) investigated how car availability and settlement structure have impacts on leisure activities. Contrary to other studies, he found that car access was not statistically significantly related to unfulfilled activity when health impairments, employment status and gender were taken into account. Both Kim (2011a) and Kim et al. (2014) analysed the effect of not being able to undertake desired out-of-home activities due to a lack of transportation (transport deficiency). Kim (2011a) found that women, people living alone or in households with one or more children and older people with no driving licence reported more transport deficiencies. Moreover, good health and positive wellbeing reduced these effects. Kim et al. (2014) found that those with health impairments and people who stopped driving (particularly men) report more transport deficiencies, while living in the same community for a long time or in flatter areas - both reduce unrealised mobility.

Nordbakke (2013) investigated how individual resources and contextual options can influence opportunities for mobility using Sen's capability approach to wellbeing (Sen,

1993). Her findings highlight that an individual's resources in terms of knowledge of a transport system, competence in using it, and control of travel time can reduce unmet travel needs. The time of activity and the geographical location of public transport were also found to affect mobility needs. Siren and Hakamies-Blomqvist (2004) examined mobility options and resources in terms of both travel behaviour and unfulfilled travel needs. Their study showed that women and people aged 75 years old and above were the ones reporting more unfulfilled travel needs, especially leisure-related ones. Moreover, holding a driving licence and living in an urban context reduced the level of unfulfilled travel needs. Similarly, Wasfi et al. (2012) assessed the relationship between travel demand and activities in terms of both fulfilled and unfulfilled mobility. Car access, walking distance and distance of bus stops from both origins and destinations were found to affect unmet travel needs. The car access' effect was found to be particularly strong in suburban areas due to lack of alternatives. Medical, shopping and social/recreational activities were the ones participants report missing the most. WS Atkins (2001) examined transport needs and requirements during later life. Unmet travel needs were related to a general lack of available transport to specific destinations, cost and difficulties in walking and in using public transport. Leisure activities and social aspects of travel were reported the most, especially in a rural context. Kasper and Scheiner (2002) investigated mobility barriers leading to unfulfilled activity wishes. Health impairments were found to be the main factor affecting desired activities, while people holding a driving licence and having a car available in the household report more unmet activities. Leisure activities, especially cultural, were the ones most reported.

Hjorthol (2013a) and Nordbakke and Schwanen (2015) investigated the relationship between transport and wellbeing in terms of travel needs satisfaction. They found that health impairments, not holding a driving license and having no access to a car were factors which negatively affected unmet travel needs. Visiting friends and family and going out for a walk

were the type of activities participants report missing the most. Similar results were found in the Nordbakke and Schwanen (2015) study, particularly due to lack of available time, poor health, living with a partner, lack of social support and overall low life satisfaction.

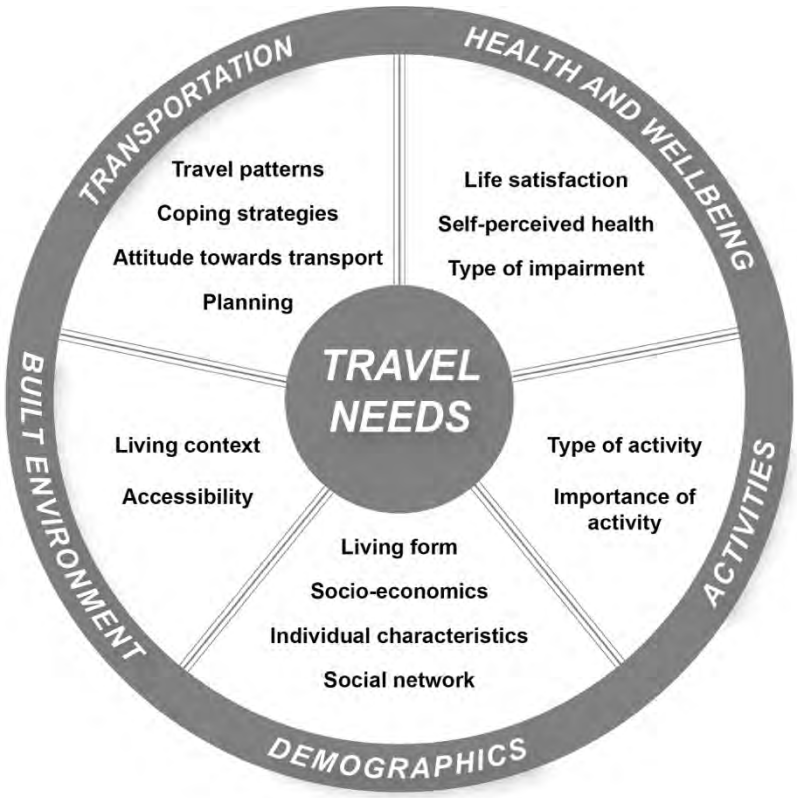

Figure 5-1. The conceptual framework to assess travel needs fulfilment in later life showing domains and sub-themes

The last stage of the analytic approach consisted in undertaking a content analysis of the findings of the methodology assessment. The analysis identified five main domains found to shape and influence the fulfilment of travel needs in later life, namely: 1) Transportation; 2) Health and wellbeing; 3) Built environment, 4) Demographics and 5) Activities.

Table 5-2. Assessment of variables investigated from selected studies

Framework domain	Sub-themes	Variables investigated	WS Atkins (2001)	Kasper & Scheiner (2002)	Siren & Hakamies-Blomqvist (2004)	Scheiner (2006)	Davey (2007)	Musselwhite & Haddad (2010)	Kim (2011)	Wasfi et al. (2012)	Hjorthol (2013)	Nordbakke (2013)	Kim et al (2014)	Norbakke & Schwanen (2014)	Haustein & Siren (2014)	Siren & Haustein (2014)	Musselwhite (2017)
Transportation	*Travel Patterns*	Transport mode used for activities	○	○			○	○				○	○			○	○
		Mode choice	○		○		○										
		Driving licence status		○	●	○	○	●	●		●		○	●	●	●	
		Trip frequency by purpose		○	○					○			○				
		Travel time										○					
		Trip cost	●										○				
		Access to transport resources	●	●	○					●	○	●			●		●
		Car access	○	○	○		●	●	●	●	●						●
		Public transport season ticket	○			○											
	Copying Strategies	Transport dependency on other					●		○	●	○				○	○	○
		Coping without a car					○	○			○						○
	Attitude towards transport	Transport satisfaction		○			○										
		Transport authonomy/familiarity per mode						○	○	○					○		
		Transport perception per mode	○												○		○
		Transport knowledge							○			●	●				
	Planning	Transport planning										○					
Health and wellbeing	*Life satisfaction*	CES-D depression scale test													○	●	
		Pearlin mastery scale test													○	●	
		Self-perceived general life satisfaction							●		○			●			
		Satisfaction with place of living				○											
		Latent factors											○				
	Self-perceived health	Self-perceived status - satisfaction									●				●		
		Self-perceived status - conditions	●	●		●	●		●							●	○
	Type of impairment	Type of syntomps/impairments												●	●	●	
		Impairments affecting walkings	●			○	●			○				●	○		
		Impairments affecting driving														○	
		Level of mobility	○										●				
Built environment	*Living context*	Residential location	○	○	●	○			●	○	●			○	●		
		Design/elements of furniture											○				
	Accessibility	Distance to PT										○	●	○			
		Topography										●	●				
		Park within walking distance											○				
		Places to meet other people at walking distance											●				
		Built environment of activity										●					
		Access to facilities		●		○			●			●					
Activities	*Type of activities*	Type of activities	●	○	○							○		○			
		Time/duration		○								●					
		Activity diversity				○											
		Activity frequency/participation	○	○		○	○							○	○	○	
	Importance of activity	Reasons for not undertaking activities		○										●			
		Need help with activies										○		○			
		Transport deficiency										○					
		Importance of activity								○							○
Demographics	*Individual characteristics*	Gender	○		○	●	○		●	○	○		●	○	○	○	
		Age	○	●	○	○	○		○	○	●	○	●	○			○
		Ethnicity	○				○		●	○							
	Socio-economic factors	Education	○		○	○			○	○	○				○	○	
		Income				○	○		○	○	○		●	○	○		
		Employment status				●							○				
	Living form	Living status		○		○			●				●	●	●	●	○
		Household characteristics							○	○			●				
	Social network	Social network		●			○		○			○		○			●
		Years lived in local community					○		○				●				

● *Variable found to have effect on travel needs fulfilment*

○ *Variable found to have no effect on travel needs fulfilment*

Figure 5-1 shows the five domains in association with the identified sub-themes for each. Moreover, Table 5-2 illustrates the five domains in relation with the variables found during the methodology assessment. The variables are differentiated by sub-themes and whether they were shown to have an effect on unmet travel needs. The five domains building the framework and their components are described in the following sections.

5.3 Detailed description of the domains

5.3.1 Transportation

Taking into account the approach used by Nordbakke (2013) with regard to the concept of opportunities for mobility highlighted in Section 2.2.1, the Transportation domain is used to evaluate the individual resources and abilities required for everyday mobility. This is done by investigating four main aspects: travel patterns and access to transport modes, attitudes towards transportation, coping strategies and planning.

As it was pointed out in Section 2.2.2, in order to understand mobility needs in later life, both realised and unrealised mobility need to be taken into account. Traditionally, travel patterns are analysed in terms of activity frequency and the most common mode of transport used for each activity. In this sense it is crucial not only to understand how and why older people move, but also how easy it is to access transport options. Access to the car and holding a driving licence have been considered to play a significant role in later life mobility, since it provides autonomy, flexibility, independence, freedom and control (Glasgow and Blakely, 2000, Siren, 2005, Davey, 2007). Nonetheless, not all older people have access to a car in their household or hold a driving licence, in part due to health and psychological issues associated with ageing (Adler and Rottunda, 2006, Hakamies-Blomqvist and Peters, 2000). Therefore, investigating access to alternative transport options to the car, such as public transport, FTS, walking and cycling is fundamental. This is valid not only in terms of access

to services and infrastructures, but also to reach other potential destinations. Moreover, another significant aspect to take into account is related to specifically designed travel schemes for older people. Indeed, one of the main criticisms of Scheiner (2006) was that older people with a public transport season ticket reported similar levels of activity fulfilment compared to older drivers.

Access to transportation resources is only a part of this process, since understanding the attitude individuals have towards these resources is also important. In their study, Haustein and Siren (2014) measured attitudes towards transportation by analysing autonomy and abilities to use a specific transport mode, in addition to enjoyment and other positive aspects associated with its use. Similarly, Wasfi et al. (2012) analysed how familiar older people were with alternative options to the car and how independent they were in terms of mobility. In this sense, another significant aspect of transport autonomy is understanding the experiences and coping strategies used by those older people who do not drive. This is significant to understanding dependency on others in terms of both knowledge/information and practical transportation. Several studies on driving cessation found that car remains the preferred option once people have stopped driving, through reliance on lifts from family or friends, but with consequences in terms of lack of spontaneity and burden placed on the drivers (Davey, 2007, Musselwhite, 2017b, Taylor and Tripodes, 2001, Glasgow and Blakely, 2000). Finally, the framework puts attention on the planning activity behind a trip in order to assess the extent of knowledge and preparation that older people have for their journeys.

5.3.2 Health and wellbeing

The second domain identified for the framework relates to existing health conditions and individuals' wellbeing. The review of the literature in Section 2.2.2.1 showed health was the

most significant barrier leading to unmet travel needs during later life. The most common approach used by the studies mentioned in Section 5.2 is to analyse health conditions from a subjective point of view. Much research in this sense relies on self-assessment using rating scales based on satisfaction or general conditions (e.g. poor/excellent). In addition to subjective judgements, both Haustein and Siren (2014) and Siren and Haustein (2014) adopted a more objective approach to measure health conditions by asking participants to report symptoms, illnesses or impairments from a list. In this study health is analysed according to cognitive, sensory and physical impairment, following the approach used by Tournier et al. (2016) to assess health barriers affecting older pedestrians. The aim of the framework is not only to assess if a health impairment does or doesn't lead to unmet travel needs, but rather trying to identify the relationship between type of impairment and difficulty in using transportation options or undertaking specific activities.

The other aspect of this domain involves assessing individuals' wellbeing, since it is important not only to focus on health and functional status (Gabriel and Bowling, 2004), but also understanding life satisfaction in relation to different aspects of everyday life and their perception. As with the health domain, few studies have analysed individuals' wellbeing using a self-perceived status assessment based on general life satisfaction (Nordbakke and Schwanen, 2014, Hjorthol, 2013a). In addition to this measure, Davey (2007) explored individuals' satisfaction regarding both place of residence and transportation. Looking at a more detailed evaluation of individual's psychological aspects and opinions, Kim et al. (2014) undertook an in-depth investigation of the impact of quality of life by assessing latent factors related to everyday life. Using a subjective approach based on an agreement Likert scale (strongly agree/strongly disagree), they explored individual points of view regarding (i) Activity propensity; (ii) Symbolic motive of automobile; (iii) Community spirit; (iv) Obey traffic regulation; (v) Environment; (vi) Dissatisfaction about public transit; (vii)

Sensitivity to pollution; (viii) Parsimonious propensity; (ix) Competitive spirit; (x) Respect others' opinion; and (xi) Health and Independence. Finally, in order to assess the extent to which individuals see themselves in control of their lives, both Haustein and Siren (2014) and Siren and Haustein (2014) adopted a more objective approach to measure individual's quality of life by using the CES-D depression scale and the Pearlin mastery scale (Pearlin and Schooler, 1978).

5.3.3 Built environment

Contrary to the findings for health, the effect of the built environment on unmet travel needs was shown in the review of the literature in Section 2.2.2.2 to be more ambiguous. This was likely mainly due to differences of settlement structures between countries, with consequent difficulties in comparative assessment. As shown in Table 5-2, much research analysed the built environment by categorising an individual's place of residence, usually as urban, suburban or rural. However, what defines these three categories might differ from country to country, with consequent issues in terms of comparison. Therefore, a more defined range of spatial characteristics should be applied when investigating the spatial structure of settlements, as highlighted by Scheiner (2006). In his study, settlements were further classified in inner city quarters, highly urbanised former villages, satellite towns with good/less developed public transport (urban); central places in suburbia, settlements with/without sufficient provision of supply in suburbia (suburban), central places in the rural area and other rural places (rural).

The second and fundamental aspect of the analysis relates to understanding the relationship between mobility and built environment in terms of access to transport resources, service facilities and goods. Distance to the closest public transport stop was a factor analysed in several studies (Nordbakke and Schwanen, 2015, Kim et al., 2014, Nordbakke, 2013). This

is likely due to the fact that density and location of bus/tram stops or train stations from both home and destination might require a physical effort that could deter or prevent older people from using public transport (Davey, 2007, Su and Bell, 2009, Wretstrand et al., 2009, Broome et al., 2010a). Moreover, the form of the built environment, often designed for vehicles rather than human mobility, can create a barrier to walking and cycling activities, due to the development of phenomena such as community severance or the lack of adequate infrastructures (Mindell et al., 2011, Rosenbloom, 2009, Ryan et al., 2016). The topography of the built environment can also hinder travel needs if hills and slopes are present, particularly to reach public transport stops or other places to visit within walking distance (Kim et al., 2014). In a similar way, lack of access to service facilities and goods might create unmet travel needs. More specifically, Kim et al. (2014) looked at presence of parks or places to meet other people within walking distance (e.g. senior or community centres). Nordbakke (2013) found that the quality of the built environment in terms of accessibility, as well as the presence of parking facilities, could be a factor affecting mobility. Finally, Scheiner (2006) concluded that a specific spatially differentiated analysis based on type of activities could produce a more detailed spatial effect, since, for example, cultural or leisure activities might be more common in an urban environment compared to the rural one.

5.3.4 Activities

In the activity domain, the framework focuses on two main aspects. First, the type of activity and the extent of engagement with activities that older people have. Nordbakke and Schwanen (2015) pointed out how actual activity participation has been scarcely measured in studies investigating unmet travel needs in later life. In their view, an inverse relationship between activity participation and unfulfilled mobility might be expected, especially if taking into account the approach used by Allardt (1993). They assessed activity participation

using a scale from never to almost every day. A similar approach was used also by Siren and Haustein (2014), Haustein and Siren (2014), Siren and Hakamies-Blomqvist (2004) and Kasper and Scheiner (2002). In addition to activity frequency, Scheiner (2006) highlighted the importance of analysing activity diversity.

The second aspect is related to the importance that activities have and how these are perceived by the older population. The majority of the studies assessing unrealised mobility use a classification of needs satisfaction to assess the importance of an activity. However, as mentioned before, the hierarchical classification of utilitarian and discretionary related to the concept of basic needs satisfaction does not consider the possibility of meeting travel needs along different dimensions, as is the case in Allardt's (1993) approach. Nonetheless, the reliance on these types of classification does not show how effectively activities are perceived, since the difference between what is needed or desired rarely comes to light using this approach. In their study, Wasfi et al. (2012) specifically differentiate between the types of activities older people need and wish to do more.

5.3.5 Demographics

The last of the five identified domains is the one associated with individuals' background demographic characteristics. The older population is characterised by being significantly heterogeneous in terms of demographic characteristics. The review of the literature in Section 2.2.2.2 showed that the effect of demographic variables varied among the investigated studies, most likely due to differences in sampling and context. Nonetheless, analysis of this information is necessary to assess the complexity and importance of demographic characteristics. To identify the demographic variables needed for the framework, this study draws on the standards used by previous studies of this type. The selected variables are presented according to individual characteristics, socio-economic

factors, living form and environment and social network (Haustein and Siren, 2015).

Individual characteristics and socio-economics factors were found to have no significant effect on unmet travel needs and can be considered as a weak predictor of mobility, given the fact that they are significantly influenced by other things (e.g. health conditions for age or access to the car for gender) (Haustein and Siren, 2015). Individual characteristics include age, gender and ethnicity. With regard to age, the framework focusses on the chronological aspect of age. Much research has shown that travel tends to decrease with age (Haustein et al., 2013), and that people aged 75+ years old report more unmet travel needs compared to the youngest group of older people (Section 2.2.2). Gender characteristics also present some differences, since women tend to report a greater desire to travel more, have lower car access, give up driving earlier and use alternative transport options more than men (Haustein et al., 2013). Ethnicity does not seem to be a relevant predictor of mobility in later life, but this may be due to little research in this area. However, as underlined by Haustein et al. (2013), our society is currently influenced not only by demographic trends related to the ageing of the population, but also through immigration and diversity.

Socio-economic factors are identified as personal or household income, education and employment status. Low income during later life has been found to be associated with constraints of both modal choice and travel frequency due to cost issues as well as the ability to run a car (Su and Bell, 2009, Knight et al., 2007, WS Atkins, 2001). Scheiner (2006) found employment status to have an impact on unfulfilled mobility, probably due to the limited amount of free time available to carry out desired activities. The vast majority of the older population is retired, and consequently they have greater possibility to adjust their schedules according to their needs due to more free time available (Su and Bell, 2009). Nonetheless, the demographic changes mentioned above might have an impact on delaying retirement age

in the near future, with consequent potential impacts in terms of mobility fulfilment.

Living form and built environment characteristics include marital status, number of people living in the household, number of dependent people and amount of years living in the local community. These variables were shown to be quite controversial in Section 2.2.2.1. On the one hand living with a partner reduced the chances of unfulfilled mobility, especially for social and leisure reasons (Haustein and Siren, 2014, Kim et al., 2014, Musselwhite and Haddad, 2010b, Nordbakke and Schwanen, 2015). On the other hand, living with a partner or other people could also lead to unmet travel needs, if these are dependent people (Knight et al., 2007, Scheiner, 2006) or when living with children under 18 years, due to caring duties (Kim et al., 2014, Kim, 2011a). The investigation of the amount of years lived in the local community used by Davey (2007), Kim (2011a) and Kim et al. (2014) could reveal important information to understand if living in the same place for an extended amount of time increases the knowledge of potential transport options available and at the same time the individual social network, with consequent opportunities to reduce unmet travel needs.

The last group of demographic information relates to the social network of an individual. More specifically, the framework proposes to analyse the extent to which people are regularly in contact with the older person. Davey (2007) investigated both participants' visit frequency and how much family, friends and neighbours visited. Similarly, Scheiner (2006) explored the extent of the level of social networks using a rating scale (dense/weak). Social networks during later life seems to have a significant role for two reasons. It can be very important to support mobility of older people with mobility restrictions, such as no driving licence or no access to car in the household (Musselwhite and Haddad, 2010b, Davey, 2007), whilst at the same time encouraging people to undertake out-of-home activities (Kasper and Scheiner, 2002, Nordbakke and Schwanen, 2015, Nordbakke, 2013). With regard to the

former, Nordbakke and Schwanen (2014) differentiated the help needed with transportation between grocery shopping and other purposes. About the latter, both Kasper and Scheiner (2002) and Nordbakke and Schwanen (2015) analysed the impact of undertaking out-of-home activities alone or with other people.

5.4 Summary

This chapter illustrated the development of a conceptual framework aimed at improving the evaluations of travel needs during later life. The proposed framework strives to address this by identifying which factors need to be taken into account when exploring the mobility of the older population and it uses a combination of qualitative and quantitative variables as a means to analyse fulfilment of their travel needs. Despite the main emphasis of scholars has been on identifying the impact of access to the car for travel needs' fulfilment, the three-stage analytic approaches revealed that five domains and fifteen associated sub-themes shape mobility amongst the older population.

The Transportation domain is used to assess individual resources and abilities for transport mobility by investigating travel patterns and access to transport modes, attitudes towards transportation, coping strategies for those and planning. The Health and wellbeing domain is employed to assess health conditions and life satisfaction from both a subjective and objective point of view, in addition to exploring the relationship between type of impairment and difficulty in undertaking activities and using transport modes. The Built environment domain is used assessed spatial characteristics from a twofold characteristic. First, by highlighting the need to investigate the contextual conditions of place of residence not only from a general point of view such as urban, rural or suburban, but also with a more defined range of settlements spatial characteristics. The second and fundamental aspect consists in assessing the accessibility of the built environment of access to transport resources, service

facilities and goods. The Activity domain is adopted to assess the type of activity and the extent of engagement with activities that older people have, in addition to how these are perceived in term of importance. Finally, the Demographics domain is used to assess individuals' background demographic characteristics with regard to individual characteristics, socio-economic factors, living form and environment and social network.

The next chapter illustrates how the developed conceptual framework was employed in a case study to investigate the fulfilment of travel needs amongst the older population.

6 AN EXPLORATION INTO THE TRAVEL NEEDS OF THE OLDER POPULATION

6.1 Introduction

This chapter describes the findings from a case study undertaken in Birmingham, UK. The case study was aimed at investigating the factors affecting the fulfilment of travel needs during later life. The study employs the conceptual framework developed for this research and outlined in the previous chapter. The framework was used to develop a survey by the means of a questionnaire and an innovative travel diary recording both realised and unfulfilled travels (see Appendix B for the complete survey). The chapter consists of three main parts. In the first are reported the findings from descriptive statistics used to analyse the questionnaire with regard to the domains related to Demographic (Section 6.2.1), Health and wellbeing (Section 6.2.2), Transportation (Section 6.2.3), Built environment (Section 6.2.4) and Activities (Section 6.2.5). The second part outlines the findings from the logistic regression analyses (Section 6.2.6) aimed at understanding the impact of investigated variables on activity frequency, unmet travel needs in general and the most reported unfulfilled activities (shopping, visiting other people and leisure/social activities). The third part presents the findings from the innovative travel diary developed for this research, looking at both realised and unfulfilled journeys (Section 6.2.7). Finally, a summary of the chapter is provided in Section 6.3.

6.2 Results

6.2.1 *Demographics*

As shown in Table 6-1, the respondents for this study consisted of 155 older women (54.0%) and 133 older men (46.0%) *(Q.43)*. The total mean age was 74 years old, with the female

group having a mean age of 73.6 years old and the male group 74.4 years old *(Q.44)*.

Table 6-1. Survey sample by age groups

		Age groups						
		60-64	***65-69***	***70-74***	***75-79***	***80-84***	***85+***	***Total***
Survey participants								
Female	n	9	34	64	23	13	13	155
	%	*3%*	*12%*	*22%*	*8%*	*5%*	*5%*	*54%*
Male	n	4	30	51	16	16	16	133
	%	*1%*	*10%*	*18%*	*6%*	*6%*	*6%*	*46%*
Total	n	12	64	115	38	29	29	288
	%	*4%*	*22%*	*40%*	*13%*	*10%*	*10%*	*100%*

Table 6-2 shows more in detail the socio-demographic characteristics of the respondents. The majority of them had a White – British ethnic background (86.7%), or White other background (6.6%) *(Q.52)*. More than half lived with a partner (50.6% married and 4.2% with a partner), or with other family members (3.9%), while 18.5 % were single, 15.1% widowed and 7.7% separated or divorced *(Q.48)*. Amongst those not living alone, 12.9% had a dependent person in their household *(Q.47)*. Almost all participants were retired (86.9%), with only 2.3% and 6.9% still working full-time and part-time, respectively *(Q.49)*. Almost two-thirds of participants have an income between £15,000 and £24,999 *(Q.51)*. With regard to education levels, almost three-quarters (74.8%) completed an education above secondary school, with 21.6% having completed a secondary education and only 1.2% a primary one *(Q.50)*. Finally, more than two-thirds lived in the inner suburbs *(Q.45)* and on average had lived in the same area for around 28 years, with more than two-thirds of respondents living in the same area for more than 20 years *(Q.53)*.

Table 6-2. Socio-demographic characteristics of the survey participants

Characteristics	*%*		*%*		*%*
Gender		***Marital status***		***Dependent person in household***	
Male	46.0	Single	18.5	Yes	12.9
Female	54.0	Living with a partner	4.2	No	87.1
		Married	50.6		
Age groups		Living with other family member	3.9	***Employment status***	
60-64	4.0	Widowed	15.1	Retired	86.9
65-69	22.0	Separated or divorced	7.7	Full-time employed	2.3
70-74	40.0			Part-time employed	6.9
75-79	13.0	***Education***		Unemployed	0.4
80-84	10.0	Primary education	1.2	Other	3.5
85+	10.0	Secondary education	21.6		
		Higher education	74.8	***Place of living***	
Household size		Other	2.4	City centre	15.9
1	39.1			Inner suburbs	70.0
2	54.5	***Ethnic background***		Outer suburb	14.1
3 or more	6.4	White British	86.7		
		White other background	6.6	***Years living in same area***	
Income		Black or Black British - Caribbean	0.4	Less than 10 years	16.8
Less than £9,999	5.7	Asian or Asian British - Indian	1.6	10-19 years	10.7
£10,000 to £14,999	15.1	Mixed - White and Black Caribbean	1.6	20-29 years	26.4
£15,000 to £24,999	65.1	Mixed – White and Black African	0.4	30-39 years	22.5
£25,000 to £44,999	11.3	Other mixed background	0.4	40-49 years	16.3
More than £45,000	2.8	Information refused	2.3	More than 50 years	7.3

6.2.2 *Health and wellbeing*

The vast majority of the respondents assessed their personal wellbeing as satisfactory with regards of the three factors investigated, namely: out-of-home mobility *(Q.5)*, place of living *(Q.34)* and health conditions *(Q.39)*. As Figure 6-1 shows, only around 10.0% of respondents reported unsatisfactory levels about their out-of-home mobility (4.0% not satisfied and 5.3% not very satisfied), while 85.0% of respondents said they were generally satisfied with their out-of-home mobility, with 32.9% stating satisfied and 52.0% very satisfied. The remaining 5.3% reported to be neither satisfied or not satisfied about their situation. In a similar way,

the participants said they were overall satisfied with the place in which they live. Indeed, 36.4% and 53.3% stated to be satisfied and very satisfied about their place of living, while only 1.4% reported to be not very satisfied and 2.4% not satisfied. The remaining 6.5% said they were neither satisfied or not satisfied about the place in which they live. The percentage of self-perceived satisfaction with regard to health conditions was found to be lower compared to the other two variables, but still significant. Indeed, almost three-quarters of respondents assessed their health conditions as satisfactory (45.3%) or very satisfactory (28.3%). However, almost 15% reported to be unsatisfied, with 4.5% not very satisfied and 9.4% not satisfied. Moreover, 12.5% mentioned to be neither satisfied or not satisfied.

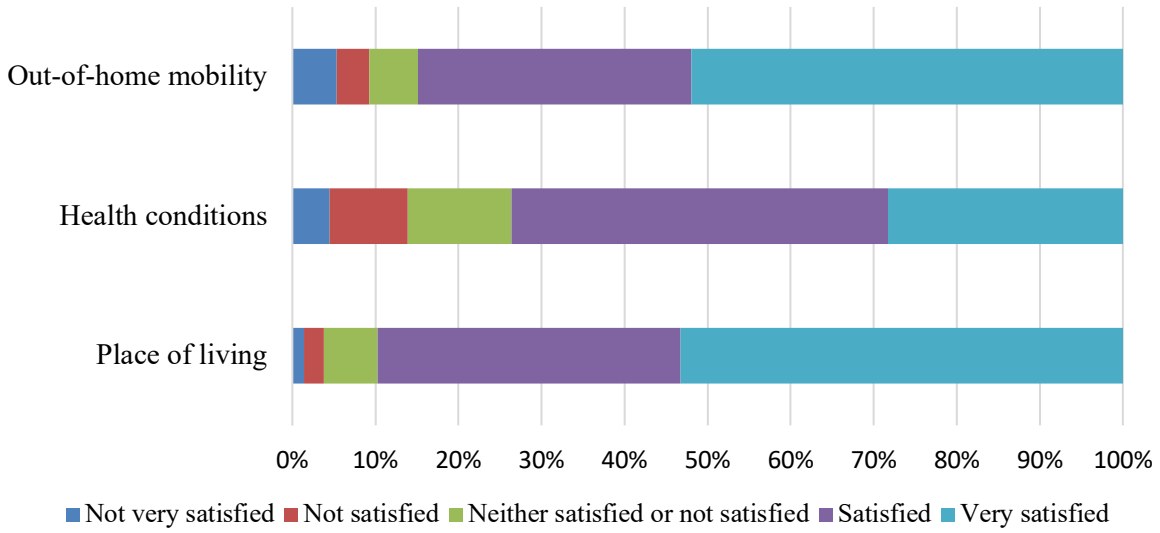

Figure 6-1. Self-perceived life satisfaction

Looking more specifically at the health conditions of the respondents, more than 40% of them reported to have experienced health problems, disabilities or general frailty that might had affected their ability to use any kind of transport modes in the five years preceding the survey *(Q.40)*. Figure 6-2 illustrates the list of these with associated percentages *(Q.41)*.

From the graph is it possible to notice that almost half of the impairments belonged to mobility issues. Indeed, 18% of respondents reported to suffering pain in joints, 14.5% reduced mobility in legs or feet and 14.2% arthritis. Other significant impairments were related to high blood pressure (14.2%) and heart problems (6.2%), and sensory impairments, with 11.8% experiencing reduced hearing and 6.2% reduced eyesight. Other health issues found related to respiratory problems (3.1%), osteoporosis (3.1%), epilepsy (2.1%), stroke (1%), hyperthyroidism (1%), anaemia (0.8%), depression (0.7%) and other symptoms at 3.1%. It is relevant to highlight that none of the respondents reported issues regarding cancer, dementia, mild cognitive impairments, obesity and Parkinson's disease.

With regard to how these impairments affected transport mode usage (Figure 6-3) *(Q.42)*, the majority of the respondents reported to not having difficulties in using them due to experiencing health impairments. In this sense, the only modes significantly affected were found to be walking and cycling. Indeed, around one-third of the respondents reported difficulties in walking (31.6% overall) and cycling (34.1% overall). Significantly, 21.5% out of 34.1% of those experiencing difficulties in cycling stated it was impossible for them to use this transport mode. Problems in walking and cycling might be connected with the high percentage of people experiencing mobility problems, as previously mentioned. Looking at the other transport modes, only 14.8% and 12.6% (overall) mentioned problems in using buses and trains, respectively, while car (90.9% overall), train (81.3% overall) bus (79.7% overall) and taxi (75.9% overall) reported high percentages of no difficulties. The percentage decreases for usage of FTS (33.4% overall), but more than half of the respondents answered N/A, likely due to no use of this transport option or lack of availability of the service.

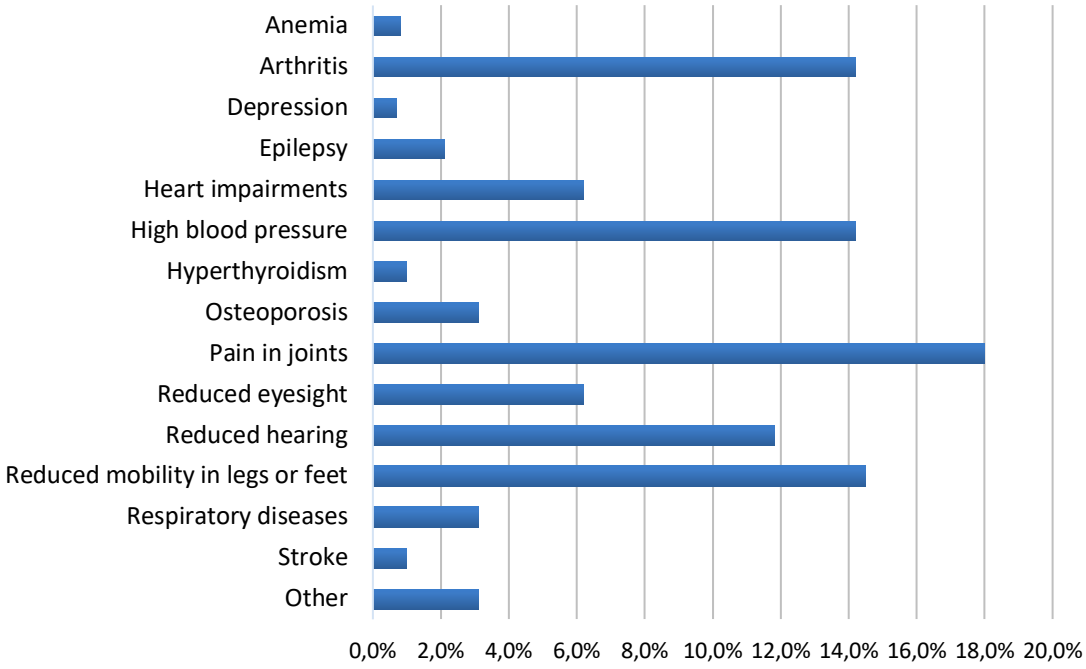

Figure 6-2. List of health problems, disability or general frailty *(Q.41)*

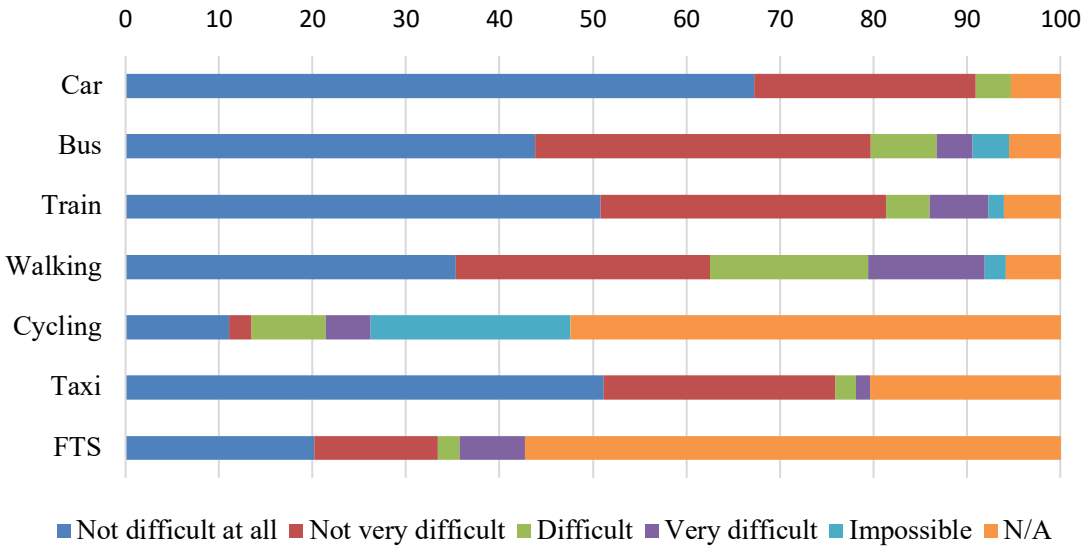

Figure 6-3. Level of difficulty experienced in using selected transport modes due to health impairments *(Q.42)*

6.2.3 Transportation

The findings from the questions related to the transportation domain show that the car has

great significance in the everyday life mobility of the respondents. Indeed, 83% of them stated that car is important for their transport *(Q.2)*. More than three-quarters of the participants have access to the car in their household, with almost 44% of participants having two or more cars *(Q.9)* and two-third of the respondent holding a driving licence (78.0%) *(Q.10)*. Of those not having a license, the majority belong to those aged 85 and above. As illustrated in Table 6-3, at the question *"Why do you not hold a driving licence?" (Q.11)* data show that having not renewed the licence, having voluntarily stopped driving and never having held a licence were found to have similar percentages, with around one-third of the respondents reporting each of them. However, a differentiation in both gender and age reveal some significant differences. Older women are more likely to have never had a driving licence, which is in line with the findings highlighted in Section 4.2.4 of this research. Moreover, the decision of voluntarily stopping driving is more often taken by females, while older males more often wait until their licences are not renewed. This is in line with several research projects which have investigated older drivers and driving cessation in later life, finding that older women are more willing to voluntarily stop driving compared to their male counterparts, while older male drivers tend to drive until they are forced to stop (Haustein et al., 2013). Furthermore, both license renewal and voluntary driving cessation are associated with advancing age, with 80 years old as the turning point. In this sense, possible explanations for the former might be related to the deterioration of individuals' health conditions such as sensory and cognitive impairment (Adler and Rottunda, 2006, Ragland et al., 2004), while for the latter due to the psychological issues and responsibilities associated with driving (Adler and Rottunda, 2006, Hakamies-Blomqvist and Peters, 2000). In terms of access to the car, at the question *"How often can you get a lift whenever you want?" (Q.13),* less than half of the respondent were found to be able to get a lift often (45.0%), while 28.0% of them reported to being able to get a lift not often or rarely, and 26% only sometimes.

Again, the female group was found to be the most affected in this sense.

Table 6-3. Reasons for not holding a driving licence by gender and age groups *(Q.11)*

	Not renewed	**Voluntarily stopped**	**Never had**
All	33.3%	31.3%	35.4%
Gender			
Female	12.5%	25.0%	25.0%
Male	20.8%	6.3%	10.4%
Age groups			
60-64	0.0%	2.1%	0.0%
65-69	2.1%	0.0%	16.7%
70-74	4.2%	0.0%	16.7%
75-79	0.0%	4.2%	0.0%
80-84	6.3%	10.4%	0.0%
85+	20.8%	14.6%	2.1%

Figure 6-4 illustrates that, in addition to the car, other transport modes considered to be important in everyday mobility life were found to be walking and public transport *(Q.2)*. In this sense, the former was found particularly significant, reaching almost 90% of positive responses, while both bus and train were reported to be important by around 80% of participants. On the other hand, cycling, taxi and FTS were reported to be mainly not important, particularly the first one. These findings somehow reflect those related to mode share amongst the older population identified in the analysis of the NTS (Section 4.2.3).

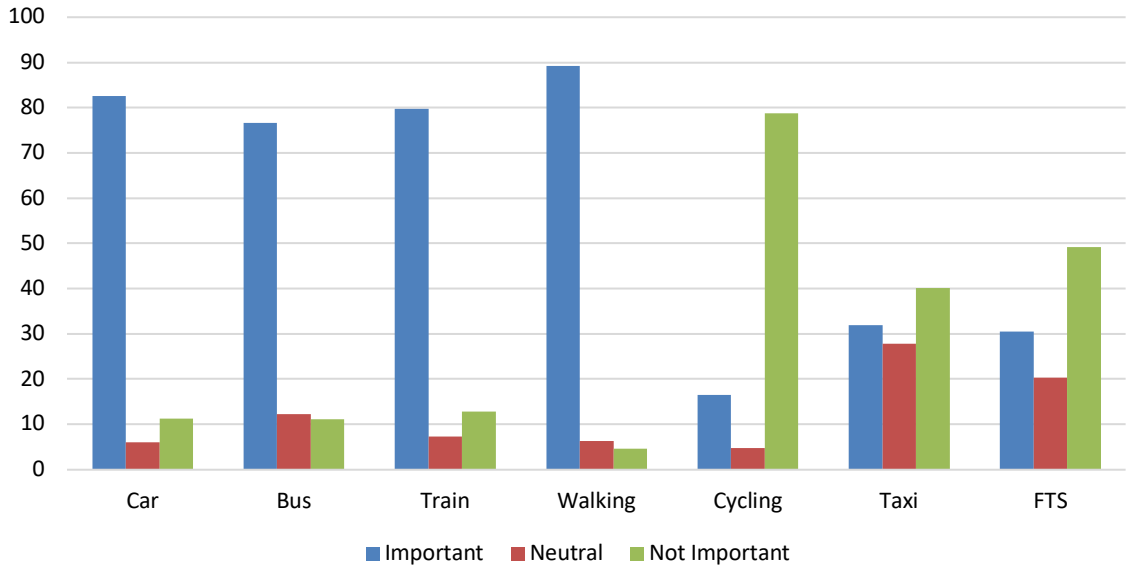

Figure 6-4. Importance of selected transport mode in everyday mobility life *(Q.2)*

The importance of the selected modes is somehow reflected in the frequency with which these modes are used. As Figure 6-5 illustrates, the car, public transport and walking were found to be the modes most used to travel. The car was found to be used often or always by almost 80% of participants *(Q.12)*. In a similar way, both public transport *(Q.15)* and walking *(Q.19)* were reported to be used by more than half of the participants on a weekly basis, with almost one-third more than twice a week or five times per week or more, respectively. On the other hand, the vast majority of the respondent said they did not cycle (86.0%), with only 5% of them doing it at least once in a week *(Q.20)*. Similarly, data show limited use of the taxi, with more than one-third never or hardly ever using this mode (35.6%) or only once or twice per month (32.2%) *(Q.22)*.

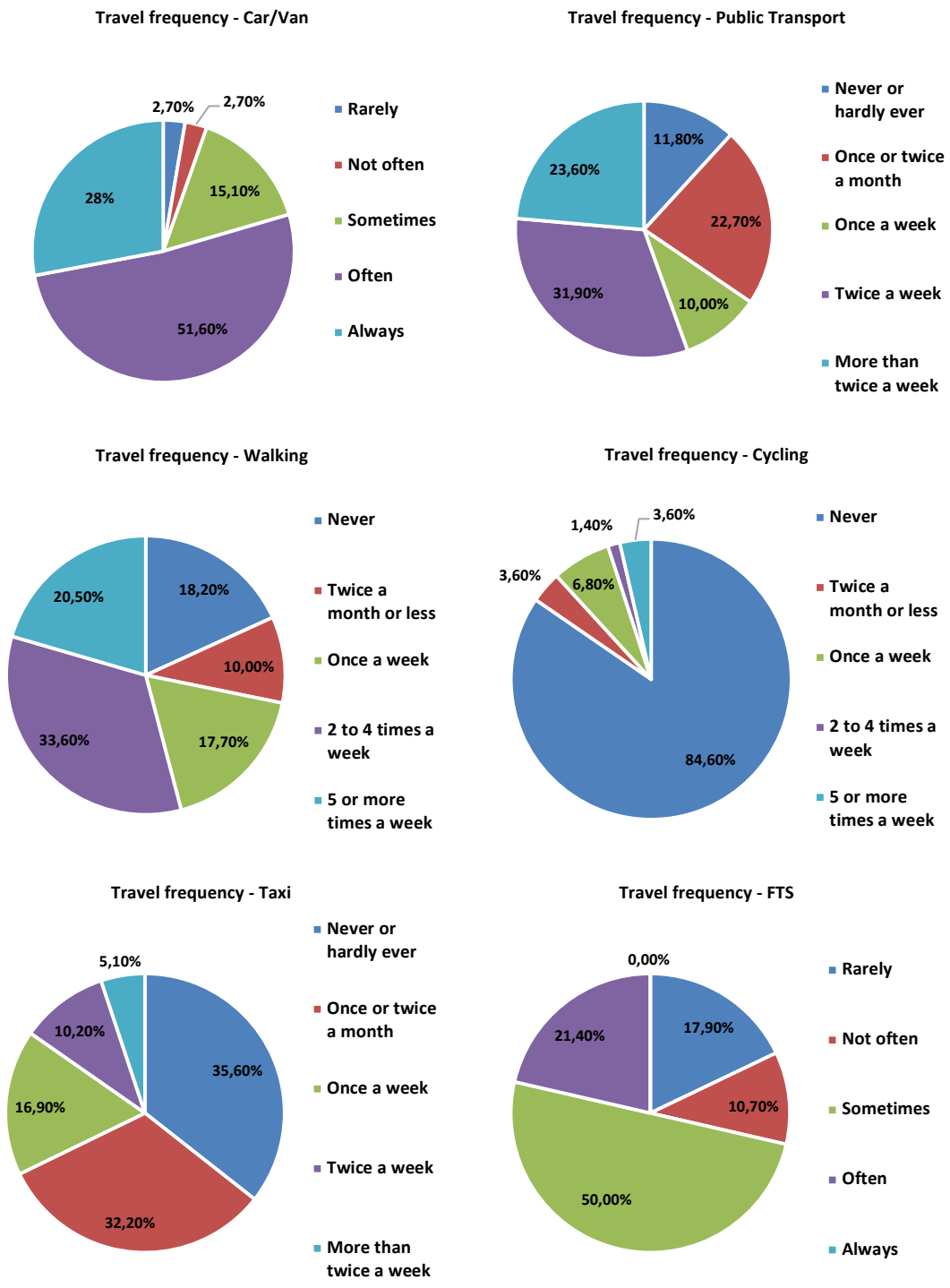

Figure 6-5. Travel frequency per selected modes

Looking at the barriers affecting alternative transport modes to the car, Figure 6-6 illustrates that respondents reported that the main issues preventing usage of public transport *(Q.16)* are associated with poor service provision. Indeed, more than half of them reported

unsuitable routes and timetable (55.5%), while the second most reported issue was found to be the poor frequency and reliability of the services (38.8%). Other barriers related to service provision mentioned were the lack of availability of bus needed in the place of living (14.0%) and the distance of the bus stop from the respondent's house (10.7%). Health impairments also affect public transport usage due to difficulties in boarding and alighting the vehicles, with 15.7% of respondents reporting this issue. A possible explanation of this might by identified in the high percentage of respondents experiencing mobility issues, as highlighted in Section 6.2.2.

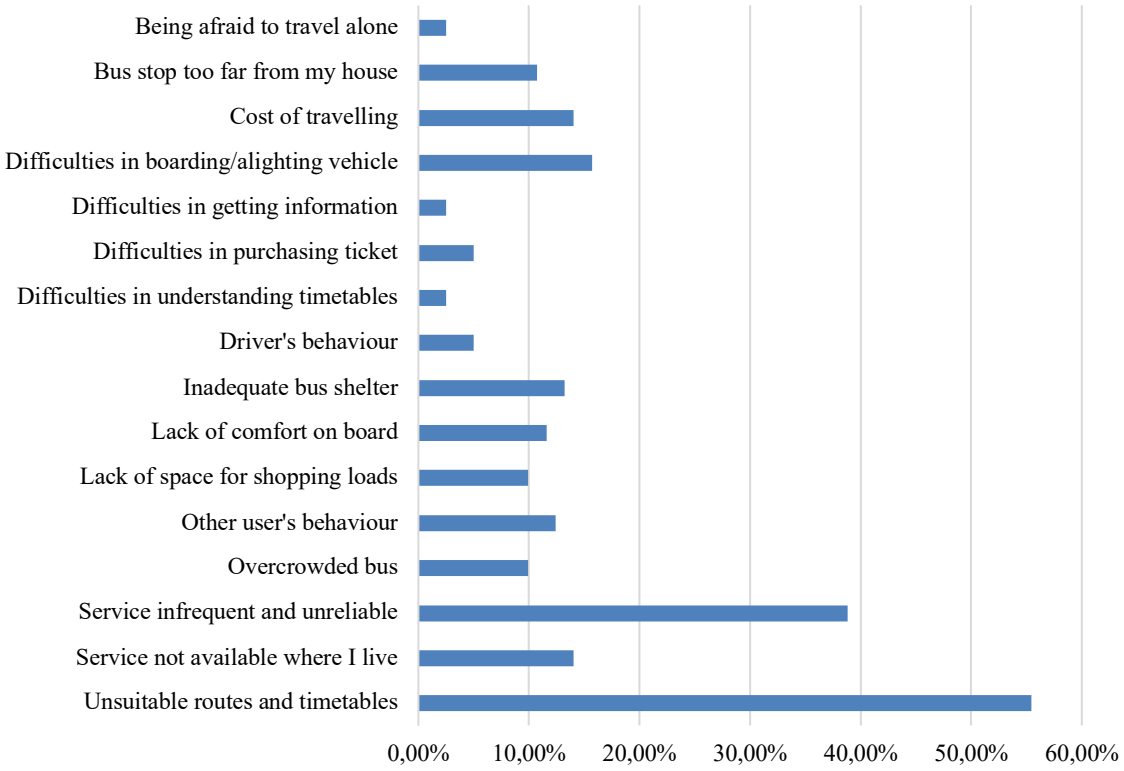

Figure 6-6. Barriers preventing public transport usage *(Q.16)*

With regard to both taxis *(Q.23)* and FTS *(Q.26)*, participants were asked to state up to three reasons preventing the usage of these modes. Several themes emerged from the analysis, but overall the main barrier identified was the lack of need in using these modes. In this regard,

the reasons why the use of the taxi was reported as not necessary are different. First, the importance of having access to a car and the implications of it in terms of travel performances are reflected in the lack of need for taxi usage. This was found valid also for those people not driving and relying on other people for their travel.

> *"I have my own car, I have the freedom to go and come in my car and taxi cost more"* (Female, 74 years old).
>
> *"I can rely on others for transport if necessary, I haven't needed to use one."* (Female, 73 years old).

Moreover, when compared to other alternatives to the car, other modes are considered a better option to travel.

> *"No need. I have excellent public transport close to hand, and free"* (Female, 73 years old).
>
> *"No need. I live close to a railway station with a frequent service. If the train doesn't go to where I want, I use the car"* (Male, 67 years old).

Another reason explaining the lack of need was identified in the usage of this mode not as a regular form of transportation, but mainly for occasional trips or situations.

> *"I do use for example to get to airport but rarely other times"* (Male, 66 years old).
>
> *"Rarely used. Hospital only time I use one"* (Male, 90 years old).
>
> *"Only use for some holidays"* (Male, 81 years old).

The usage of this transport mode was also perceived as associated only to impaired or disabled people and therefore avoided for this reason.

> "*I am fit, so I don't need to use a taxi"* (Male 77 years old).

The costs involved in using the taxi to travel was another common theme that emerged from

the analysis. More than half of the respondents reported affordability issues as a factor preventing the use of this mode. Indeed, the taxi was addressed as *"high cost"* or *"too expensive"*. As shown in the previous statements, this was found particularly valid when comparing the taxi with other modes, especially the bus, for which the vast majority of respondents have a concessionary free travel pass. This finding is in line with previous research (WS Atkins, 2001) showing that taxi is the most expensive transport mode in the UK and that cost is the main disincentive to use this mode (Davey, 2007).

Finally, the taxi was found to be affected by two main issues related to the provision of the service, as highlighted in Section 2.3.4. First, the potential concern regarding late arrivals or waiting times.

> *"Unreliable at turning up especially when going to hospital appointments. I don't like using them on my own"* (Female, 69 years old).
>
> *"Too time consuming"* (Male, 73 years old).

The other factor associated to the service provision was related to the behaviour of the taxi drivers, who were found to be not efficient and not responsive to older people needs.

> *"The drivers lack of understanding of disabled passengers"* (Male, 90 years old).
>
> *"Drivers are poor"* (Male, 66 years old).

FTS presents similar factors to the taxi preventing their use. Again, the lack of need was the most reported reason for not using this mode, especially due to the availability of other modes and their travel characteristics.

> *"I have a car so I don't need it. It's expensive and less convenient than my car"* (Female, 73 years old).
>
> *"No need to use this sort of transport as we have first class bus service and we also*

have a car" (Female, 70 years old).

Issues related to the provision of the service were also found associated with the factors preventing the usage of this mode. In this sense, some of the participants reported problems with potential destinations not served by the service available and poor quality of the service once used.

> *"I was once delivered so late I found that the event had finished. I was once wheeled away half an hour early as 3rd. act of opera began (in spite of protests)"* (Female, 88 years old).

> *"Ring & Ride cannot get one to ones destination at times required"* (Male, 90 years old).

Furthermore, FTS requires the necessity of booking in advance the journey, which was found to be somehow problematic and affects the experience of travelling itself, as found also in Glasgow and Blakely (2000) and WS Atkins (2001).

> *"Removes travel spontaneity, requires planning and it involves a lot of waiting around"* (Male, 74 years old).

> *"I need to book ahead with no guarantee of a journey"* (Female, 88 years old).

Similarly to the findings for taxi, but in a more significant way, the usage of FTS is affected by the stigma that this transport mode is provided as a special type of service only for those people with mobility problems or disability, and therefore not used because of people think they are ineligible or that they do not need it. Significantly, respondents with this latter belief belong to the youngest age groups (below 75 years old).

> *"I'm glad to say that I don't really feel I need it. I would be using a resource that would benefit someone with less mobility"* (Female, 72 years old).

"No needed because I'm not disabled (at the moment)" (Male, 74 years old).

Finally, another finding in line with the literature highlighted in Section 2.3.3 was the lack of awareness about this type of transportation. Indeed, only some respondents reported to know little about how and where this service was provided, but also mentioned not being aware of what this mode was.

> *"I'm ignorant of what's available. I wonder just how flexible it is - of want to go to the park, take dog for a walk, visit a museum, attend an event.* (Male, 74 years old).
>
> *"Haven't heard of it. Wouldn't know where or when to get it"* (Female, 73 years old)
>
> *"I don't know what it is"* (Female, 72 years old).

The last sub-theme regarding the transportation domain was related to the investigation of the travel planning activity amongst the older population. Planning a journey was found to be a common practice amongst the respondents, with almost 90% of them stating they plan in advance their travel *(Q.29)*. Around two-thirds mentioned planning their journeys often or always *(Q.30)*. Looking at the time spent in the preparation of the journey, data show that the majority of the respondents (82.5%) require less than 1 hour to organise their travel. As shown in Figure 6-7, at the question *"What kind of planning tool do you usually use for your trips?" (Q.32)*, data show that older people rely mainly on digital sources to plan their journeys. Tools most used were found to be Google Maps and National Rail enquires (only for train), which were reported by more than half of participants.

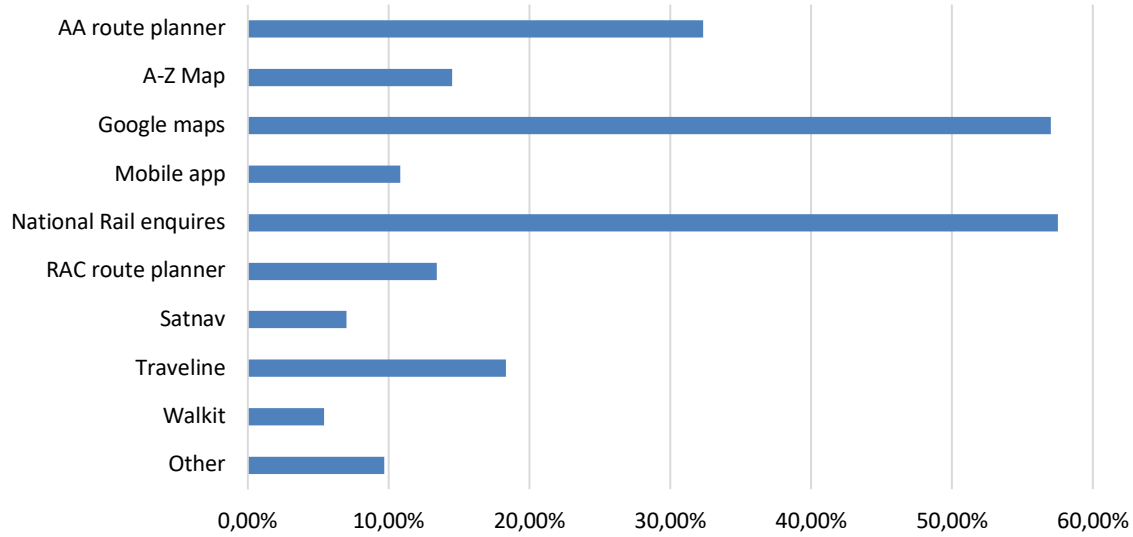

Figure 6-7. List of tools used to trip planning *(Q.32)*

Furthermore, participants were asked to state up to three reasons preventing the use of planning tools for their travels *(Q.33)*. The lack of need was found again as the main reason preventing the use of planning tools, although for different reasons. In this sense, the majority of respondents reported to rely on their personal knowledge and experience for travelling.

> *"No need. Knowing the best route already"* (Male, 76 years old).
>
> *"Mainly I know route"* (Male, 82 years old).

A few participants reported the lack of need to plan their journeys due to the fact they only undertake very short distance trips or the same journeys over time and therefore due to the familiarity of the route do not require advance planning.

> *"Apart from going into the city by bus or train I am never more than 5 miles from home"* (Female, 88 years old).
>
> *"I often make the same journey, so I don't need it."* (Female, 72 years old).

Finally, another theme that emerged was the lack of need due to relying on other people for the organisation of their journey, particularly spouses.

"My Husband has always done it and he is very good at it" (Female, 73 years old).

6.2.4 *Built Environment*

Looking at how both public transport and facilities, services and goods were accessible and available, results show that all participants reported to be served by public transport services in their place of living *(Q.35)*, though only 85.5% with regard to facilities, services and goods *(Q.36)*. In terms of how easy it was to access them, Figure 6-8 shows that public transport stops/stations and facilities, services and goods were found for around two-thirds of respondents to be close to their home (68% and 76%, respectively). Only 10% reported having public transport stops to far away, while 6.5% considered it difficult to reach facilities, services and goods from their dwelling *(Q.36-Q.38)*.

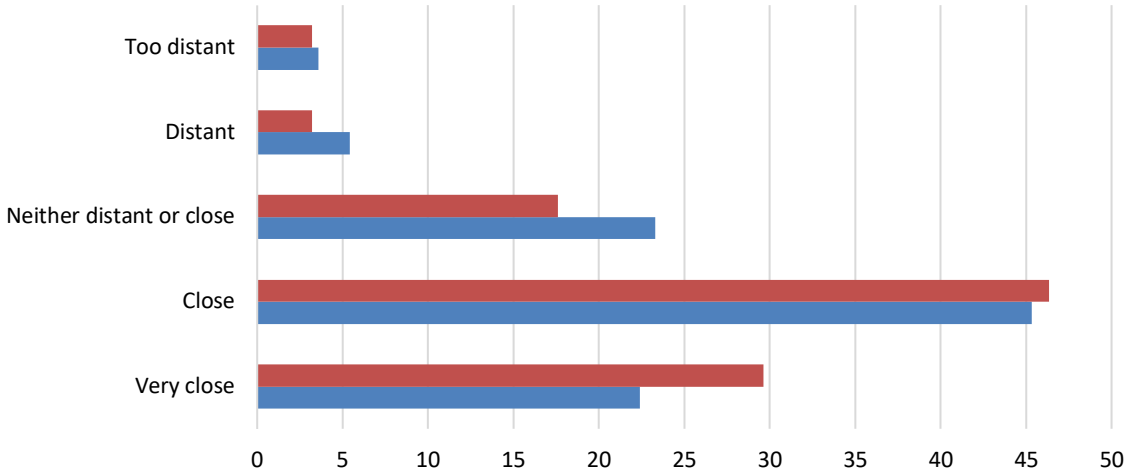

Figure 6-8. Distance of bus stops or train stations and facilities, services and goods from place of living.

6.2.5 *Activity patterns*

Observing the activity frequency (Figure 6-9) *(Q.3)* respondents reported shopping, leisure/social/sport activities and having a walk as the three main reasons for travelling on a weekly basis. Shopping journeys are those accounting for more trips, with more than two-

third of respondents reporting to undertake this activity at least twice a week (55% for shopping purpose and 21.3% for other type of shopping) and around the same amount once per week (30.8% for shopping purpose and 38.3% for other type of shopping). With regard to social, leisure and sport activities, 63.2% of participants reported undertaking these activities at least twice a week and 20.1% once a week. These findings are in line with in analysis of the NTS with regard to purpose of travelling (Section 4.2.5) and other studies investigating the mobility of the older population (Siren and Haustein, 2014, Hjorthol, 2013a). In a similar way, having a walk was found to be undertaken by 54.3% at least twice a week and 20.1% once a week, while visiting other people was mentioned to be undertaken 27.8% and 33.8%, respectively. Other activities mentioned to be undertaken on a weekly basis involved volunteering in charities, church and hospitals; gardening or attending a garden club; walking the dog, visiting the church, dancing classes, choir group, geriatric swimming and playing bridge and bowling.

Looking at monthly trip frequency, the graph shows that the vast majority of journeys related to medical issues are undertaken once a month or less (79.4%), while the remainder twice a month (18.4%). Journeys for eating outside home and visiting the bank or post office were reported to be undertaken both twice a month and one a month or less by around 35% of the respondents. Other activities mentioned to be undertaken on a monthly basis included short trips by trains to nowhere in particular, visiting the library and going on holiday.

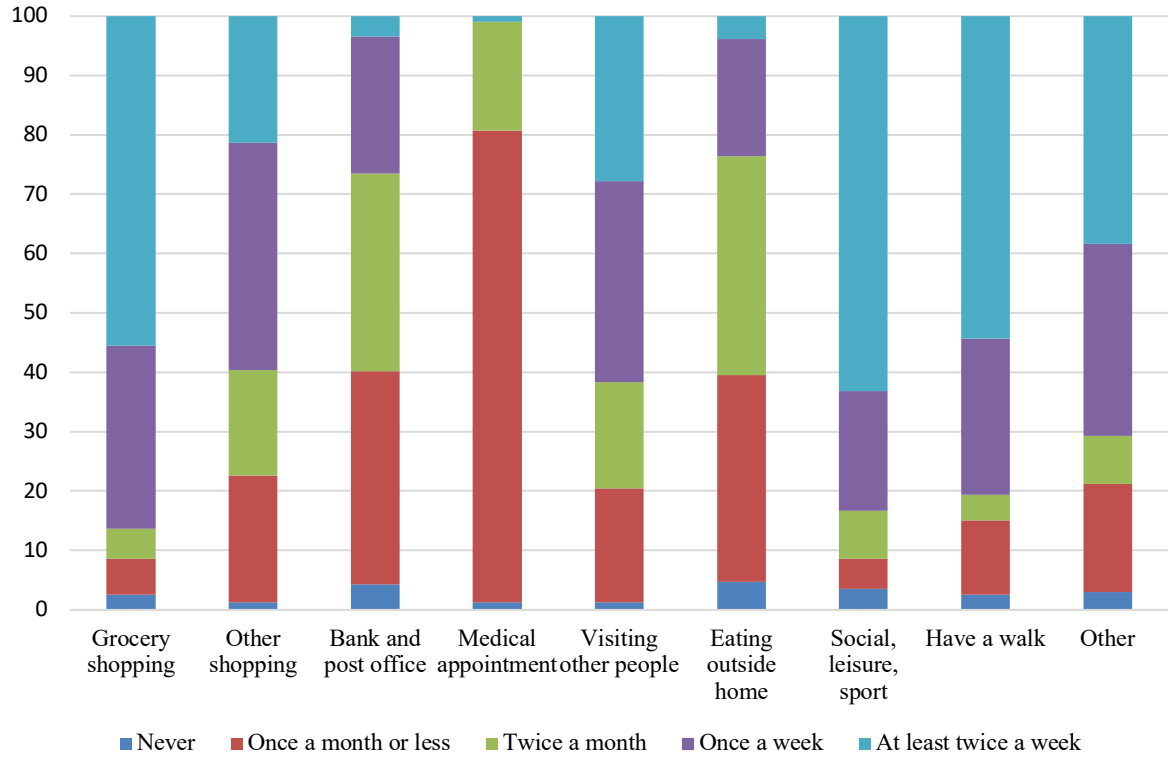

Figure 6-9. Trip frequency per single activity *(Q.3)*

Table 6-4. Travel purpose by main transport mode *(Q.4)*

	Activities								
	Grocery shopping	**Other shopping**	**Bank**	**Medical visit**	**Visiting others**	**Eating outside**	**Social Leisure**	**Have a walk**	**Other**
Transport modes									
Car (Driver)	44.4%	20.7%	25.4%	24.3%	37.3%	37.2%	29.3%	13.8%	32.9%
Car (Passenger)	8.5%	5.8%	6.6%	6.3%	18.0%	27.0%	14.1%	0.7%	7.1%
Bus	22.0%	24.0%	18.4%	11.1%	14.2%	10.0%	12.0%	6.0%	18.8%
Train	2.8%	16.2%	5.9%	0.0%	7.1%	7.1%	14.1%	4.9%	9.4%
Walking	15.2%	25.9%	39.3%	48.0%	12.3%	9.7%	11.0%	74.6%	21.2%
Cycling	6.2%	6.5%	3.3%	6.9%	5.7%	4.5%	9.2%	0.0%	7.1%
Taxi	0.0%	0.0%	0.0%	2.4%	2.0%	2.9%	4.7%	0.0%	3.5%
FTS	0.9%	1.0%	1.1%	1.0%	3.4%	1.6%	5.6%	0.0%	0.0%

As shown in Table 6-4, driving a car was found to be the most used way to undertake the majority of activities, particularly for grocery shopping, visiting other people, eating outside,

leisure and social activities. Walking was the second most used mode, particularly for undertaking other shopping, bank/post office and medical appointments. This finding is in line with previous research showing that walking is often regarded as a faster and more feasible travel option to accomplish everyday (Mindell et al., 2011, Buys et al., 2012). Looking at the other modes, public transport was found to be used mainly for both grocery shopping and other shopping activities *(Q.4)*.

Another aspect investigated regarding activity patterns was the amount of unfulfilled mobility experienced during later life. In this sense, participants have been asked if there were times when they could not make trips they wanted to do *(Q.6)*. The findings show that almost one-third of respondents (28%) reported to have unmet travel needs. As Figure 6-10 illustrates, visiting other people was the most reported activity older people wanted to undertake more often, with more than half of participants having unmet travel needs. Around 40% of respondents reported the desire to undertake shopping and leisure/social activities or going out for a walk *(Q.7)*. Significantly, for all the unfulfilled activities, the female group reported more unmet travel needs than males, particularly for visiting other people and leisure/social activities. For those activities with highest unmet travel needs almost half of respondents reported health issues as the main cause, while around one-third mentioned lack of transport service availability, lack of time and not knowing how to get to a specific place (Figure 6-11) *(Q.8)*. These findings are in line with previous studies on unmet travel needs, as highlighted by the review of the literature outlined in Section 2.2.2.

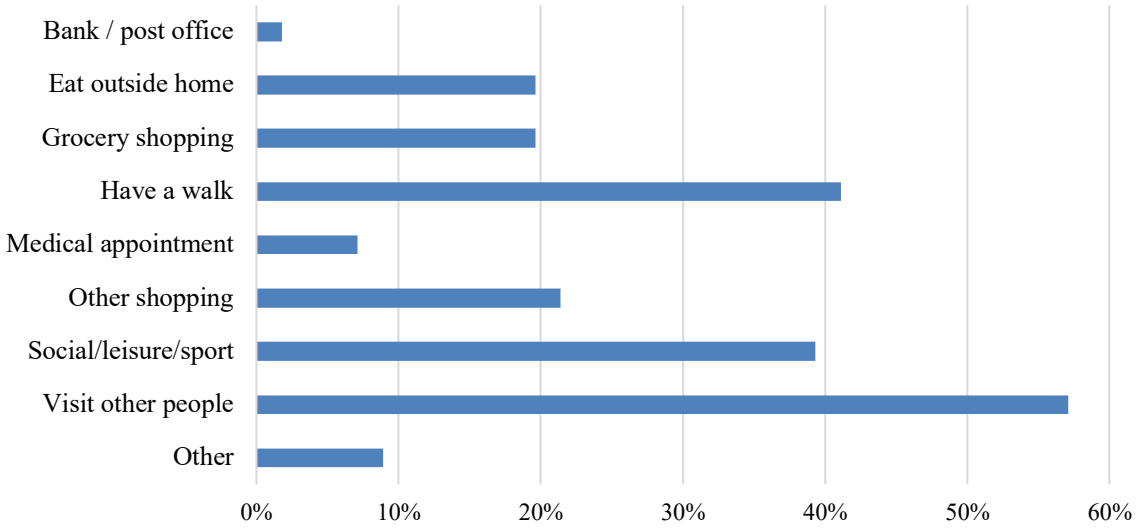

Figure 6-10. Activities older people would like to undertake more often *(Q.7)*

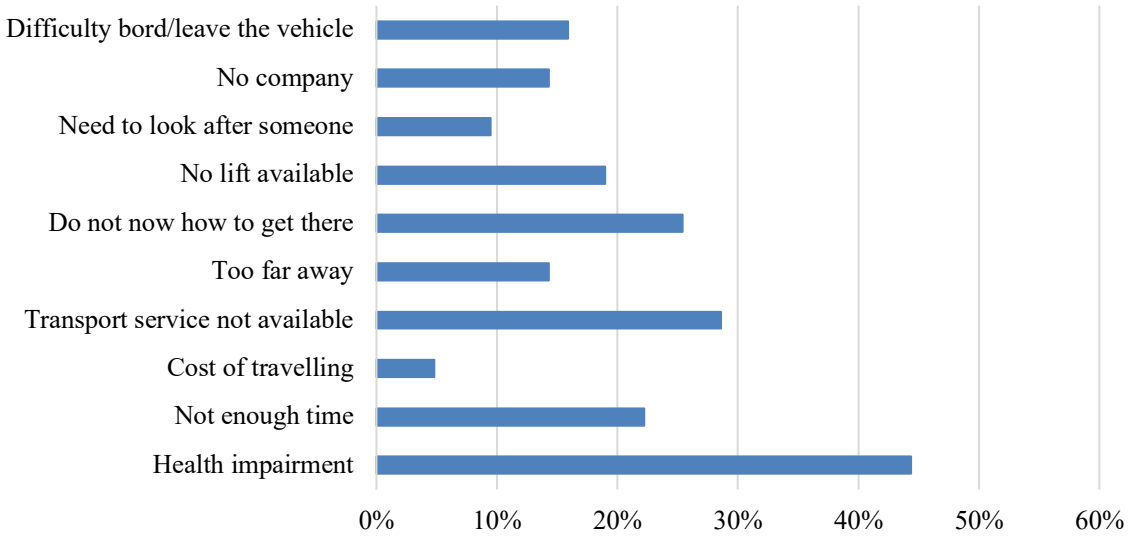

Figure 6-11. Barriers preventing older people to undertake more trips *(Q.8)*

6.2.6 Understanding the impact of investigated variables on realised and unfulfilled mobility

In order to understand the propensity of respondents to fulfil their travel needs and the impact of the variables identified in Section 3.3.4.5 on both realised mobility and unmet travel

needs, a set of logistic regression analyses were carried out. Given the relatively small sample (n=288) and the implications of this for logistic regression analysis (Scheiner, 2006), both dependent and independent variables for the analyses were recoded as solely dichotomous variables. Realised mobility was investigated in terms of whether respondents were active or not in undertaking their activities. With regard to unmet travel needs, the dependent variable has been formulated based on the question: "*Are there times when you cannot make trips you want?"*, with participants having a yes/no option to respond. In addition to this, a set of analyses has been employed to investigate the impact on the three most reported unfulfilled needs: shopping (sum of grocery shopping and other shopping), leisure activities (sum of leisure/social, eating outside home and having a walk) and visiting other people. Even though visiting other people might be considered a leisure activity, it was decided to analyse it separately given it was the most reported unfulfilled activity. Overall, access to the car and health conditions were found to be the two main factors influencing fulfilment of travel needs amongst the investigated sample, although with some differences.

Table 6-5 shows that holding a driving license and having easy access to lifts for those that do not drive were found to be the only significant variables affecting activity frequency in terms of access and usage of transport modes. Moreover, having one or more impairments affecting the use of transport mode was found to reduce activity frequency, but this was not the case for subjective satisfaction with mobility, health conditions and place of living. Demographic variables did not appear to affect activity frequency in Models 2 and 3. However, with the introduction of built environment variables in Model 4, both living alone and reduced amount of years living in the same area were found to be significant and affect activity frequency.

Table 6-5. Logistic regression analysis of activity frequency

	Model 1		Model 2		Model 3		Model 4	
	B	*p*	B	*p*	B	*p*	B	*p*
Holding a driving licence	0,903	0,174	1,250	0,098	2,349	0,022	2,780	0,016
Easy to get a lift	2,483	0,046	3,226	0,042	5,313	0,020	6,102	0,013
Frequent public transport user	-0,306	0,744	-0,071	0,947	0,104	0,934	-1,034	0,523
Frequent walking user	0,780	0,255	0,789	0,337	0,210	0,840	-0,466	0,709
Frequent cycling user	2,848	0,909	2,676	0,936	2,615	0,947	2,258	0,963
Frequent taxi user	-1,522	0,258	-1,082	0,521	-1,901	0,373	-3,325	0,470
Frequent FTS user	-2,430	0,137	-2,426	0,214	-1,454	0,499	-0,503	0,837
Gender			-0,367	0,653	-0,733	0,488	-1,415	0,238
Age			-0,635	0,490	-1,201	0,342	-2,308	0,141
Dependant person in household			-0,240	0,779	0,182	0,870	-0,084	0,946
Being single or widowed			-1,067	0,332	-1,747	0,207	-3,695	0,046
Years living in current area			1,019	0,261	2,534	0,051	4,050	0,018
Having higher education			0,197	0,390	0,498	0,097	0,467	0,219
Satisfactory out-of-home mobility					-1,339	0,464	-5,044	0,099
Satisfactory health conditions					0,692	0,694	2,133	0,315
Having a health impairment					2,981	0,010	3,019	0,021
Living in city centre							1,783	0,348
PT stop far							-3,013	0,212
Facilities distant from home							-2,208	0,093

p <.05

Table 6-6. Logistic regression analysis of unmet travel needs

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	*p*	B	*p*	B	*p*	B	*p*	B	*p*
Holding a driving licence	-1,783	0,032	-2,175	0,036	-3,229	0,035	-3,856	0,039	-5,626	0,017
Easy to get a lift	-0,074	0,911	-0,054	0,945	-0,699	0,521	-1,285	0,335	-4,223	0,058
Frequent public transport user	0,104	0,864	0,157	0,826	0,001	0,999	0,805	0,475	1,323	0,370
Frequent walking user	-0,899	0,143	-0,483	0,517	0,096	0,931	-0,999	0,480	-1,734	0,316
Frequent cycling user	1,757	0,336	1,995	0,339	2,116	0,437	2,830	0,578	-0,273	0,972
Frequent taxi user	1,212	0,357	0,055	0,972	-0,270	0,893	0,193	0,934	1,540	0,698
Frequent FTS user	-0,748	0,675	-1,001	0,644	-1,375	0,648	-1,697	0,755	0,195	0,980
Gender			0,389	0,615	1,267	0,232	1,239	0,335	1,100	0,509
Age			1,242	0,174	-0,969	0,547	-1,519	0,342	-1,983	0,265
Dependant person in household			1,557	0,123	0,843	0,514	1,214	0,406	3,082	0,129
Being single or widowed			0,363	0,682	0,830	0,437	1,284	0,376	2,374	0,185
Years living in current area			-0,040	0,083	-0,039	0,290	-0,026	0,509	-0,014	0,773
Having higher education			0,708	0,418	1,797	0,274	1,632	0,368	2,149	0,266
Satisfactory out-of-home mobility					-6,525	0,017	-7,422	0,034	-12,790	0,023
Satisfactory place of living					-0,055	0,973	2,415	0,285	7,214	0,077
Satisfactory health conditions					1,822	0,378	2,625	0,309	7,333	0,085
Having a health impairment					-1,017	0,270	-0,372	0,710	-1,164	0,352
Living in city centre							2,272	0,118	2,620	0,131
PT stop far							1,091	0,735	2,221	0,456
Facilities distant from home							2,917	0,037	6,527	0,027
Active respondent									4,870	0,058

p <.05

In terms of unmet travel needs, Table 6-6 illustrates that fewer factors influence fulfilment of needs compared to the realised mobility. Access to a car and health conditions were found to be statistically significant, despite some differences with realised mobility. Indeed, only holding a driving license was found to decrease unmet travel needs in terms of transportation variables, while for health and wellbeing variables it was a case of being satisfied with both out-of-home mobility and health conditions. Demographic variables did not appear to affect unmet travel needs, nor did being active in terms of undertaking out-of-home activities. Finally, having facilities, services and goods distant from place of living is a predictor of unfulfilled needs for leisure activities.

Looking more specifically at factors affecting the fulfilment of leisure activities (Table 6-7), visiting other people (Table 6-8) and shopping activities (Table 6-9), the analysis reveals two main findings. Firstly, activities to pursue leisure are influenced by more factors compared to the other two and are affected along different domains. Similar to the findings for the overall unmet travel needs, factors significantly decreasing the chance to experience unfulfilled leisure activities were holding a driving licence, being satisfied with out-of-home mobility and health conditions, in addition to limited distance of place of living from facilities, services and goods. Both shopping activities and visiting other people present similar findings, with holding a driving licence and subjective satisfaction with out-of-home mobility and health being the only variables leading to unmet travel needs.

Table 6-7. Logistic regression analysis of unmet travel needs - leisure activities

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	*p*	B	*p*	B	*p*	B	*p*	B	*p*
Holding a driving licence	-1,288	0,111	-1,759	0,088	-2,864	0,050	-3,709	0,059	-4,940	0,035
Easy to get a lift	0,127	0,847	0,087	0,911	-0,631	0,553	-1,201	0,354	-3,772	0,078
Frequent public transport user	0,310	0,613	0,452	0,521	0,332	0,702	1,315	0,266	1,993	0,190
Frequent walking user	-1,116	0,072	-0,752	0,315	-0,078	0,942	-1,242	0,390	-1,993	0,256
Frequent cycling user	1,728	0,341	1,788	0,392	2,045	0,444	3,049	0,604	0,319	0,969
Frequent taxi user	1,166	0,376	-0,243	0,878	-0,591	0,779	0,335	0,891	1,338	0,739
Frequent FTS user	-0,493	0,780	-0,888	0,680	-1,565	0,593	-2,199	0,722	-0,340	0,968
Gender			0,355	0,646	1,067	0,299	1,170	0,353	0,802	0,610
Age			1,261	0,171	-0,751	0,626	-1,408	0,370	-1,796	0,294
Dependant person in household			0,012	0,989	0,287	0,780	0,760	0,590	1,758	0,304
Being single or widowed			1,479	0,137	0,798	0,531	1,266	0,384	3,088	0,130
Years living in current area			0,697	0,426	1,396	0,346	1,004	0,549	1,547	0,391
Having higher education			-0,321	0,153	-0,413	0,230	-0,326	0,375	-0,230	0,603
Satisfactory out-of-home mobility					-5,607	0,021	-6,125	0,029	-10,609	0,047
Satisfactory place of living					1,174	0,529	1,762	0,503	5,654	0,187
Satisfactory health conditions					0,998	0,546	3,986	0,108	8,080	0,044
Having a health impairment					-1,110	0,233	-0,533	0,599	-1,155	0,340
Living in city centre							2,670	0,059	3,159	0,061
PT stop far							1,707	0,574	2,672	0,353
Facilities distant from home							3,259	0,031	6,455	0,028
Active respondent									4,221	0,084

p <.05

Table 6-8. Logistic regression analysis of unmet travel needs - visiting other people

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	*p*	B	*p*	B	*p*	B	*p*	B	*p*
Holding a driving licence	-1,149	0,077	-0,990	0,207	-2,031	0,038	-1,952	0,045	-2,107	0,036
Easy to get a lift	-0,328	0,614	-0,018	0,981	0,360	0,696	0,504	0,598	0,921	0,391
Frequent public transport user	0,027	0,962	0,221	0,711	0,394	0,597	0,503	0,508	0,569	0,460
Frequent walking user	-0,611	0,325	-0,371	0,611	-0,760	0,451	-0,940	0,385	-1,032	0,355
Frequent cycling user	0,058	0,971	-1,368	0,515	0,123	0,945	0,358	0,840	1,011	0,591
Frequent taxi user	0,446	0,721	0,127	0,929	-0,645	0,717	-0,734	0,734	-1,258	0,569
Frequent FTS user	1,417	0,312	2,769	0,157	3,559	0,104	3,437	0,122	3,419	0,134
Gender			0,612	0,386	0,770	0,397	0,838	0,361	0,804	0,375
Age			0,230	0,773	-2,071	0,158	-2,094	0,166	-2,332	0,160
Dependant person in household			0,909	0,275	0,858	0,351	0,916	0,339	0,766	0,447
Being single or widowed			0,402	0,612	0,324	0,753	0,329	0,746	0,144	0,888
Years living in current area			-0,414	0,245	-0,525	0,122	-0,298	0,423	-0,106	0,807
Having higher education			1,892	0,101	0,685	0,566	0,556	0,648	0,232	0,852
Satisfactory out-of-home mobility					-4,556	0,005	-4,328	0,015	-4,582	0,016
Satisfactory place of living					-0,283	0,833	0,150	0,991	0,074	0,959
Satisfactory health conditions					4,873	0,025	5,072	0,026	5,689	0,023
Having a health impairment					-0,827	0,277	-0,668	0,396	-0,383	0,656
Living in city centre							2,509	0,078	2361	0,122
PT stop far							0,041	0,983	-0,286	0,887
Facilities distant from home							0,756	0,341	0,675	0,416
Active respondent									-1,124	0,271

p <.05

Table 6-9. Logistic regression analysis of unmet travel needs - shopping activities

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	*p*	B	*p*	B	*p*	B	*p*	B	*p*
Holding a driving licence	-1,978	0,014	-0,969	0,323	-2,354	0,051	-2,606	0,074	-3,318	0,039
Easy to get a lift	-0,399	0,634	-0,554	0,571	-0,853	0,466	-1,761	0,272	-3,438	0,119
Frequent public transport user	1,148	0,110	1,069	0,156	1,709	0,119	1,802	0,148	1,957	0,189
Frequent walking user	-1,056	0,171	-0,607	0,487	-0,547	0,653	-0,510	0,742	0,491	0,809
Frequent cycling user	1,109	0,486	0,584	0,744	1,569	0,375	0,843	0,675	-0,653	0,792
Frequent taxi user	1,347	0,241	0,800	0,585	0,004	0,999	-0,475	0,859	0,993	0,751
Frequent FTS user	0,322	0,832	-0,579	0,760	-1,385	0,545	-2,737	0,405	-2,616	0,501
Gender			0,528	0,508	0,822	0,457	1,309	0,294	1,859	0,273
Age			1,210	0,146	-0,091	0,946	-0,274	0,861	-0,089	0,957
Dependant person in household			0,165	0,874	-0,313	0,786	-0,406	0,760	1,392	0,405
Being single or widowed			-0,233	0,801	0,030	0,980	-0,633	0,632	-0,682	0,671
Years living in current area			-0,332	0,232	0,487	0,195	-0,631	0,195	-0,631	0,195
Having higher education			0,441	0,650	0,949	0,462	1,048	0,505	1,160	0,525
Satisfactory out-of-home mobility					-4,452	0,003	-5,018	0,037	-5,913	0,040
Satisfactory place of living					3,113	0,252	3,113	0,252	3,113	0,252
Satisfactory health conditions					1,367	0,021	1,540	0,032	2,763	0,048
Having an health impairment					-0,233	0,781	0,514	0,610	-1,055	0,407
Living in city centre							-2,364	0,359	-3,677	0,285
PT stop far							0,674	0,783	3,399	0,230
Facilities distant from home							1,833	0,075	1,506	0,190
Active respondent									4,659	0,066

p <.05

6.2.7 Travel diary

Together with the questionnaire, participants were asked to complete a travel diary. The travel diary was aimed at recording both their realised journeys and those they would have wished or needed to do, but that for some reason they could not undertake (see Appendix B pp XV to XVIII). Participants were asked to complete the travel diary in the day following its delivery. Out of the 288 participants, 91 (32.0%) returned the travel diary completed. Of these, 63% did not leave the house to undertake a trip on the selected day of the travel diary.

Looking at realised trips, participants recorded a total of 77 trips. Of these, the vast majority (91%) consisted of a round-trip, with participants leaving the house to undertake a single activity followed by a trip to return home. Preferred travelling times were found to be the morning, especially between 10am and 12pm (26.0%), and the late afternoon, with almost 21% of the trips done between 4pm and 6pm. In terms of distance travelled, the average distance travelled was 2.5 miles. However, almost 70% of the journeys were within 2 miles, with short trips of half a mile the most reported (24.7%), while journeys of 5 miles and above accounted only for 13.0%.

Contrary to the findings from Sections 6.2.3 and 6.2.5, the travel diary shows that walking was the most used mode of transport for travelling, with more than half of the journeys undertaken with this mode (54.5%). This finding might be associated with the amount of short trips reported. The car was the second transport mode used for travelling, with 32.5%. Of these, 17% used the car as a passenger. In terms of travel purpose, apart from going home (45.0%), social and leisure activities were found the most reported reasons for travelling (23.5%). Trips for shopping account for 17.0%, followed by visiting other people (8.0%). These findings are in line with the results of the analysis in Chapter 4 and Section 6.2.5. Table 6-10 illustrates the reasons for travelling by transport modes. The table shows that

walking was the most used transport modes for all activities, with the exception of trips for medical issues.

Table 6-10. Travel purpose by main transport mode -Travel diary

	Going home	Grocery shopping	Other shopping	Medical visit	Visiting others	Social leisure	Change mode
Transport modes							
Car (driver)	17.1%	28.6%	0.0%	0.0%	16.7%	16.7%	0.0%
Car (passenger)	17.1%	28.6%	16.7%	66.7%	0.0%	11.1%	0.0%
Bus	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%
Train	0.0%	0.0%	0.0%	0.0%	16.7%	0.0%	50.0%
FTS	5.7%	0.0%	0.0%	0.0%	0.0%	11.1%	0.0%
Walk	54.3%	42.9%	83.3%	33.3%	66.7%	55.6%	0.0%
Bicycle	2.9%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%
Taxi	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

With regard to the unfulfilled mobility, 74 out of 91 participants (75.5%) reported not having experienced unmet travel needs during the travel diary day. The remaining 17 participants reported a total of 24 unfulfilled journeys. Of these, 46.0% of the trips were classified as “need to travel”, while the remaining 54.0% as “wish to travel”. Around half of the unfulfilled journeys were experienced in the morning, particularly between 10am and 12pm, while during the afternoon (41.0%) the majority of unmet travel needs were reported between 4pm and 6pm.

Looking at the activities that participants would have wished or needed to undertake more, visiting other people and activities to pursue leisure and social were the most reported, with 37.5% and 33.0% respectively. Unmet shopping activities were amongst the other most mentioned and accounted for 25% overall, with grocery shopping and other shopping reported by 16,7% and 8,3%, respectively. Regarding the reasons preventing trips, suffering from health impairment was found to be the most stated cause for unmet travel needs by

45,6% of respondents. Moreover, one-quarter of respondents reported lack of availability of lifts as another factor preventing the undertaking of out-of-home activities. These findings confirm the findings in sections 6.2.5 and 6.2.6 highlighting the impact of heath and access to the car for the fulfilment of travel needs, in addition to the importance of discretionary activities during later life. Finally, other reported issues in this sense were the lack of public transport service availability and having not enough time to undertake the needed/wished activity, both with 12,5%.

6.3 Summary

This chapter has presented the investigation of a case study aimed at understanding which factors affect the fulfilment of travel needs amongst the older populations, in terms of both realised mobility and unmet travel needs. The investigation is built upon the conceptual framework presented in Chapter 5 and it comprises descriptive statistics and logistic regression analysis to examine data collected through a survey questionnaire and a travel diary.

The overall results indicate that both access to the car and health conditions are the two main factors playing a significant role during later life with regard to both realised mobility and unmet travel needs. Holding a driving licence was the only variable to be found statistically significant in all the logistic regression analyses performed. Furthermore, difficulties in getting a lift easily was found to affect activity frequency, highlighting the importance of accessing a car when not possible to drive anymore. Health-related variables were also shown to affect both realised and unfulfilled mobility. Indeed, while having one or more impairment affecting the use of transport was found to reduce activity frequency, poor subjective perception of both health conditions and out-of-home mobility were found to increase the chance of unmet travel needs, particularly for leisure activities. Furthermore,

health was reported by almost half of the respondents as the main reason amongst the subjective indicators for those not being able to carry out their activities when they wanted to do.

In terms of other domains, demographic variables were not found to be significant factors in leading to unmet travel needs, but both living status and the amount of time living in the same area were found to affect activity frequency. Moreover, the logistic regression revealed that having facilities, services and goods distant from the place of living is amongst the factors increasing the chances to report unmet travel needs, especially those to pursue leisure. The travel diary confirmed some of the findings from the questionnaire, highlighting the effect of poor health and access to the car for unmet travel needs, and at the same time that walking can be a valid alternative option to the car for short trips.

In the next chapter the findings from Chapters 4, 5 and 6 will be discussed by critically reviewing the research.

7 RESEARCH DISCUSSION

7.1 Introduction

The three previous chapters of this thesis have outlined the key findings of the analyses based on a mixed method approach aimed at identifying the travel patterns and needs of the older population. This chapter seeks to draw together and critically interpret these findings in order to address the aim and research objectives as stated in Section 1.2 of this thesis. The chapter comprises of two main parts. It commences with the critical discussion of the findings related to the investigation of the travel patterns of the older population (Section 7.2.1), the development of a conceptual framework to assess their travel needs (Section 7.2.2) and the application of the conceptual framework to a case study based on a questionnaire survey and a travel diary (Section 7.2.3). Moreover, based on the findings of the three above-mentioned studies, a segmentation of the older population based on the fulfilment of their travel needs is proposed in Section 7.2.4. The second and final section (Section 7.3) provides an outline of the limitations behind the methods and findings of this research.

7.2 Critical review of the research

7.2.1 Identification of older people's travel patterns

The investigation of the travel patterns of the older population was carried out by employing an APC approach based on descriptive analysis. The investigation focused on the analysis of the NTS with regard to travel patterns and changes over a period of 25 years for the English older population. As the English population is ageing rapidly, identifying their travel patterns is necessary to understand which travel needs they might face while ageing and also to forecast future mobility trends. The results from the analysis indicate that the older population have been travelling more in terms of both number of trips undertaken and

distance travelled in the period between 1995 and 2015. The car is the main transport mode used for travelling, both as driver and passenger, while shopping and leisure activities were found to be the most common reasons for travelling.

Trends in trip frequency of the overall ageing population suggest that the average number of trips undertaken per week has slightly increased throughout the period of investigation. However, while older men have shown a gradual fall in trip frequency from 2004 onwards, older women are displaying the opposite trends. Distance travelled per week has significantly grown in the period between 1995 and 2015, with an increase of around 30 miles per week travelled. Both genders display steadily rising trends, but the male group travelled constantly around 30 miles more per week than their female counterparts. Looking at the age and cohort differentiation, the analysis shows that both average number of trips and distance travelled diminish with age. In this sense, data reveal that while the 60-69 and 70-79 age groups are similar in both trip frequency and distance travelled, the 80-89 and 90+ groups travel significantly less. This is in line with the studies that showed a mobility decrease after the age of 75 years (Haustein et al., 2013). Decreasing mobility related to ageing is also confirmed by the cohort trends, showing a fall for all six cohorts throughout the period of investigation. Nonetheless, both 1960' Boomers and Post-War Boomers travelled significantly more compared to the older cohorts. As found in different studies (Coughlin, 2009, Siren and Haustein, 2013), both Boomer cohorts differ from the previous generation by being healthier and wealthier, and as they are starting to age, it is expected that they will be more mobile.

Analysis of mode share shows that the car is the most used transport mode for travel, accounting for almost two-thirds of the journeys undertaken, both as driver and passenger. In Chapter 2, the importance of access to the car during later life has been stressed, and the

results from this analysis seems to match with some findings from the literature. Data regarding the overall older population illustrate that car use trends have been steadily increasing over time. Access to the car has also shown steadily increasing trends over time, as have trends in holding a driving licence. Moreover, while travelling as a car passenger has remained stable between 18% and 20% throughout the period of investigation, the percentage of journeys undertaken as driver has constantly grown, indicating that driving cessation is shifting upwards in terms of age. In this sense, the percentage of older car passengers seems to suggest that car remains the preferred mode of travel when not driving. This is in line with several studies (Davey, 2007, Glasgow and Blakely, 2000, Hanson and Hildebrand, 2011, Ward et al., 2013, Zeitler and Buys, 2015) suggesting that older people prefer to switch from driver to passenger in order to maintain the advantages granted by travelling by car. A consequence of the increasing trends in car usage is the related low percentage share regarding alternative modes, particularly public transport and walking. While the former showed a constant share between 11% and 9% over the period of study, despite the availability of concessionary fares for the older population, the latter experienced a significant fall from 32% to 19% between 1995 and 2015.

The cohort analysis reveals that the three younger cohorts, especially the Boomers ones, travel by car more than their older counterparts. At the same time, the younger cohorts walk and travel by public transport significantly less than the older ones. As highlighted by Tacken (1998), "*mobility behaviour follows the general rule that people stay as long as possible with the type of behaviour they are used to*". If so, it might be expected that the younger cohorts of older people will keep using the car as their main mode for travel as they age. In a context where our society is experiencing the so-called peak car phenomenon (Newman and Kenworthy, 2011, Goodwin and Van Dender, 2013), these car trends related to the Boomer cohorts should not be underestimated, since they are going in an opposite direction

compared to the younger generations. Nonetheless, the analysis of both age groups and cohorts shows decreasing trends in mode share related to car usage as older people age. Moreover, as older people age is it possible to notice an increase in percentage of travel as a car passenger, on public transport and as a taxi/minicab user. This suggests that car usage is affected by age effects.

The analysis of why the older population travel reveals that shopping and leisure activities are the main purposes for travelling. From both the age and cohort analyses it is possible to notice age effects regarding shopping, leisure and personal business, as their percentage decreases with age. In the same way, commuting and business journeys are consistent in both Boomers cohorts, especially the 1960's one, but not in the others. Nonetheless, no cohort effects are found from the analysis.

Finally, differences in travel patterns between men and women seem to be reducing. The literature illustrates plenty of evidence showing that older males travel more than their female counterparts (Rosenbloom, 2004b, Haustein et al., 2013, Bell et al., 2013). However, as highlighted by Coughlin (2009) women are achieving greater independence, higher educational levels and are working more compared to their previous generations. As consequence, the gap in mobility with regard with gender differentiation is converging, especially in the younger cohorts (Tilley and Houston, 2016). The APC analysis undertaken in this study reveals findings showing that changes in female travel patterns are significant. For example, despite older men travelling more in terms of both trip frequency and distance, older women are showing faster rates of increase in both. The age analysis shows that differences in numbers of trips for all the age groups, except the 80-89 year one, is reducing, while the cohort analysis reveals that the two female Boomer cohorts present similar trends to their male counterparts. Furthermore, data related to access to the car reveals that the

percentage of older women without access to this transport mode has been steadily decreasing in the last 20 years. Consequently, more older women have access to a car. In this sense, the percentage of older females with access to car as main driver has doubled over time, while the one related to access as a passenger has dropped by around 6.5%. The cohort analysis highlights this trend by showing that at least 60% of the two Boomer cohorts access the car as main driver throughout the period of investigation. Lastly, data related to driving licence provides a further example of how the gap between the two genders is converging, with numbers of older males and females holding a full driving licence converging and at the same time showing that the trends of older females with other or no license has been constantly decreasing in the last 10 years.

7.2.2 The conceptual framework to assess the travel needs in later life

One of the main gaps identified in the literature was that, despite the increasing interest of scholars about the travel needs of the older population, existing studies investigate mainly realised journeys and activities, with the effect that they do not provide a complete picture of older people's mobility in terms of needs fulfilment. Moreover, the review of the literature investigating those studies focusing on unmet travel needs (Section 2.2.2) was found to be insufficient to identify which factors affect the fulfilment of travel needs mainly due to differences in approaches undertaken and specific issues investigated. Therefore, the research reported here was aimed at proposing a framework to improve the evaluation and identification of those factors which should be taken into consideration when assessing travel needs in later life. The development of the framework was based on a three-stage approach comprising of the mapping of the literature, assessing the methodologies used by the identified studies and finally a content analysis to identify which domains shape out-of-home mobility in later life.

Overall, the main emphasis of existing studies has been on understanding the impact of access to the car to fulfil travel needs. In spite of the impacts that driving or using a car can have, the theoretical premise of the proposed framework is that out-of-home mobility in later life needs consideration of much more than just the transport environment and options available. In this sense, as shown in Section 2.2.2 and illustrated in Table 5-2, some variables are more significant than others in terms of having an effect on travel needs' fulfilment, namely: health impairments, holding a driving licence, having access to a car and living status. Nonetheless, due to the variety of approaches and foci, there is still ambiguity in the literature on the real impact on the variables investigated. Therefore, this framework does not build on a specific theoretical concept, but rather on an intensive review and assessment of the aims and variables investigated to date about travel needs in later life.

The content analysis undertaken to categorise the information obtained during the methodology assessment confirmed that factors other than transportation influence out-of-home mobility amongst the older population. Indeed, the framework is a construct of five interrelated domains, namely transportation, health and wellbeing, demographics, built environments and activities. Moreover, these domains have been disaggregated into fifteen sub-themes (see Figure 5-1), which are addressed by at least one of the identified studies addressing travel needs amongst the older population.

7.2.3 Identification of the travel needs of the older population

Chapter 6 presented the investigation of a case study aimed at understanding which factors affect the fulfilment of travel needs amongst the older populations, in terms of both realised mobility and unmet travel needs. The investigation was based on descriptive statistics and logistic regression analysis of data collected through a survey questionnaire and a travel diary. The questionnaire explored in detail the domains identified in the conceptual

framework presented in Chapter 5 and the potential relationship amongst the investigated variables. The travel diary was designed with the peculiarity of including unmet travel needs to the traditional format and was aimed at recording information to assess travel behaviour, trip-chain complexity and unmet travel needs of the survey respondents.

The overall results indicate that both access to the car and health conditions are the two main factors playing a significant role during later life with regard to travel needs in terms of both realised and unfulfilled mobility. Holding a driving licence was the only variable to be found statistically significant ($p<.05$) in all the logistic regression analyses performed. Furthermore, difficulties in getting a lift easily was found to affect activity frequency, highlighting the importance of accessing a car when it is no longer possible to drive. Several studies show how often switching from driving to being a passenger is the preferred option for older people in order to carry out their activities (Davey, 2007, Kim, 2011b). The survey showed that the majority of non-drivers had access to the car in their household, but at least one-third mentioned not being able to get a lift whenever they wanted. Hence, it may be postulated that having access to a car in the household does not imply at the same time an ability to use it and that it is important to understand access to the car more in terms of how easy it is to get a lift whenever required. Another significant aspect of the importance of the car amongst older people was related to the factors preventing the use of alternative transport modes, particularly taxis and FTS. While these two options might provide similar characteristics to the car in terms of performance indicators such as flexibility, door-to-door access and availability, the main reported barrier was the lack of need to use them, due to the fact that respondents either had a car or someone would take care of them in case of need. These findings stress not only the importance of the car amongst older people, but also highlight the gap between the car and its alternative modes, as outlined in Section 2.4. Finally, the overall importance of the car confirms what was found from the analysis of the

NTS data and the investigation of the travel patterns in England, showing that the car is the most used mode in terms of both distance travelled and trip frequency.

Health-related variables were also shown to affect both realised and unfulfilled mobility, although in different ways. Indeed, while having one or more impairment affecting the use of transport was found to reduce activity frequency, poor subjective perception of both health conditions and out-of-home mobility were found to increase the chance of unmet travel needs, particularly for leisure activities. Furthermore, health was reported by almost half of the respondents as the main reason amongst the subjective indicators for those not being able to carry out their activities when they wanted to do. Around one-third of the respondents stated that health issues affected particularly walking and cycling journeys, due most likely to the fact the most frequent impairments were those associated with mobility, namely: pain in joints, reduced mobility in legs or feet and arthritis. This could be the reason why, amongst the factors preventing public transport usage, boarding and alighting operations were amongst the most mentioned, as found in several other studies (Wretstrand et al., 2009, Broome et al., 2010a, Broome et al., 2013, Kim et al., 2014). Finally, it is acknowledged that the car can compensate for the limiting effects of health issues in order to carry out daily activities (Siren and Hakamies-Blomqvist, 2004), however health impairments are at the same time amongst the main predictors for driving cessation (Haustein and Siren, 2014, Hjorthol, 2013a, Haustein et al., 2013). This might explain why those who have voluntary stopped driving or not renewed their licence fall amongst the older age groups, since health impairments tend to be more frequent with advancing age (Haustein et al., 2013).

In terms of other domains, demographic variables were not found to be significant factors in leading to unmet travel needs. Nonetheless, both living status and the amount of time living in the same area were found to affect activity frequency. A possible explanation for this is

that people living alone might experience lack of company to undertake out-of-home mobility compared to those living with family members and have reduced access to a car in case they are not able to drive. At the same time living for a long time in the same area can increase individual knowledge with regard to both transport options and facilities available in that area, as well as increasing the likelihood of an extended social network of neighbours, as also found by Kim et al. (2014). Difference in gender was not found statistically significant in the regression analyses with regard to both realised mobility and unmet travel needs. Nonetheless, the descriptive analysis showed that older women are those suffering more health impairments, having less access to the car and reporting more unmet travel needs. With regard to the built environment, the logistic regression revealed that having facilities, services and goods distant from the place of living is among the factors which increase the likelihood of reporting unmet travel needs, especially those to pursue leisure. However, the analysis does not show any statistical effect of the living context (inner city, inner suburb and outer suburb). A possible explanation in this sense might be the fact that despite some studies showing that living in inner cities might reduce the chances of experiencing unmet travel needs (Siren and Hakamies-Blomqvist, 2004, Kim, 2011a), it is more a matter of how services, goods, activities and transport are easily accessed rather than where they are located.

In the light of these findings, the conceptual framework outlined in Figure 5-1 can be revised by highlighting the three sub-themes of the Health and wellbeing domain (i.e. Life satisfaction, Self-perceived health and type of impairment), together with the one related to Travel patterns and access to transport modes in the Transportation domain are those having more impact on travel needs fulfilment in later life (Figure 7-1).

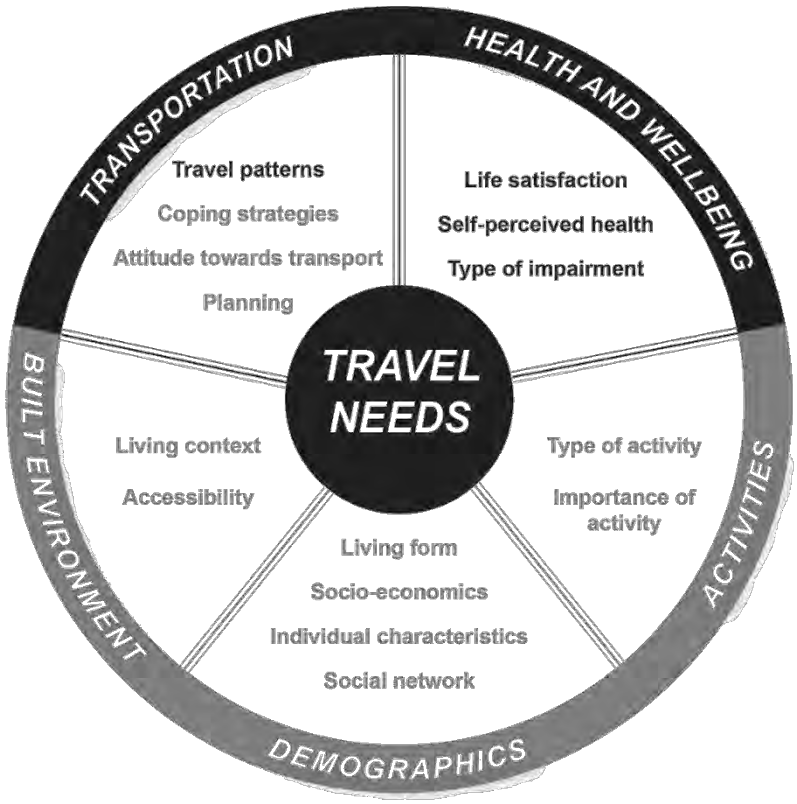

Figure 7-1. Revised conceptual framework to assess travel needs fulfilment in later life showing domains and sub-themes

An additional significant finding was the extent of unmet travel found amongst the respondents. The descriptive statistics show that almost one-third reported the desire or need to undertake more activities than they currently do, particularly women. In this sense, discretionary activities were found to be the most unfulfilled. These findings are in line with the findings from Section 2.2.2, stressing the importance that unfulfilled mobility has during later life and how this topic should not be underrated in transport research, especially for discretionary activities. Scheiner (2010) showed these types of activities are liable to be more individualised than the utilitarian ones, and therefore the effect of driving a car might be explained in this sense compared to the other transport modes and asking for a lift from other people (Haustein and Siren, 2014).

Finally, the results of the travel diary were found to support some of the findings from the questionnaire survey. This was found particularly valid with regard to unfulfilled mobility. Indeed, discretionary activities were those reported the most, especially visiting other people and social/leisure activities. Moreover, respondents said health issues and the lack of available lifts were amongst the main reasons for not being able to undertake needed or desired out-of-home activities, stressing once more the importance of accessing the car and health for the fulfilment of travel needs during later life. In terms of realised mobility, shopping and social/leisure activities were confirmed to be the main reasons for travel, particularly in late morning (10am-12pm) and late afternoon (4pm-6pm). Nonetheless, the travel diary highlighted three additional significant findings. Firstly, the vast majority of the journeys consisted of round-trips, with trip-chaining accounting for less than 10%. Secondly, more than two-thirds of the journeys consisted of short trips under two miles, with trips of under half a mile the most reported. This was found particularly valid for activities such as social and leisure activities, such a going to a café. These findings are in line with the common insight that, while ageing, older people tend to travel less in terms of distance and number of trips (Haustein and Hunecke, 2013). Ultimately, walking accounted for more than half of the journeys recorded in the travel diary and it was the preferred mode for the majority of the activities undertaken. This finding somehow diverges with that found in the questionnaire in terms of both preferred mode for undertaking out-of-home activities and trip frequency, where car was found to be the best option. However, a possible explanation in this sense might be associated with the relatively short distance travelled by the respondents, highlighting that walking can be a more valid and feasible transport option to accomplish everyday activities compared to the car or public transport, as found in other studies (Buys et al., 2012, Mindell et al., 2011).

7.2.4 Segmenting the older population

In Chapter 2 it was highlighted how the heterogeneity that characterises the older population poses challenges when describing this group. A common approach used in transport studies consists of segmenting older people according to demographic characteristics, travel behaviour, attitudinal and spatial variables. However, as these approaches are built on only realised activities, they lack a consideration of all those factors that lead to unfulfilled mobility, which was identified in this research as a main gap related to transport research regarding the older population. Therefore, starting from the results of the analyses related to the identification of the travel patterns and the factors affecting the fulfilment of the travel needs in later life, in addition to the findings from Haustein and Siren (2015)'s review, a segmentation of the older population is provided as follows:

- *The Boomers* – these comprise of the two Boomers cohorts presented in Section 3.3.2.2 and are characterised by very low unmet travel needs, high car availability and heavy usage trends, but limited walking and public transport usage. They are further characterised by having high and diverse activity engagement, particularly with regard to leisure and social activities, in addition to being healthier and wealthier than the other segments.

- *Active multi-modal seniors* - comprise of those older people not belonging to the Boomers cohorts that manage to easily fulfil their travel needs due to the ability to drive and at the same time are willing to use other transport modes without problems. They are further characterised by having low unmet travel needs, high activity engagement, and good health.

- *Active car dependents* - similar to the Active multi-modal seniors with regard to activity engagement and low unmet travel needs, this group differs by relying

predominantly on car usage to fulfil their travel needs. In this sense, they present a negative attitude towards other transport modes and keep driving as long as they can until they are forced to stop. This group is generally composed of older males.

- *Pragmatic seniors*- comprise of older people with low access to the car but that manage to contain their unmet travel needs by relying on public transport, FTS and walking, particularly for short trips. They are characterised by medium/low activity engagement and present lower income and health condition levels compared to the previous segments.

- *Captive car dependents*– comprise of older people characterised by significant unmet travel needs due to no holding a driving licence and that predominantly rely on lifts from other people to fulfil their travel needs, due to their negative attitude towards other transport modes. They are further characterised by medium/low activity engagement, especially in terms of discretionary activities, and report advanced age and poor health conditions.

- *Unfulfilled seniors* – comprise of older people with high levels of unmet travel needs. They are characterised by being captive public transport, FTS or car passenger users, have low activity engagement, experience poor health conditions, have low income and are more often older women and in advanced age.

A set of potential recommendations and implications associated with each group are outlined in Section 8.5.

7.3 Limitations of the research

This section provides a discussion of the methodological limitations of this research with regard to the investigation of both travel patterns and factors affecting travel needs' fulfilment in later life.

7.3.1 Limitations of the APC analysis

Despite the recognised efficacy of using the APC analysis to investigate changes over time and the richness of the available data provided by the NTS dataset, it is necessary to highlight that there are some limitations which need to be considered in this analysis relating to the understanding of the travel patterns of the ageing population. When using APC analysis, usually longitudinal data are preferable compared to cross-sectional in order to understand changes through time of the same group of people (Newbold et al., 2005). However, no longitudinal data in this sense are available to keep records of the mobility patterns of the ageing population within the UK context and the NTS is the only survey that allows travel behaviour analysis over a consistent period of time. A few studies in the transport field address this issue by creating a pseudo cohort, defined as cohort groups artificially created on the basis of age groups from repeated cross-sectional data (McIntosh, 2005). Tilley and Houston (2016) used this approach to investigate changes in travel behaviour by gender and cohort of the overall English population using the NTS data. Similarly, Hjorthol et al. (2010) used the Danish, Swedish and Norwegian national travel surveys to understand changes in activity and travel patterns within the Scandinavian older population. Newbold et al. (2005) analysed changes in driving behaviour of the Canadian older population by using data from the Canadian General Social Survey, while Hjorthol (2016) used the Norwegian national travel survey to investigate changes in driving licence and access to the car amongst Norwegian young adults over a period of 25 years. As mentioned before, the NTS is repeated

every year and it is based on a significant sample. Therefore, the NTS dataset can be used to construct aggregate cohort groups to investigate travel patterns, but bearing in mind that these will not be as valid as using a longitudinal cohort-based dataset, since it is defined only on birth year.

An additional limitation relates to the fact that despite the core survey of the NTS staying largely constant over the years, it is necessary to highlight that it has undergone a number of minor changes over time (Department for Transport, 2016b). Every year the survey presents additions and removal of questions compared to the previous versions. In 2002, the sample size trebled compared to the previous years, leading to potential differences in trends between the periods 1995-2001 and 2002-2015. Moreover, the travel diary has been redesigned in 2007, while since 2013 the NTS no longer covered Wales, but only households in England. Lastly, there are some types of addresses that are considered not eligible to take part in the NTS survey. Amongst these, communal establishments/institutions are defined as "*address at which four or more unrelated people sleep. While they may or may not eat communally, the establishment must be run or managed by the owner or a person (or persons) employed for this purpose*" (Lepanjuuri et al., 2016). Therefore, the older population residing in dwellings such as care and nursing homes, retirement villages and sheltered housing are not taken into account by the survey, and consequently in the APC analysis of this study.

Finally, an analysis of barriers and factors affecting mobility would have been appropriate to this study in order to understand travel problems faced in everyday life by the older population. Nonetheless, questions in this sense are available in the NTS only from 2002 and have not been constant throughout the period of investigation of this study. Given this, the six aspects mentioned above for understanding the travel behaviour during later life were

those that have been constantly present in the NTS over the period between 1995 and 2015.

7.3.2 Limitations of the survey questionnaire and travel diary

Looking at the methodology employed for the case study aimed at investigating the factors influencing the fulfilment of travel needs during later life, a main challenge consisted in targeting a specific age group to recruit participants for the survey process. A direct consequence was to discard a random sampling approach geographically distributed in the context of the case study (Birmingham), due to the risk of not being able to collect an adequate sample of respondents. Therefore, the approach used to recruit participants relied mainly on non-random sampling through the identification of potential organisations, charities and public locations linked to the older population. In this sense it is important to highlight that potential participants belonging to dwellings such as care and nursing homes or sheltered housing were not taken into consideration during the recruitment process due to the fact that people living in these types of residence are fulfilled of several needs investigated in this study without the need to fulfil them personally with out-of-home mobility.

This target-based approach allowed the researcher to reach potentially a bigger number of older people compared to a random sampling approach, but presented some caveats. The main issue consists in the representation of the population. In this sense, the identified sample was not geographically representative of the Birmingham population, due to the fact that some areas were more represented than others due to the reliance on the Age UK centres. Similarly, the demographic background characteristics illustrated in Table 6-2 show that some sub-categories of older people were more represented than others (e.g. White-British people in terms of ethnic background characteristics).

Given that the main target of the study focussed on older people, the main design criteria for

the questionnaire was to develop a format easily accessed and understood by older people, reducing any concerns and strains on the respondents. Therefore, the majority of the questions were organised according to close-ended questions with a tick box format rather than open-ended questions. This approach makes it difficult for those respondents with no opinion or knowledge about a specific topic to choose not to provide a response or to induce a response that the respondent might not have considered while reading the question.

As the questionnaire consisted of a self-reported attitudinal survey, participants might not be accurate in the way they completed the survey, by avoiding reporting individual issues/problems or in general to show themselves better than they are. An additional caveat of this type of question consisted in the subjectivity of the answers with regard to Likert-scale questions. The questionnaire presented several questions aimed at collecting information about importance, satisfaction, frequency of activities or transport mode usage based on a five-point rating scale. As a consequence, each respondent might have interpreted the options available in different ways and at the same time considered differently the distance between each of the five choices.

Together with the questionnaire, a travel diary was requested to be completed by potential respondents. As previously stated, the proposed travel diary differs from traditional travel diaries due to the fact that respondents have to record not only all the trips they undertake, but also those they would have desired or needed to undertake, but they could not. A potential implication of this might be associated with the complexity of the instructions provided and lack of understanding them to complete the records. Due to financial constraints, it was not possible to rely on technologies and employ a GPS-tracking based approach to record participants' trips, and therefore the travel diary provided was based on a paper-based record approach. This has two main implications. First, while GPS-based data collection is passive

and therefore minimise potential strains for participants, a paper-based approach implies that respondents have to manually record the trips they undertake. A direct consequence might be a lowering in the response rate of the travel diary, especially after having completed the survey questionnaire. Then again, as the this approach imply a self-reported attitudinal survey, participants might have not been accurate in the way they completed the diary, due to having depend on their memory to record the trips undertaken. This is especially valid with regard to time of travel, distance travelled and trip-chaining.

Finally, the results related to the questionnaire were based on a smaller sample (n=288) compared to other similar studies investigating the fulfilment of travel needs during later life (e.g. Haustein and Siren, 2014, Hjorthol, 2013a, Nordbakke and Schwanen, 2015, Siren and Haustein, 2014). A direct consequence of this consists in the design of the analyses and the reduction of the potential number of variables able to be tested in the logistic regression analyses. In this sense, considering the impact of health and wellbeing variables such as differentiation of categories of impairment (e.g. sensory, mobility or physical) and the effect of these for each transport mode usage might have provided a wider picture of the impact that health has on out-of-home mobility needs satisfaction. Similarly, adding to the analysis of subjective indicators for not undertaking more activities might have helped to better explain unmet travel needs, as shown by Nordbakke and Schwanen (2015). Moreover, the investigation regarding transport usage relied mainly on understanding frequency and barriers affecting mode usage. However, no investigation has been undertaken to assess willingness to use alternative modes in their everyday life or in case of life changing events (e.g. driving cessation) as done in other studies (Kim, 2011b, Rahman et al., 2016, Wasfi et al., 2012). This might have added additional information about individuals' perception and knowledge of alternative modes, particularly to the car given the findings of the study. Similarly, no specific preferences about public transport usage or if participants self-selected

to live in places of high public transport access was asked in the survey.

8 CONCLUSIONS

8.1 Introduction

This chapter summarises the findings of this research project. The chapter starts by providing an outline of how the research objectives stated in Section 1.2 have been addressed and achieved (Section 8.2). Second, it draws together the outcomes from the three studies outlined in Chapters 4, 5 and 6 and it provides of the key findings of this research (Section 8.3). Then, it describes the contribution of this research to existing knowledge (Section 8.4). Starting from these insights, the chapter concludes with an overview of potential avenues for future research investigations that might further contribute to investigate the fulfilment of travel needs amongst the older population (Section 8.5).

8.2 Addressing the research objectives

This research was built on five different research objectives. This section of this chapter discusses each research objective in turn, by describing how these have been addressed and achieved through this work.

Research Objective 1: *To analyse current and past travel pattern of the older people in order to understand how and why they travel and if it is possible to forecast future patterns.*

This objective was addressed in Chapter 4 by investigating the data from the NTS with regard to the period between 1995 and 2015. The investigation focused on mobility trends regarding trip frequency, distance travelled, mode share, travel purpose, access to the car and driving licence ownership. Older people were found to have been travelling more in terms of both trip frequency and distance travelled throughout the period of investigation, particularly by car.

Research Objective 2: *To investigate if different age and cohorts groups of older people show peculiarity and different characteristics in terms of travel behaviour during the ageing process.*

This objective was addressed again in Chapter 4 by employing an APC analysis for the investigation of the data from the NTS with regard to the period between 1995 and 2015. The investigation focused on understanding how four distinct age groups and six cohorts differed throughout the period of investigation with regard to trip frequency, distance travelled, mode share, travel purpose, access to the car and driving licence ownership. Age effects are identified for all the six aspects investigated, with 80 years old as turning point for reduced mobility. Cohort effects were found for the two groups associated with the Baby Boom generation.

Research Objective 3: *To develop a conceptual framework in order to assess travel needs fulfilment of the older population.*

This objective was addressed in Chapter 5 by employing a three-stepped approach consisting of: 1) mapping the literature investigating the factors affecting the fulfilment of travel needs amongst the older population; 2) undertaking a methodology assessment of aim(s), hypotheses, approaches, variables and findings from each of the identified study, and 3) developing a content analysis to code the information obtained in the previous stage and identify what shapes out-of-home mobility in later life. The content analysis identified five main domains and fifteen sub-themes that should to be taken into account when assessing the travel needs of the older population.

Research Objective 4: *To investigate which are the factors affecting the fulfilment of travel needs during later life.*

This objective was addressed in Chapter 6 by undertaking a case study in the city of Birmingham, UK, aimed at investigating the factors affecting the fulfilment of travel needs of the local population aged 60 years old and above. The investigation comprised of a survey questionnaire designed on the basis of the themes outlined by the conceptual framework presented in Chapter 5, and an innovative travel diary aimed at recording both realised and unfulfilled journeys. Health and wellbeing conditions and access to the car, particularly driving a car, were found to be in the survey the two main factors affecting travel needs' fulfilment with regard to both realised mobility and unmet travel needs. Around one-third of participants experienced unmet travel needs, especially visiting other people and undertaking social and leisure activities.

Research Objective 5: *To develop a segmentation of older people based on the fulfilment of their travel needs.*

This objective was addressed in Chapter 7 by developing a segmentation of older people that takes into account both realised mobility and unmet travel needs, according to the findings of the studies presented in Chapters 4, 5 and 6. Six groups are identified based on their level of travel needs fulfilment, attitude towards transport and activity engagement, namely: the Boomers; active multi-modal seniors; active car dependents; pragmatic seniors; captive car dependents; unfulfilled seniors.

8.3 Key findings of the research

The main findings of this research can be summarised as following:

- With regard to the identification of the older people's travel patterns, the investigation of the NTS shows that in the period between 1995 and 2015 the English older population have been steadily travelling more with regard to both

trip frequency and average miles travelled per week. The car is shown to be the most used transport option for travel by accounting for almost 70% of the trips. Also significant is the share of older people using the car as a passenger. Moreover, both access to the car and driving licence ownership have shown steadily increasing trends over time. These findings might explain the low usage of alternative modes to the car and particularly the decreasing trends in walking throughout the period of investigation.

- The APC analysis revealed that both age and cohort effect can be identified with regard to changes in mobility patterns in later life. Age effects were recognised for all the six mobility aspects, confirming findings from the existing literature that mobility trends decline during the ageing process. In this sense, the turning point was identified with reaching 80 years old. Cohort effects were identified regarding the significant differences in travel patterns between the two Boomers cohort groups and the remaining four cohorts. The Boomers were shown to be more mobile with regard to trip frequency, distance travelled and car usage trends than other groups.

- An additional finding was the converging trends in terms of gender differences. The investigation of the NTS shows that older men have been travelling more than their female counterparts with regard to number of trips and distance travelled, in addition to having higher trends in car usage. Nonetheless older women have been showing steadily increasing trends in trip frequency and distance travelled, driving licence ownership and access to the car, particularly as a driver. Moreover, the APC analysis reveals that the two female Boomers cohorts present similar trends to their male counterparts, while the age analysis illustrates that the gap in terms trip frequency is reducing with regard to all four

age groups.

- Looking at the identification of factors affecting the fulfilment of travel needs in later life, the analytical approach leading to the development of the conceptual framework proposed in this research outlined the need to consider a more inclusive approach when assessing out-of-home mobility of the older population. As result, the conceptual framework builds on five interrelated domains that shape and influence mobility in later life, namely: transportation, health and wellbeing, built environment and activities.

- The application of the conceptual framework through a survey questionnaire revealed that access to the car, especially driving, and health and wellbeing variables are the main factors affecting the fulfilment of travel needs amongst the older population. The descriptive statistics highlighted the importance of the car for older people's mobility and confirmed some of the issues associated with the alternative to the car identified in the literature review. Moreover, activities most unfulfilled were identified amongst those belonging to the discretionary domain, particularly social and leisure and visiting other people. This was found particularly true for those suffering health impairments and lack of availability of transport options. The logistic regression analyses revealed that lack of driving licence ownership and suffering from health impairments or reporting self-perceived poor satisfaction with health and out-of-home mobility were found to be the only variables statistically significant affecting both realised and unfulfilled mobility by increasing the chance of reducing activity frequency and experiencing more unmet travel needs. Other variables found to be statistically significant were in terms of experiencing unmet travel needs and living alone or for a limited amount of time in the same area with regard to activity frequency.

- Finally, the travel diary confirmed several findings from the questionnaire. With regard to unfulfilled mobility, discretionary activities were the most reported, particularly due to poor health conditions and lack of availability of lifts, highlighting once again the importance of the car and health for the fulfilment of travel needs. Looking at realised mobility, shopping and those activities to pursue leisure were the most undertaken. Moreover, it outlined the importance of walking for short distance trips, which accounted for more than half of the journeys undertaken.

8.4 Value of the research

The value of this research was reached by producing both theoretical and empirical notions regarding transport culture and rationales, mobility coping strategies and the identification of the factors affecting the fulfilment of travel needs amongst the older population. This research develops and employs a conceptual framework to assess both realised and unmet travel needs of the older population, by the means of not only transport variables, but also on the basis of other domains that shape and influence out-of-home mobility during later life. While the existing studies investigating this topic are usually built upon theoretical concepts of needs satisfactions and wellbeing, the peculiarity of the proposed framework relies on overcoming potential contrasts of these theories by adopting an intensive methodology assessment of studies in order to identify all aspects that have to be taken into consideration when assessing mobility amongst older people. Therefore, the framework has the potential to contribute to a better understanding regarding mobility fulfilment amongst older people and future research can employ this framework in order to further investigate the insights generated on travel needs fulfilment. These insights can be used to help the development of more targeted interventions regarding age-friendly transport and environments and, more generally, the linkage between mobility and wellbeing in later life.

It is important to highlight that individual studies might differ from a more theoretical approach according to their purpose, sample and context of investigation, which may lead to some bias in the choice of variables for inclusion. Hence, the conceptual framework outlined here does not set out a precise protocol to follow, but rather highlights the factors and variables which need to be taken into account when addressing travel needs fulfilment in later life.

In particular, this research deepens the investigation of the unmet travel needs in later life, by developing an exhaustive review of the literature and by helping to understand not only how the investigated variables affect this issue from a general point of view, but also for specific types of unfulfilled activities. In this sense, an additional contribution to existing knowledge is the development of an innovative travel diary aimed at collecting information not only about realised travel, but also trips that older people would have liked or needed to undertake, but for some reason they were not able to do.

An additional contribution consists in providing a wider picture of travel needs fulfilment amongst the older population in the context of the UK, by adding value and contributing to the work done so far by other scholars (Musselwhite, 2017b, Knight et al., 2007, WS Atkins, 2001, Musselwhite and Haddad, 2010b). Finally, it confirms that not driving a car and having poor health and wellbeing conditions are the main predictors of unfulfilled mobility and that discretionary activities are the most reported in this sense, in line with the findings of the literature review stated in Section 2.2.2.

8.5 Recommendation for future research

A series of potential avenues for future research have arisen as a result of the findings from this study. Looking at the case study context, the NTS data show that trends in car dependence in later life are less accentuated than other contexts, such as the U.S.A or

Australia, but are still significant. The car is the most used mode for undertaking activities and also the preferred option for those who do not drive and driving license trends are forecast to increase notably, especially due to the contribution of the new generation of older women who currently drive. Nonetheless, there will still be the need to provide a transport system supporting mobility for those who cannot access and use the car to fulfil their travel needs.

Older drivers planning their driving cessation in advance were found to report less problems in dealing with everyday mobility once they stopped driving due to the knowledge acquired and mastered in using alternative transport resources during the process (Musselwhite, 2011, Musselwhite, 2010). Conversely, older drivers who did not plan their driving cessation will be likely to experience loss of independence and overall reduction of out-of-home mobility trends which might affect their quality of life and lead to potential depression symptoms (Marottoli et al., 1997). The segmentation of older people provided in Section 7.2.4 identifies three group that might be affected in this sense due to their significant reliance on car and negative attitude towards alternative modes (i.e. the Boomers, Active car dependents and Captive car dependents). Therefore, it might be interesting to investigate the effect on training schemes provided by local transport authorities and/or public transport service providers and operators, specifically run for older people on how to use public transport or FTS. Potential training could be aimed at preventing accidents, on how to behave on-board (e.g. how to safely board or alight, stand and sit) and understanding information related to the journey, both on-board and at stops/stations.

An additional measure to address older people's needs and improve their attitude towards alternatives to the car could rely on investigating directly with them potential barriers or in general factors preventing them using these transport modes. In this sense, older people

might be involved by local transport authorities and service providers in participatory sessions (e.g. round-table workshops), to understand directly their points of view not only in terms of problems and barriers faced, but also with regard to suggestions for:

- planning (e.g. bus stop location);
- service provision (e.g. providing information at all stages of the trip – from bus stop to on-board- or improving awareness about available services by locating timetables and maps in places frequented traditionally by the older population, such as churches, ageing and community centres, doctor's surgeries and other medical institutions and shopping malls);
- design issues (allowing more complete shelter from adverse weather and granting more comfort, visibility and better information about service and routes available.

Segments such as Pragmatic seniors, Captive car dependents and Unfulfilled seniors (see Section 7.2.4) might particularly benefit from these activities.

At the same time, it is crucial to reduce the gap with the car in terms of the performance of other modes, particularly for flexibility, availability, and the ability to fulfil discretionary needs. The integration within the public transport network system of both FTS and taxis might allow a more customised service provision able to meet the travel needs of all segments of the older population, and at the same time reduce the impact of the identified perceived barriers for these modes.

The advent of new transport options related to the improvements of ICT, such as dynamic car-sharing services (e.g., Car2Go, DriveNow and Zipcar), dynamic ridesharing services (e.g., BlaBlaCar and Flinc) and peer-to-peer transport schemes (e.g., Uber and Lift), if

integrated in the transport network, could also help with this process in the near future (Ambrosino et al., 2016). Ambrosino et al. (2016) highlighted how the concept of a shared mobility service agency might be able to produce a new form of transport service provision for individual and collective transport that might address both the overall service accessibility and the environmental implications of transport. These modes can potentially represent a more suitable option compared to taxis, since they are characterised by being usually cheaper and providing reduced booking and waiting times. This might help to reduce the gap with private vehicles especially in relation to spontaneity of trips for leisure activities. Moreover, helpful features such as background information about the driver and car, fare estimation and split fare options might help overcome issues related to taxi service provision. Very little research has investigated ridesharing among the older population. Research about usage trends and how service providers could target older people as customers, especially from the technological point of view, might lead to new opportunities for mobility in later life. This might show particularly interesting results considering that the next generation of older people is likely to be more accustomed to technology than the current one.

The development of Autonomous Vehicles (AV) might add a further option in this sense. AV can be defined as those vehicles in which direct control by the driver is not required due to the self-driving characteristics of the vehicle (NHTSA, 2013). In spite of the implications associated with potential increases in travel demand, especially from an environmental point of view, AV technology offers the possibility to create a revolution in the transport system (Nielsen and Haustein, 2018, Thomopoulos and Givoni, 2015). Potential advantages in this sense are those related to improvements in route operations, with consequent reductions in traffic congestion, fuel emission, cost and driving stress; improved road safety and the opportunity to engage with other activities while travelling. Moreover, AV are likely to

increase transport access to unserved populations such as older people, disabled and more generally the non-driving population (Anderson et al., 2014, Clark et al., 2016, Harper et al., 2016, Thomopoulos and Givoni, 2015). As advocated by Burns (2013), AV have the potential for the development of a system based on better connected, coordinated, shared, driverless, electric and tailored vehicles. AV can offer the opportunity to accommodate a new travel demand by offering a more accessible transport option. With regard to older people, a key element to investigate in future research is their potential attitudes and perception towards driverless technology. Despite potential safety benefits of in-vehicle safety technologies (e.g., warning collision/mitigation, parking assist, navigation assistance), older people might find difficulties in adapting to a new way of transportation highly based on technology. Shergold et al. (2016) found in their review that older people are open to new technologies increasing their safety, but less so with regard to the concept of AV. In this sense older people were found to be less likely to embrace driverless cars compared to younger generations, to be concerned about the lack of control of the car and about the implications of learning how to use a new transport mode at an advanced age.

As the demographic trends associated with ageing are predicted to increase, it is likely that this will have a significant impact on the transport system. This research has proposed a framework to assess the factors affecting travel needs fulfilment in later life, however there is a need to investigate if policy makers, decision-takers, transport authorities and transport service providers are fully aware of the implications of these changes and which are their views in this sense. Therefore, it will be crucial to understand the level of awareness regarding the demographic changes that the UK society is forecast to face, and consequently what kind of policies, strategies and actions need to be planned and developed, considering that older people might become a more sizable travel market.

The APC analysis suggests that the Boomers cohorts will be significantly different in travel patterns and behaviour compared to previous generations, and the segmentation of the older people outlined in Section 7.2.4 shows that this group presents specific characteristics in terms of level of travel needs fulfilment, attitude towards transport and activity engagement, as also found by both Coughlin (2009) and Siren and Haustein (2015). In the light of these findings, three main issues might be needed to be addressed by future policies and studies. First, to specifically investigate their travel patterns and needs, attitudes towards transport, unmet travel needs and mobility expectations that this group has related to their ageing. Second, the role of women is changing. Older women are expected to be more independent compared to previous generations (Coughlin, 2009), and therefore it is reasonable to expect more demand for general mobility from this group. However, older women are also usually the ones burdened with running a household. In this sense, Baby Boomers have been described as the "sandwich generation", due to caregiving duties of both their parents and grandchildren (as cited in Siren and Haustein, 2015). Given this research identified that women experience more unmet travel needs, there is a need to understand more deeply the changes forecast for older women and solutions to reduce potential risks of unrealised mobility. Third, the Boomers cohorts will be characterised by increasing demands for discretionary activities. However, this research found that those type of activities are the ones older people report to be more unfulfilled. Therefore, there is a need for more investigation of discretionary activities and factors that influence these, as well as mobility patterns, accessibility, travel choice and lifestyle in order to meet not just basic and utilitarian needs.

Ageing in place is another phenomenon associated with the older population, particularly amongst the Boomers cohorts. This is especially valid for contexts such as the U.S.A., in which almost two-thirds of older people live in sub-urban and rural areas (Rosenbloom,

2004a). This research found a positive association between ageing in place and increase of activity frequency, while Kim et al. (2014) found it to decrease the chances of experiencing unmet travel needs. Urban, sub-urban and rural structures vary from country to country and therefore comparison of findings is difficult. Nevertheless, Scheiner (2006) underlined how a specific spatially differentiated analysis of both leisure and non-leisure activity might lead to a more peculiar spatial effect. Moreover, Nordbakke (2013) highlights how the quality of location, built environment and presence of parking facilities at an activity may constitute either a barrier or an incentive for mobility. Further investigation of this aspect, as well as supporting studies with spatial analysis designed to understand accessibility to transport options, service and leisure facilities might help to assess the real relevance of built environment and the development of transport services that effectively meet the needs or desired activities in later life.

Finally, travel survey methods are generally not designed to understand unmet travel needs. On average, unfulfilled mobility is usually assessed solely by asking questions about general mobility satisfaction or if there are times older people cannot carry out activities they want to make. In the first case the main weakness is that, unless not exactly defined, satisfaction rates might be biased due to the fact that satisfaction and dissatisfaction do not automatically exclude each other, but are two different concepts (Siren and Hakamies-Blomqvist, 2004). In the second case the level of importance of the desired activities is not always clear. In the literature, travel needs are often categorised from a hierarchical point of view based on importance of the journey (e.g. serious versus discretionary travel). However, when asking older people about the importance of their unmet needs, this difference rarely comes to light, with a few exceptions (Wasfi et al., 2012, Siren and Haustein, 2014). As future generations of older people are likely to be healthier and wealthier and with higher mobility expectations, it might be important to understand the difference between the activities older people need

to do more and the ones they wish to do more. This research attempted to accomplish this by developing a travel diary that combined the two dimensions of travel, in order to gather not only detailed information about realised mobility, but also all trips that for some reason are not achievable. The NTS might employ this approach for their travel diary, in addition to improving the amount and the consistency of questions over the years regarding travel barriers and difficulties in undertaking single out-of-home activities.

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APPENDIX A

List of publications

LUIU, C., TIGHT, M. & BURROW, M. 2015. Design of urban transport systems to meet the needs of an older population. In: MACÁRIO, R. (ed.) *The 14th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED 2015).* Lisbon, Portugal.

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APPENDIX B

Survey package

UNIVERSITY OF BIRMINGHAM

Design of urban transport systems to meet the needs of an older population

Dear Birmingham Resident,

The British older population is expected to rise by 50% over the next decades. Such rapid increase is likely to pose major challenges to the provision transport and accessibility.

This research project is aimed at investigating if the current UK urban transport system meets the mobility needs of the older population.

Now you can help! We are inviting people aged at least 55 years old and living in the Birmingham area to take part in this research project. Participation involves answering a survey questionnaire and filling a travel diary. The aim of the survey is to understand experiences in everyday mobility, your travel activity and behaviour and barriers affecting your mobility. Participation in this study is voluntary.

The research project has been reviewed and received ethical approval through the University of Birmingham Ethic Review Committee.

Please read the enclosed instructions and complete the enclosed household survey and travel diary within 2 weeks after you receive this survey package. The survey and travel diary should be mailed using the enclosed postage-paid envelope.

Thank you very much! The log is easy to complete and will be helpful to our community.

Sincerely,

Carlo Luiu
Doctoral researcher
School of Engineering
College of Engineering and Physical Sciences
University of Birmingham

Design of urban transport systems to meet the needs of an older population

INVITATION

You are being invited to take part in a research study assessing if the current UK urban transport system is adequate and meet the mobility needs of the older population. This research is part of a PhD project of the School of Civil Engineering at the University of Birmingham.

PARTICIPANTS' RIGHTS

Participation to the research is voluntary and you will be free to withdraw during the research without any negative consequences by simply notifying your decision to the researcher within 30 calendar days after the submission of the questionnaire or the day of the interview. If you decide to withdraw, all the data collected during both questionnaire and potential follow-up interview will be considered not valid and discarded, while the audio record deleted.

The research may involve investigating issues such as health impairment, experiences in daily life and reduction/cessation of mobility that can be potentially emotive to you. Although you decide to take part in the interview session, you are free to refuse to answer to particular questions, and also to interrupt and/or finish the interview at any time.

CONFIDENTIALITY/ANONYMITY

Your personal data will be treated as confidential. No one will link the data you provided to the identifying information you supplied. Personal data present in the questionnaires will be associated with an ID code number. The audio data for potential follow-up interview sessions will be associated with an arbitrary name and used only for transcription purpose.

COST, REIMBURSEMENT AND COMPENSATION

Your participation in this study is voluntary, no financial compensation will be provided for the questionnaire session. A £10.00 voucher for supermarket will be offered for participation in potential follow-up interview sessions. You will be reimbursed for travel expenses if you have to come to the University of Birmingham for the interview session. Hot beverages and biscuits will also be supplied during interview if taken at the University of Birmingham. If for any reason you decide to withdraw, both voucher and travel expenses will be will be guaranteed anyway.

DISADVANTAGES AND RISKS

There are no potential risks or disadvantages to you in taking part to this research.

SURVEY INSTRUCTIONS

THE MATERIALS

This packet contains:

a) a cover letter and these instructions
b) a household travel questionnaire
c) a travel diary
d) a postage pre-paid return envelope.

Please review the materials briefly before continuing to read the instructions. If any materials are missing, or you need further information about the survey, please contact Carlo Luiu at c.luiu.1@pgr.bham.ac.uk or 07455702118.

HOUSEHOLD TRAVEL QUESTIONNAIRE

The questionnaire is aimed at understanding the relationship between mobility and ageing, with regard to health conditions, age, gender, place of residence, modal choice and travel behaviour. The questionnaire will help this research to better understand your use of transport, perception and level of satisfaction of the transport system provision. There are no right and wrong answers to the questions. Your answer will be kept in strict confidence and only used for this research.

An online survey questionnaire is also available at

http://www.surveygizmo.eu/s3/90012435/1ea8252c2066

TRAVEL DIARY

The travel diary is aimed at collecting data on travel behaviour and unfulfilled travel needs and wishes by recording both realised and unrealised mobility

An online survey questionnaire is also available at

http://www.surveygizmo.eu/s3/90012444/TRAVEL-DIARY

Your travel diary day

The day selected for you to record your travel on the enclosed Travel Diary is the first day after you receive this document.

You should keep your travel diary on this day regardless of weather or number and type of activities you have planned.

Completing your travel diary

Your Travel diary is composed of 2 main parts:

1) a diary for realised mobility, in which you keep record of the purpose of your journeys and the transport mode used for travelling;

2) a diary for unrealised mobility, in which you keep record of potential journeys you need or wish to do, but for some reason you were not able to do it.

You should not change your travel behavior just because you are keeping this diary. If you were going to take the car, take the car. If you were planning to go by bus, go by bus. Don't let the fact that you are recording your travel influence how or whether you go places.

Honest responses of your travel behavior for a single day whether your travel is typical or unusual are needed for this study to be reliable. Please record all trips whether you are a passenger, driver or pedestrian. If you will be out of town or have a problem with the day you have been assigned, you may complete the diary on the same day of the next week.

What is a trip

A trip is a one-way journey that takes you further than 200 yards from your original location.

Examples of what does NOT count as a journey include:

1) you walk across the hall to use the telephone

2) you drive to the next building (less than 200 yards away) for shopping.

A round journey counts as two trips. For example:

1) You drive to the grocery store and back. Record two journeys on your diary.

2) You go for a 20 minutes' walk or bike ride and then go home. (This is counted as two trips because you leave home on the first leg of the journey and return home on the second leg. Your "destination" is your halfway point.)

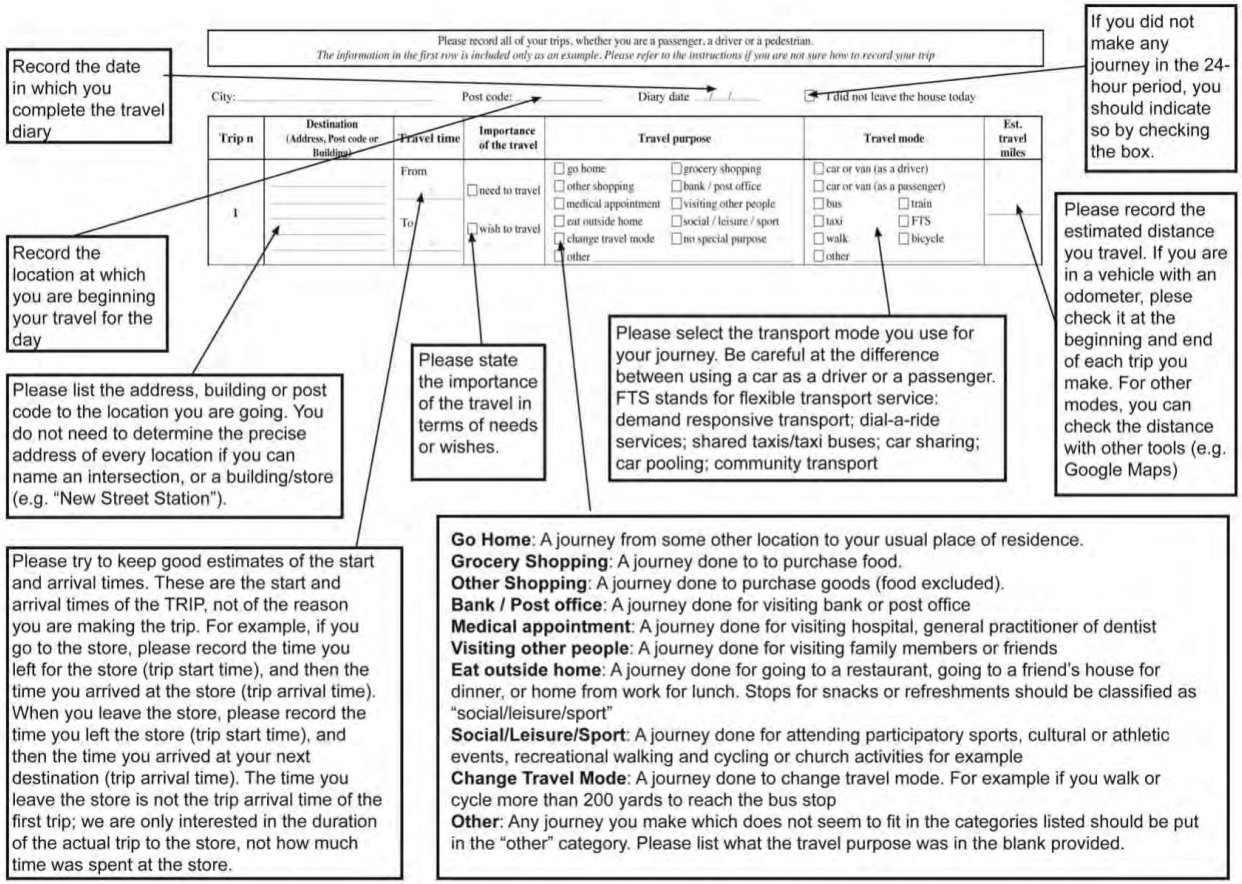
What about journeys with multiple stops? Record each leg of the journey. An example:

You walk with your grandchild to school, then take a bus to shop, then while returning home you stop to pick up a prescription at the pharmacy. This would be counted as 4 journeys.

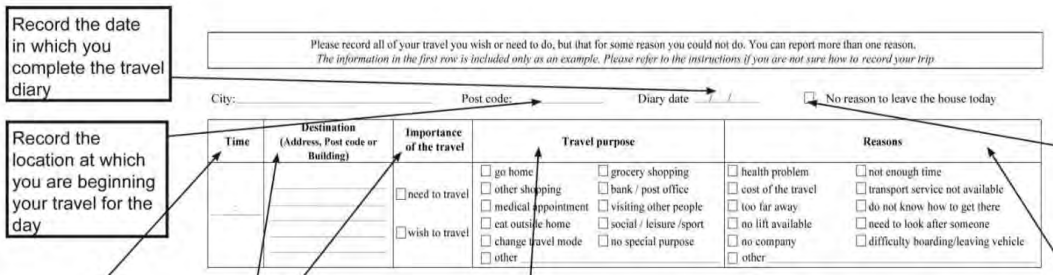
Outbound from your home the destination is the school. The next destination is shop store.

Inbound back to your home, record first the stop at the pharmacy, and then your home.

INSTRUCTIONS FOR COMPLETING THE TRAVEL DIARY – REALISED MOBILITY



INSTRUCTIONS FOR COMPLETING THE TRAVEL DIARY – UNREALISED MOBILITY



Please record all of your travel you wish or need to do, but that for some reason you could not do. You can report more than one reason.
The information in the first row is included only as an example. Please refer to the instructions if you are not sure how to record your trip

City: _____ Post code: _____ Diary date __/__/____ ☐ No reason to leave the house today

Time	Destination (Address, Post code or Building)	Importance of the travel	Travel purpose		Reasons	
		☐ need to travel	☐ go home	☐ grocery shopping	☐ health problem	☐ not enough time
			☐ other shopping	☐ bank / post office	☐ cost of the travel	☐ transport service not available
			☐ medical appointment	☐ visiting other people	☐ too far away	☐ do not know how to get there
		☐ wish to travel	☐ eat outside home	☐ social / leisure /sport	☐ no lift available	☐ need to look after someone
			☐ change travel mode	☐ no special purpose	☐ no company	☐ difficulty boarding/leaving vehicle
			☐ other _____		☐ other _____	

Record the date in which you complete the travel diary

Record the location at which you are beginning your travel for the day

Please try to keep good estimates of the time of your needed or wished travel

Please state the importance of the travel in terms of needs or wishes.

Please list the address, building or post code to the location you are going. You do not need to determine the precise address of every location if you can name an intersection, or a building/store (e.g. "New Street Station").

If you did not make any journey in the 24-hour period, you should indicate so by checking the box.

Go Home: A journey from some other location to your usual place of residence.
Grocery Shopping: A journey done to to purchase food.
Other Shopping: A journey done to purchase goods (food excluded).
Bank / Post office: A journey done for visiting bank or post office
Medical appointment: A journey done for visiting hospital general practitioner of dentist
Visiting other people: A journey done for visiting family members or friends
Eat outside home: A journey done for going to a restaurant, going to a friend's house for dinner, or home from work for lunch. Stops for snacks or refreshments should be classified as "social/leisure/sport"
Social/Leisure/Sport: A journey done for attending participatory sports, cultural or athletic events, recreational walking and cycling or church activities for example
Change Travel Mode: A journey done to change travel mode. For example if you walk or cycle more than 200 yards to reach the bus stop
Other: Any journey you make which does not seem to fit in the categories listed should be put in the "other" category. Please list what the travel purpose was in the blank provided.

Health problem: A journey unrealised due to physical and health impairments
Not enough time: A journey unrealised due to lack of time
Cost of the travel: A journey unrealised due to not being to afford the cost
Transport service not available: A journey unrealised due to lack or inefficiency of transport service
Too far away: A journey unrealised due to physical distance to destination
Do not know how to get there: A journey unrealised due to lack of knowledge about how to reach a destination
No lift available: A journey unrealised due to lack of availability of lift from relatives or friends
Need to look after someone: A journey unrealised due to need to look after someone (e.g. spouse or granchild)
No company: A journey unrealised due to lack of people to share the journey with
Difficulty boarding / leaving vehicle: A journey unrealised due to physical difficulties to board or alight a vehicle
Other: Any reason you have which does not seem to fit in the categories listed should be put in the "other" category. Please list what the travel purpose was in the blank provided.

Design of urban transport systems to meet the needs of an older population
HOUSEHOLD TRAVEL SURVEY

Please complete the following survey regarding your household and return with your Travel Diaries. This survey should take only a few minutes. It is important because it will help this research to better understand your use of transport, perception and level of satisfaction of the transport system provision. There are no right and wrong answers to the questions. Your answer will be kept in strict confidence and only used for this research. Thank you for your time and help.

IMPORTANCE OF TRANSPORT IN LIFE

1. Overall, how important do you rate the role that transport has for you, in order to be able to do what you want?

☐ not very important ☐ not important ☐ neither important or not important ☐ important ☐ very important

2. Overall, how important do you rate the role that these transport modes have for you, in order to be able to do what you want?

	not very important	not important	neither important or not important	important	very important
car / van	☐	☐	☐	☐	☐
bus	☐	☐	☐	☐	☐
train	☐	☐	☐	☐	☐
walking	☐	☐	☐	☐	☐
cycling	☐	☐	☐	☐	☐
taxi	☐	☐	☐	☐	☐
flexible transport services*	☐	☐	☐	☐	☐

** demand responsive transport; dial-a-ride services; shared taxis/taxi buses; car sharing; car pooling; community transport.*

TRAVEL PURPOSE INFORMATION

3. On average, how many times you carry out the following travel activities?

	at least twice a week	once a week	twice a month	once a month or less	never
grocery shopping	☐	☐	☐	☐	☐
other shopping	☐	☐	☐	☐	☐
bank / post office	☐	☐	☐	☐	☐
medical appointment	☐	☐	☐	☐	☐
visit other people	☐	☐	☐	☐	☐
eat outside home	☐	☐	☐	☐	☐
social / leisure / sport	☐	☐	☐	☐	☐
have a walk	☐	☐	☐	☐	☐
other	☐	☐	☐	☐	☐

specify other: _____

4. Which travel mode do you mainly use to carry out the following activities?

	car / van (as driver)	car / van (as passenger)	bus	train	walking	cycling	taxi	flexible transport services
grocery shopping	☐	☐	☐	☐	☐	☐	☐	☐
other shopping	☐	☐	☐	☐	☐	☐	☐	☐
bank / post office	☐	☐	☐	☐	☐	☐	☐	☐
medical appointment	☐	☐	☐	☐	☐	☐	☐	☐
visit other people	☐	☐	☐	☐	☐	☐	☐	☐
eat outside home	☐	☐	☐	☐	☐	☐	☐	☐
social / leisure / sport	☐	☐	☐	☐	☐	☐	☐	☐
have a walk	☐	☐	☐	☐	☐	☐	☐	☐
other	☐	☐	☐	☐	☐	☐	☐	☐

specify other: _____

5. On average, how satisfied are you with your own outdoor mobility?

- ☐ not very satisfied
- ☐ not satisfied
- ☐ neither satisfied or not satisfied
- ☐ satisfied
- ☐ very satisfied

6. Are there times when you cannot make trips you want?

☐ yes ☐ no *(if no, please go to Q. 9)*

7. If yes, for which one of the following activities would you like to make more trips? *(you can select more than one option)*

- ☐ have a walk
- ☐ grocery shopping
- ☐ other shopping
- ☐ bank / post office
- ☐ medical appointment
- ☐ visiting other people
- ☐ eat outside home
- ☐ social / leisure / sport
- ☐ other _____

8. Which are the main reasons that prevent you from making these trips? *(you can select more than one option)*

- ☐ health problem
- ☐ not enough time
- ☐ cost of the travel
- ☐ transport service not available
- ☐ too far away
- ☐ do not know how to get there
- ☐ no lift available
- ☐ need to look after someone
- ☐ no company
- ☐ difficulty board/leave vehicle
- ☐ other _____

GENERAL TRAVEL INFORMATION

9. How many cars / vans are owned by people in your household? _____

10. Do you hold a car driving licence?

☐ yes ☐ no

11. If you answered no, why do you not hold a car licence?

- ☐ never had
- ☐ not renewed
- ☐ voluntary stopped driving

12. *For those who use a car / van as driver*
How often do you currently drive a car or a van?

- ☐ rarely
- ☐ not often
- ☐ sometimes
- ☐ often
- ☐ always

13. *For those who use a car / van as passenger*
How often can you get a lift whenever you want?

- ☐ rarely
- ☐ not often
- ☐ sometimes
- ☐ often
- ☐ always

14. Do you regularly use any form of public transport?

☐ yes ☐ no

15. How often do you use public transport for your travels?

- ☐ never or hardly ever
- ☐ about once or twice a month
- ☐ once a week
- ☐ twice a week
- ☐ more than twice a week

16. Which are the main barriers that prevent you from using public transport? *(you can select more than one option)*

- ☐ unsuitable routes and timetables
- ☐ service infrequent and unreliable
- ☐ service not available where I live
- ☐ bus stop too far from my house
- ☐ difficulties boarding / alighting vehicle
- ☐ being afraid to travel alone
- ☐ driver's behaviour
- ☐ other users' behaviour
- ☐ overcrowding
- ☐ inadequate bus shelter
- ☐ lack of space for shopping loads
- ☐ cost of the travel
- ☐ difficulties in getting information
- ☐ difficulties in understanding timetables
- ☐ difficulties in purchasing ticket
- ☐ lack of comfort on board
- ☐ other _____

17. Are you eligible to hold a concessionary pass?

☐ yes ☐ no ☐ don't know

18. Do you hold a concessionary pass?

☐ yes ☐ no

19. In the last month, how many times have you walked?

For recreation	As transport mode
☐ 5 or more times a week	☐ 5 or more times a week
☐ 2 to 4 times a week	☐ 2 to 4 times a week
☐ once a week	☐ once a week
☐ twice a month or less	☐ twice a month or less
☐ never	☐ never

20. In the last month, how many times have you cycled?

For recreation	As transport mode
☐ 5 or more times a week	☐ 5 or more times a week
☐ 2 to 4 times a week	☐ 2 to 4 times a week
☐ once a week	☐ once a week
☐ twice a month or less	☐ twice a month or less
☐ never	☐ never

21. Do you frequently use taxi for your travels?

☐ yes ☐ no *(if no, please go to Q.23).*

22. If you answered yes, how often do you use taxi from your travels?

☐ never or hardly ever
☐ about once or twice a month
☐ once a week
☐ twice a week
☐ more than twice a week

23. Can you state up to 3 reasons that prevent you from using taxi?

24. Do you use any form of flexible transport service for your travels?

☐ yes ☐ no *(if no, please go to Q.28)*

25. *For those who are flexible transport services user*
How often do you use this kind of service for your travel?

☐ rarely
☐ not often
☐ sometimes
☐ often
☐ always

26. Can you state up to 3 aspects you like about the use of flexible transport services for your travel?

27. Can you state up to 3 aspects you dislike about the use of flexible transport services for your travel?

28. Can you state up to 3 reasons that prevent you from using flexible transport services for your travel?

29. Do you usually plan your trips?

☐ yes ☐ no *(if no, please go to Q.33)*

30. If you answered yes, how frequently do you plan your trips?

☐ rarely
☐ not often
☐ sometimes
☐ often
☐ always

31. On average, how much time do you spend planning your trips?

☐ less than 1 hour
☐ less than 10 hours
☐ one day
☐ more than two days
☐ more than a week

32. What kind of planning tool do you usually use for your trips? *(you can select more than one option)*

- ☐ AA route planner
- ☐ Cyclestreets
- ☐ Google maps
- ☐ National Rail enquires
- ☐ RAC route planner
- ☐ Traveline
- ☐ Walkit
- ☐ mobile app _____
- ☐ other _____

33. Can you state up to 3 reasons for not using planning tools for your travels?

_____

_____

_____

_____

PLACE OF LIVING

34. On average, how do you rate your overall satisfaction about the area where you live?

- ☐ not very satisfied
- ☐ not satisfied
- ☐ neither satisfied or not satisfied
- ☐ satisfied
- ☐ very satisfied

35. Is there any public transport service in the area where you live?

☐ yes ☐ no ☐ don't know

36. If you answered yes, how distant are bus stops or train stations from your house?

- ☐ too distant
- ☐ distant
- ☐ neither distant or close
- ☐ close
- ☐ very close

37. Are there any facility services and shops in the area where you live?

☐ yes ☐ no ☐ don't know

38. How difficult do you consider accessing the service facilities and shops in the area where you live?

- ☐ very difficult
- ☐ difficult
- ☐ neither difficult or easy
- ☐ easy
- ☐ very easy

HEALTH CONDITION INFORMATION

39. On average, how do you rate your overall satisfaction about your health conditions?

- ☐ not very satisfied
- ☐ not satisfied
- ☐ neither satisfied or not satisfied
- ☐ satisfied
- ☐ very satisfied

40. Do you have any health problem, disability or general frailty that might affect your ability to use any kind of transport mode?

☐ yes ☐ no *(if no, please go to Q.43)*

41. Can you state what kind of health problem, disability or general frailty do you have or had in the last 5 years?

- ☐ anemia
- ☐ arthritis
- ☐ cancer
- ☐ mild cognitive impairments
- ☐ dementia
- ☐ depression
- ☐ epilepsy
- ☐ heart impairments
- ☐ high blood pressure
- ☐ hyperthyroidism
- ☐ obesity
- ☐ osteoporosis
- ☐ pain in joints
- ☐ Parkinson's disease
- ☐ reduced eyesight
- ☐ reduced hearing
- ☐ reduced mobility in legs or feet
- ☐ respiratory diseases
- ☐ stroke
- ☐ other _____

42. Can you rate the extent to which your health problem, disability or general frailty makes it difficult to use the following transport modes?

	not difficult at all	not very difficult	difficult	very difficult	impossible	N/A
car / van	☐	☐	☐	☐	☐	☐
bus	☐	☐	☐	☐	☐	☐
train	☐	☐	☐	☐	☐	☐
walking	☐	☐	☐	☐	☐	☐
cycling	☐	☐	☐	☐	☐	☐
taxi	☐	☐	☐	☐	☐	☐
flexible transport services	☐	☐	☐	☐	☐	☐

PERSONAL INFORMATION

43. Are you:

☐ female ☐ male

44. Age: _____

45. Post code: _____

46. How many people live in your household?
(including yourself) _____

47. Do you have any dependant persons in your household?

☐ yes ☐ no

48. Which of the following best represents your family status?

☐ single ☐ living with a partner
☐ married ☐ living with other family member
☐ widowed ☐ separated / divorced
☐ other _____

49. Which of the following best represents your working status?

☐ retired ☐ full-time employed
☐ unemployed ☐ part-time employed
☐ other _____

50. How much education have you completed?

☐ primary education
☐ secondary education
☐ higher education
☐ other _____

51. How much was your total gross 2015 income?

☐ less than £9,999
☐ £10,000 to £14,999
☐ £15,000 to £24,999
☐ £25,000 to £44,999
☐ more than £45,000

52. Which of the following best describes your ethnic background?

☐ White British
☐ White other background
☐ Black or Black British - Caribbean
☐ Black or Black British – African
☐ Black other background
☐ Asian or Asian British - Indian
☐ Asian or Asian British - Pakistani
☐ Asian or Asian British – Bangladeshi
☐ Chinese
☐ Arab
☐ Mixed - White and Black Caribbean
☐ Mixed – White and Black African
☐ Mixed – White and Asian
☐ Other mixed background _____
☐ Other ethnic background _____
☐ Not known
☐ Information Refused

53. How many years have you lived in your current neighbourhood? _____

THANK YOU FOR YOUR TIME AND YOUR HELP WITH THE SURVEY

Please record all of your trips, whether you are a passenger, a driver or a pedestrian.
The information in the first row is included only as an example. Please refer to the instructions if you are not sure how to record your trip

City: _____ Post code: _____ Diary date __/__/____ ☐ I did not leave the house today

Trip n	Destination (Address, Post code or Building)	Travel time	Importance of the travel	Travel purpose	Travel mode	Est. travel miles
example	Harborne Medical Practice B17 0HG	From 10 : 30 To 10 : 45	☒ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☒ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☒ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	1.5
1		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	
2		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	
3		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	

Please record all of your trips, whether you are a passenger, a driver or a pedestrian.
The information in the first row is included only as an example. Please refer to the instructions if you are not sure how to record your trip

City: _____ Post code: _____ Diary date __/__/____ ☐ I did not leave the house today

Trip n	Destination (Address, Post code or Building)	Travel time	Importance of the travel	Travel purpose	Travel mode	Est. travel miles
4		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	
5		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	
6		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	
7		From : To :	☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other _____	☐ car or van (as a driver) ☐ car or van (as a passenger) ☐ bus ☐ train ☐ taxi ☐ FTS ☐ walk ☐ bicycle ☐ other _____	

Please record all of your travel you wish or need to do, but that for some reason you could not do. You can report more than one reason.
The information in the first row is included only as an example. Please refer to the instructions if you are not sure how to record your trip

City: ____________ Post code: ____________ Diary date __/__/____ ☐ No reason to leave the house today

Time	Destination (Address, Post code or Building)	Importance of the travel	Travel purpose	Reasons
14 : 00	Harborne Medical Practice B17 0HG	☒ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☒ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure /sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☒ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
:		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
:		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
:		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____

Please record all of your travel you wish or need to do, but that for some reason you could not do. You can report more than one reason.
The information in the first row is included only as an example. Please refer to the instructions if you are not sure how to record your trip

City: ________ Post code: ________ Diary date __/__/____ ☐ No reason to leave the house today

Time	Destination (Address, Post code or Building)	Importance of the travel	Travel purpose	Reasons
__:__		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure /sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
__:__		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
__:__		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____
__:__		☐ need to travel ☐ wish to travel	☐ go home ☐ grocery shopping ☐ other shopping ☐ bank / post office ☐ medical appointment ☐ visiting other people ☐ eat outside home ☐ social / leisure / sport ☐ change travel mode ☐ no special purpose ☐ other ____	☐ health problem ☐ not enough time ☐ cost of the travel ☐ transport service not available ☐ too far away ☐ do not know how to get there ☐ no lift available ☐ need to look after someone ☐ no company ☐ difficulty boarding/leaving vehicle ☐ other ____