A FRAMEWORK FOR MODELLING SPATIAL TRANSPORT VULNERABILITIES FOR THE OLDER POPULATION IN MALTA

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A Doctoral thesis submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy at the University of Malta

May 2018

To my parents & Karl

Declaration

This is to declare that this thesis is an original and unpublished study carried out by the undersigned and is presented to the University of Malta for the first time as part of the requirements for the award of Doctor of Philosophy.

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Abstract

In recent years, several countries around the world have continued to experience growing older populations. This increase is a reflection of social and economic progress. However it is also a major challenge in various sectors, including transport.

Transport is an essential infrastructure for older people to be independent and maintain a good quality of life. The current generations of older people are becoming more active and mobile, primarily due to the rapid increase in older drivers. However, the older population is also ageing in itself which means that the number of older-old people is increasing. Due to physiological changes associated with ageing, these usually suffer from limitations in their travel. Travel behaviour in later life is therefore very heterogeneous, and the determinants of mobility very complex.

Malta experienced a significant increase in its older population in recent years, is a country which suffers from very high car dependence and has the highest population density in Europe. Nevertheless, it is still an under-researched case study and mobility of older people is not given much consideration in transport policy. The aim of this study is to investigate the travel behaviour of older people in Malta and provide recommendations for independent mobility in later life. The research adopts a social psychological approach, using the Theory of Interpersonal Behaviour (TIB) as its underpinning framework. The research method employed to fulfil this aim is a telephone-based questionnaire survey with older people in Malta.

The aim of the study is primarily achieved through an understanding of the objective and psychological determinants of travel behaviour in later life. Clusters of older people are also developed to understand the differences and similarities between older road users and their implications for policy are discussed accordingly. The five top determinants that affect travel behaviour for older people in Malta are age, district, participation in social activities, occupation status and the presence of an assistive device. With regard to the psychological factors, travel behaviour of older people in Malta is mostly guided by their cognitive thinking i.e. intention. The latter is mostly affected by their social norms and self-concept. Although with a smaller impact than that of intention, habit and facilitating conditions are also positive significant factors predicting mobility in later life. The three clusters of older people in Malta are *Complacent and Autonomous Younger-Old*, *Slightly Restrained Younger-Old* and *Pessimistic Limited-Mobility Older-Old*. Significant differences emerge between these three clusters, even between the two composed of younger-old people.

The study also provides recommendations for more independent mobility in later life. These range from a reduction in the car use habit, an understanding of the psychological characteristics of travel behaviour and improvements in the public transport system to further cater for the mobility needs of older people. The introduction of new flexible transport services, road safety training courses, informal seminars and volunteer driving programmes in Malta is also discussed. Older people in Malta should also be provided with a more "facilitating" transport infrastructure and should be encouraged to participate further in social activities.

Keywords: *Older population, travel behaviour determinants, clusters, Theory of Interpersonal Behaviour, Malta.*

Acknowledgements

My sincerest thanks must go firstly to my PhD supervisors, Professor Maria Attard (University of Malta) and Professor Stephen Ison (Loughborough University). Aside from their extensive ability and knowledge, I have greatly benefited from their experience, support, patience and encouragement throughout the course of my studies. It has been my greatest pleasure working with them both.

I would also like to express my gratitude to Professor Liberato Camilleri (University of Malta) and Professor Mohammed Quddus (Loughborough University) for their invaluable guidance with regard to the statistical analysis conducted in this research. I am also indebted to all the respondents who participated in the study and willingly gave up their time to answer the questionnaire survey. Without their help, this study could not have been carried out.

Lastly, my greatest word of thanks goes to my mother Irene, my father Mario, my brother Leonard and my fiancé Karl. Their love, support, patience and encouragement are appreciated more than I could ever explain. I am lucky to have them in my life.

Publications

Parts of this thesis have been published in journals and book chapters and presented in conferences:

Mifsud, D., Attard, M., & Ison, S. (2018). Using Cluster Analysis to examine Older People Travel Behaviour in Malta. Paper presented at UTSG 50th Annual Conference, University College of London, UK.

Mifsud, D., Attard, M., & Ison, S. (2018). Old Age: What are the main Difficulties and Vulnerabilities in the Transport Environment? In: Musselwhite, C. (Ed.), *Transport, Travel and Later Life* (Chapter 3). Bingley, UK: Emerald Group Limited.

Mifsud, D., & Attard, M. (in press). Mobility Behaviour of Older People. In: Formosa, M. (Ed.), *Active and Healthy Ageing in Malta: Gerontological and Geriatric Inquiries* (Chapter 2). San Gwann, Malta: BDL Publishers.

Mifsud, D., Attard, M., & Ison, S. (2017). To drive or to use the bus? An exploratory study of older people in Malta. *Journal of Transport Geography*, *64*, 23-32.

Mifsud, D., Attard, M., & Ison, S. (2017). *Determinants of Travel Behaviour for Older People in Malta*. Paper presented at Royal Geographic Society Annual Conference, Imperial College London, UK.

Mifsud, D., Attard, M., & Ison, S. (2017). *The Travel Behaviour of Older People in Malta*. Presented at a Research Seminar at the School of Architecture, Building and Civil Engineering, Loughborough University, UK.

Mifsud, D., Attard, M., & Ison, S. (2016). *Malta's Ageing Society: Determinants affecting elderly travel behaviour*. Paper presented at American Association of Geographers Annual Conference, San Francisco, USA.

Mifsud, D., Attard, M., & Ison, S. (2016). *An Understanding how Older People in Malta Travel.* Paper presented at Royal Geographic Society Annual Conference, Imperial College London, UK.

Mifsud, D., & Lucas, K. (2015). *The Complexity of old age: What are the transport equity issues?* (STSM Report, TU 1209 TEA COST Action), Institute for Transport Studies, University of Leeds, UK.

Mifsud, D., Attard, M., & Ison, S. (2015). *A Holistic Overview of Transport Vulnerabilities for the Elderly: The Maltese Case Study*. Paper presented at Royal Geographic Society Annual Conference, Exeter, UK.

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List of Abbreviations

ADAS	Advanced Driver Aid Systems
AENEAS	Attaining Energy-Efficient Mobility in an Ageing Society
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
CAYO	Complacent and Autonomous Younger-Old
CFA	Confirmatory Factor Analysis
CFI	Confirmatory Fix Index
EFA	Exploratory Factor Analysis
FTS	Flexible Transport Services
GFI	Goodness Fit Index
GOAL	Getting Older, Staying Mobile
ICF	International Classification of Functioning, Disability and Health
ITS	Intelligent Transport Systems
IVIS	In Vehicle Information Systems
KMO	Kaiser Meyer Olkin
MLE	Maximum Likelihood Estimation
MOBILATE	Enhancing Mobility in Later Life: Personal Coping, Environmental Resources and Technical Support
MOTRS	Multilevel Older Persons Transportation and Road Safety Model
NAM	Norm-Activation Model
NFI	Normed Fit Index
PLMOO	Pessimistic Limited-Mobility Older-Old
PMN	Perceived Mobility Necessities
PWN	Prototype Willingness Model
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modelling
SHARE	Survey of Health, Ageing and Retirement in Europe
SIZE	Life quality of Seniors in relation to Mobility Conditions
SPED	Strategic Plan for the Environment and Development
SRHI	Self-Reported Habit Index
SRYO	Slightly Restrained Younger-Old
TIB	Theory of Interpersonal Behaviour
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TRACY	Transport needs for an Ageing Society

CHAPTER 1

INTRODUCTION

1.1 Introduction

The world's population is ageing as evidenced by the fact that between 1970 and 2025, the growth in the global share of people above the age of 60 years is expected to be of some 694 million (223%). The 60+ population is growing at a rate of 3% per year. When compared to 2017, the number of persons over the age of 60 years is expected be more than double by 2050 (2.1 billion) and to more than triple by 2100 (3.1 billion). Europe is the "oldest" continent and in 2017, 25% of its population was already over the age of 60 years. This is projected to increase to 35% in 2050. The older population is also ageing in itself. Globally, the number of people over the age of 80 years is expected to triple by 2050, from 137 million in 2017 to 425 million (UN, 2017).

While there are commonly used definitions for old age, there is no general agreement as to the age at which a person becomes old. Most developed countries accept the chronological age of 65 years as the basic definition since it is usually the time equivalent to the retirement age. Nevertheless, the United Nations refers to older people as those who are 60 years or more (WHO, 2013). A very common classification used to define the older population is the one created by the psychologist Bernice Neugarten in 1974 where she distinguished between the "younger-old" and "older-old". There is also a high diversity between the baby-boomers and the seniors in general. There is a debate on whether chronological age is sufficient to define people as "old". Ageing is a process which depends on the relationship between biological, psychological and social factors. A change in one of these three factors causes repercussions in all the others (Aguiar and Macário, 2017).

1.2 The Research Problem

The increase in number of older people is a reflection of social and economic progress. However the older population is also a challenge. A major issue is to provide the necessary resources and infrastructure for the well-being of older citizens. One such area is transport. Transport is a derived demand which is essential for independent mobility. In later life, mobility is both a means to accomplish daily activities and an end in itself due to the sense of independence it evokes (Hodge, 2008). As a result, it is associated with a good quality of life in old age (Nordbakke and Schwanen, 2014). This is because Active Ageing is defined as "*the process of optimizing opportunities for* *health, participation and security in order to enhance quality of life as people age"* (WHO, 2002, p.12).

However, with age, a person's functional abilities change and they can eventually limit the level of mobility and independence. For an array of reasons (e.g. health or financial issues) older people tend to travel less than other demographic groups (Carr, 2003). Nevertheless, the future generations of older people will be different from the previous ones due to changes in the environment, their own needs, skills and behaviours. Consistent with the notion of active ageing, research has shown that being healthier, more licensed to drive, more educated and working longer, the current generations of older people are remaining highly mobile and active, particularly after retirement (Haustein and Siren, 2015). It is thus indispensable to understand the mobility patterns of the "new" older population because when they grow older they will have a travel behaviour which is different from that of their parents' generation (Siren and Haustein, 2013). However, due to longer life expectancies, there is also the "ageing of the ageing" which means that the number of older-old people suffering from chronic diseases and from reduced mobility performance will *also* increase (Rudinger et al., 2006). Older-old age is also linked with driving cessation, which often results in a lower quality of life and well-being (Davey, 2007).

The effect of an increasing number of older people in the transport environment is not a minor one but a major problem which needs restructuring in public policies (Aguiar and Macário, 2017). The different challenges that older people face in the transport environment present an unprecedented situation that poses a significant challenge for transport planning. Hence, there needs to be an understanding of their travel behaviour and attitudes to transport, so as to guide transport policy development which ensures safe mobility and healthy lives in ageing societies. Given this, different European projects also studied such phenomenon throughout the years. Some examples were MOBILATE (Enhancing Mobility in Later Life: Personal Coping, Environmental Resources and Technical Support), AENEAS (Attaining Energy-Efficient Mobility in an Ageing Society), SIZE (Life quality of Seniors in relation to mobility conditions), GOAL (Getting Older, Staying Mobile) and TRACY (Transport Needs for an Ageing Society).

In brief, the research problem shows that although older people are today more active with higher travel demands, due to longer life expectancies older-old people with mobility limitations are also increasing at a fast rate. This makes mobility in later life a complex phenomenon which is affected by a variety of interrelated determinants that can make older people vulnerable in the road environment. Hence, what factors affect the way older people travel and how can their independent mobility be improved? This shows the need for more holistic studies focusing on the actual determinants of travel behaviour in later life.

1.3 The Context of the Study

1.3.1 Malta

Malta is an island state (316 km^2) in the central Mediterranean with a population of 434,403 in 2015, with 216,834 females and 217,569 males (NSO, 2016a). Malta is an archipelago with two sister islands, Gozo and Comino. Gozo has a population of 31,000 people in a land area of 67km^2. Gozo has several similarities to Malta, but also considerable diversity. It has a distinct set of characteristics which include lifestyle, language intonations, folklore and traditions (NSO, 2014a). Comino is an uninhabited island. As shown in Figure 1.1, Malta is divided into 68 local councils (LAU2) which are grouped in six districts (LAU1).

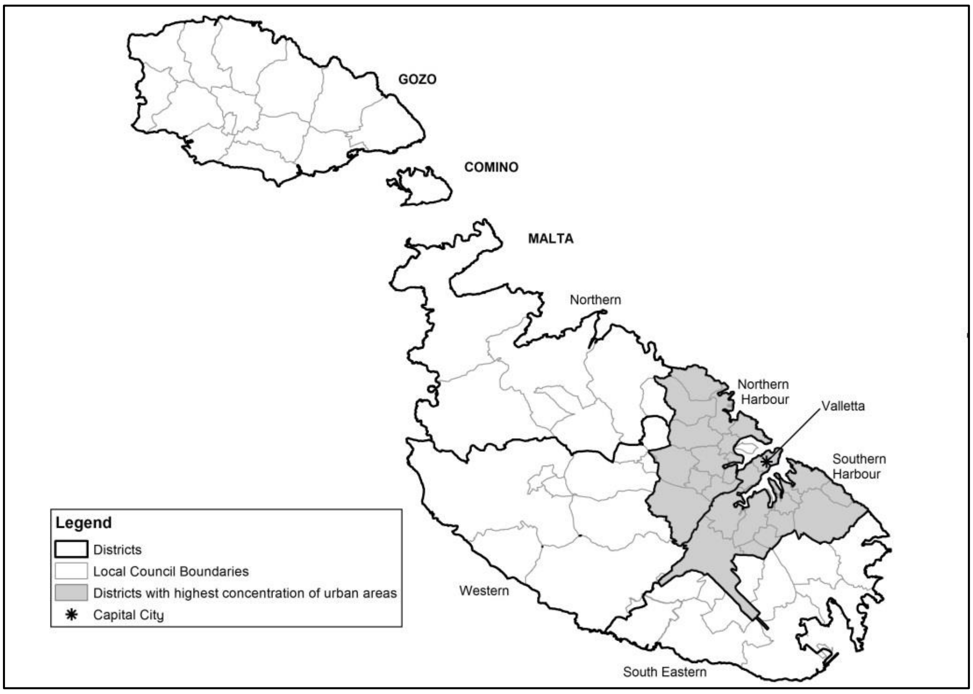

Figure 1.1: The six districts in Malta

Malta has been a member state of the European Union since 2004. Given its population and land area, Malta is the country with the highest population density (1,369.5 people per kilometre squared in 2015) among all member states. The second highest densely populated country in 2015 was the Netherlands with 502.9 people per kilometre squared. Malta's population density was almost ten times more than that of the EU28 average (117.1 people/km^2) (Eurostat, 2016a). In 2015, Malta was also the most urbanised country in the European Union (Eurostat, 2016b).

Both the high population density and the built-up area strongly affect the transport system. The ability of transport services to meet the demand requirements is strongly dependent on the spatial land use planning and the allocation of appropriate space to transport networks which are required both to support people and the economy (TM, 2016a).

1.3.2 The Transport System in Malta

Concurrent with the high density and the dense built environment, Malta also has a very high motorisation rate. In 2015, Malta had the highest number of cars per inhabitants (634 cars per 1000 inhabitants), second only to Luxembourg (661 passenger cars per 1000 inhabitants) (Eurostat, 2017a). In 2015, the number of licensed motor vehicles was almost equal to the number of persons aged 18+ (NSO, 2016a). The stock of licensed motor vehicles by the end of 2016 reached 358,947 which was an increase of 3.5% over the same period in 2015. This represented an increase of 17.8% over the beginning of 2010 and an increase of 32.3% over the beginning of 2005. The net stock of licensed vehicles increased to an average of 33 vehicles per day in 2016, up from 20 vehicles per day in 2011. Malta's road network is extensive, stretching over 2,400 kilometres in 2014. This makes it one of the densest road networks in the world (762km/100km^2) (TM, 2016a). Haustein and Sick Nielson (2016) developed eight clusters of mobility cultures within the EU-28 countries, and showed that Malta had the highest percentage of "*Convenience Drivers*" (59.3%), well above the EU average of 46.6%. These represented people who drive due to convenience and not price. Unsurprisingly, Malta had a significantly lower percentage than the EU average with regard to the "green" clusters.

Public transport in Malta is served primarily by buses. Prior to 2011 a private-based monopoly operated the bus service. In 2011 a public transport reform took place and through a competitive tendering the first ever international operator (ARRIVA) was awarded the contract to operate all services. Due to several problems with the operation of the services, ARRIVA left Malta and the services were nationalised in 2014. In the meantime, the Government issued another tender which it awarded to the current operator (Autobuses de León) under the brand name of Malta Public Transport in 2015 (Bajada and Thiteridge, 2016). Following the 2011 reform, buses were modernised and equipped with modern facilities like access and air conditioning which improved the infrastructure and the accessibility of the service.

Due to significant economic growth in Malta and increase in car ownership, and urban sprawl away from the Grand Harbour area, by 1990 patronage started to decline. The public transport modal share reduced by 13% between 1990 and 2010 in all parts of the island except in Valletta which saw a 9% growth due to various sustainable mobility measures introduced in the city between 2006 and 2010 (Attard and Ison, 2010; 2015). After the 2011 reform there was a change in trend and patronage started to increase (Figure 1.2). However such increase did not result in a modal shift from the car to public transport (TM, 2016a). In 2014, the national mode share of bus trips during a typical weekday was just 11.3% of all trips.

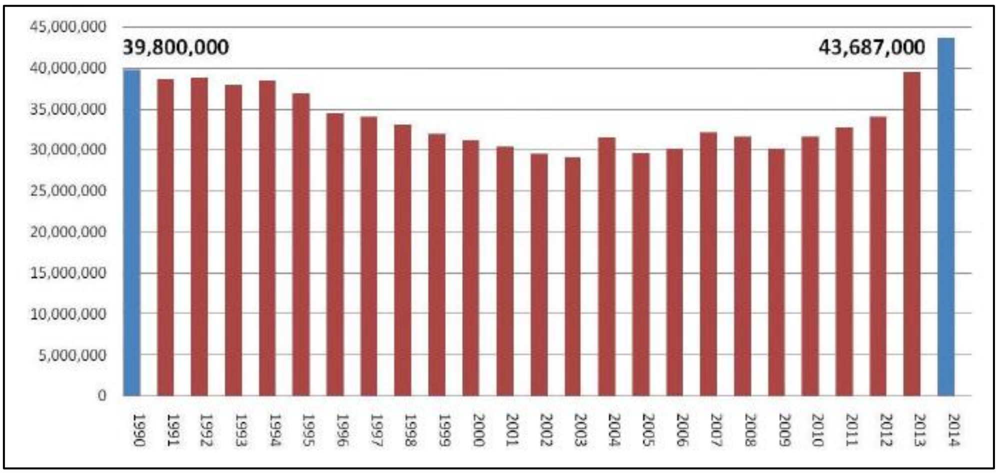

Figure 1.2: Bus patronage in Malta between 1990 and 2014 (TM, 2016a)

The extent of the bus network in 2014 was 2,600 kilometres. To date buses have to share infrastructure with private vehicles since the provision of bus priority lanes is very limited (<1% of road network) (TM, 2015). In 2014, over one third of the Maltese population never used public transport and 60% of the regular bus users were females. Moreover nearly half of the regular bus users were all either under 18 or 60+. When considering the time to access the bus stop, waiting time, travel time and time to reach the destination once a passenger disembarks, the average travel time by bus in Malta is 34 minutes more than that by car (TM, 2016a). With regard to active modes of transport, despite some improvements in the recent years (e.g. implementation of some cycle lanes and improvements in safety measures) Malta is not yet equipped with the appropriate infrastructures for walking and cycling.

1.3.3 The Older Population in Malta

Malta has an older population (60+) which has been increasing at a fast rate throughout the years (Formosa and Scerri, 2015), reaching 108,260 persons in 2014 (NSO, 2016b). This represented 25.2% of the entire population. After recent legislative changes, the retirement age in Malta was changed to 65 years. Prior to this, the pensionable age was at 61 years old in the case of males and at 60 years old for females. Such change was introduced in a gradual manner and currently depends on the year when individuals were born and the number of tax contributions paid. Despite this, as explained by Mifsud et al. (2017), people in Malta are considered "old" from the age of 60 years. On the 60th birthday, all Maltese Identity card holders are automatically presented with a special identification called *Kartanzjan*, which entitles them to a variety of concessionary and discounted services. For public transport, a fare concession is available to *Kartanzjan* Holders (Maltese 60+) and to holders of Special Identification Cards issued by the National Commission for Persons with Disabilities. This entitles them to discounted fares (Euro 0.25 for one journey up to 2 hours when compared to Euro 0.75 for the rest of the population). Moreover, people are entitled to participate in Active Ageing Communities in Malta as from the age of 60.

Although in 2014 the number of older females (53,562) was larger than that of older males (49,698), the percentage increase throughout the past years was larger for males than for females (an increase of 11% for older males and 9% for older females between 2011 and 2014) (NSO, 2016b). Between 2006 and 2016, Malta was the country with the highest percentage increase in people over 65 years (+5.2 percentage points) among all European member states (Eurostat, 2017b). Moreover, whilst the EU28 fertility rate in 2015 was of 1.58, in Malta it was 1.45 (Eurostat, 2017c). The European Commission anticipates that in the period 2010-2060, the Maltese life expectancy at birth is projected to increase from 77.6 to 84.9 years for males and from 82.3 to 88.9 years for females. The older population in Malta is also ageing in itself. Between 2011 and 2035, whilst the 65+ population will increase from 16.2 to 24.8% of the total population, the 75+ population will increase from 6.8 to 13.7% (Parliamentary Secretariat for Rights of Persons with Disability and Active Ageing, 2013).

In 2012, an Active Ageing Index for the EU-27 member states (Zaidi et al., 2013) was developed based on four domains: *Employment*, *Participation in society, Independent, healthy and secure living*, and *Capacity and enabling environment for active ageing*. Overall, Malta ranked 19th in 2014, with the lowest ranking being in the employment domain (26th). This showed that improvements are still required for the Maltese older population to really live in an active manner. Contrastingly, Malta ranked very well in its Health Life Expectancy. Amongst the EU28 Member States in 2015, after Sweden, Malta had the highest number of healthy life years at 65 years; 14 years and 13.4 years for women and men respectively (Eurostat, 2017d). However, due to the physiological changes associated with ageing, in 2011 more than half the persons in Malta aged 70+ were suffering from a long-term illness and/or chronic condition (NSO, 2014b). Also, recent studies showed that over 3% of the Maltese population is estimated to suffer from dementia by 2050 (Scerri, 2015). Such factors all have their implications on the transport sector.

Due to the improved health and socio-economic factors, a large number of older people in Malta are choosing to remain car drivers. Compared with all the other age groups over 18 years, between 2007 and 2015, the steepest increase in the number of driving licence holders was for the older population. The number of older male drivers increased from 29,143 to 41,051 (+41%), whilst the number of older female drivers increased from 7,758 to 14,589 (+88%) (NSO, 2009a-2017). This shows that although the number of older female drivers is smaller than that of males, the percentage increase in female drivers is very high (Figure 1.3). A driving licence in Malta is valid for ten years. For drivers over the age of 70 years it is valid for five years. Upon the renewal process, a driving licence medical certification form has to be filled by a medical doctor indicating whether the driver is fit to continue driving or not (based on health limitations such as eyesight, hearing, diabetes mellitus, mental disorders, chronic renal conditions and organ transplant).

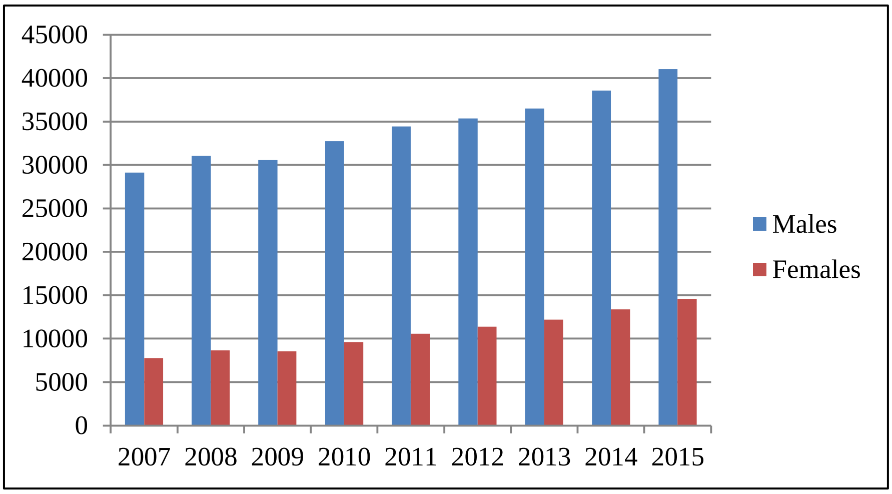

Figure 1.3: Number of 60+ drivers by gender in Malta between 2007 and 2015 (Adapted from NSO, 2009a-2017)

No recent national data is available specifically related to older people's public transport use in Malta. Despite this, between 2011 and 2014, the Institute for Climate Change and Sustainable Development at the University of Malta was commissioned by Transport Malta to conduct a "Public Transport Customer Satisfaction Survey" in multiple localities across Malta and Gozo. Such surveys showed that although public transport use by older people was higher than the rest of the population, the majority of older people either used public transport in an infrequent manner or did not use it at all. Moreover, the frequent bus users were mostly older female users who did not have any car available to them (ICCSD, 2014).

As shall be explained in further detail in the following chapters, one important motivation for choosing Malta as the case study of this research was the high scarcity of knowledge on older people's travel behaviour. Formosa (2013) stressed the need to integrate the different constituents that affect ageing in Malta in a holistic policy. Although in 2013 the *National Strategic Policy for Active Ageing 2014-2020* (Parliamentary Secretariat for Rights of Persons with Disability and Active Ageing, 2013) was published, there was no specific reference to transport and mobility in later life in such policy. This will be further discussed in Chapter 3.

1.4 Research Aim and Objectives

Given the research problem discussed above and the need to analyse such problem within the Maltese context, the aim and objectives of this research are listed below.

The aim of the thesis is:

To investigate the travel behaviour of older people in Malta and provide recommendations for independent mobility in later life.

Objectives:

1. To identify the main determinants that influence older people's mobility and travel
2. To determine the theoretical underpinning in order to analyse older people's mobility and travel behaviour in Malta
3. To understand the key determinants that affect the travel behaviour of older people in Malta
4. To develop clusters of older people based on objective and psychological determinants that affect travel behaviour
5. To make recommendations for independent mobility in later life

1.5 Structure of the Thesis

The remainder of the thesis consists of eight distinct yet interrelated chapters:

Chapter 2: Literature Review: Identifying the main determinants that influence older people's mobility travel

The review of literature is used to understand the main travel patterns in later life. This is followed by a thorough discussion on the main individual, social and environmental determinants that affect mobility in old age, and the main difficulties that older people encounter in the road environment (as drivers, pedestrians and public transport users). Subsequently, given the heterogeneity in how older people travel, a discussion on how older people were clustered in the body of literature based on different criteria follows. The chapter finally makes reference to different ways how mobility in later life could be improved.

Chapter 3: Determining the theoretical underpinning for the study to explain older people's mobility and travel behaviour in Malta

Given the understanding of the topic area, Chapter 3 outlines the theoretical underpinning of the research. Complementing Chapter 2, this chapter highlights the underlying psychological determinants of older people's travel behaviour. Two established theories of attitude-behaviour relations, the Theory of Planned Behaviour (Ajzen, 1991) and the Theory of Interpersonal Behaviour (Triandis, 1977), are discussed. A justification of why the Theory of Interpersonal Behaviour is chosen as the theoretical framework of this study is given, followed by an explanation of how it relates to older people's mobility. The research gap of the study is also explained at the end of Chapter 3.

Chapter 4: Research Design and Methods

The research design is developed in light of the ontological position of the researcher, the objectives of the study and the research strategy. These in turn are used to justify and describe the various methods employed in the data collection and analysis. The limitations of the study are also outlined.

Chapter 5: Assessing the personal, social and environmental characteristics of older people's travel behaviour

This is the first of three chapters that use Malta as a case study for understanding older people's travel behaviour. Based on a questionnaire survey, regression models are used to assess the objective (personal, social and environmental) determinants of how older people travel. Travel behaviour is understood through nine indicators: driver/not (driver or non-driver), public transport use, travel range, travel accompaniment, travel frequency, travel time, number of travel purposes, number of utilitarian purposes and number of discretionary purposes.

Chapter 6: Evaluating the psychological antecedents of older people's travel behaviour

Analysis in Chapter 6 considers the underlying attitudinal and psychological antecedents of older people's travel behaviour through Structural Equation Modelling. The psychological constructs included in the analysis are based predominately on the

Theory of Interpersonal Behaviour discussed in Chapter 3. These include attitudes, emotions, social factors (self-concept, roles and social norms), habit, facilitating conditions and intention.

Chapter 7: Determining clusters of older people based on the objective and psychological determinants that affect travel behaviour

Following the analysis in the previous two chapters, clusters of older people are developed based on the objective (Chapter 5) and psychological (Chapter 6) determinants of their travel behaviour. These clusters explain the similarities and differences between different groups of older people. This is important to understand the complexity of mobility in later life and identify how different transport measures can target different groups of people.

Chapter 8: Discussion of findings and providing recommendations for more independent mobility in later life

Chapter 8 is the *Discussion* chapter which deliberates the results presented in the previous three chapters. It discusses how the findings of this research relate with the body of literature, and outlines similarities and differences based on the context of the study. It concludes with several suggestions necessary to improve independent mobility in later life in Malta.

Chapter 9: Conclusion

In the final chapter a summary of the main findings is presented. The empirical and theoretical contributions of the research are discussed, the limitations of the study are acknowledged and possible areas for future research are proposed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The main purpose of this chapter is to achieve the first objective of the study, to identify the main determinants that influence older people's mobility and travel. In order to do so, the chapter is divided into five main sections. The first section discusses the common travel patterns in later life and explains why older people are a transport-disadvantaged group. The second section gives a detailed review of the main objective travel behaviour determinants in old age. These are discussed from three main perspectives: individual, social and environmental factors. The third section of the chapter gives an explanation of the main difficulties that older people encounter in the road environment as drivers, pedestrians and as public transport users. The different techniques that they use to compensate for such limitations are also discussed. This is followed by the fourth section of the chapter that discusses multiple ways in which older road users were clustered in order to have specific target groups when developing transport policy. Finally, the fifth section concludes with a discussion on different ways to improve mobility in later life.

2.2 The Main Travel Patterns in Later Life

The diversity of out-of-home activity participation reduces as age increases (Habib and Hui, 2017). When analysing the mobility and well-being of older people in Copenhagen, Siren et al. (2015) divided travel purposes into two: utilitarian and discretionary. Utilitarian purposes refer to everyday activities as shopping, health-related errands or any other activity with an everyday characteristic. Discretionary travel refers to activities related to leisure, social activities, visiting friends or family or outdoor exercise. Utilitarian activities were important to maintain the independence and fulfil basic needs in old age. Yet, discretionary activities were essential for the older individuals to be part of the society in a meaningful way. Musselwhite (2017) stressed the importance of discretionary travel in later life and highlighted that it is very important for the health and well-being of older people, particularly the non-drivers.

Overall, older people travel mostly for shopping and errands, for leisure, to obtain medical care and to attend religious activities (e.g. Su et al., 2009; van den Berg et al., 2011; Siren and Haustein, 2013). In the UK, Mackett (2015) identified shopping (particularly for the older-old) followed by leisure and social activities as the most common travel purposes for older people. For the latter travel purposes, the oldest category made fewer trips than the 60-69 age group reflecting a decrease in mobility. Similarly, Boschmann and Brady (2013) found that in the Netherlands, shopping and general errands were the most common travel purposes of older people. In Bangkok, health care was the most common out-of-home activity, followed by shopping and religious activities respectively (Srichuae et al., 2016). As people get older, due to more time availability, leisure travel increases (Schwanen et al., 2001; Coughlin, 2001; Aguiar and Macário, 2017). Although the average trip distance decreases with age, recreational trip distances tend to increase until the age of 80 years (Schmöcker et al., 2005). van den Berg et al. (2011) found that in the Netherlands older people were as mobile as their younger working counterparts with regard to the number of social trips.

Walking is the most important mode for shopping trips in later life (Su et al., 2009). Walking as a mode of transport tends to be more important for older people than for younger ones because older people walk shorter distances and own fewer cars (Jianxi and Zhenshan, 2015; Böcker et al., 2017). In the Netherlands, the number of trips by car for compulsory activities was the highest amongst older people (Yang et al., 2013). Yet this reduced significantly with an increase in age. This decrease was mostly compensated by more walking trips.

2.3 Older People as a Transport Disadvantaged Group

The natural process of ageing is associated with different physiological changes that can have significant consequences on mobility (Shrestha et al., 2016). Although the demand for leisure activities usually increases with age, the mobility capability to do so usually becomes limited. This causes a confrontation between the desire to travel and the inability to perform it (Aguiar and Macário, 2017). Actually, older people are usually considered as one of the *transport-disadvantaged groups* in society (Lucas et al., 2001; Siren, 2007), and are amongst those that have a higher risk of being excluded from society (Social Exclusion Unit, 2003).

Older people, particularly the non-drivers, can easily suffer from social exclusion due to various difficulties associated with travelling to access basic services such as hospitals (Shergold and Parkhurst, 2012). Such situations are made more difficult when public transport does not adequately cater for their needs (Engels and Liu, 2011). Given this, when compared with younger individuals, various studies have shown that the overall mobility of older people is lower than that of younger individuals (e.g. Haustein and Siren, 2015; Srichuae et al., 2016; Cui et al., 2017). They travel less frequently and for shorter distances than younger generations (e.g. Banister and Bowling, 2004; Mercado and Páez, 2009). For example, Böcker et al. (2017) found that in Rotterdam, older people did 2.9 trips per day when compared to the younger cohorts who did 3.2 trips per day. Jianxi and Zhensham (2015) showed how in Nanjing (China), although older people made more trips, they travelled shorter distances and had shorter travel time per day when compared with young adults. Trip distance is an indicator of quality of life since it provides an indirect measure of mobility and freedom to move around. It is also an important indicator of active ageing (Mercado and Páez, 2009). Older people tend to walk and use public transport more than the younger cohorts (Haustein and Siren, 2015), and thus their shorter distances are also a reflection of their higher walking trips.

Mobility decreases more significantly after the age of 75 years (O'Fallon and Sullivan, 2009; Boschmann and Brady, 2013; Mandl et al., 2013; Haustein et al., 2013; Cui et al., 2017). When analysing the travel behaviour of the non-driving 75+ population in the U.S., Evans (2001) showed how beyond this age, mobility reduced regardless of other factors. Similarly, in Melbourne, in O'Hern and Oxley (2015)'s study, the average trip distance, trip duration and walking speed decreased over the age of 75 years. All this shows that the two key factors that make older people transport-disadvantaged are physiological changes (particularly after the age of 75) and difficulties when travelling due to inefficiencies in transport systems. Such factors restrict their mobility and may limit them to travel in just familiar areas around their residence.

2.3.1 Older people travelling in familiar areas and/or accompanied by others

Older people's own homes and their immediate surrounding are one of the most important socio-spatial contexts in later life (Giesel and Köhler, 2015). Familiarity and safety affect their mobility because the feeling of being secure decreases with age (Mollenkopf et al., 2004).

Unfamiliarity can lead to insecurity, disorientation, fear and loss of independence (Phillips et al., 2013). It also creates a sense of unpredictability, risk and uncertainty for older people. Familiarity with the environment not only hides certain limitations in the physical and cognitive functioning of older people, but also increases their road confidence (Findlay and McLaughlin, 2005). Consequently, as individuals get older, their environment tends to shrink to the immediate neighbourhood, and is usually a circle around their home (King, 2008; Jianxi and Zhenshan, 2015). It is thus fundamental for older people to have readily accessible stores, medical and care services and good public transport services that help them to keep independent lives (Rudinger et al., 2006).

Correspondingly, although leisure activities are popular in later life, van der Meer (2008) indicated how with age, such activities become more concentrated in a small spatial unit. The diversity of such activities also decreases. Figure 2.1 shows that the activities at the edge of the model are those which are more demanding (e.g. cultural activities) when compared to social activities at home (e.g. watching television). Hence, these are the first activities that older people usually let go, and a contraction takes place in the spatial action radius. Travelling in just familiar areas is not a positive aspect. Tsunoda et al. (2015) showed how older people who travelled within walking distance of their house were more likely to have lower levels of physical activity, lower mental status and diminished social networks. This issue is more pronounced for older females who tend to travel in a geographically smaller area than males (Siren et al., 2001).

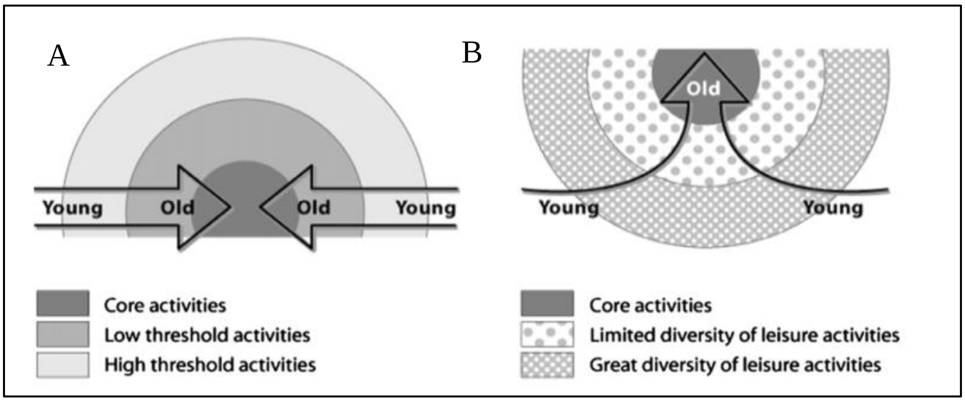

Figure 2.1: A – Contraction in leisure activity types. B – Convergence in leisure activity combinations (van der Meer, 2008)

The inability of older people to travel alone is also an important factor that can make them transport disadvantaged. Schwanen et al. (2012, p.1314) defined independence "*as the ability to function unaided and as the absence of dependence or reliance on others for carrying out everyday activities*". In their study in the UK and in Scotland, Schwanen et al. (2012) explained that "not depending on others" was the most widespread meaning of independence for older people (79%). Similarly, Secker et al.

(2003) discussed how for older people, independent mobility is that in which relatives and friends play a limited role (if any) over their decisions of where and when to go.

2.3.2 Mobility and Quality of life for Older People

Although mobility declines as people get older it does not mean that it is less important (Kim, 2011). Mobility entails measurements of the ability to access people and places (Metz, 2000). Yet, mobility is beyond just the transport perspective. It involves motivations, emotions, biographical characteristics, social factors and learning (Kaiser, 2009). Musselwhite and Haddad (2010) grouped the needs of older people into three: utilitarian, affective and aesthetic. Utilitarian needs refer to the mobility needed to arrive from A to B in a cheap, efficient and safe manner. Affective needs refer to the psychological needs, primarily to the sense of control, status and independence fulfilled through travel, especially when a car is available. Travel is also needed for aesthetic purposes such as enjoying the natural scenery whilst travelling. In Musselwhite and Haddad's study, older people were mostly aware of the utilitarian needs and least aware of the tertiary needs.

Hence, good mobility is associated with a good quality of life and well-being for older people (Metz, 2000; Gilhooly et al., 2002; Rudinger et al., 2006; Kaiser, 2009; Spinney et al., 2009; Aguiar and Macário, 2017). This is usually because mobility ensures a more active ageing and independence (WHO, 2002; Johnson et al., 2017). Independence permits older people to go out, meet other people and avoid being dependent on others (Gabriel and Bowling, 2004). Therefore, good mobility is essential to increase older people's participation in social activities and reduce social isolation (Metz, 2000; Spinney et al., 2009; Mackett, 2015). Apart from the different transport modes, a supportive environment is also associated with a better quality of life for older people (Rantakokko et al., 2010).

Mobility also refers to the potential for movement, which is often difficult to measure (Ziegler and Schwanen, 2011). This potential depends on various characteristics such as car access. Most studies just focused on the revealed mobility, rather than on the potential mobility in later life. Yet, unrealised mobility is equally important to understand since it represents their desired and unmet travel needs (Luiu et al., 2017). Lyons (2003) explained that the discrepancy between what you can do to what you want to do is an important interpretation of social exclusion. For example, Siren et al.

(2015) showed that older people's unfulfilled mobility needs were primarily related to discretionary travel (e.g. outdoor activities experiencing the nature). Correspondingly, Siren and Hakamies-Blomqvist (2004) analysed the unfulfilled travel needs of older people in Finland. Older females, those living in rural areas, the oldest-old, those without a driving licence and those with lower levels of education were more likely to want more trips. Once again, leisure trips, particularly visiting friends, were the most often unrealised. Consequently, in a review of studies dealing with unrealised mobility of older people, Luiu et al. (2017) explained that on average one third of older people have unmet transport needs, particularly the older-old and older females.

2.4 Mode Choice in Later Life

Despite older people being a transport-disadvantaged group, even in the developed world, their mobility has improved considerably throughout the years. Older people today have more active lifestyles and are travelling more than older people in the past (both in terms of frequency and distance) (Hjorthol et al., 2010; Haustein et al., 2013; Kim et al., 2014). Apart from healthier lifestyles, one key reason for this is the increasing number of older drivers (Rosenbloom, 2001; Böcker et al., 2017). Different studies analysed the mode choice of older people and proved that the car is the most common mode of transport used (e.g. Buys et al., 2012; Li et al, 2012; Turcotte, 2012; Holley-Moore and Creighton, 2015; Nakanishi and Black, 2015; 2016). By making reference to Adams (1999), Musselwhite and Haddad (2010) explained that future generations of older people will need to use their car more due to the hypermobile society we live in where services are being situated further away from residential areas.

The use of public transport is still relatively low in later life when compared to car use (Davey, 2007; van den Berg et al., 2011; Kim, 2011; Mifsud et al., 2017). In Canberra, Nakanishi and Black (2015) found that older people chose the car because of the perceived inadequacy of public transport services. Hence, older people who use public transport can be "captive users". Cao et al. (2010) showed that in Northern California, older people with limitations in driving, or did not have a car used transit about ten times per month more often than older people without such constraints. van den Berg et al. (2016) discussed that when older people use different modes of transport (e.g. car, public transport, cycling) they are less likely to suffer from loneliness since different transport modes enhance people's social network. Public transport is an ideal mode for older people to socially interact. Nonetheless, after driving, travelling as passengers is the most common mode of transport for older people. This is the primary coping strategy for mobility loss when more convenient modes of travel are no longer available (Kostyniuk and Shope, 2003; Silvis and Niemeier, 2009). Davey (2007) found that in New Zealand, nearly one third of the older people took lifts for all their transport needs. Two-thirds had lifts as least weekly and 20% had them almost daily. Walking was a significant mode of transport but only a very small percentage said that this was their main mode of travelling. None of the respondents used public transport as their main mode of transport, particularly when living in small towns. Similarly, Kim (2011) showed that 60% of the older people in the US got rides from family or friends when they were no longer able to drive.

Despite this, older people may feel uncomfortable taking lifts because they know that they could not reciprocate and do not want to be a burden on others (Schwanen et al., 2001; Gilhooly et al., 2002; Adler and Rottunda, 2006; Musselwhite, 2017). In fact, in Greater London, Schmöcker et al. (2008) found that older people did not like to be dependent on friends and family. Davey (2007) also revealed that although most older people saw their family at least once a week, this did not guarantee assistance with transport due to the busyness of most adult children and the unwillingness of older people to impose on them. Given this, Dahan-Oliel et al. (2010) indicated that older people who depended on others for their transport needs participated in less leisure activities.

2.4.1 Implications of Car use in Later Life

Older people make up the fastest growing segment of the driving population (Banister and Bowling, 2004). The "new old cohort" of older people, the baby-boomers, are characterised with high car dependency and high mobility levels (Siren and Haustein, 2013). In a comparative study in Hamilton, Toronto and Montreal, Roorda et al. (2010) showed that although trip making propensity reduced for older people, the effect of age was cancelled by car ownership. Trip generation of older people (65+) was more influenced by vehicle ownership than the rest of the population. Older people, particularly males, want to continue driving as long as possible (mostly in their 80s and beyond), and most of them do not think about a life without a car (Siren and Haustein, 2013). Some older people tend to keep driving despite their falling income (Nakanishi and Black, 2016). At the first driving renewal process at 70 years, Siren and Haustein (2014) found that the absolute majority of older people in Denmark wanted to renew their licence. They were also very confident about it and did not think it would be difficult. The primary reason for this is that the car is a symbol of independence (D'Ambrosio et al., 2008). The car also has different psychosocial benefits such as mastery, self-esteem, feelings of autonomy, protection and prestige (Ellaway et al., 2003).

Given this, having a car is one factor which improves older people's quality of life and well-being (Gabriel and Bowling, 2004; Siren and Hakamies-Blomqvist, 2004; Siren and Haustein, 2014; Nordbakke and Schwanen, 2015). When evaluating the relationship between car use and the level of successful ageing in older people living in the Mediterranean region (including Malta), Tyrovolas et al. (2017) showed that older people who used the car on a regular basis had a significantly higher level of successful ageing. This was irrespective of the age, gender, urban or rural residence and other confounding factors. Car ownership is also usually associated with a status (Davey and Nimmo, 2003). Some older people, particularly males, see the car as the only way how they can embed in society and "compete" with youngsters (Musselwhite and Haddad, 2010). The car could also be used to compensate for health limitations that do not permit mobility with other modes (Siren and Hakamies-Blomqivst, 2004; 2009; Ziegler and Schwanen, 2011). It can also overcome problems associated with public transport use (Beirão and Sarsfield-Carbral, 2007).

The importance of car use for older people is also evident from the negative implications associated with driving cessation. This will also be discussed in further detail in Section 2.6.1. Davey (2007) analysed how older-old non-driving people "coped without their car" in New Zealand. He showed that while utilitarian needs could be provided by alternative modes of transport, when private transport was unavailable, discretionary trips (e.g. visiting friends) reduced significantly. Older people were unwilling to ask relatives for lifts in these cases and most of them considered the use of a taxi as extravagant. Thus, although discretionary travel is fundamental for older people's quality of life, it may be more difficult to access using public transport when compared to utilitarian travel (Siren et al., 2015).

Although car use is increasing in most developed countries, there are some contexts in which it is less pronounced than others. For example, in China, car ownership was not a significant determinant for trip-making of older people. This was due to the low possession of both driving licences and cars in this country (Feng et al., 2013). Additionally, the car is usually an important resource for older people who had always been driving. Those who had never driven consider the car's roles as less important (Siren and Hakamies-Bomqvist, 2009). Nordbakke (2013) argued that the ability to drive is not the only solution to have independent mobility in later life. She explained that older people can manage their travel needs even without driving if (a) they have sufficient experience with alternative modes of transport, (b) if they have a high quality transport system and (c) if the activities are accessible and properly localised.

Higher car use can reflect negatively on the health status of older people due to the lack of physical movement (Kemperman and Timermans, 2014). It is also widely acknowledged that the increase in car use has negative implications on the environment (Gössling et al., 2016). Therefore, policy makers should work towards a sustainable balance in the modes of transport that older people use. This will be discussed in further detail in Section 2.8. Mode choice is just one indicator of travel behaviour. After having a clear idea of the main travel patterns in later life the next section will now explain the key determinants for such behaviour.

2.5 Travel Behaviour Determinants in Later Life

The travel behaviour of older people was analysed from different perspectives such as trip making, trip distance, travel patterns, trip chaining, mode choice and transport deficiencies (e.g. Kim, 2011; Mercado and Páez, 2009; Páez et al., 2007; Lucas et al., 2007; Su et al., 2009; Tsunoda et al., 2015; Nakanishi and Black, 2016). From the perspective of environmental gerontology, mobility is regarded as a person-environment interaction (Lawton, 1983). Travel in later life involves the person, transport modes, social factors and the environment which all interact together (Mollenkopf et al., 2004).

Given such complexity in travel behaviour, different studies explained such phenomenon using models and theories. For example, Webber et al. (2010), following the same approach developed in life-space literature (Peel et al., 2005), created a new comprehensive framework that analysed the complexity of issues related to mobility determinants in old age. Mobility was defined through five fundamental categories: *cognitive*, *psychosocial*, *physical*, *environmental* and *financial*. Three critical cross-factors, *gender*, *culture* and *biography* were also included because they shape opportunities and behaviour, which consequently affect all the key determinants (Figure 2.2). Webber et al. (2010) stressed the interdependence between such determinants. For example although speed of information and visual attention are important for safe driving, if a person has low self-efficacy beliefs, s/he may not even want to move beyond home despite the actual driving capabilities.

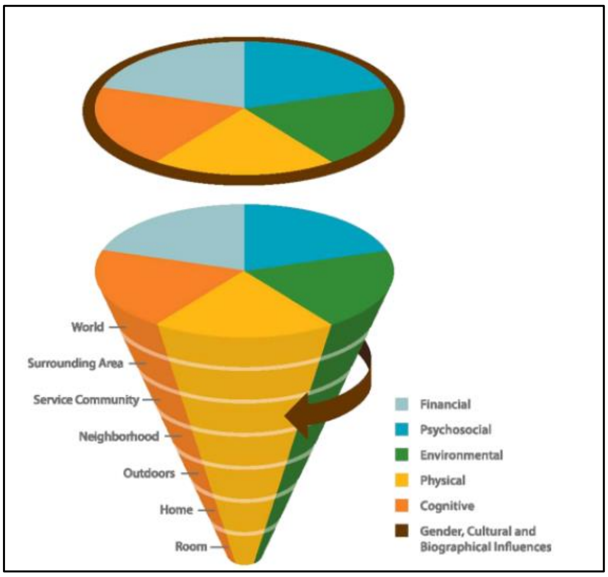

Figure 2.2: Conical Model representing a comprehensive framework for mobility determinants (Webber et al., 2010)

Another model that is commonly used to define the determinants of mobility in later life is the multilevel conceptual ecological model. This model originated from public health literature (Sallis et al., 2008) and states that behaviour is affected by individual (personal), social/cultural and environmental factors. Individual factors refer to the individual's skill to act and participate in the desired activities. Social and cultural factors refer to the relationships of individuals with the surrounding social and cultural environment, whilst environmental factors refer to the effects of the physical environment on behaviour. As a result, this framework has been a key foundation for several studies analysing older people's mobility (e.g. Hough et al., 2008; Winters et al., 2015).

Using the capability approach, Nordbakke (2013) explained that both individual resources, contextual conditions and individual strategies are interlinked in shaping the opportunities for mobility in later life. Correspondingly, when developing a holistic conceptual model that defines travel behaviour, Van Acker et al. (2010) explained that the individual decision hierarchy and its underlying components should be considered within a social and spatial environment. Inspired by these studies and put within the framework proposed by the multilevel conceptual ecological model (Sallis et al., 2008), the travel behaviour determinants reviewed and discussed in this study are divided into four main groups:

- **Individual/Personal Factors**: age, retirement, gender, health, education, income, driving licence and car ownership
- **Social Factors**: social networks, living arrangement, participation in social activities
- **Environmental Factors**: neighbourhood design, geographic context, access to public transport
- **The role of context and policies**

2.5.1 Individual Factors

Age

The effects of ageing on mobility are quite complex due to the high heterogeneity in the older population (Alsnih and Hensher, 2003). Rather than just age, different life situations may impact travel behaviour in later life (Rau and Manton, 2016). Yet, it is a fact that even if older people succeed in increasing their mobility levels, immobility is quite inevitable as times go by (Lord et al., 2011). In fact, the very old are usually the least mobile group with the most difficulties in the transport environment (Schwanen et al., 2001; Holley-Moore and Creighton, 2015).

Car ownership and age are related to each other (Schwanen et al., 2001). Kim and Ulfarsson (2004) showed that the choice of the car was negatively influenced by age since the younger-old were more likely to drive. Mercado and Páez (2009) argued that age was a significant determinant of the distance travelled by car in Hamilton Metroplitan Area since older people were likely to travel around 4-5 kilometres less than the younger adults (20-35 years). In the same case study, Páez et al. (2007) showed that trip frequency decreased with age. Similarly, Hahn et al (2016) did not only find significant differences in trip making between the 65+ and younger population, but also a difference between the 65-74 and 75+ group.

Contrasting with the above findings, in Denver metropolitan area, age had a very limited effect on trip distance as with each year increase, travel distance decreased by just 0.047 of a mile (Boschmann and Brady, 2013). Kim (2011) also showed that age was not statistically significant with transport deficiency. It was personal health condition rather than chronological age that affected most the mobility of older people. Siren and Hakamies-Blomqivst (2006) also did not find any statistically significant differences between age groups with regard to unfulfilled travel needs among older people. Such contrasting findings are due to the fact that, as Haustein and Siren (2015) explained, there are many other phases that occur in later life which affect mobility. One such phase is retirement.

Retirement

Retirement is a life-stage phenomenon which has been of great interest to the research academia because it brings several changes in the travel patterns of people due to a reduction in work trips (Newbold et al., 2005). It modifies the preconditions for mobility and creates new space-time restrictions (Berg et al., 2014). Retired older people usually travel shorter distances (Siren and Haustein, 2016) and such pattern continues to decline after 75 years when the retirement transition is usually complete (Boschmann and Brady, 2013). For example, in Montreal (Canada), Moniruzzaman et al. (2013) found that retirement led to a decline in daily travel from an average of 4.1 to 2.9 trip components per day.

When older people retire they do not have "obligations" to travel to a fixed location and have a greater freedom to choose new destinations (Aguiar and Macário, 2017). In Sweden, Berg et al. (2014) showed how spending more time on activities that were previously done outside working time (e.g. caring for grandchildren) were the main factors that affected older people's demands for mobility and choice of transport mode after retirement. When analysing the mobility patterns of older people after retirement in Denmark, Siren and Haustein (2016) revealed that although retirement was a transition point linked with a decrease in driving, car use for certain leisure trips increased significantly. Retirement had a larger impact on males' car use. Yet, older females who continued working had a higher car dependence that did not decline over time. One possible reason for this was that women who had not retired, had high-income jobs that prolonged their career and economically enabled their active car use. The percentage of professional women attached to their car is expected to increase in the future (Coughlin, 2009). The increasing number of older people working in informal agreements with flexible hours, as well as informal care-giving are also removing the traditional concept of retirement (Coughlin, 2009). Such factors will all have implications on the way older people travel.

Gender

The ageing effects on mobility act differently according to gender. Among the socio-economic determinants, gender was amongst those that received the most academic attention (Cui et al., 2017). This is because gender gaps in trip making and in driving licence possession are usually larger for older people when compared to younger cohorts (Rosenbloom, 2006; Hahn et al., 2016).

Older females tend to be disadvantaged and the main reason for this is that they have lower driving licence rates and less access to private transport than males (e.g. Siren et al., 2001; Siren and Hakamies-Blomqvist, 2006; Lucas et al., 2007; Siren and Haustein, 2013; Mifsud et al., 2017). Older females travel for shorter distances and for less trips than males (e.g. Charlton et al., 2003; Rosenbloom, 2006; Boschmann and Brady, 2013). Women are also more likely to travel for more shopping trips and fewer leisure trips than males (Feng et al., 2013). They also tend to travel more on foot, with public transport and as passengers (e.g. Rosenbloom, 2006; Truong and Somenohalli, 2011; Li et al., 2012). Nordbakke (2013) found how in Oslo, older women walked and used public transport more frequently, even when they had a car available. Consequently, older females also tend to suffer from a higher transport deficiency (Kim, 2011; Kim et al., 2014).

Females tend to have a longer life expectancy, and as a result they tend to suffer from health-related issues that affect their mobility more than males (Siren and Hakamies-Blomqvist, 2005). Males usually drive their spouse, and thus women report being chauffeured around and dependent on others for their transport needs more often (Rosenbloom, 2006; Siren and Haustein, 2013; 2016). However, due to the longer life expectancy, women usually suffer from the loss of their husband who is usually the sole driver in the household (Hensher, 2007; Hjorthol et al., 2010). Their travel choices become very narrow and they may suffer from a lack of participation in social activities (Gabriel and Bowling, 2004; Hough et al., 2008; Engels and Liu, 2011). This can lead to social isolation if there are no support mechanisms available (Hensher, 2007). Additionally, in their study in Finland, Siren et al. (2004) indicated that financial reasons, also combined with social factors, were amongst the causes that led older women to cease driving. Older females have usually earned less money and thus have smaller pensions. This restricts the income needed to address their travel needs (Rosenbloom, 2006).

Rather than just for pleasure, older females tend to drive for more practical reasons than males (e.g. to chauffer their family and friends). Older females usually feel a social responsibility towards their family members, which give the car a responsibility-related meaning (Siren and Hakamies-Blomqvist, 2005). Older females usually need to drive both their grand-children and their older-old parents. For this reason they are often called the “sandwich generation” (Rosenbloom and Fielding, 1998 in Siren and Haustein, 2013). When qualitatively discussing the meanings associated with driving for older women in Sweden, Siren and Hakamies-Blomqvist (2005) showed that driving a car gave them a sense of flexible identity. Whilst for older males driving as long as possible was normal, for older females this was something that broke the norms and stretched the limits of being a woman (Siren and Hakamies-Blomqvist, 2006). Hahn et al. (2016) also found that in Seoul, older men had less trips than women for mandatory trips (e.g. taking care of grandchildren, shopping). The difference between genders was smaller for discretionary purposes.

In a study in Michigan, older drivers were presented with scenarios involving driving to an important appointment under unfavourable conditions (e.g. bad weather) (Kostyniuk and Molnar, 2008). They showed that the effect of gender on self-regulation was very important and was in fact greater than that of age and physical functioning. Older females usually have a lack of confidence when driving, and subsequently are more likely to self-regulate in the road environment, particularly when driving long distances and in unfamiliar areas (e.g. Charlton et al., 2003; Choi et al., 2013; McNamara et al., 2013; Meng and Siren, 2015). Older females also tend to stop driving at a younger age than males, and more on their own initiative when they are still fit to drive (Siren et al., 2001; 2004; Davey, 2007; Siren and Haustein, 2013; 2014; Haustein et al., 2013). This shows a voluntary but unnecessary resignation from active and independent living.

Older females usually just serve as "co-pilot" for their husband, providing directions (Rosenbloom, 2006). The driving disadvantage for older women is thus also a result of socio-cultural expectations (Siren and Hakamies-Blomqvist, 2005).

Older women are not just transport-disadvantaged in terms of driving. For example, when discussing self-reported transport disadvantage and its link with social exclusion in Melbourne, Delbosc and Currie (2011) found older women to be mostly represented in one of the groups established in their study called "*The Vulnerable/Impaired*". They had high self-report difficulties and were more likely to feel socially excluded and unsafe on public transport and in their own street. Moreover, Norbakke (2013) showed that older females hesitated to participate in activities during the night due to fears of using public transport. Older females also usually have a higher fear of falling and lower self-efficacy (Meyers et al., 1996; Scheffer et al., 2008).

Contrasting with the previous findings van den Berg et al. (2011) found that gender did not have any effects on the number of social trips amongst older people in Eindhoven. The discrepancy between older males and females is constantly declining (Banister and Bowling, 2004; Hjorthol et al., 2010; Li et al., 2012; Siren and Haustein, 2013; Shergold et al., 2015). More women are obtaining a driving licence as a result of increased female employment, higher general income and gender equality (Shergold et al., 2015; Haustein and Siren, 2015). However, whether the current disadvantage of older women will continue in the future is quite unknown (Rosenbloom, 2006) due to the cultural meanings attached to cars. The driving experience that women and men gain is always different and this is likely to affect car driving in old age (Siren and Hakamies-Blomqivst, 2005). Although this experience gap is disappearing even for younger people, women still drive fewer miles than males of the same age (D'Ambrosio et al., 2008). Older females will enter the retirement phase with significantly less driving experience than males and will continue to drive less. Hence, it is very unlikely that older females and males will have the same driving patterns in the coming decades (Rosenbloom, 2006; Siren and Haustein, 2014).

A critical aspect which is associated with ageing is the changing health status. Although this is also complex and affects everyone differently, the next section will briefly review how different health limitations in later life can affect older people's mobility.

Health Factors

The biological changes linked to ageing are usually associated with different health limitations. Health is a critical aspect of older people's quality of life (Gabriel and Bowling, 2004) because it is fundamental for their out-of-home mobility (Siren and Hakamies-Blomqvist, 2009). Apart from the result of gradual processes, mobility decline can also occur overnight due to catastrophic events as a hip fracture (Rantakokko et al., 2013). Kim (2011) showed that older people in the US with a good health and well-being had a substantially low percentage of transport deficiency when compared with those with fair health and well-being. Health factors are usually the key reason why older people limit the activities that they participate in. For example, in China, Li and Loo (2017) found that as seniors got older and had more severe mobility impairments, they participated in less social activities and had lower satisfaction levels due to this. Illnesses are also a key reason why older people stop driving (Siren and Haustein, 2014). Health factors can also affect the self-identity of older people because physical movements can have negative impacts on their self-confidence, self-efficacy and mental health. Given this, older people may become disconnected from the society (Ziegler and Schwanen, 2011).

Mercado and Newbold (2009) found that in Canada, regardless of age, poor health discouraged both car driving and public transport use among older people. In Sweden, Hovbrandt et al. (2007) discussed how the older-old people with both movement and cognitive functional limitations that reported outdoor activities were less satisfied with their frequency of activity than those without limitations. Lyman et al. (2001) using a sample of older drivers from Mobile County (Alabama) also showed that older drivers with a functional impairment tended to drive less than four days per week. The use of mobility aids by older people during walking also tends to reduce their trip distance. Thus, although mobility aids have other benefits (e.g. increase confidence in older people) they tend to limit the range of mobility (Moniruzzaman et al., 2015; Srichuae et al., 2016). Hovbrandt et al. (2007) explained that although older people with mobility devices were satisfied with their frequency of activities, this could have been an adapted behaviour due to low physical capacity and high environmental demands (Lawton and Nahemow, 1973).

Visual, hearing and motion impairments are the most distinct problems that affect mobility in later life (Scheiner, 2006). For example, Viljanen et al. (2009) established how older women with hearing impairment had slower maximal walking speed, lower walking endurance and more self-reported major difficulties in walking two kilometres than those without a hearing impairment. There was also an association between hearing acuity and poor balance, which led to a greater risk of falls. Other two common medical conditions associated with ageing that affect mobility are arthritis and dementia. Arthritis can result in motion restrictions, a loss of joint motion and a minimisation of physical endurance. It may thus restrict the range of movement such as the turning of head and neck, and lead to involuntary hesitancy. This can lead to unsafe situations, particularly when crossing busy roads (Dunbar et al., 2004). Alzheimer's disease is the most prevalent form of dementia and this usually leads to a slower performance on timed tasks, difficulty to switch attention from one source of information to the other and lack of safety when wandering or getting lost (O'Neill, 2010).

Falls are also highly significant in old age. The contributing factors could be both individual (e.g. gait problems) and environmental (e.g. slippery roads). The latter will be discussed in further detail in Section 2.5.3. However, another highly contributing factor for falling in old age is fear. Through focus groups with Finnish older people, Siren and Hakamies-Blomqvist (2009) established that the fear of falling in older women limited their mobility as pedestrians. This is because the number of falls in the previous year and the catastrophic beliefs about falls increase the concerns and subsequently restrict mobility (Keskin et al., 2008; Delbaere et al., 2009).

Another correlated aspect with the ageing health limitations is medication. It is a fact that polypharmacy (the intake of different medicines simultaneously) is more prevalent among older people due to the latter suffering from multiple illnesses (Holland et al., 2003). Although medications are necessary for quality of life needs, they can negatively affect the skills of older people while on the road (Aguiar and Macário, 2017). A case in point is the psychotropic medication, mainly prescribed as anti-depressants. This is usually linked with falls, confusion and morbidity (Gurwitz and Rochon, 2000). Medication may also slow down reaction time and diminish hazard awareness (Oxley et al., 2004).

Although medical conditions may lead to immobility amongst older people, they do not necessarily reduce their desire to travel (Sikder and Pinjari, 2012). As shall be explained in more detail in Section 3.4.3, self-efficacy is a major asset that can counter balance health limitations. This refers to an individual's belief in his or her capacity to execute a specific behaviour (Bandura, 1986). In their study amongst older women, McAuley et al. (2006) highlighted how self-efficacy was one major factor that helped manage functional limitations. Siren and Hakamies-Blomqvist (2009) also stressed the importance of mental ability in periods of change and adaptation in old age. For older people that have been highly active, the adaptation process can be complex because their priorities are related to the maintenance of identity. Different compensation techniques that older people use to counterbalance their health limitations will be discussed in Section 2.6.2.

Ultimately, the health status of an individual could also be affected by social and economic issues. For example, the social disadvantaged tend to suffer from chronic illnesses and disabilities more than the higher-status groups (Giesel and Köhler, 2015). Therefore, health issues can accelerate the risk of social exclusion, particularly when combined with other socio-economic determinants. Two such determinants are the education and income levels of older people.

Education and Income Levels

Higher income levels are usually associated with higher education standards. In later life, lower education levels and limited disposable income are usually negatively linked with mobility (e.g. Kim, 2003; Roorda et al., 2010; Truong and Somenohalli, 2011). Hough et al. (2008) showed that in rural and small urban North Dakota, older women with higher education made more trips to the doctor, to visit a store or an exercise place than those with lower standards. When analysing the leisure activities of older people in the Netherlands, Schwanen et al. (2001) found that those with the highest level of education were 2.6 times more likely to leave home than those with the lowest educational levels. Correspondingly, van den Berg et al. (2011) proved that older people with high education made more social trips. This shows that if the education levels increase in the future, social trip-making might increase as well. Other studies contrasted with the general trends. For example, Böcker et al. (2017) found how in Rotterdam the lower-educated older people travelled more than the higher educated ones. Moreover, Hahn et al. (2016) showed that in Seoul, the number of pre-schoolers did not have a significant effect on trip making of older adults.

High income levels are usually positively related with mobility (e.g. Roorda et al., 2010; Feng et al., 2013; Kim et al., 2014). In Giesel and Köhler (2015)'s study in Germany, older people at risk of poverty were less mobile and had higher restrictions on their access to transport. They also made fewer and shorter trips than the groups with above-average income. Such situation was worse for females than for males. One key reason for this is that high income levels are related to car ownership and to the ability to afford taxis (Kim and Ulfarsson, 2004; Chudyk et al., 2015), whilst lower income is more related to public transport use and walking (Kim and Ulfarsson, 2004, Su and Bell, 2009). For example, Schmöcker et al. (2008) and Truong and Somenohalli (2011) both showed that higher income had a negative effect on public transport use in London and Adelaide, respectively. Congruently, Engel et al. (2016) concluded that low-income older people relied more on their local neighbourhood and services that are reachable on foot.

Driving Licence and Car Ownership

As previously discussed, driving licence and car ownership are usually positively related to mobility in later life. Driving is usually seen as the safest and easiest mode of transport for older people since the latter usually have problems with other forms of transport, namely walking (Whelan et al., 2006).

The more older people own a driving licence, the more they depend on private cars (Alsnih and Hensher, 2003). The likelihood to use other modes of transport, particularly public transport, declines if there is a vehicle in the household (Böcker et al., 2017). The possession of a driving licence also affects older people's propensity to walk (Moniruzzaman et al., 2013). In fact, when analysing leisure activities for older people in the Netherlands, Schwanen et al. (2001) found that car ownership had the strongest positive influence. In the UK, Titheridge et al. (2009) revealed that older people that were the main car drivers in the household made 50% more trips that those who occasionally had access to a car and 80% more trips than those who did not have access to a car. The latter made food shopping trips more frequently due to difficulties faced when carrying heavy shopping loads on foot or by public transport. In the Hamilton metropolitan area, Mercado and Páez (2009) found that the magnitude of travel distance between the younger-old and the older-old was similar. Older people of different ages travelled about the same distance as long as they kept on driving. Relative to car driving, travelling by bus and as a car passenger reflected negatively on the distance travelled.

2.5.2 Social Factors

Besides the individual factors discussed in the previous section, social characteristics are also amongst the main determinants of travel behaviour in later life. This research focuses specifically on the effects of older people's social networks, their relationship with family members, the effects of their living arrangement and their participation in social activities.

Social Networks

Social networks are important for older people's mobility and quality of life (Schwanen and Páez, 2010), particularly for those who do not have a car in the household (Nordbakke, 2013, van den Berg et al., 2016). The closer older people live to their relatives the more they meet, because having family members living nearby provide an important sense of security, including the reassurance that somebody can provide help if needed (Gabriel and Bowling, 2004). This encourages older people to go out and travel. In five European countries, Mollenkopf et al. (2004) showed that older people without any important people to them (e.g. relatives, good friends) made fewer trips than people with a diversified social network (1.8 trips vs. 2.2 trips per day). In fact, a strong social network is positively related to the number, diversity and frequency of outside-home activities carried out by older people (Scheiner, 2006; Haustein, 2012). Franke et al. (2013) also established that social connections supported high levels of physical activity among older people in Metro Vancouver.

Family connections and physicians' comments are also important for the process of driving self-regulation in old age (Friedland and Rudman, 2009) (discussed in detail in Section 2.6.1). However, Aguiar and Macário (2017) highlighted that for the future generations of older people, the household structure will change. The baby-boomers had less children than their parents, and this raises the question on how general care will be provided by their offspring if the number of children reduced. Thus, given the important role that family members have in older people's mobility, their living arrangement is also an essential travel determinant.

Living Arrangement

The effects of the living arrangement on older people's travel behaviour can be contrasting, depending on the context of the respective case studies. Some studies showed that older people living alone used their car relatively more (e.g. Mercado and Newbold, 2009; Truong and Somenohalli, 2011), and made more trips than those living as couples (Páez et al., 2007; Roorda et al., 2010). When discussing leisure activities in the Netherlands, Schwanen et al. (2001) found that older people living in one-person households stayed home less. They had to meet with other people to interact socially since they did not have the opportunity to do it with household members. D'Ambrosio et al. (2008) also concluded that when other family members were available, older females restricted their driving more voluntarily. When living alone, they did not have the luxury to do so. Despite the common lack of confidence among older women, D'Ambrosio et al. (2008) also showed that when controlling for other factors, older women living alone had higher confidence and enjoyment levels (whilst driving) than those who lived with others. Contrastingly, other studies showed how older people living in single households were the most disadvantaged (Turcotte, 2012, Siren and Haustein, 2014).

Other studies established how living arrangements had a mixed effect on the exposure to benefits of transport mobility. In Canada, Spinney et al. (2009) revealed that older people living alone were more likely to socialise outside home as a way of avoiding social isolation. Yet, those living in multi-member household also had to travel due to the social and support obligations which occur outside their home. Waara and Stjerborg (2010) also explained that passing from a two to one-person household in later life can have mixed implications on mobility. They showed that most respondents considered such transition as a positive one due to lower responsibilities, more independence and more extra time. Yet 41% of the older respondents saw such transition in a negative manner due to a higher dependence on public transport or the need for lifts from other people. With regard to extended families, in China, Feng et al. (2013) found that when living in extended families, older people shared household responsibilities and thus had less time and energy for out-of-home activities. In the US and in Seoul, Kim (2011) and

Kim et al. (2014) respectively established how older people living in households with children were more likely to suffer from transport deficiency due to their role as "carers".

Other studies highlighted the relationship between the living arrangement and the modes of transport that older people used. For example, when analysing factors that affect public transport use in Adelaide, Truong and Somenahalli (2015) found that those who lived alone and those who had children living close tended to use public transport less frequently. Contrastingly, there were also other studies that showed no significant relationship between the living arrangement and mobility of older people. For example, in Seoul, household size was not a significant predictor for making more trips (Hahn et al., 2016). In combination with the importance of good social networks in later life, one key factor that affects the way older people travel is their participation in social activities.

Participation in Social and Leisure Activities

As highlighted in Section 2.2, older people travel for social and leisure activities more than the average total population, particularly after retirement. In fact, social networks, leisure activities and community involvement have a positive impact on the well-being and life satisfaction of older people (Gabriel and Bowling, 2004; Musselwhite and Haddad, 2010; Li and Loo, 2017). For example, Lei et al. (2016) showed that in China, older adults' participation in social activities was related to positive dimensions of health-related quality of life. Social activity is also associated with a lower probability of developing disabilities (James et al., 2011). People who are involved in their social communities are usually healthier, both physically and mentally (Leyden, 2003; Dahan-Oliel et al., 2010). Ziegler and Schwanen (2011) discussed that for some older people the social engagement associated with mobility is more important than the physical movement.

Older people prefer to drive their car for leisure trips (Schwanen et al., 2001; Böcker et al., 2017). Yet, when analysing the determinants of ride sharing in Davis and Rosevill in California, Silvis and Niemeier (2009) found that older people who participated more frequently in social activities were more likely to rideshare regularly. Since they travelled more often, they have more opportunities to ask for rides. Similarly, Hough et al. (2008) showed that being part of a social club was positively related with the mobility of older women since they could rely more on club members for rides and could sometimes give rides themselves. One key factor that permits participation in social activities is the environment where older people live. The next section will now discuss the environment as a determinant of travel behaviour in later life.

2.5.3 Environmental Factors

When analysing mobility in later life, different studies (e.g. Mollenkopf et al., 2005; Rantakokko et al., 2013) discussed the barriers faced by older people in road environments applying the ecological theory of Person-Environment Fit (Lawton and Nahemow, 1973). The environment can put a certain level of stress on individuals (Yeom et al., 2008), and how well people function is a reflection of the degree to which their competence meets such stress (Musselwhite, 2015). As shown in Section 2.3.1, older people tend to participate in activities which are closer to their home. Thus, the spatial extent to participate in an activity which is beyond an older person's immediate surroundings usually depends both on personal competences and environmental conditions (Hodge, 2008). This section will focus specifically on the effects of the neighbourhood design, the geographical context and access to public transport.

Neighbourhood Design

The travel behaviour of older people can be spatially different (Páez et al., 2007), and the neighbourhood design, settlement structure and the built environment play an important role in this (Cao et al., 2010; Van Holle et al., 2015). For example, the built environment can strongly affect how much people engage in active transport (Brownson et al., 2009).

Walkable neighbourhoods are important for a good quality of life amongst the older population (Moniruzzaman et al., 2015). Walking as a physical activity has several health benefits for older people, which range from physical, social to psychological benefits (Koh et al., 2015; Winters et al., 2015). The distribution of land uses is critical to determine how older people travel (Giuliano et al., 2003; Van Holle et al., 2015). They usually desire neighbourhoods that make them drive less such as through proximity to services. For example, in Northern California, Cao et al. (2010) showed that older people preferred driving-reducing neighbourhoods and highlighted that improvements in accessibility (to increase walking trips) had a larger effect on older people than on younger individuals. Dispersed land use patterns can cause social exclusion among older people because they “oblige” travel-intensive lifestyles (Lucas et al., 2001). Habib and Hui (2017) showed that improving accessibility to locations influenced extensively the daily activity engagement of older people in Canada, implying that increasing accessibility would increase the out-of-home activity.

Hence, different studies showed that higher densities and mixed land uses encourage walking and public transport use whilst discouraging private car use (e.g. Newman and Kenworthy, 1999; Monrizzuman et al., 2013; Moniruzzaman and Páez, 2016). For example, Srichuae et al. (2016) found that in Bangkok, high urban density, the ability to travel without assistance, the distribution of public spaces with accessible transport modes and the urban development patterns were all positively related with the mobility of older people. Franke et al. (2013) also showed that the built and natural environments facilitated high levels of physical activity among older people in Metro Vancouver. Central areas with higher densities also tend to have a better access to public transport which is of significant importance for older people (Böcker et al., 2017). Hence, compact urban forms and higher population densities increase the number of trips made by older people but reduce their distances (Giuliano et al., 2003). In an Australian case study, Buys et al. (2012) showed that whilst private car trips amongst older people were mostly inter-suburban, most of the trips with public transport were city-centric. In Singapore, housing and land use policies have always been in favour of the age-in-place concept, allowing older people to grow old in the neighbourhood that they were most familiar with (Koh et al., 2015). Personal meanings are usually associated with such environments (Lord et al., 2011), and thus transit-friendly and mixed-use communities are needed to improve local accessibility and support ageing in place (Giuliano et al., 2003).

Other studies contrasted the previous findings. For example, Kim (2003) showed that urban form in terms of population and employment densities was not significantly associated with the mobility of older people. Moreover, Schwanen et al. (2001) found that the residential context was mostly important when older people did not own a car. When they did, they used it regardless of the environment. Buys et al. (2012) also showed that in Australia, older people who had access to a car usually drove or were driven to their destinations even when the latter were serviced by public transport.

Given the importance of walking in later life, the appropriate infrastructure promoting good walkability is critical (Hess, 2009). Common environmental challenges are high curbs, steep grades, uneven sidewalks, increased traffic, dangerous entrances on busy roads, excessive number of stairs and short timing for crosswalks (Hanson et al., 2013). When discussing spatial anxieties of older people and barriers in unfamiliar surroundings, Phillips et al. (2013) highlighted that in new environments, the key problems were related to poor signage, confusing spaces, poor paving, noise and complexity of the environment. Because of such factors, older people anticipated the feelings of discomfort and retreated in just familiar areas. Unfriendly pedestrian environments and poor urban design can also result in high speed vehicular traffic which makes walking unattractive (Cui et al., 2017). Moniruzzaman and Páez (2016) analysed the characteristics within streetscapes that affected the propensity for older people in Montreal to walk. They showed that in single-lane segments, walking amongst seniors was more common due to lower volumes of traffic. The idea that the road environment is a dangerous and hostile place can make older people think that the "safest option" is to stay at home (Musselwhite and Haddad, 2010). Yet, this alternative can have serious problems on their self-esteem and risk of depression (Aguiar and Macário, 2017).

Geographic Context

Older people living in low density environments such as rural and suburban areas tend to have more travel restrictions than those living in urban areas, and thus have a more auto-oriented lifestyle (Nakanishi and Black, 2015; Holley-Moore and Crighton, 2015). For example, van den Berg et al. (2011) concluded that older people living in urban areas were more likely to travel shorter distances for social activities due to the latter being more concentrated. Moreover, Hough et al. (2008) showed that older women residing in rural areas in North Dakota had to travel longer distances to their preferred destinations and as a result travelled less frequently. Rural areas also tend to have public transport services which make travelling for older people, particularly women, even more difficult. In the Netherlands, Schwanen et al. (2001) found that older people living in urban areas used public transport approximately eight times more than those living in least urbanised areas. Older people in Dutch urban areas also walked more than those living in rural areas (Kemperman and Timmermans, 2014).

Public transport is also usually poor in low density suburban environments where older people prefer to age in place (Rosenbloom, 2006; Kim, 2011). Zeitler et al. (2012) demonstrated how in Brisbane, the lack of active and public transport modes in suburban areas increased car dependency in later life. In North California Cao et al. (2010) showed that older residents of suburban neighbourhoods had distinct travel attitudes, with suburbanites favouring driving. Thus, communities must begin to retrofit existing ageing in place suburban neighbourhoods with accessible homes, pedestrian facilities and better public transport services (Rosenbloom, 2006).

This shows that public transport is fundamental to provide the necessary mobility for older people, particularly in specific geographic contexts. Access to public transport can therefore be a significant determinant for travel behaviour in later life given the transport disadvantage of older people (Lucas et al., 2001) and their higher possibilities to become isolated (Titheridge et al., 2009).

Access to Public Transport

Several transport planners consider access to public transport as the main measure for its overall use and performance (Gutiérrez et al., 2011). Walking is the most common mode of transport for access to public transport, and it is therefore a critical factor that determines public transport use (Zhao et al., 2003; Schmöcker et al., 2008; Su et al., 2009). Different studies showed that proximity to public transport services increases their usage amongst older people (e.g. Wretstrand et al., 2009; Hess, 2012). For example in London, the higher the public transport density, the higher was its usage by older people for shopping trips (Schmöcker et al., 2008), because they could access services in an easier manner. Even Currie and Delbosc (2010) showed that public transport use was more frequent in Inner Melbourne where both population density and public transport service coverage were higher. Nordbakke (2013) explained that a short walk to public transport is actually a capability for older people whilst a long distance walk is a lack of such capability. Despite these general trends, some studies contrasted these findings. For example, in the US, Kim (2011) showed that the availability of public transport services within walking distance did not significantly affect the transport deficiency of older people. Even in Malta, Mifsud and Attard (2013) showed that proximity to bus stops was not a determinant of older people public transport use.

2.5.4 The role of Context and Policies

The previous sections showed that although there were several similarities between studies, several findings also contrasted each other. One principal reason for this is the different contexts of the studies. As Buehler and Nobis (2010) discussed, the explanatory factors that affect travel behaviour have a different impact in each country, and contribute to a unique transport system. For example, with regard to the social networks and living arrangements discussed above, Böcker et al. (2017) explained that whilst in some cultures it is common that children take care of their parents, in western cultures older people are increasingly expected to be independent. Moreover, the significance of the car varied based on the case study considered. For example in the Netherlands, the positive effect of bicycle availability on trip making in later life made the car less important when compared to other studies in the western world.

Culture can superimpose some of the determinants discussed in this chapter. For example, Buehler and Nobis (2010) highlighted that the distance to bus stop as a measure of access, does not capture the negative stigma attached to public transport in the US. Van Holle et al. (2015) showed that when compared to Belgian older people, a similar study in the US (Carlson et al., 2012) found that older people were much less likely to walk due to their car-dependent culture. They needed a combination of high walkability, support of others and high self-efficacy to engage in walking. Even when discussing the relationship between well-being and mobility in later life, Norbakke and Schwanen (2014) highlighted that such relationship is very context-dependent and is shaped by the characteristics of a given place. For example, when comparing the reasons for driving reduction in three European countries (Finland, Germany and Italy), Raitanen et al. (2003) found that although there were similarities, there were also differences even within the same country. A case in point was that driving reduction was more common in the former West Germany than in the former East Germany. Context also plays an important role in how older drivers self-regulate their behaviour (Wong et al., 2016).

An important point which is correlated with this discussion is the role of policies**.** These could also act as travel behaviour determinants in themselves. Buehler and Nobis (2010) discussed how different policies that made car use cheaper and easier in the US encouraged older Americans to drive their car more often. This contrasted with

Germany where policies made public transport more attractive than the car. When governments provide subsidies for public transport this can encourage people to use this mode further (Cui et al., 2017). Different studies discussed the advantages of concessionary fares and free bus programmes for the mobility of older people (e.g. Green et al., 2014; Mah and Mitra, 2017). For example, in Adelaide, public transport use increased after the *Senior Free Travel* was introduced in July 2009 (Truong and Somenohalli, 2011). The role of context when analysing the effects of such concessionary fares is also important with regard to the (in)equity implications that they might have (Mifsud and Lucas, 2015). It would also be interesting if more studies could focus on how new policies developed to tackle sustainability will impact older people. For example, O'Fallon and Sullivan (2003) questioned the impacts of road user charges or electric vehicles on older people who tend to have lower income than the general population.

When analysing different governments' approaches to cater for older people needs, Johnson et al. (2017) highlighted several differences between countries. For example Switzerland, the Republic of Ireland and Germany had the highest amount of policy documents related to old age mobility. The content of the policies also strongly differed. They discussed that although some policies may not always be transferable, governments should learn important lessons from each other. Along the same lines, Siren and Haustein (2015) discussed the large variation in the institutional practices with regard to the management of older drivers in the European Union. They showed that across the EU there is variation both in the periodicity of license renewal and on the type of medical assessment needed. Subsequently, this has implications on the mobility of older people in different contexts.

After this overview of the main objective travel determinants in later life, the next section will now explain the main difficulties that older people, as drivers, pedestrians and public transport users face in the road environment. The different ways how they adapt and compensate for such limitations will also be discussed.

2.6 Difficulties Older People face within the Transport Environment

As previously highlighted, older people are one of the transport disadvantaged groups which can experience multiple difficulties in the road environment. Mifsud et al. (2018) gave a detailed overview of such difficulties for older drivers, pedestrians or public transport users. This will be briefly reviewed in this section. The important implications of driving cessation on older people's mobility will also be discussed.

The main difficulties that older drivers encounter are mainly related to fatigue, increased sensitivity to glare, slower reaction time, turning left at intersections, driving across busy intersections, driving in complex roundabouts, overtaking vehicles in narrow streets, reading difficult signs in urban areas, following road markings, recognizing hidden signs and driving in bad weather (e.g. Lyman et al., 2001; Chandraratna and Stamatiadis, 2003; Mayhew et al., 2006; Gelau et al., 2011).

Although walking in later life has several benefits, old pedestrians are also usually over-represented in pedestrian fatalities (Dommes and Cavallo, 2012) because walking can be a very dangerous mode of travel (Dunbar et al., 2004). Some common consequences of ageing are slower walking speed, longer start-up and reaction time, slower decision making, less stable balance and longer time to notice vehicles approaching from the side due to limited peripheral vision and less flexible necks (e.g. Oxley et al., 2005; Lobjois and Cavallo, 2009; O'hern and Oxley, 2015; Tournier et al., 2016). Musselwhite (2015) showed that in the UK, although the local authorities implement crossings assuming a walking speed of 1.2 metres per second, only 11% of older people in his study were walking at such speed. Such situation was worse for females and for older-old people, who had even slower walking speeds.

As highlighted in earlier discussions, public transport is an essential resource for older people which can offer them independent travel particularly if they do not drive (Fiedler, 2007; Nordbakke, 2013). Travelling by public transport is also a social acceptable way to tackle loneliness (Green et al., 2014). Despite this, as explained in Section 2.2 public transport patronage remains low. In several instances, older persons' physical limitations and other problems in the service discourage them from using such mode of transport (Fiedler, 2007; Hess, 2009). The most common barriers that older people encounter when using public transport are related to unreliability, inflexible routing, lack of accessibility, lack of facilities at bus stops, boarding constraints, over crowdedness during peak hours, feelings of resentment from other passengers, long waiting times, fear of crime and to travel alone, scarce information, lack of comfort and difficulties while navigating the urban environment (e.g. Knight et al., 2007; Wretstrand et al., 2009; Hu et al., 2013; Susilo and Cats, 2014). Bus design, bus driver behaviour, the positioning of bus stops, the unavailability of direct routes to key services, fear of falling and safety matters (especially during the night) are all other issues which create limitations for older people using public transport (e.g. Marsden et al., 2007; Broome et al., 2010; Buys et al., 2012).

2.6.1 Driving Cessation

In later life, although many persons remain relatively healthy and unimpaired, some are faced with two options: either to continue driving with an unacceptable crash risk or to stop driving (Langford and Koppel, 2011). The lack of desire to continue driving and health reasons are usually the two most important predictors for driving cessation (Siren and Haustein, 2014). Charlton et al. (2003) discussed that together with health, safety concerns and crash involvements are also an issue. When analysing the main reasons for why Finnish older people (70+) stopped driving, Hakamies-Blomqvist and Wahlström (1998) found that although the main reason was deteriorated health, only 6.9% of the ex-drivers stopped driving after a professional advice. A similar finding emerged in Denmark by Siren and Haustein (2014). Adler and Rottunda (2006) also found that health, costs related to driving, a frightening experience, family, physicians, lack of alternative transport and gender were all factors that led to driving cessation.

Symptoms of depression are very common repercussions of driving cessation (Marottoli et al., 2000). In fact, when analysing the travel needs of older people, Musselwhite and Haddad (2010) showed that stopping driving caused many changes to the travel behaviour of older people including anxiety about being able to access basic needs as shopping. The effects of driving cessation are usually worse for males than for females (Siren and Hakamies-Blomqvist, 2004; Musselwhite and Shergold, 2012). Males often find driving cessation as humiliating (Ziegler and Schwanen, 2011). Whilst females usually take the decision on their own, males often have others do it for them (Oxley and Charlton, 2009) because they tend to have a higher emotional link with their car

(Musselwhite and Haddad, 2010). Davey (2007) showed that older males got particularly emotional when discussing their lifestyle after stopping driving through phrases as "*It was like cutting off an arm or leg"*. This is because women usually plan driving cessation and are more likely to self-regulate for it (Oxley and Charlton, 2009). Since women drive for more practical reasons than males (Section 2.5.1), they are also willing to look at other alternative modes earlier on in life in order to keep their roles going (Musselwhite and Haddad, 2010).

Family support is very important in the driving cessation process (Kostyniuk et al., 2009; Friedland and Rudman, 2009). Older adults may not want to stop driving not to become a burden on their children and the latter may be unwilling to start the caregiver role by assuming responsibility for transport. Thus, family dynamics can be quite complex with regard to older relatives' decision to limit or stop driving (Kostyniuk et al., 2009). Musselwhite and Shergold (2012) also found that older people who had relatives providing them with lifts after driving cessation were still satisfied with their travel to shopping and to access services (although with a lower frequency). Some of them even became closer with their family members as a result of car sharing. Yet, McNamara et al. (2013) showed that in the Australian context, advice from relatives or friends were not as influential as those from a local doctor in the driving cessation process.

Given this, Adler and Rottunda (2006) grouped former older drivers (70-85 years) into three categories: proactive (decided to stop on their own), reluctant (planned to stop but made gradual resignation) and resister (continued driving until forced to stop). Kowalski et al. (2012) discussed that irrespective of the cognitive status, current older drivers did not think seriously of restricting or quitting driving in the next couple of months. Davey (2007) discussed that the frequent response of '*not thought about it*', showed both acceptance and an unwillingness to consider alternatives to the private car. Charlton et al. (2006) showed that although 83% of the 75+ Australian drivers considered their transition away from driving only 17% made plans for it. This highlights that very few older people plan for the time when they will not be able to drive anymore and therefore when faced with restricted or terminated driving privilege, it often results in lack of access to essential services, loss of independence and reduced mobility (Adler and Rottunda, 2006). Consequently, physicians have a very important role during the driving cessation process, both for the older people themselves and for their families (Carr et al., 2006). Older people should be called to think about the time when they stop driving (Davey, 2007) because those who plan the transition are more likely to find driving cessation easier than those who were instructed to stop driving (Windsor et al., 2007; Musselwhite and Shergold, 2012).

Despite the negative consequences of driving cessation, in the UK (Paisley and inner and outer London), Gilhooly et al. (2002) showed that older people who had given up on driving were more positive about the advantages of not driving than those who were currently driving. A similar finding was found by Oxley and Charlton (2009) in Australia. They showed that although the out-of-home activities were lower for former drivers when compared with the current ones, satisfaction with mobility did not diminish as expected. When older people felt that they stopped driving at the right time, they had higher satisfaction levels. Thus, the extent to which the mobility varies after driving cessation depends on the alternative transport modes available, the perceived ability to use them as well as the individuals' previous knowledge on using them (Knight et al., 2007).

2.6.2 Compensation Techniques

The previous sections showed that evidently age-related limitations affect older persons' experience in the road environment. However, such problems do not automatically mean unsafe or limited travel behaviour. Usually older people acknowledge their own limitations and develop more awareness of their restrictions and movement in physical space (Ziegler and Schwanen, 2011). These are often referred to as compensation techniques, which help people to cope with changes and continue living in a satisfactory manner. For example, Scheiner (2006) showed that older people with health restrictions did not become less active but reduced their activity diversity, and concentrated on the remaining physically possible activities.

Hodge (2008) made reference to Finlayson and Kaufert's (2002) study to explain that perceived risks of older people in the transport environment can either be continuous or unpredictable. The former refers to the knowledge of older people about unsafe conditions (e.g. unsafe areas in neighbourhood), whilst the latter refers to unpredictable risks (e.g. bad weather). Although both can cause difficulties for older people, Finlayson and Kaufert (2002) showed that continuous perceived risks had less influence than the unpredictable risks on the mobility of older women in their study. Knowing about these risks, older women planned their trips accordingly and developed various coping strategies to minimize difficulties. Oxley et al. (2004) argued that although such adaptations are called “compensatory”, these are often a result of mature judgements of road use, lifestyle choices and personal preferences.

The most common compensation techniques amongst older drivers are an increase in cautiousness and conservativeness, taking more time to execute a driving manoeuvre, avoiding certain driving situations, driving more slowly, avoiding parallel parking and restricting driving to optimal conditions (e.g. good weather, daylight, off-peak hours) (e.g. Charlton et al., 2003; D’Ambrosio et al., 2008; Nakanishi and Black, 2016). Such adaptive driving strategies are mainly found in the 80+ group, primarily due to the lower health levels at this age (Rush et al., 2011). The long driving experience of older people is also an important compensation technique especially in familiar situations where future events can be anticipated (Langford and Koppel, 2011; Leversen et al., 2013). Supporting previous discussions, older males tend to compensate less than females (D’Ambrosio et al., 2008). For example, older women limit their driving and trips length by about 20% more than males (Burkhardt et al., 1996).

Similar to drivers, older pedestrians also compensate for their limitations. For example, they avoid complex traffic intersections, cross only at formal crossings, stop at kerb before crossing, stand further back at the edge, plan walking routes, select large gaps in traffic and break the crossing of two-way roads into parts (Oxley et al., 2004; Dunbar et al., 2004). For example, Lobjois and Cavallo (2009) showed that older people tended to start their crossing sooner than younger people in order to compensate for their increased crossing time. Nonetheless, despite all this, there is no strict evidence that such compensation techniques are effective.

The Inability to Compensate

The lack of older persons’ self-awareness for their limitations is a major factor that can put them at a double disadvantage. This issue is mainly related to three concepts: whether the beliefs about the changing capacity are correct, whether they alter behaviour in response and whether the attempts to compensate are successful (Dunbar et al., 2004). When there is a discrepancy between perceived and actual abilities (indicating a lack of awareness) older drivers tend to be more confident and regulate their driving less (MacDonald et al., 2008). In a study designed to assess older people's awareness of their sensory and cognitive abilities with regard to road use, Holland and Rabbitt (1992) found that older people were most aware of their physical problems but not the cognitive ones. When older people have abnormal or excessive cognitive impairments (e.g. dementia), they usually have a further reduced insight of their own difficulties which limits the ability to compensate (Dunbar et al., 2004). Older people may not be aware of their mistakes and can even not remember making them (Holland and Rabbitt, 1992).

Moreover, Oxley et al. (2004) concluded that older pedestrians rarely judged themselves as the cause of the accident, and usually referred to other road users as doing something unusual. Dommes and Cavallo (2012) also found that although training interventions helped older persons' street-crossing behaviour, their ability to recognize the oncoming car's speed did not improve. This showed that such age-related perceptual and cognitive impairments cannot always be compensated by behavioural or educational training methods. With regard to drivers, as stated in the previous discussions, older women are generally more accepting of changes in their driving skills and are more open to improvements (Tuokko et al., 2007). Older males are also unlikely to take any defensive or driving refresher courses (D'Ambrosio et al., 2008). Tuokko et al. (2007) discussed that older people driving courses attracted mostly older drivers who were interested in maintaining their mobility and not those who were concerned about their driving. However, Mayhew et al. (2006) showed that in most cases older drivers were at fault in crashes due to the lack of yield in right-of-way, ignorance of traffic signals or other types of traffic violation. Further detail on the compensation techniques that older people usually adopt in the road environment and the inability of some of them to compensate could be found in Mifsud et al. (2018).

2.7 Clusters of Older People

Several researchers have studied clusters of older people (e.g. Haustein, 2012; Siren and Haustein, 2013) in order to understand the heterogeneity in their respective travel behaviour. Segmentation helps to develop an action plan with innovative solutions that fulfil the transport needs of ageing societies (Mandl et al., 2013). It is needed to identify the target groups that specific measures should tackle (Haustein, 2012). In order to be successful, hard and soft measures, information campaigns and new mobility services should be oriented towards specific groups of older people and not the entire population at once. To date, most measures focused on the “mobility impaired” segment of the older population (Marin-Lamellet and Haustein, 2015). Yet, as shall be explained in this section, a wider picture is needed to thoroughly understand the older population. Haustein and Siren (2015) reviewed all the transport segmentation studies (in English and German) of older people since the year 2000. Motivated from their review paper, Table 2.1 provides a summary of the main characteristics of these studies. A more detailed and expanded version of this table is attached in Appendix A (Table A.1). This outlines the case study, the variables used for the clusters’ formation and the clusters developed with a detailed description of each. Tables 2.1 and A.1 slightly expand on Haustein and Siren (2015) who included eight studies in their review. Since Aigner-Breuss et al. (2010) and Bell et al. (2010) were both written in German, they were directly cited from Haustein and Siren (2015).

Clusters		Description
Aigner-Breuss et al. (2010)	*Selective Car Use*	Old drivers who also use other modes,
	Always used their cars	Mostly drivers or else passengers, no alternative to car
	Restricted group	Live alone, low income, errands on foot and public transport
Bell et al. (2010)	*Fully mobile seniors*	Work, active, preferred car as transport mode
	Slightly physically impaired seniors	Retired, satisfied with health state, , preferred walking and cycling
	Highly physically impaired seniors	70+ years with physical restrictions, used public and special transport, leave home less frequently
Haustein et al. (2008)	*Mobile Car Oriented*	Highest car use, lowest percentage of walking, highest distance travelled per year
	Restricted Mobiles	Highest car use, high percentage of walking, lowest distance travelled per year
	Self-Determined Mobiles	Almost equal percentage of car use and walking, lower use of public transport, second most longest distance travelled
	Pragmatic Public Transport-Oriented	High percentage of walking followed by car (as passengers) and public transport, low activity engagement
	Bike-Oriented	Highest percentage of bike use followed by walking and car, positive ecological norms
	Eco-Friendly Public transport oriented	Highest percentage of walking and highest percentage of public transport use, lowest car use
Haustein (2012)	*Affluent Mobiles*	Mostly men, healthy, longest distance travelled, active in leisure activities
	Self-Determined Mobiles	Mostly men, healthy, open to use all modes of transport, no pressure to always be mobile, satisfied with mobility
	Captive Car Users	Mostly females, older-old, restricted in mobility, dependant on the car, not satisfied with mobility
	Captive Public Transport Users	Mostly females, older-old, restricted in mobility, dependant on public transport, not satisfied with mobility
Siren & Haustein (2013)	*Independents*	Mostly males, good health, best car access, optimistic about not depending on others
	Flexibles	Gender balanced, expected to use all transport modes and used the car to a lower extent
	Restricted	Mostly females, most restricted in transport especially in car use, dependent on others, lowest annual mileage

Clusters		Description
Mandl et al. (2013)	*Fit as a Fiddle*	Youngest, healthiest, employed, good social networks, complex and long trips, high car users, low public transport use
	Happily Connected	Driving is the most important transport mode (male as drivers, female as passengers), complex trip chains but drive fewer kilometres than younger drivers
	Oldie but Goodie	80-90 years, overall healthy, not severely limited in activities, walking and public transport are preferred modes of transport
	Hole in the Heart	50-57 years, sick, strongly limited in activities, car is preferred since public transport use is difficult
	Care-Full	80-100 years, frail, immobile, depend on care and assistance from others, do not leave home often
Mollenkopf et al. (2004)	*High outdoor mobility/high mobility satisfaction*	Mostly younger-old males, healthy, high education, active car drivers. Frequency of trips above average
	Medium outdoor mobility/high mobility satisfaction	Lower education but still pair with average, lower use of transport modes and variety of outdoor leisure activities
	Low outdoor mobility/still satisfied with mobility	Satisfaction with mobility still in positive score range, components of mobility lower than first two groups
	Low outdoor mobility/unsatisfied with mobility	Older-old females, highest health impairments, non-drivers, all mobility characteristics in negative range of values
Hildebrand (2003)	*Workers*	Mostly males, employed, licensed to drive a car, mobile
	Affluent Males	Males, second youngest age, second highest income, drivers, independent, highest trip duration
	Mobile Widows	Mostly females, live alone, have a driving license, mobile
	Granny Flats	Mostly females, live with their children, one-third disabled, few licensed to drive, rely on others, lowest trip duration
	Mobility Impaired	Mostly older-old females, more than one-quarter disabled, no driving license, depend on others, rely on walking and transit
	Disabled Drivers	Mostly females, have a driving license but have a disability which affects outside travel, older than average
Beaudoux & Deleu (2010)	*Young Active Retirees*	Healthy, travel similar to workers, car is import to permit freedom, abandoning the car is “social death”
	Retirees in declining	Lower health status, mobility in decline, collective public transport more than car
	Dependent Retirees	Older-Old, bad health, limited capacity of mobility, collective public transport but afraid to travel alone

Table 2.1: Review of studies that clustered older people (Adapted from Haustein and Siren, 2015)

For the clusters developed as part of the MOBILATE project, Mollenkopf et al. (2004) showed that no immediate measures were needed for the *High Outdoor Mobility/High Mobility Satisfaction* group, whilst stimulation to maintain mobility was needed for the intermediate group (*Medium Outdoor Mobility/High Mobility Satisfaction*). For the group showing a lack of resources (*Low Outdoor Mobility/ Still Satisfied with Mobility*), prevention efforts that avoid further loss in outdoor mobility were required. For the mobility poor (*Low Outdoor Mobility/Unsatisfied with Mobility*) immediate intervention was needed through social, technical and organisational support.

Mandl et al. (2013) discussed the clusters of older people developed by the GOAL research project. Figure 2.3 is a graphical representation of the five clusters listed in Table 2.1 showing their predominant range of age and the level of activity.

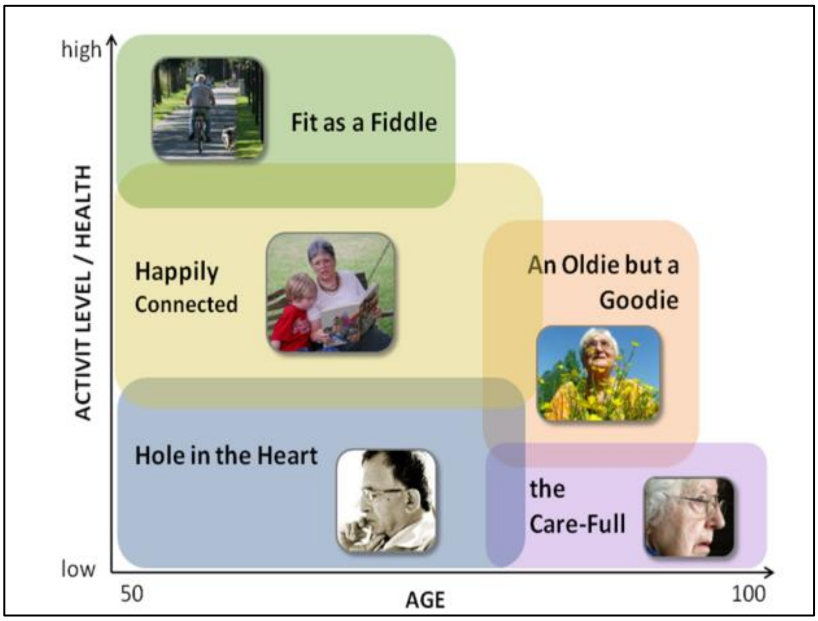

Figure 2.3: Profiles of older people vis-à-vis their age and activity level (Mandl et al., 2013)

For each cluster developed, Mandl et al. (2013) described the most important factors concerning their demographics, health, transport, environment, life satisfaction, technology use and important transitions. They showed that although health is usually related to age, the *Oldie but a Goodie* were still relatively healthy until high age whilst the *Hole in the Heart* were much younger with severe health problems. The *Oldie but Goodie*, the *Hole in the Heart* and the *Care-Full* groups had the highest fears of assault and crime. Coping mechanisms for life transitions were important and the two clusters that suffered the most were the *Hole in the Heart* and the *Oldie but Goodie*. Due to such transitions, these may eventually transfer to more problematic profiles. Hoedemaeker (2013) made projections of how such clusters will change in 2030 and 2050. Figure 2.4A shows the clusters distribution based on demographic changes, whilst Figure 2.4B visualises how such clusters will change based on demographic and societal changes. All clusters, particularly the *Oldie but a Goodie* and the *Care-Full*, shall increase from 2010 to 2050. The *Happily Connected* will decrease in 2050 compared to 2030.

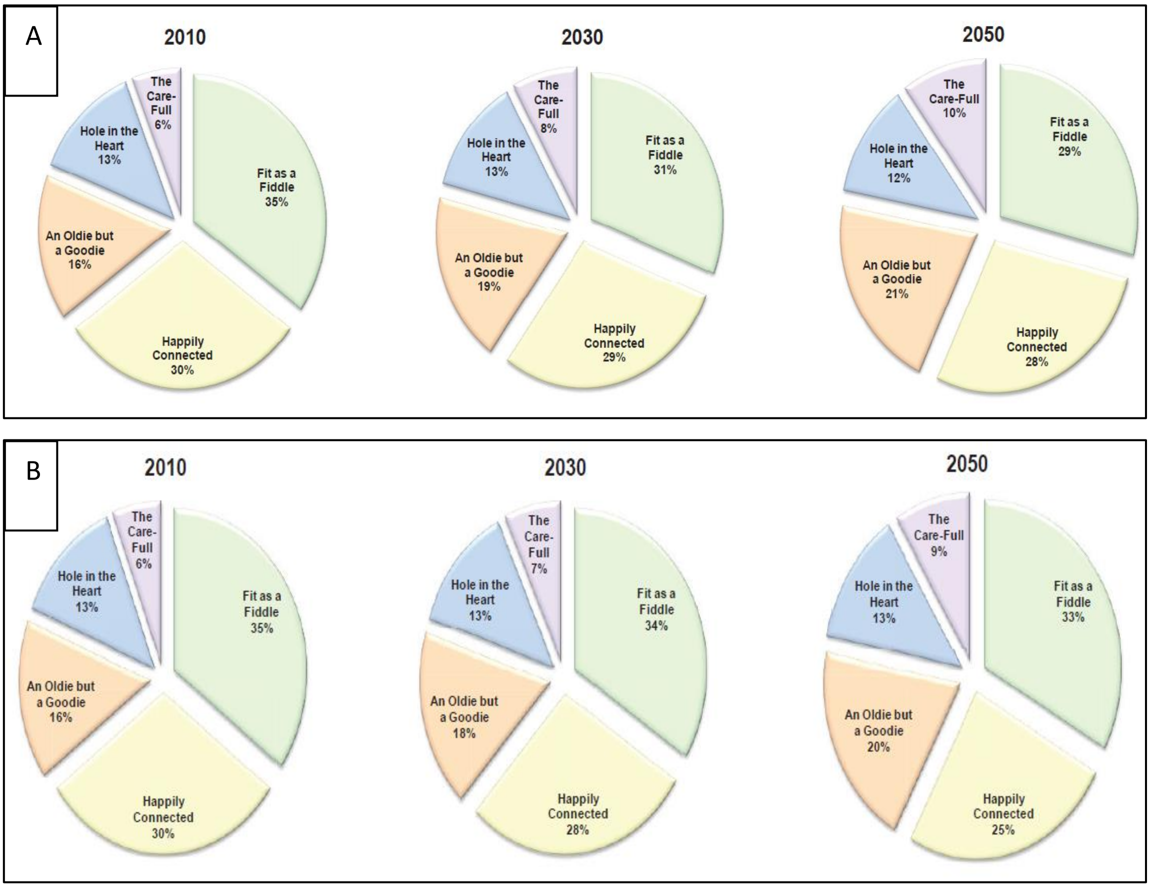

Figure 2.4: Distribution of profiles in 2010 and projections to 2030 and 2050
A – Effect of demographic changes; B – joint effect of demographic and social changes (Adapted from Hoedemaeker, 2013)

Siren and Haustein (2013) categorised Danish baby-boomers according to their future expectations (Tables 2.1 and A.1). Given their high car dependence the *Independents* were the most vulnerable to driving cessation, particularly if no alternatives were available. Although the *Restricted* group was the most disadvantaged, they were the least open to technical services that could help them. This was the group that would have benefitted the most from improvements in public transport accessibility, safety and security.

As shown in Tables 2.1 and A.1, the only two studies that included attitudinal factors in the cluster analysis were Haustein et al. (2008) and Haustein (2012). When mobility-related attitudes are incorporated with socio-demographic variables in segmentation, the differences in mobility behaviour are made much clearer (Hunecke et al., 2010). As a result, better interventions that tackle the mobility of older people could be developed (Haustein, 2012). Both studies discussed different interventions vis-à-vis the respective clusters. Haustein et al. (2008) showed that for example, training and escort services for public transport use should be oriented towards the *Restricted Mobiles*. Better cycling facilities, public environmental awareness campaigns and support of current behaviour should target mostly the *Bicycle-Oriented* and *Eco-friendly Public Transport-Oriented* clusters.

In Haustein's (2012) study, objective factors were more important than attitudinal ones for the two socially disadvantaged groups (*Captive Car Users* and *Captive Public Transport Users*). For *Captive Car Users*, the limited access to public transport and poor infrastructure led to a low mobility satisfaction and a higher car dependency. Although the *Captive Public Transport Users* had limited access to the car, they had better infrastructural conditions which helped them to access their destinations more easily (on foot or with public transport). Although the *Affluent Mobiles* had restrictions with public transport use, they evaluated walking and cycling more positively and could reach their destinations easily using these modes (given their younger age). The *Self-Determined Mobiles* were open to all modes of transport, supported by low perceived mobility necessities.

Similar to Haustein et al. (2008), Haustein (2012) discussed different interventions needed vis-à-vis each of the four clusters (Table 2.1). Since it was difficult for *Captive Car Users* to switch from their car to other modes of transport, compensating mobility services such as delivery instead of public transport were particularly helpful for this group. Yet, she highlighted that it is actually more important to prevent people from becoming *Captive Car Users*. For the *Affluent Mobiles*, shifting away from the car was easier due to their more positive attitudes towards other modes of transport. For this cluster, Haustein (2012) suggested the advertisement of high quality bikes for short distances and flexible public transport for longer ones. The *Self-Determined Mobiles* were the easiest to change from the car to alternatives due to their positive attitudes towards walking, cycling and high public transport control. They also had high proenvironmental norms, so environment-related campaigns promoting alternative modes of transport and car-sharing were effective. Ultimately, Haustein (2012) discussed that the *Captive Public Transport Users* used environmental friendly modes since they had no alternatives. They participated in more leisure activities than the *Captive Car Users* not only because of infrastructural differences but also due to their positive attitudes towards walking and cycling. Such cluster will decline in the future due the increasing number of female drivers. After their thorough review, Haustein and Siren (2015) summarised all the clusters into four main groups as shown in Table 2.2.

Similar to Haustein and Siren (2015) and by making reference to the previous older people clustering research, Marin-Lamellet and Haustein (2015) explained that all studies identified at least three of the following segments:

- Highly mobile car-oriented people: *Affluent Mobiles* (Haustein, 2012); *Affluent Males* (Hildrebrand, 2003); *Fit as a Fiddle* (Mandl et al., 2013)
- Flexible people who use all modes of transport: *Self-Determined-Mobiles* (Haustein, 2012); *Happily Connected* (Mandl et al., 2013)
- Car-oriented people but with restricted mobility: *Captive Car Users* (Haustein, 2012); *Disabled Drivers* (Hildrebrand, 2003)
- Older people who depend on public transport at different degrees: *Captive Public Transport Users* (Haustein, 2012); *Restricted Group* (Bell et al., 2010)

Affluent Mobile Drivers: Males, highly mobile car-oriented, high income and education, high activity engagement.		**Mobile Multi-Modal Seniors:** Active younger-olds with car access but not restricted to car use, transport mode is chosen based on situation taking health and environmental aspects into consideration, balanced genders, average health high/medium activity engagement.	
Affluent Mobiles (Haustein, 2012)	Independents (Siren and Haustein, 2013	Medium Outdoor Mobility/High Mobility Satisfaction (Mollenkopf et al., 2004)	Self-determined Mobiles (Haustein, 2012)
Mobile Car-Oriented (Haustein et al., 2008)	Fully Mobile Seniors (Bell et al., 2010)	Self-determined Mobiles (Haustein et al., 2008)	Bike-Oriented (Haustein et al., 2008)
Workers (Hildebrand, 2003)	High Outdoor Mobility/High Outdoor Satisfaction (Mollenkopf et al., 2004)	Flexibles (Siren and Haustein, 2013)	Ecology-Minded Public Transport Users (Haustein et al., 2008)
Affluent Males (Hildebrand, 2003)	Predominant Car Users (Aigner-Breuss et al., 2010)	Selective Car Users (Aigner-Breuss et al., 2010)	Slightly Impaired Seniors (Bell et al., 2010)
Fit as a Fiddle (Mandl et al., 2013)	Mobile Widows (Hildebrand, 2003)	An oldie but a goodie Mandl et al., 2013)	
Happily Connected (Mandl et al., 2013)			
Transport Service Dependent Seniors: Rely solely on the car without other alternatives due to health restrictions, negative attitudes towards alternative modes, balanced genders, restricted socio-economic resources, low activity engagement.		**Car dependent seniors:** Mostly females, mobility restricted, get lifts from others, lower health status, low activity engagement.	
Pragmatic Public Transport-Oriented (Haustein et al., 2008)	Highly impaired seniors (Bell et al., 2010)	Captive Car Users (Haustein, 2012)	Hole in the Heart (Mandl et al., 2013)
Captive Public Transport Users (Haustein, 2012)	Mobility Impaired (Hildrebrand, 2003)	Mobility Impaired (Haustein et al., 2008)	Disable Drivers (Hildrebrand, 2003)
Granny flats (Hildebrand, 2003)	The care-full (Mandl et al., 2013)		
Low Outdoor Mobility/Still satisfied with mobility (Mollenkopf et al., 2004)	Low outdoor mobility/unsatisfied with mobility (Mollenkopf et al., 2004)		
Restricted Groups (Aigner-Breuss et al., 2010)	Restricted (Siren and Haustein, 2013)		

Table 2.2: The different segmentation studies grouped into four main clusters as defined by Haustein and Siren (2015)

2.8 Improvements needed for Better Mobility in Later Life

Following the understanding of how older people move and the factors affecting their travel behaviour, a discussion on improvements to mobility follows in this section. Based on a review of previous literature and on the TRACY European Project, Johnson et al. (2017) summarised eleven qualities which are needed for a transport system to support mobility in later life. It should be affordable, available, barrier-free, comfortable, comprehensible, efficient, friendly, reliable, safe, secure and transparent.

Coughlin (2009) explained that the baby-boomers' future travel patterns will be dominated by four characteristics: the baby-boomer women's behaviour, the caregiving provided by the boomers, their extended work life (including part-time retirement, informal work and volunteering) and their increase in leisure activities. Hence, the traditional policies focusing just on the less able bodied older adults need to be changed (Marin-Lamellet and Haustein, 2015). Supporting the clusters discussed in the previous section, it is strongly emphasised that policies should not target older people as a homogenous group. They should acknowledge their diversity and target specific groups of the population (Phillips et al., 2013). Older people have a broad range of skills and resources (Aguir and Macário, 2017), and thus policies cannot be one-size fits all (Alsnih and Hensher, 2003). For example, with regard to public transport, there should be courses that target the non- or infrequent users to increase their mobility options, and other campaigns that target frequent users particularly on their safety (Marin-Lamellet and Haustein, 2015).

This shows that mobility is a multidisciplinary theme and thus transport policies should be integrated with urban and social policies such as health, infrastructure and land use (Hu et al., 2013; Koh et al., 2015). In the case of older people's mobility, the range of stakeholders vary from government, planners, engineers, operators, road safety representatives, health practitioners, psychologists, sociologists, environmentalists and of course older people themselves (Agiur and Macário, 2017; Cui et al., 2017). Policies should be developed based on the experiences of older people rather than on the assumptions of their needs (Phillips et al., 2013). This increases the acceptance of changes, both by the older persons and those around them (Goins et al., 2015).

The "New Mobilities Paradigm" developed by Sheller and Urry (2006) discussed the hypermobile world we live in, and explained that the increase in travel and technologies have enabled a sharp increase in connections at a distance which are important to hold social life together. They explained that mobility sociology should cover the assemblages of human beings and their reconfiguration over space and time. Consequently, different studies stressed the fact that older people should be encouraged to keep on driving as much as possible (e.g. Musselwhite et al., 2015; Cui et al., 2017). Siren and Haustein (2015) suggested that policy makers should focus on prolonging older drivers' safe driving careers. Given the various transport disadvantages for older females, it is important to increase older women's confidence in driving so as to keep them safe and mobile (Oxley and Charlton, 2009; Haustein et al., 2013). Rosenbloom (2006) insisted that policy analysts should encourage older women to share the driving task equally with their husbands, to participate in retraining programmes, to use vehicles equipped with devices that help to compensate for ageing problems and to choose self-regulatory driving behaviours.

Nevertheless, it is acknowledged that encouraging driving has serious implications on environmental and social sustainability (Rudinger et al., 2006). Older people are over-represented in traffic accidents due to their fragility which increases their fatality risk per unit of travel (Mifsud et al., 2018). Thus, one main call is for alternative transport which replicates the attributes of private cars, especially for older people with mobility difficulties (Metz, 2003). Older people should be educated and provided with solutions about alternatives to driving way before driving cessation so as to remove the stress typically associated with this decision (Musselwhite and Haddad, 2010; Buys et al., 2012).

In the South of England, Musselwhite (2010) also discussed the role of education and training to help older people gain confidence in alternative modes of transport when they stop driving. He explained that both formal and informal travel information is needed. Apart from formal information as the provision of timetables through leaflets, he also suggested that "social travel groups" could be set-up where older people could be provided with specific travel training or buddy support systems. These are essential to provide informal information to older people which in most cases is missing. Some examples of informal knowledge are whether it is easy or not to carry shopping bags and whether benches and formalised crossing are available. Such information could easily be provided in support groups and buddy systems. The latter are also important for emotional support. They can help older people to gain confidence and increase their willingness to use alternative modes. Despite this, the attractiveness of public transport may not be enough to break the car use habit. Hence, it is fundamental to prevent people from becoming habitual car users in the first place (Matthies et al., 2002; Musselwhite and Shergold, 2012).

The most vulnerable individuals should always be protected with work targeting their inclusion in society (Aguir and Macário, 2017). This is because, for example, despite the increase in car use, there will always be older people who depend on public transport, particularly those with lower income and with lower health (Schwanen et al., 2001). Actually, as discussed in Chapter 1, due to the "ageing of ageing" the number of older people needing public transport will increase in the future. Broome et al. (2013) tested the impact of age-friendly guidelines for public buses, usability and social participation for older people in Hervey Bay over a three year period. They showed that the implementation of such changes actually resulted in improved usability of bus systems for older people and increased participation in social activities. Hence, policies targeting public transport should not just deal with physical issues but also with cognitive accessibility and other "soft measures". For example, information provision is critical (Hounsell et al., 2016). In South Korea, although public transport systems were well established in urban areas, older adults found it difficult to access information about public transport (Kim et al., 2014). Moreover, although infrastructural improvements are vital, it is equally important that older people are well educated on how to use public transport (Kim et al., 2014). Better services do not lead to a higher use if older people are not aware that they exist (Haustein, 2012).

Besides amelioration in public transport services, strong improvements are also needed in active modes of transport (Holley-Moore and Creighton, 2015). These are also important to make older people appreciate more the environment that surrounds them and improve their bond with it (Aguiar and Macário, 2017). Moreover, active modes of transport have several health benefits for older people (O'Hern and Oxley, 2015). Walking is also an inexpensive mode of transport (Moniruzzaman et al., 2013) that can easily be incorporated in older people daily routine. When restricting driving activities, older people may often make utilitarian trips on foot, replacing utilitarian car trips with walking if good walkability is present (Van Holle et al., 2015). It is thus important to understand the factors that encourage walking in old age (Moniruzzaman et al., 2013).

A case in point is the compact urban form with higher densities and mixed land uses discussed in Section 2.5.3.

Usually older people acknowledge the benefits of walking (Musselwhite and Haddad, 2010), however, they feel excluded from the pedestrian environment due to its poor design (Musselwhite et al., 2015). Hence, there should be efforts to improve the pedestrian environment and access on foot to key services (Scrichuae et al., 2016). Some examples are through separation of modes, improved intersection design, alteration of signal times at intersections to accommodate older pedestrian walking speed and installation of median refuges to reduce crossing distances (O'Hern and Oxley, 2015; Cui et al., 2017). More benches, more public toilets, higher safety from crime and better street lighting should also be provided to make walking easier and more attractive to older people (Van Cauwenberg et al., 2014). Such improvements are mostly needed in shopping areas since this is the most common trip purpose for which older people travel with active modes of transport (Cui et al., 2017). Musselwhite (2015) goes on to describe why males usually feel more comfortable in the road since it is traditionally masculine-built, which in turn may psychologically exclude females' interaction. For example, he suggested urgent updates in the UK Department for Transport recommendations to consider older females' walking speed. Rosenbloom (2006) also stressed the urgent need for planning that considers the safety and mobility needs of a society marked by feminization of ageing.

Voluntary driver training is another example of how to help older people (Kostyniuk and Shope, 2003; Haustein and Siren, 2015). Local organisations (e.g. churches, social clubs) should be aware of older people who are interested to participate in their activities, and could "broker" lifts. Supporting previous discussions, this significantly reduces the embarrassment of older people to have to ask for lifts (Silvis and Niemeier, 2009), and thus increases their participation in social activities. Facilitating lifts is more difficult in large cities (fewer people know each other) and in rural areas (due to longer distances). Such programmes are an example of a public transport alternative which still retains some of the characteristics of the private car (Kostyniuk and Shope, 2003). Given the different extents of disadvantage that older people have in the respective contexts, it is also important that transport policies include an equity assessment that considers the heterogeneity of the older population (Mifsud and Lucas, 2015).

Supporting the discussion in Section 2.5.4, the priority of transport policies regarding older people's mobility differ significantly between countries. Johnson et al. (2017) showed that overall in the European Union (and Norway and Switzerland), *safety*, *barrier freedom* and *affordability* were the mostly addressed topics.

This showed that most governments take the *safety* of older people very seriously, focusing mostly on driving licence renewal and road safety strategies. *Barrier freedom* measures were mostly related to public transport. Whilst some measures as the *Federal law for equality of disable people and effects on the transport sector* in Germany were quite wide-ranged, others as the *Senior-proof road design* in the Netherlands focused on specific topics as technical standards of transport modes. *Affordability* measures were mostly related to discounted travel for older people on public transport services (e.g. *Kartanzjan* in Malta and *Free Travel 65+* in Hungary). Apart from public transport, some Controlled Vehicular Access exemptions also apply for Malta. People staying more than 30 minutes in Valletta are charged. Amongst other people, residents are exempted from such charge. First (or in some circumstances second) generation relatives of residents are also exempted when their relative who is 61+ lives in Valletta.

On the other hand, Johnson et al. (2017) found that the topics that were the least discussed in European policies dealing with older people's mobility were *comfort*, *friendliness*, *efficiency* and *reliability*. Although *comfort* was not the main focus of many documents, they still wanted to promote comfortable travel for older people. One document that highlighted comfort was the *Action plan for people with reduced mobility* in Luxembourg. *Friendliness* was not a characteristic that was widely considered in national documents except from those making older people feel 'welcome' when using public transport (e.g. *Transport sector action plan on age friendly transport services* in the Republic of Ireland). *Efficiency*, by not making journeys impractical was discussed in eight documents reviewed. *Reliability* was actually worse since it was listed in only four European documents. It mostly referred to the reliability of transport and infrastructure as well as to the ability to cope in unforeseen circumstances. Johnson et al. (2017) discussed that one reason why safety, barrier freedom and affordability were very common is because they are quite straightforward to deliver and are linked with "hard" engineering interventions (e.g. raised kerbs). "Softer" qualities such as friendliness are more difficult to measure.

Marin-Lamellet and Haustein (2015) reviewed different international practices for older people and analysed to what extent they were meeting their diverse needs. These practices were summarised under six headings: Personal Schemes, Public Transport Training, Public Transport Information, Pricing and Incentive measures, Older Driver Courses and Health Issues. They did not only discuss the clusters of older people which such practices are currently targeting, but also suggested the clusters that such practices *should* target. The following section now concludes the literature review by discussing the role that technology has in contemporary life in order to aid older people to remain mobile as long as possible

2.8.1 The use of Technology for Improving Mobility in Later Life

Several new opportunities for mobility improvements are arising due to transport-related technological developments (Holley-Moore and Creighton, 2015). Shergold et al. (2015) explained that there are three types of technology that influence the travel of older people: 1) transport technologies (can improve the performance of transport systems and guide the traveller), 2) substitution technologies (e.g. teleworking and e-shopping that replace travel or enhance activity without the need to travel) and 3) non-transport technologies (technologies not intended to influence travel but indirectly affect travel significantly). For example, virtual technology (e.g. online shopping, social networking) can meet certain needs when physical mobility is reduced (Musselwhite and Haddad, 2010).

An important innovation that will affect the mobility of older people is the introduction of autonomous cars. Older people are actually the key market for driverless cars. Yet, as Shergold et al. (2015) discussed, the effects of fully driverless cars on older people are still uncertain. A case in point are their attitudes and acceptability towards different technological developments (e.g. Zmud and Sener, 2017; Siren and Grønborg Knudsen, 2017). Intelligent Transport Systems (ITS) do not only help drivers, but can also be essential for pedestrians. For example, intelligent crossing facilities such as the puffin crossing in the UK are adapted to the slower walking speed of older people. They monitor slower walkers and adjust the time allocated to the pedestrian clearance phase accordingly (Edqvist et al., 2011).

Despite such developments, there will always be older people who are not willing to use technological devices. Technological developments should target the respective clusters of older people (Section 2.7). For example, the *Captive Car Users* (Haustein, 2012) had a low technology intake. In this case, public transport information should still be provided using paper-based campaigns and community meetings. Courses could also be provided to these people to try and convince them to use the respective technologies by highlighting their benefits in a non-commercial environment (Marin-Lamellet and Haustein, 2015). On the other hand, the *Affluent Mobiles* (Haustein, 2012) were open to different technologies and could thus be easily attracted to their use. Nonetheless, whilst car-dependent older people may like technologies to prolong their driving ability, the *Affluent-Mobiles* might not feel "old" enough and may not want to benefit from their service.

2.9 Conclusion

This chapter provided important considerations regarding the travel behaviour of older people. Although mobility is increasing in later life when compared to previous years, older people are still considered as a transport-disadvantaged group. Their travel behaviour is determined by several individual, social and environmental factors, which may have corresponding or contrasting impacts throughout studies. For example, whilst living in a multi-member household usually reflects positively on mobility, some studies proved that older people living alone are more advantaged. Another example is that whilst living close to public transport stops is usually described as increasing it use, some studies contrasted this by showing that proximity to bus stops does not have any effect. Thus, one important conclusion is that the roles of context and policies vis-à-vis travel behaviour in later life are essential and should always be considered.

Older people also face several difficulties in the transport environment that automatically affect the way they behave in the road. These difficulties are mostly related to physiological changes such as slower reaction time, motion restrictions and longer time to notice vehicles approaching. In this regard, another key conclusion of this chapter is that older people usually acknowledge their own limitations and compensate for them (e.g. drive during nice weather only). Nevertheless, this may not always happen because either older people are not fully aware of their limitations or else their compensation techniques are not appropriate.

A third consideration of this chapter is that the travel behaviour of older people is very heterogeneous and consequently transport interventions need to tackle the specific needs of clusters of older people. For example, whilst there are older people who always use their car and have no intention of changing mode, others are flexible to use different modes of transport and suffer from less transport deficiencies. Certain groups of older people can also use specific transport modes in a “captive” and “obliged” manner due to different restrictions. Given this, the ultimate conclusion is that mobility in later life should be improved. Based on previous research, this chapter discussed some improvements needed such as the required support for safe driving, the encouragements to increase active modes of transport and the relevance of technology in keeping older people mobile.

Although this chapter gave a thorough overview of the mobility determinants in later life, it only did so from an objective perspective (individual, social and environmental factors). Mobility is also strongly determined by different psychological factors such as attitudes and habits when travelling. The next chapter will now discuss the determinants of travel in later life from a psychological point of view. This is also necessary to explain and justify the theoretical underpinning of the study. After having a holistic picture of *both* the objective and psychological determinants of travel in later life, the research gap will then be discussed in the next chapter (Chapter 3).

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Introduction

This chapter discusses the underlying psychological determinants of older people's travel behaviour. By doing this it also targets the second objective of the thesis, that of determining the theoretical underpinning for the study in order to analyse older people's mobility and travel behaviour. This issue is essential in older people's mobility given the heterogeneity of their behaviour and the complex nature of their individual characteristics, social relations, environmental context and mobility patterns. Given such need, a review of different l theories related to behaviour was undertaken in order to determine the best underpinning framework for the study. The present chapter considers the main psychological theories of attitude-behaviour relations commonly used in travel behaviour, and explains why the Theory of Interpersonal Behaviour (TIB) (Triandis, 1977) was chosen as the theoretical framework for this study.

In Section 3.2, the use of psychological theories in transport is addressed and other social theories which are essential to understand behaviour and its determinants are also acknowledged. This is followed by an explanation of how psychological factors were studied within older people transport research in Section 3.3. Section 3.4 provides a description of the theoretical underpinning of the study (the TIB), justifies its choice for use over other frameworks (primarily the Theory of Planned Behaviour) and explains its relevance to the current study. The chapter concludes with an explanation of the research gap (Section 3.5).

3.2 The role of Psychology in Transport

Until recently mobility was often seen as a cost which people wanted to minimise (Salomon and Mokhtarian, 1997). However, more recently, travel behaviour research has opened up the discussion to also include psychological determinants that impact mobility. Heath and Gifford (2002) discussed how psychological studies of travel behaviour are a departure from the common socio-demographic and econometric factors that influence mobility.

Through their conceptual model, Van Acker et al. (2010) highlighted the need to link transport geography theories with social psychology ones. Transport geography theories (e.g. Hägerstrand, 1970) explain the factors external to the individual on travel behaviour (e.g. context, spatiotemporal component, activity patterns). Social psychology theories explain factors that are internal to the individual (both reasoned influences as attitudes and perceptions and unreasoned influences as habit). Linking these two disciplines together provides a holistic understanding of travel behaviour (Van Acker et al., 2010).

As discussed by Kroesen et al. (2017), initial studies investigating the attitude-behaviour relationship in transport go back to the late 1970s (e.g. Tardiff, 1977; Dobson, 1978). Early studies did not have a clear theoretical framework, so understanding how the different psychological variables related to one another was quite difficult (Bamberg and Schmidt, 2003). Recently, studies focusing on psychological factors in transport have used established socio-psychological theories of attitude behaviour-relations. Such theories are important because they have precise operationalization of the theoretical constructs used and show the causal processes through which behaviour is affected (Bamberg and Schmidt, 2003). In several cases, theoretical frameworks are flexible to additional psychological constructs that could be added to the original theory based on the different research contexts.

In a review of theories related to travel behaviour, Adjei and Behrens (2012) discussed that such theories help to explain how behavioural choices are made, the factors that affect choice-making, understand when behaviour change occurs and how decision makers respond to behaviour change interventions. Kroesen et al. (2017) explained that although attitudes have an essential role in determining the travel behaviour of people, this is a bi-directional relationship because travel behaviour also affects the attitudes of people. They showed that the effects of behaviours on attitudes are larger than the other way round because people are more likely to change their attitudes when faced with dissonance rather than their behaviour. Yet, changing attitudes does not automatically mean changing behaviour. For example, if policy makers do not work on dissonance regarding public transport (by improving the services and/or introducing lower fares) people may adjust their attitudes towards this mode in a downward method.

Consequently, a significant amount of the psychological research in transport focuses on the determinants of mode choice. Lanzini and Khan (2017), in a meta-analysis of studies dealing with the psychological determinants of mode choice, listed 51 studies with the respective theory used, the outcome variable, sample and country of case study. The theories used ranged from the Theory of Planned Behaviour (TPB) (Ajzen, 1991), Theory of Interpersonal Behaviour (TIB) (Triandis, 1977, 1980), the Norm Activation Model (NAM) (Schwartz, 1977), the Theory of Normative Conduct (Cialdini et al., 1990), Self-Determination Theory (Deci and Ryan, 1985), the TransTheoretical Model (Prochaska and DiClemente, 1984) and the Model of Goal-Directed Behaviour (Perugini and Bagozzi, 2001). Similarly, Gardner and Abraham (2008) also did a meta-analysis of research (25 studies) on the psychological correlates of car use and intentions to drive. Other examples where psychological theories were used in transport research were to understand:

- the intention to reduce car use (e.g. Abrahamse et al., 2009),
- the intention to use public transport instead of the car (e.g. Bamberg et al., 2007),
- the determinants of speeding behaviour (e.g. Dinh and Kubota, 2013),
- the willingness to cycle (e.g. Forward, 2014),
- pedestrians' road crossing intentions (e.g. Evans and Norman, 1998),
- the factors that determine departure time choice (e.g. Thorhuage et al., 2016),
- the determinants of ecological impact caused by mobility behaviour (Hunecke et al., 2010), and
- if a self-help intervention could increase active commuting (e.g. Mutrie et al., 2002).

The use of the TPB in transport research is extensive (Kroesen et al., 2017), particularly when analysing mode choice determinants (e.g. Verplanken et al., 1998; Bamberg and Schmidt, 2003; Heath and Gifford, 2002; Wall et al., 2007; Haustein and Hunecke, 2007; Abrahamse et al., 2009; Donald et al., 2014). On the other hand, as noted by Adjei and Behrens (2012), the TIB is quite unexplored in the travel behaviour change field.

Additional to the extensive use of psychological theories to understand travel behaviour, it is equally important to acknowledge the significance of social theories (e.g. Symbolic Interaction Theory, Functionalist Theory, Feminist Theory and Self-Learning Theory). This is because individuals do not live in a vacuum but in a society which affects their behaviour. Amongst the main social theories is the Social Practice Theory developed by Reckwitz (2002). The latter explained that practices are shaped by many elements interconnected to each other which make up the conditions of existence for the respective practices. Shove et al. (2012) described this idea through a framework with three main bodies that together make up and shape social practices. Such three bodies are: *meanings* (e.g. ideas, aspirations, symbolic meanings), *materials* (e.g. tools, infrastructure, objects, the human body) and *competences* (the skill and the knowledge to execute the practice). Such theory demonstrates that an individual's behaviour is usually related to what the collective development of society sees as "normal" (Shove, 2003). This is related to what was discussed in Section 2.5.4, in the sense that social practices are strongly dependent on their contextual factors which usually change with space and time. For example, throughout the years in the UK and in America, there was a continuous push towards individualism and an associated undermining in public consciousness of public transport. Such social practice led to the natural reaction of much of the population to drive or to strongly rely on the car. Constrastingly, in other countries such as in Germany, social practices do not put a negative stigma on public transport or on cycling and people do not see themselves as losers when they use such modes of transport. This means that the Social Practice Theory is a sociological theory which shows that behaviour change is not specifically related to the rational choice of individuals but to a more holistic understanding of society (Shove et al. 2012). For these reasons, it was used in different fields such as to understand and improve environmental-responsible behaviour (e.g. Barr et al., 2011). Therefore, although the emphasis of this chapter is on the psychological factors of older people's travel, it is also essential to acknowledge and interpret such factors within their respective social practices.

3.3 Psychological factors in Older People Transport Research

Analysing the psychological determinants of older people's travel behaviour helps to understand their travel patterns in a more holistic manner. Together with socio-demographic and infrastructural characteristics, psychological factors can improve the prediction of various aspects of mobility behaviour (Hunecke et al., 2007; 2010).

Psychological processes are fundamental to mobility in later life, and factors as intentions, fears and needs of older people should be included in mobility studies (Kaiser, 2009). Mollenkopf et al. (2004) also explained that older persons' motives for making trips, the importance they assign to mobility and psychological variables as control beliefs and visuomotor coordination are fundamental. Amongst other factors, Nakanishi and Black (2016) explained that mode choice in later life is explained by various psychological factors as personal norm, perceived mobility necessity, identity, habit, social norms and the environment. Kim et al. (2014) also analysed some psychological factors that affect transport deficiency of older people such as the community spirit, their sensitivity to pollution, their competitive spirits and respect of others' opinions. They showed that older people who were pliable (flexible) had a lower probability to be transport deficient since they could balance the external environment and social contexts.

As explained in Section 2.7, two key studies that analysed the transport psychological determinants in later life were those by Haustein (2012) and Haustein et al. (2008). In Haustein's (2012) study in Germany, attitudes, social norms and perceived behaviour control were derived from the TPB and personal norm was derived from the Norm-Activation Model. They also used Perceived Mobility Necessities (PMN) as developed by Haustein and Hunecke (2007). The psychological scales in Haustein et al. (2008) were related to car orientation, bicycle orientation, public transport excitement, ecological norm, weather resistance and perceived mobility needs. Another key factor was public transport control, which showed the perceived ability of older people to use public transport. Through such control, public transport was influenced in a positive manner and car use was influenced in a negative manner. To understand driving cessation in later life, Haustein and Siren (2014) also included transport-related attitudes based on Haustein (2012) and Hunecke et al. (2010) (e.g. public transport autonomy, public transport excitement, cycling autonomy, car autonomy, walking attitudes). They showed that the *never-drivers* had more positive attitudes towards all modes when compared to the *ex-drivers*. Yet, both the *ex-drivers* and the *never-drivers* had more positive attitudes towards public transport and negative ones towards the car, showing that they could get along without a car and like to travel by public transport. Drivers had positive attitudes towards both the car and cycling indicating a preference and need for individual modes of transport.

Correspondingly, when discussing older people attitudes towards travel in Northern California, Cao et al. (2010) included 32 statements that were divided into six groups: pro-bike/walk, pro-transit, safety of car, car dependent, pro-travel and travel minimizing. They showed how due to the heterogeneity of older people, those living in traditional and suburban neighbourhoods had distinct travel attitudes with the suburbanites favouring driving. Cao et al. (2010) found that travel attitudes were important determinants for the residential and travel choices of older people.

Other studies focused specifically on the driving behaviour of older people. For example, Lindstrom-Forneri et al. (2007) used the TPB to examine the relations between difficulties in driving behaviours, motives towards driving and the intention to change driving behaviour in old age at the Capital Regional District of Victoria (British Columbia). Their findings showed that the social pressures and the perceived benefits of driving (to maintain independence) affected older drivers' intention to change their travel behaviour. Using the TPB and the prototype willingness model (PWM) as their frameworks, Rivis et al. (2011) also studied younger and older male drivers' willingness to drive while intoxicated. Moreover, Jouk et al. (2014) analysed older drivers' perceptions and attitudes based on the Social Cognition Theory (Bandura, 1986), the Transtheoretical Model of Behaviour Change (Prochaska and Velicer, 1997) and the TPB (Ajzen, 1991), in relation to each other and to various self-reported measures of driving restrictions in later life. They found that perceptions and attitudes can contribute to behaviour change, especially for the constructs derived from the Social Cognitive Theory and the Transtheoretical Model.

Furthermore, when analysing the personality traits that affected older drivers' performance, Adrian et al. (2011) showed that extraversion was linked with a poorer driving performance. Extraverted older people took more risks when driving, acted more in a hurry and felt more confident when driving. Psychosocial inputs interacted with cognitive factors and determined the understanding of older people on their driving abilities. Based on factors that were important predictors of self-regulation and health behaviours, they proposed a Multilevel Older Persons Transportation and Road Safety Model (MOTRS) that consisted of four hierarchal levels: socio-demographic variables, driving-specific variables (e.g. insights of driving abilities), psychosocial variables (e.g. normative influence) and self-regulatory driving behaviour. This model was then tested with Australian data by Wong et al. (2017). Through an initial partial validation of the MOTRS, they proved that psychosocial variables were key determinants of driving self-regulation in later life.

Psychological factors also affect older pedestrians (e.g. Carlson et al., 2012). Van Holle et al. (2015) analysed whether psycho-social factors moderated the association between neighbourhood walking and older adults' physical activity in Belgium. The psychosocial factors included in the study were social norms, social support, perceived benefits, perceived barriers, modelling and self-efficacy. Walking was less dependent on the interplay between the neighbourhood environment and the psychosocial profile of older people. It was more directly affected by the neighbourhood environment characteristics. Sundling (2015) also analysed the psychological factors that led older people to change their travel behaviour based on earlier incidents encountered when travelling with public transport in Stockholm (Sweden).

It should be highlighted that for the travel behaviour of older people, there is a link between psychological factors and the objective determinants (individual, social and environmental factors) discussed in the previous chapter. For example with regard to individual factors, the health status of older people can affect their attitudes towards specific modes of transport. For example, if they use some walking aids (e.g. a wheelchair) and have problems to access public transport in their region, then they would normally have negative attitudes towards this mode of transport. Additionally, social pressure from people surrounding older individuals (e.g. family members) can be a key determinant for their norms towards travel, because they may feel "restricted" to use specific modes of transport. A case in point is the important role that family members have throughout the driving cessation transition (Section 2.6.1). With regard to the environmental factors, since for example the geographic context can affect car access for older people (Section 2.5.3), it can automatically determine the attitudes and habits that they develop when travelling.

3.4 The Theoretical Underpinning

As previously highlighted, the behavioural theory used in most transport studies is the Theory of Planned Behaviour (TPB) by Ajzen (1991) (Gardner and Abraham, 2008; Lanzini and Khan, 2017). Yet, as shall be explained in the next sections, given specific limitations within this theory, this study used the Theory of Interpersonal Behaviour (TIB) (Triandis, 1977) as the underpinning theoretical framework.

3.4.1 The Theory of Interpersonal Behaviour (TIB)

The TIB (Triandis, 1977) includes the concepts of the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and the TPB (Ajzen, 1991) (attitudes, social influence and intentions) with the addition of two important concepts: affect and habit (Figure 3.1).

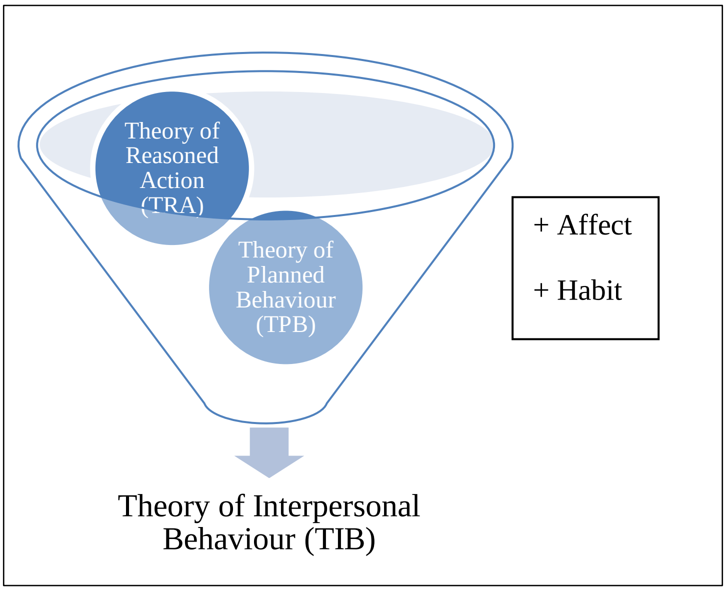

Figure 3.1: The additions of the TIB with the TRA and TPB

The TRA states that attitudes and subjective norms are the main antecedents of behaviour intentions, which eventually precede behaviour. Whereas the TRA did not include volitional control in behaviours, the TPB states that intention can only lead to behaviour if the particular behaviour is under volitional control. According to the TPB, when people need to decide about a specific behaviour they consider three aspects, which eventually affect their intention for the respective behaviour. The three main constructs are:

1. **Behavioural Beliefs**, which refer to the individual attitudes towards behaviour,
2. **Subjective norms**, which refer to the perceived social pressure to perform or not that behaviour,
3. **Perceived behavioural control**, which refers to the individual's perception of control over performing the behaviour.

The TIB predicts behaviour through the relationship between habit and intention moderated by facilitating conditions (Figure 3.2). The highest weight of the theory is on the role of repetitive previous behaviour i.e. **habit**. This refers to the strength of previous behaviour in producing the target behaviour. **Intention** refers to the cognitive thought of the behaviour whilst **facilitating conditions** refer to the presence or absence of conditions that facilitate the performance of behaviour. This creates a mix between conscious and unconscious processes. The initial use of the TIB was in the 1970s (Jaccard and Davidson, 1975) and since then it has been used in different contexts in order to predict behaviours. Some examples are the following:

- Intention for family planning (Jaccard and Davidson, 1975),
- Understanding of software piracy behaviour (Limayem et al., 2004),
- Personal use of internet/computing at work (Woon and Pee, 2004; Pee et al., 2008; Moody and Siponen, 2013),
- Sexual behaviour (Boyd and Wandersman, 1991; Reece et al., 2006),
- Telemedicine adoption by physicians (Gagnon et al., 2003),
- Mode choice of University Staff or students (Bamberg and Schmidt, 2003; Domarchi et al., 2008; Gardner, 2009; Galdames et al., 2011),
- Structural relationships among knowledge-sharing enablers, process and outcomesin hotels (Kim and Lee, 2011), and
- Mode choice of Undergraduate students (Verplanken et al., 1997).

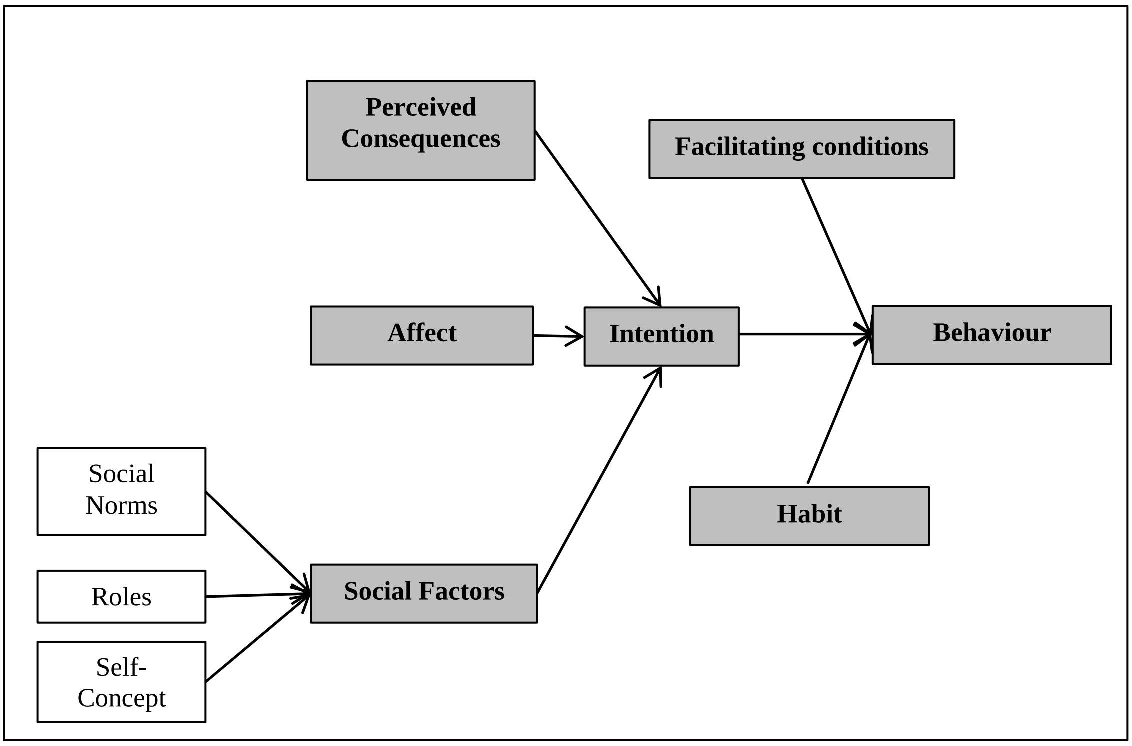

Figure 3.2: The Theory of Interpersonal Behaviour (Triandis, 1977)

The following section is now a description of each construct within the TIB as explained by Triandis (1977). **Behaviours** (acts) differ in various ways depending on the duration, intensity, frequency and probability of occurrence. The frequency of an act is in part a function of how natural the act is. **Intention** is linked with the goals and motivations of an individual and represents the cognitive processing of information before an act. The intention for behaviour is predicted by three aspects: *perceived consequences*, *affect* and *social factors*. The **attitudinal** part of the model (perceived consequences) refers to the subjective thought of an individual on the consequences that will follow a specific behaviour. All behaviours have potential outcomes that are of positive or negative value. **Affect** refers to the emotions that an individual feels at the thought of the behaviour. Such emotions can either be positive or negative, weak or strong. Emotions are usually determined by instinctive behavioural responses to specific situations. The inclusion of emotional factors in understanding behaviour has gained support in recent transport studies (e.g. Steg et al., 2001; Steg, 2005).

With regard to the **Social Factors** of the model, Triandis (1977) explained that these reflect the social pressures on an individual in whether s/he should perform a behaviour or not. This is primarily attributed to **social norms, roles and self-concept** (Figure 3.2). **Social norms** refer to social rules and pressures that can make a behaviour considered as correct and appropriate or vice-versa. Norms differ between individuals and societies depending on different cultures. **Roles** refer to a set of behaviours that are considered as appropriate for persons holding particular positions in a group. Again, roles are defined differently in different societies. In modern societies roles are consistently changing and often people belong to several groups, which can result in conflicting roles. **Self-concept** refers to how and what an individual thinks about himself, which also incorporates self-esteem. Self-concept is also affected by the memory that an individual has of past behaviour and the theory that an individual has constructed about himself. When an individual's behaviour is under surveillance, the weight of the social factors is larger.

Habit is usually measured by the number of times the behaviour has already been performed in the past. Frequency of past behaviour can reflect habit strength and has a direct effect on future performance (Oullette and Wood, 1998). A habit can be strong due to the natural way a person engages in a behaviour or through the reinforcement to perform that behaviour in the past. Habit refers to an automatic behaviour that involves no or little deliberation. When a behaviour is new and unlearned, only intention is responsible for the behaviour. Yet, the higher the frequency of behaviour, the more the habit component becomes an accurate predictor of behaviour. Triandis (1977) stated that when a behaviour has a significant habit component, adding this information to the behavioural intentions increases its predictability. This is because a person is (a) neither fully autonomous nor entirely social and (b) neither fully deliberative nor fully automatic. Thus, such theory deals with the common criticisms related to rational choice theories (Jackson, 2005).

Stable contexts (place, time, people surrounding you, sequence) are essential for behaviours to become automatic (e.g. Verplanken and Wood, 2006; Friedsrichsmeier et al., 2013; Légal et al., 2016; Thomas et al., 2016). For example, Gardner (2009) showed that although in stable commuting contexts habits and intentions concurred, habits dominated the behavioural outcome. Darnton et al. (2011) explained that the three pillars of habit formation are: frequency, automaticity and stable context. When there is a change in context, usually there is an interruption in habit and alternatives are rationally evaluated (Verplanken and Wood, 2006; Lanzini and Khan, 2017). The role of habit in transport will be explained in further detail later on.

Ultimately, **Facilitating Conditions** refer to the objective factors that can make a behaviour easier or more difficult to be carried out. These are particularly related to the following three aspects:

- the individual's knowledge, ability and arousal to carry out the behaviour,
- the difficulty of the act, and
- the environmental and situational factors present that increase the probability of the behaviour.

Triandis (1977) stated that facilitating conditions are objective factors that directly affect the actual behaviour instead of the intention towards behaviour. An individual may have the intention to perform a particular behaviour, but if the environment does not support this behaviour, it will probably not be executed. Triandis (1977) explained that behaviours cannot be predicted accurately if facilitating conditions are not accounted for.

3.4.2 The TIB over TPB

As shown from the previous discussions, the TIB is one of the most complete theoretical frameworks that understand behaviour and its relationship with personal factors (Galdames et al., 2011). Theoretical frameworks provide a supporting structure to studies on which concepts can be built and data can be collected. Jackson (2005) highlighted how Triandis was one of the few theorists that offered an explicit explanation for affective factors on behavioural intentions. Triandis (1977) discussed that his theory is important as it guides data collection when cognition and other psychological states are being related to behaviour. It is a theory that unifies the field of social behaviour because it consists of behavioural determinants that are usually associated with other theories (e.g. the attitudes component from the TPB and the self-efficacy component from the Social Cognitive Theory of Bandura, 1986). As explained by Limayem et al. (2004), the TIB is a comprehensive theory which explains people's behaviour with regard to what they usually do (habits), what they think they should do (social norms) and by the consequences that they link with their behaviour (perceived consequences). It also contains factors that are directly linked with the individual (e.g. habits, perceived consequences, intentions) but also those linked with the individual's environment (e.g. social norms, facilitating conditions).

As previously stated, the main comparison between the TIB and TPB is that of the individuals' conscious state vis-à-vis their behaviours. The TIB explained that both conscious and unconscious factors predict behaviour, and these can be restricted with situational factors (facilitating conditions). The latter are also analysed in the TPB, however these are done in a subjective manner since they affect the intention building process. In the TIB, Triandis (1977) did not discuss the perceived degree of facilitating conditions but their objective presence. The main differences between the TPB and TIB are summarised in Table 3.1. Pee et al. (2008) also compared the two theories as shown in Table 3.2. Whilst the TPB is related to an understanding of what factors affect choice making, in addition to this, the TIB also deals with understanding how behavioural choices are made (Adjei and Behrens, 2012).

Theory of Planned Behaviour	Theory of Interpersonal Behaviour
Intention is a direct antecedent of behaviour	Physical conditions and facilitating conditions are a direct predictor of behaviour
Roles, self-image and interpersonal agreements are felt within the individual's attitude toward behaviour	Roles, self-image and interpersonal agreements are separate factors
Affect is the sum of the perceived consequence multiplied by the value attached to those consequences	Affect is a separate factor
Restrictive factors are expressed through the subjective norm and personal behaviour control	Facilitating conditions are a separate objective predictor
Subjective norm is slightly narrow to reflect all social factors influencing intention	Analyse perceived social pressure as well as more internalized self-generated expectation (e.g. social role)

Table 3.1: Main differences between TPB and TIB

Theory of Planned Behaviour	Theory of Interpersonal Behaviour
N/A	Habit
N/A	Affect
Attitude	Perceived consequences
Subjective Norm	Social Factors
Perceived Behaviour Control	Facilitating Conditions
Intention	Intention
Behaviour	Behaviour

Table 3.2: Comparison of constructs between the TPB and TIB (Pee et al., 2008)

Due to such differences, despite the extensive use of the TPB, several studies from different domains (e.g. Bamberg and Schmidt, 2003; Bamberg et al., 2003a; Woon and Pee, 2004; Reece et al., 2006; Pee et al., 2008) showed that the TIB is more comprehensive and has a higher predictive and explanatory power. There is criticism on the fact that the TPB does not consider the effect of habit (Verplanken et al., 1994; Aarts et al., 1998; Aarts and Dijksterhuis, 2000). As a result, various studies (e.g. Evans and Norman, 1998; Heath and Gillford, 2002; Bamberg et al., 2007; Forward, 2009; Eriksson and Forward, 2011; Donald et al., 2014) used extended versions of the TPB to account for additional variance in intentions when predicting the respective behaviours.

Haustein and Hunecke (2007) discussed that the most common and important extensions made to the TPB include habits (e.g. Verplanken et al., 1994) and personal norm (e.g. Heath and Gifford, 2002). When comparing three models to predict students' car use at the University of Giessen (Germany), Bamberg and Schmidt (2003) found that one variable from the TIB model, role beliefs, increased the explanatory power offered by the components of the TPB. Additionally, in the prediction of self-reported car use, one variable of the TIB model, car use habit, significantly increased the predictive power of the TPB. Given the lack of evidence that the TPB can explain all social behaviours and the increasing interest in the habitualisation of behaviour (Verplanken et al., 1994), interest in the TIB increased. Hence, the important role of habit in transport will be explained in further detail in the next section.

The role of Habit in Transport Research

There are different concepts and understandings of habit (Schwanen et al., 2012; Friedrichsmeier et al., 2013) and studies dealing with the role of habit in the transport domain are extensive (e.g. Gärling and Axhuasen, 2003; Bamberg and Schmidt, 2003; Bamberg et al., 2003b; Eriksson et al., 2008; Gardner & Abraham, 2008; Haustein et al., 2009; Schwanen et al., 2012; Friedrichsmeier et al., 2013). This is because among the most common habitual behaviours occurring in stable contexts, transport is probably ranked in the top ten with eating, working and sleeping (Légal et al., 2016). A common assumption in travel behaviour research is that it consists of routines. Travellers prefer to repeat the activity patterns that they were satisfied with in the past without carefully judging the alternatives (Schlich and Axhausen, 2003).

Orbell and Verplanken (2010) explained habitual behaviour as a form of automaticity that involves an association between a cue and a response. Thus, the performance context and the presence of specific people can automatically trigger a specific automatic behaviour. This makes habit a form of goal-directed automatic behaviour (Aarts and Dijksterhuis, 2000). With a repetitive positive reinforcement, the behaviour is usually said to become *script-based* (Verplanken et al., 1994; Gärling et al., 2001; Gärling and Axhausen, 2003). For example, in a study at Göteborg University, Gärling et al. (2001) showed that positive attitude towards driving potentially led to script-based travel. After several times, the information that was already stored in the mind was automatically retrieved, rather than applying conscious thinking before every trip.

Given this, most of the studies that analysed mode choice using the TPB framework, acknowledged the important role of habit (e.g. Klöckner and Blöbaum, 2010). Car use is a clear example of habitual behaviour that can make mode choice automatic (Verplanken et al., 1997; Aarts et al., 1998; Bamberg et al., 2003b). Amongst the first pioneers in analysing this there were Verplanken et al. (1998) in a small Dutch village. Corresponding to Triandis' (1977) theory, they showed that although external incentives might increase the role of intentions, habits were always present as boundary conditions for the applicability of the TPB. Similarly, when analysing the potential interruption of habitual car use in two municipalities in Sweden, Eriksson et al. (2008) showed that a strong habit blocked deliberate processing prior to behaviour.

When people have strong habits they hold expectations about the environment. With such expectations, people may fail to inform themselves about new and better alternatives simply because their expectations reduce the awareness of such information (Verplanken and Wood, 2006). For example, people with a strong car-use habit usually have low motivation to attend and process information about public transport (Bamberg et al., 2003b). Thus, attempts to influence travel behaviour and travel choices may fail if the concerned behaviour is habitual (Verplanken et al., 1998; Gärling and Axhausen, 2003). For interventions to be successful they should be consider the habit strength of the respective behaviour (Verplanken and Wood, 2006).

As already pointed out in Section 3.4.1, habit is a better predictor for behaviours that occur in stable environments (Ouellette and Wood, 1998; Matthies et al., 2002). Thus, people who travel by car in similar contexts may develop a stronger car habit than those who travel less often or in changing contexts (e.g. sometimes by car and sometimes by bus) (Matthies et al., 2002). Thus, habit-breaking interventions tend to work better when there are undergoing changes, discontinuities and instabilities such as when relocating home or office (e.g. Thøgerson, 2009; Walker et al., 2015; Thomas et al., 2016). Discontinuities can also be unplanned such as when there is a road closure (Fujii and Gärling, 2003). Verplanken et al. (2008) called such phenomenon the *habit-discontinuity hypothesis*. In their case, they showed that university employees who were recent home movers (less than 12 months) with strong environmental views had lower levels of car use than people who had high environmental views but did not move home recently.

Walker et al. (2015) also found that when an environmental charity (WWF) relocated from one town to another, travel habits were weakened immediately both for people who changed mode and for those that did not. Yet, even for those who changed mode, habit for the old mode did not disappear at once. Context supportive of the new mode was necessary for more than four weeks for old travel habits to decay and for new ones to form. Apart from relocation, habit-discontinuity was also studied from other perspectives. For example, Thøgersen (2009) showed that when in Copenhagen car users received a free month travel card there was an increase in commuting by public transport. Although the effect became weaker when the promotion offer expired, an effect was still evident after five months. Despite such knowledge, information on the timescale for how habitual behaviour form and change is quite limited (Thomas et al., 2016).

In line with what was discussed in Section 2.5.1, habitual travel behaviour also varies by gender (Schwanen et al., 2012). Since women in European countries have a lower access to the car, they use the car less frequently and less continuously than males. Thus, females may develop weaker car habits (Matthies et al., 2002). Given this, Matthies et al. (2002) analysed whether the more ecological travel behaviour of women was the result of restricted car access, environmental obligation or weaker car habits. The relationship between gender and willingness to reduce car use was actually mediated by ecological norms and car habit. Correspondingly, Turcotte (2012) showed that despite the general trend of more walking and public transport use in higher residential density, even in neighbourhoods with some of the highest residential density levels in Canada, the majority of older men still reported using the car as their main mode of transport. For older males, due to driving habits, offering other transport options was not enough to give up on driving.

Although most studies focused on habitual practices in terms of driving, habits and routines are also evident in other modes of transport. For example, the decision to walk is not only related to factors as the built environment and people's health (Section 2.5.3) but is also linked to people's day-to-day routines and habits (Middleton, 2011). Through her study in London, Middleton (2011) discussed that habits and routines that emerged through pedestrian activities also made other activities (e.g. talking on the phone, spending time with friends) possible. She stressed that habit should not just be seen as an external factor that obstructs sustainable travel behaviour. The potential of habit and routines with regard to walking should be studied in further detail.

Légal et al. (2016) also studied habitual practices and mindfulness (awareness of what is taking place in the present) of subway use among undergraduate students from Paris Ouest University. They showed that only habitual users of public transport needed less time to select such mode of transport because the transport goal was non-consciously primed compared to a condition with no prime. When there were high levels of mindfulness, habits and travel goal contributed additively to decision making.

Ultimately, it is important to acknowledge that despite the important role of habit, there was other research which contrasted such findings. For example, when analysing intentions to use public transport in Norway, Şimşekoğlu et al. (2015) showed that regardless of car use, intentions were still mostly influenced by deliberate psychological processing. Moreover, supporting the discussion on the *habit-discontinuity* hypothesis, when analysing the effects of a prepaid bus ticket among college students, Bamberg et al. (2003a) showed that travel mode was a reasoned action and most students who drove to campus reconsidered their options when the initiative was introduced. Correspondingly, Bamberg et al. (2003b) showed that past behaviour and habit did not predict future travel behaviour when there was an intervention (combination of information and a free public transport ticket) in a changed decision context (moving to a new residence). This showed that past behaviour is not always a good predictor of future behaviour, particularly when contexts do not remain stable. When a behaviour becomes a routine, it is still expected to be affected by a certain level of awareness and cognitive effort (Bamberg et al., 2003a). Conclusively, it is fundamental to highlight that as shown from this section, the role of habit was vaguely discussed with regard to the mobility of older people.

3.4.3 TIB in Transport Research – its relevance to this study

The TIB is a useful theory that explains and understands complex human behaviours, especially those that are influenced by their social and physical environment (Reece et al., 2006). This is absolutely the case for the mobility of older people which has a mix of interrelated determinants, and thus requires specific policy interventions.

As shown in the previous sections, to date, the TIB has not been widely used in transport due to the complex correlation between its components (Jackson, 2005; Domarchi et al., 2008). Anable et al. (2006) explained that this was also the case with regard to environmentally-oriented behaviour. Nevertheless, they claimed that this was quite surprising since the theory has notions of habit, self-identity, affective response and situational constraints. All such factors are omitted from the more commonly applied TPB and VBN models, but are extremely relevant in the travel context. Some transport studies used the TIB as their theoretical framework. For example, when analysing mode choice at University through the use of the TIB, Galdames et al. (2011) showed that when describing the behaviour, the attitudes towards the modes used and habit were more important than affect and attitude towards the alternative mode. By using the TIB to predict mode choice of staff in the University of Concepcion (Chile), Domarchi et al. (2008) also found that the theory's constructs (attitude, habit, affective appraisal) influenced mode choice. Amongst other factors they showed that when there were positive attitudes, positive emotions were induced by car use. These developed habits which were often quite strong. This showed that mode choice could be affected by factors related to attitudes and affective appraisal as proposed by the TIB. When based on the TIB, Verplanken et al. (1997) analysed psychological factors related to mode choice of undergraduate students, they also showed that habit strength had an important role in the prediction of behaviour.

Such theory was never used in older people's mobility studies. Yet, psychological factors are essential when analysing older people's travel behaviour. Table 3.3 summarises how the TIB can be relevant to old age and the respective travel behaviour of older people. As shall be explained in this section, in each of the constructs of the TIB (Figure 3.2), there are close correlations with old age.

Theory of Interpersonal Behaviour	Relevance to research about mobility in later life
Theory that predicts behaviour	Travel behaviour prediction in later life is critical for transport policy due to the projected increase in older people
Analyses interpersonal behaviour through the merger of personal, social and contextual components	Older people's mobility is affected by personal, social and environmental factors
Helps to understand direct and indirect determinants of complex human behaviour, especially those with high social and environmental influence	Old age is very complex. Psychological factors are important to understand what is causing the behaviour
	Understand WHY older people behave the way they do and not just HOW they behave
Theory that focuses on intention and habit of behaviour	Through the understanding of intention, policies can be implemented to change/improve issues related to old age
	Habit is critical in old age due to the effect of daily repetitive behaviour for several years

Table 3.3: The relevance of the TIB in older people transport research

Given the various improvements in lifestyles and health in later life, the ***intentions*** of older people for the future are particularly relevant and can strongly affect their travel behaviour. In fact, Coughlin (2009) explained that the main difference between the baby-boomer generation and their previous one is their expectation on ageing and on the future. For example, Siren and Haustein (2013) showed that the baby-boomers in Denmark were very optimistic in their intentions for future mobility and on the modes of transport that they intended to use to have an independent life. They also showed that women had lower intentions of driving a car at the age of 80.

With regard to the ***habit*** component, old age can easily be characterised by routine behaviour. One typical case for this is the “age in place” phenomenon (Giuliano et al., 2003; Clarke and Gallagher, 2013). As previously highlighted, travel usually occurs on a daily basis and it is rather impossible to have daily conscious thinking prior to every trip. Past experiences of people determine their psychological processes and form habitual behaviour. For this reason, Nakanishi and Black (2016) analysed the driving habit for older people through different perspectives such as through their transport experience in childhood, their feelings when they obtained the driving licence and their travel patterns when raising their family.

Aguiar and Macário (2017) also discussed how older people who use their car to avoid public transport usually remember the lack of comfort, inaccessibility and dangerous situations in public transport when they were younger. Therefore, with ageing they would like public transport further less. This situation is actually more pronounced for the current younger generations of older people since they have been more exposed to driving than their previous generations. Similarly, Schwanen et al. (2001) discussed that older people like to stick to old habits as they age.

Older people can also use habitual travel practices as a way to compensate for their limitations. Reusing past solutions is a way to make behaviour easier and less risky (Klöckner and Blöbaum, 2010; Lanzini and Khan, 2017). Gärling and Axhausen (2003) explained that previous learning experiences can affect subsequent choices because the cost for searching new alternatives can be too high. Nevertheless, older people’s travel is associated with several limitations (Section 2.6) and multiple changes occur in their travel patterns, particularly after retirement. The latter is a main factor that causes diversity and instability in later life because travel behaviour is always more stable on work days (Schlich and Axhausen, 2003; Van Acker et al., 2010). So, the main concern centres on the extent to which automatic travel behaviour can remain static and stable throughout the years in old age. Hence, travel behaviour in later life is a mix of reasoned and unreasoned components. The TIB captures well such complexity since it is a dual-path model. It shows that behaviour can result either from a rational path or from a habitual path (or a mix of both) (Darnton et al., 2011).

Sections 2.5-2.7 showed that ***facilitating conditions*** are also a key determinant for older people's travel behaviour. Empirical data showed that older people have different knowledge and skills and may or may not be aware of their limitations. Thus, older people response to life course changes in different manners, and employ different self-regulatory strategies to adjust to later life. The transport environment can either make older people's movement easier or else put them at a double disadvantage. By making reference to Lawton and Nahemow's (1973) "Ecological Theory of Ageing", Hodge (2008) explained that the relationship between older people and the environment is an interdependent one. Although the components have to adapt to one another's presence, in the older person-environment system it is the older person who has to adapt the most because physical environments are difficult to change especially in the short term. Therefore, although older people usually respond to environmental demand by adapting to it (Hodge, 2008), whether or not and to what degree the adaptation occurs depends upon the competence of the individual (Section 2.6.2). This goes beyond just physical capabilities, and incorporates several other factors as cognitive functioning, ego strength and social norms.

Kaiser (2006) showed that in the SIZE European Project social problems of mobility were ranked very high by older people. Amongst such problems there were issues of lack of reliability of other people and decline in interpersonal trust. The project stressed that the negative attitudes towards older people should be reduced in the mobility context, and more respect to ageism is needed. Siren et al. (2015) also pointed the "struggle for space" of several older people due to conflicts with other road users. This was quite common in public transport, on sidewalks and in cycle paths. Some older people saw themselves as "invisible" to others and felt that they were not considered enough. Since the TIB analyses the objective role of facilitating conditions in predicting behaviour, it makes it easier to understand the direct relationship between the role of the transport environment and the corresponding travel behaviour in old age.

The TIB model shows that intention is predicted by three main constructs: affect, perceived consequences and social factors. In line with the ***affect*** component, various studies (e.g. Anable, 2005, Hunecke and Haustein, 2007) discussed the emotional evaluation of travel mode. For example, Steg et al. (2001; 2005) highlighted that symbolic-affective functions as prestige and excitement are key factors that attract car use. They also made reference to instrumental-reasoned functions that attract car use such as the financial cost and driving conditions. When discussing work journeys, Anable and Gatersleben (2005) showed that instrumental aspects were more important, whilst for leisure purposes, almost equal importance was noted for instrumental and affective aspects (e.g. flexibility, relaxation, convenience, freedom, lack of stress). Hence, this shows that since older people travel more for leisure purposes (Section 2.2), affective factors can be a particularly important determinant in this regard.

Chapter 2 clearly showed that older people can have different emotions towards their mobility. They can either be enjoying the way they travel or else be feeling disadvantaged, restricted or forced to do it. For example, Musselwhite and Haddad (2010) showed that older people who were anxious when walking had a lower quality of life. Barriers in the environment, particularly in unfamiliar areas (e.g. poor signage, confusing spaces, noisy and crowded streets, bad pavements), can all make older people further worried and anxious when travelling (Phillips et al., 2013) (Sections 2.3.1; 2.5.3).

When discussing the psychological factors that led to a change in the travel behaviour of older people after specific incidents on public transport, Sundling (2015) discussed that critical reactions (e.g. worry) can become a barrier to travel. She explained that if for example an older person repeatedly experiences a fear of falling when getting off the bus, this may lead to a lowered perceived functional ability in similar situations. This study also found that although the older interviewees' emotional and cognitive critical reactions usually correlated with their "choice" of travel behaviour, in some cases the emotional reaction overpassed their intentions. As a result, Sundling (2015) highlighted that the reactions to incidents, including the attitudes and emotions, can give a better understanding of the needs and behaviour of an older individual.

Perceived consequences (attitudes) can also have an important impact on older persons' travel behaviour and mobility patterns. Older people's predispositions for positive ageing are crucial (Bowling, 2008), and positive attitudes tend to lead to a better quality of life (Ziegler and Schwanen, 2011). Coping strategies, particularly acceptance of certain situations are important to deal with negative changes associated with health and mobility in later life (Gabriel and Bowling, 2004). In County Durham (England), Ziegler and Schwanen (2011) discussed that positive attitudes and willingness to engage actively in the world were critical for older people to remain socially active and mobile. When older people were too conscious of their mobility restrictions they had lower confidence and willingness to be active in the social world. They showed that attitudes affected their mobility more than just their health. However, for some older people it is difficult to have positive feelings about their future due to worries associated with deteriorated health and independence (Gabriel and Bowling, 2004). Davey (2007) showed that many older people had a sense of acceptance and resignation to stay at home with the attitude of "*What can you expect at my age*?"

Attitudes are also an important determinant with regard to the use of specific modes of transport in later life. For example, when analysing the psycho-social impacts on self-reported driving restriction among older drivers, Jouk et al. (2014) showed that perceptions and attitudes were linked with self-reported restrictions in driving behaviour. Older adults with positive attitudes towards their driving ability had a greater self-reported driving exposure. On the other hand, older drivers with negative attitudes towards driving travelled for fewer kilometres per week, avoided challenging driving situations and engaged in more restrictions. By making reference to Davey and Nimmo (2003), Aguiar and Macário (2017) also explained that psychological factors such as the loss of confidence (due to a lack in driving practice or to an involvement in a traffic accident) may affect the willingness and ability to drive. As discussed in Section 2.5.1, older women usually suffer from more discomfort and lack of confidence when driving, and as a result can feel more relieved when they stop driving (Davey, 2007). In Northern California, Cao et al. (2010) also explained that older people with favourable attitudes toward walking and public transport used these modes of transport more. In her German case study, Haustein (2012) also stressed the important role that attitudes had in the modes of transport that older people used (Section 3.3).

With reference to the **social component** of the TIB model, Chapter 2 clearly showed that the role that ***social norms*** have on the mobility and travel behaviour of older people is very important (Sections 2.5.2 and 2.6.1). Bamberg and Schmidt (2003) found a significant influence of social expectations on the intention to use the car amongst the sampled University students. Although they stated that their finding could be specific to a student population, Donald et al. (2014) argued that this is incorrect. When analysing modal choice to work in the north and south of England (through an extended version of the TPB), Donald et al. (2014) found that social expectations had a strong effect on intentions and habit, irrespective of age or occupational group. Moreover, in Bristol (UK), Nikitas et al. (2011) discussed how social norms (from family and friends) were important for the formation of attitudes of older people towards road charging. Older people were also more open to form opinions that reflected the interests of others. In fact, social norms and pro-social value orientations about road charging were two important exploratory variables of older people positive attitudes towards road charging. Additionally, due to different lifestyles, the ***roles*** of newer generations of older people are continuously changing. For example older people are participating in more leisure activities and thus have corresponding roles.

One should also consider the fact that retirement brings a discontinuation in important social roles and the activities that are associated with them, such as daily trips to work (Hodge, 2008). However, as discussed in Chapter 2, older people can also have simultaneous roles, such as those discussed for the "sandwich generation" (Rosenbloom and Fielding, 1998). As stated by the TIB model the mixing of roles then affects the intention for behaviour. Finally, the social component of the model also highlights the role of ***self-concept***. Mollenkopf et al. (2004) pointed out that the self-perception of being in control over one's life and a strong motivation to be active can offset the negative impacts of immobility on social contact in later life. In fact, in Metro Vancouver, Moniruzzaman et al. (2015) showed that those who were over confident about their ability to walk took longer trips than those who were not. Moreover, Section 2.6.2 showed that self-concept is a major mobility determinant in later life because it can lead to different compensation techniques which affect mobility.

Conclusively this shows that when an older person carries out a daily activity, it has both objective and subjective dimensions (Hodge, 2008). The objective side includes aspects as the old person's age, gender, health and education, whilst the subjective side includes non-measurable aspects such as preferences for activities, perceptions of the activity's meaning and the satisfaction to be gained by participating in it. Objective factors were always easier to understand: the *who, what, where,* and *how* of trips. The *why* for activities that older people participate in has always been more problematic (Hodge, 2008). Thus, only through an understanding of such concepts can intervention strategies be developed in order to increase independent mobility amongst older people.

With regard to the Maltese scenario, Zammit (2015) analysed in a qualitative manner older adults' perspectives on cognitive and psychological well-being. The sampled Maltese older people stated that their goals have changed in life and that participation in various activities was significant for their well-being. They also discussed the importance of being active and independent, and explained their adjustments to the changes they experienced as they grew older. Zammit's (2015) study indicated that the TIB can be linked to the behaviour of Maltese older people due to several reasons, such as the changes in older persons' roles within society.

3.5 The Research Gap

The literature review conducted in Chapter 2 revealed that most studies that analysed the determinants of older people's mobility did so by using objective factors (e.g. socio-demographic factors, health, income etc.). However, this chapter also proved that psychological determinants strongly affect the way older people travel. This means that more interdisciplinary research that recognises the complex interactions between determinants of mobility in different contexts is needed. For this reason, this study goes beyond just the use of objective factors and links the latter with psychological variables. Mobility is also understood holistically through multiple travel behaviour indicators including mode choice, travel range, travel accompaniment, travel time, travel frequency, number and type of travel purposes (see Chapter 4 for more detail). In this manner, this study complemented and added to current literature which focuses on holistic approaches to mobility in later life (e.g. Meyer et al., 2014).

This research will have innovations from the theoretical and methodological perspectives. To the author's knowledge the TPB was used in few cases with regard to older people's mobility and the TIB was never used. Although different studies clustered older people based on different criteria, most of them did not go in depth in describing the attitudinal and psychological determinants of older people's mobility behaviour (Section 2.7). As previously explained, the only studies that did so were those by Haustein (2012) and Haustein et al. (2008) who however used different underpinning frameworks (the TPB and the NAM). Since previous studies showed that the TIB is more comprehensive and has a higher predictive power (Section 3.4.2), this study showed how using the TIB as the theoretical framework influenced the results when compared to those of Haustein's (2012).

Habit can be highly related to travel behaviour in old age (Section 3.4.3), so it was important to analyse how such an addition impacted (or otherwise) the findings (Chapters 6-7). Whereas both Haustein (2012) and Haustein et al. (2008) focused more on the effects of psychological factors towards specific transport modes, travel behaviour in this research was studied in a more comprehensive way without specific priority to modal choice. Hence, by using a different theory and case study, this research strengthens the knowledge on clusters of older people in the transport environment.

This study used Structural Equation Modelling (SEM) to determine the psychological antecedents that predicted the Maltese older population's travel behaviour. Studies using SEM and dealing with older people in the transport sector were related to specific mobility characteristics such as falls (Delbaere et al., 2009) and the effects of mobility impairments on social participation (Sundar et al., 2016). Other studies used SEM to understand psychological characteristics of mobility in later life such as:

- the relationship between mobility impairment, social engagement and life satisfaction (Li and Loo, 2017),
- the psychological and physical dimensions that explained older people life satisfaction (Meléndez et al., 2009), and
- older persons' intentions to change driving behaviours (Lindstrom-Forneri et al., 2007).

Kim (2003) used a structural equation model to analyse older people's mobility (non-home activity time, travel time and travel distance) by testing individual and household characteristics with the residential urban form in the Puget Sound region (Washington State). By also using a structural equation model, Dong et al. (2016) analysed the correlation between the activities that older people participated in and their travel behaviour characteristics in Kunming (China). The exogenous variables used in the model were personal (e.g. gender, age, education) and family attributes (e.g. family structure, living state), whilst the endogenous variable was travel behaviour (trip purpose, departure time, travel mode and travel intensity). As shall be explained in detail in Chapter 6, the structural equation model that was developed for this research focused on underlying psychological determinants of travel. This was an addition on Kim's (2003) and Dong et al.'s (2016) models which analysed travel behaviour through objective factors. When compared with the other studies that used SEM to analyse psychological factors in later life, this study did not focus on individual aspects of mobility (e.g. falls, driving) but included multiple indicators of travel behaviour. This was mostly inspired from Meyer et al. (2014), who by using SEM analysed the predictors of older adults' personal and community mobility following Webber's (2010) framework. Predictors included objective and psychosocial factors (e.g. age, gender, educations cognitive factors, depression scale, social activity index), whilst personal and community mobility were each measured with a composite index reflecting multiple aspects of the respective mobility.

Ultimately, one key innovation of this research is in the case study itself i.e. Malta. As discussed in Chapter 1, the *National Strategic Policy for Active Ageing 2014-2020* was launched in 2013 (Parliamentary Secretariat for Rights of Persons with Disability and Active Ageing, 2013). Its three main themes were active participation in the labour market, social participation and independent living. When discussing older persons' participation in social activities, one of the policy's recommendations was for reliable and affordable public transport. Additionally, with regard to independent living, the policy stated that inter-sectorial guidelines are needed to create age-friendly communities through appropriate development of accessible public spaces, housing and methods of transport. Thus, the policy discusses indirectly the correlation between transport and older people independent living. Formosa (2015) also discussed the various determinants of active ageing with particular reference to Malta. Amongst such determinants, was transport. To date there have been no studies in Malta that focused on older people's travel except that of Mifsud and Attard (2013). However this analysed the role of public transport accessibility in a specific town in Malta (Luqa).

In brief, this means that this research will be an important planning and policy contribution locally as much as being a contribution in the field of active ageing and mobility. The *National Strategic Policy for Active Ageing 2014-2020* (Parliamentary Secretariat for Rights of Persons with Disability and Active Ageing, 2013) calls for more comprehensive national research focusing explicitly on the role of transport in older people's mobility behaviour in Malta. In order to understand the challenges that population ageing will pose on the transport system and on society, more detailed research is necessary. Thus, the methods used in this research to collect and analyse the data and their potential findings complemented current international efforts that investigate older people’s travel determinants. These can eventually be transferable to other regions or countries, particularly to those with similar characteristics to Malta.

3.6 Conclusion

This chapter discussed travel behaviour determinants in later life from a psychological perspective. It explained why psychology is an important phenomenon in transport and highlighted its specific role in older people’s mobility; in which to date there is still a lack of overall research.

This was followed by a detailed overview of the theoretical underpinning of the study, the TIB, and an explanation of its relevance to older people’s mobility proceeded. The main constructs of such theory: perceived consequences (attitudes), affect, social pressure, intentions, habit and facilitating conditions are all strongly related to how older people travel. Due to the lack of use of such theory in transport studies, particularly in those related to older people, such research wanted to test its applicability and relevance to the Maltese older population. Given this, the research gap of the study primarily focused on the case study, the theoretical underpinning, the constructs used to collect the data and the techniques used to analyse it. The next chapter will now go into further detail on this, explaining the methodology and methods used to collect and analyse the data for this study.

CHAPTER 4

RESEARCH DESIGN AND METHODS

4.1 Introduction

Chapter 4 outlines the research design adopted, the data requirements for the study and the methods employed to fufil the aim, that is to investigate the travel behaviour of older people in Malta and provide recommendations for independent mobility in later life.

The research design is discussed in Section 4.2. This is the framework which explains the research paradigm, the objectives and the research strategy. This, in turn has informed what type of data was collected and how it was analysed. The data was sourced from a questionnaire survey, which is detailed in Section 4.3. Methods of data analysis are detailed in Section 4.4 and conclusions are drawn in Section 4.5.

4.2 Research Design

The research design determines what type of data will be collected and how it will be analysed. Its purpose is to provide a structure for fulfilling each of the research objectives and is guided by the objectives and research questions as well as the research paradigm (Oppenheim, 1992).

4.2.1 Aim, Objectives and Methods

Yin (2013) identified five major designs that can be used to collect and analyse data (Table 4.1). Since one main gap in the research is the case study in itself, this research followed a case study approach to understand ***why*** older people in Malta travelled the way they did, and ***how*** their limitations could be defined and improved. There was no need of any control over behaviour events and focus was just on contemporary issues. As shall be explained in the next sections, a survey within the case study was conducted in order to broaden the questions that can be investigated (Yin, 2013).

Method	**Form of research question**	**Requires Control of Behavioural Events?**	**Focuses on Contemporary Events?**
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case Study	How, why?	No	Yes

Table 4.1: Different situations for different research methods (Yin, 2013)

In order to address the research gap discussed in Section 3.5, the study used the research design displayed in Table 4.2, which lists the study objectives and research questions as well as the methods used to achieve them.

AIM: To investigate the travel behaviour of older people in Malta and provide recommendations for independent mobility in later life				
Objective		**Research Questions**	**Method**	**Chapter**
1	To identify the main determinants that influence older people's mobility and travel	i) What are the determinants identified in the academic literature that influence older people's travel behaviour?	Literature Review	2
2	To determine the theoretical underpinning in order to analyse older people's mobility and travel behaviour in Malta	ii) What is the theoretical construct of the study and how does it relate with older people's mobility?	Literature Review	3
3	To understand the key determinants that affect the travel behaviour of older people in Malta	iii) What personal, social and environmental factors significantly affect older people's travel? iv) What psychological determinants predict travel behaviour for the older population in Malta?	Survey: Regression Models and Structural Equation Modelling	5-6
4	To develop clusters of older people based on objective and psychological determinants that affect travel behaviour	v) How are older people grouped based on the objective and psychological determinants of travel behaviour?	Cluster Analysis	7
5	To make recommendations for independent mobility in later life	vi) What measures are needed so as to capture the heterogeneity of older persons' travel needs?		8

Table 4.2: Research design of the study

4.2.2 Research Paradigm

Reasoning and observations are organised through a mental model that affects beliefs. This is usually referred to as *Paradigm* (Bhattacherjee, 2012). Social science is usually conceptualised in terms of **ontology** and **epistemology** (Burrell and Morgan, 1979).

As shown in Table 4.3, the research paradigm defines the types of methods that are employed. Quantitative methods are usually associated with the **Positivist** philosophy. The basic theory behind this philosophy is that the knowledge should be restricted only to what can be measured and observed (Bhattacherjee, 2012; Aliyu et al., 2014). In contrast, qualitative research methods usually reject the positivist philosophy and state that multiple realities can exist where conclusions can be drawn up through observations and empirical reality. In this way the researcher cannot keep the distance from what is being researched and thus the research is highly value-laden (Johnson and Onwuebhuzie, 2004). This is referred to as the **Constructivist** philosophy.

Newer paradigms stand between the two ends of Positivism and Constructivism and are referred to as **Post-Positivism** and **Pragmatism**. Oppositions in the positivist philosophy led to post-positivism during the mid to late 20th century. This states that one can make reasonable inferences about a phenomenon by combining empirical observations with logical reasoning. Science is not seen as certain but as probabilistic. The main ontological belief for Post-positivism is *critical realism*. Critical realists admit that explanations to theoretical terms are not directly compliant to observation. They also identify the importance of context since this highlights the conditions that promote or impede the operation of a causal mechanism (Bhattacherjee, 2012). There are many forms of pragmatism (Creswell, 2003). For many of them, knowledge and truth arise out of actions, situations and consequences rather than from antecedent conditions (as in post-positivism). Pragmatism takes a dynamic position to epistemology which means that the position of the researcher can change throughout the course of the study. This contrasts with post-positivism in which the researcher remains objective throughout knowledge discovery.

	Positivism	**Post-Positivism**	**Pragmatism**	**Constructivism**
Ontology: Researcher's beliefs about nature of reality	Realism: Truth about reality, independent of social factors	Critical Realism: Truth exists but cannot be accurately detected due to flaws or due to the nature of phenomenon	External and multiple: based on the best way to answer the research question	Relativism: Truth based on interaction with social environment
Epistemology: how to philosophically come to know knowledge	Objective: researcher maintains distance from researched. Only observable data can provide credible facts	Objective: but acknowledges the fact that external factors exist. Not possible to maintain total distance from the researched but try to control potential influences from researcher's background	Dynamic: objective or subjective meanings can provide knowledge depending on the research question: Practical applied research. Researcher's stance can change throughout the research	Subjective: subjective meanings motivating actions
Axiology: researcher's view of the roles of values in research	Value-free: objective stance	Values are important but can be controlled to ensure validity of findings	Values are important but are not a threat to validity of findings	Value-bound: researcher is part of reality being researched
Methodology: data collection techniques most often used	Experimental: mainly quantitative	Modified Experimental and Interpretative. Mostly Deductive and context-based	Mixed-Methods: subjective and objective	In-depth qualitative investigations

Table 4.3: The main research paradigms and their characteristics (Adapted from Guba and Lincoln, 1994; Saunders et al., 2009; Bryman, 2012)

The paradigm that was adopted in this study was **post-positivist** using the **critical realism ontology**. This is because although the study was quantitative, it is recognised that other qualitative data may be required to gain a full understanding of the how and why older people travel. Qualitative data (e.g. through interviews or focus groups) would have helped to understand travel behaviour in later life in a higher level of detail. By building a stronger relationship with the participants, a qualitative approach would have helped to understand the mobility determinants, especially the psychological ones, in a more comprehensive manner. A clearer picture of how the specific context of the study (Malta) affects the older population's mobility would also have been provided (Bryman, 2012). However, due to the complexities in old age the author was aware that the total truth with regard to the travel behaviour of older people can never be revealed. Although the researcher's position remained as objective as possible, it was acknowledged that external factors may have affected the interpretation of data.

The study took a deductive approach in which the constructs of the TIB were tested using empirical data from the case study (Malta). Given this case study approach, the research was primarily an explanatory one. It sought to explain observed travel behaviour and identified causal factors. As explained in Table 4.1, the "how" and "why" of the case study approach are more explanatory in nature (Yin, 2013). This involved an understanding of the reasons behind older people's travel behaviour, with the goal of proposing strategies to overcome possible limitations (Bhattacherjee, 2012).

4.2.3 The Research Agenda

Figure 4.1 shows the structure of the research agenda. The research aim is addressed by five sequential objectives, each of the data collection stages further disaggregated into research questions. The first two objectives were based on secondary sources related to the literature review and theoretical framework. The third and fourth objectives were based on the primary findings of this case study. These complemented (or otherwise) the corresponding discussions presented for the first two objectives. All such findings were then discussed in a holistic manner and recommendations for improvement were provided in order to achieve the fifth objective of the study.

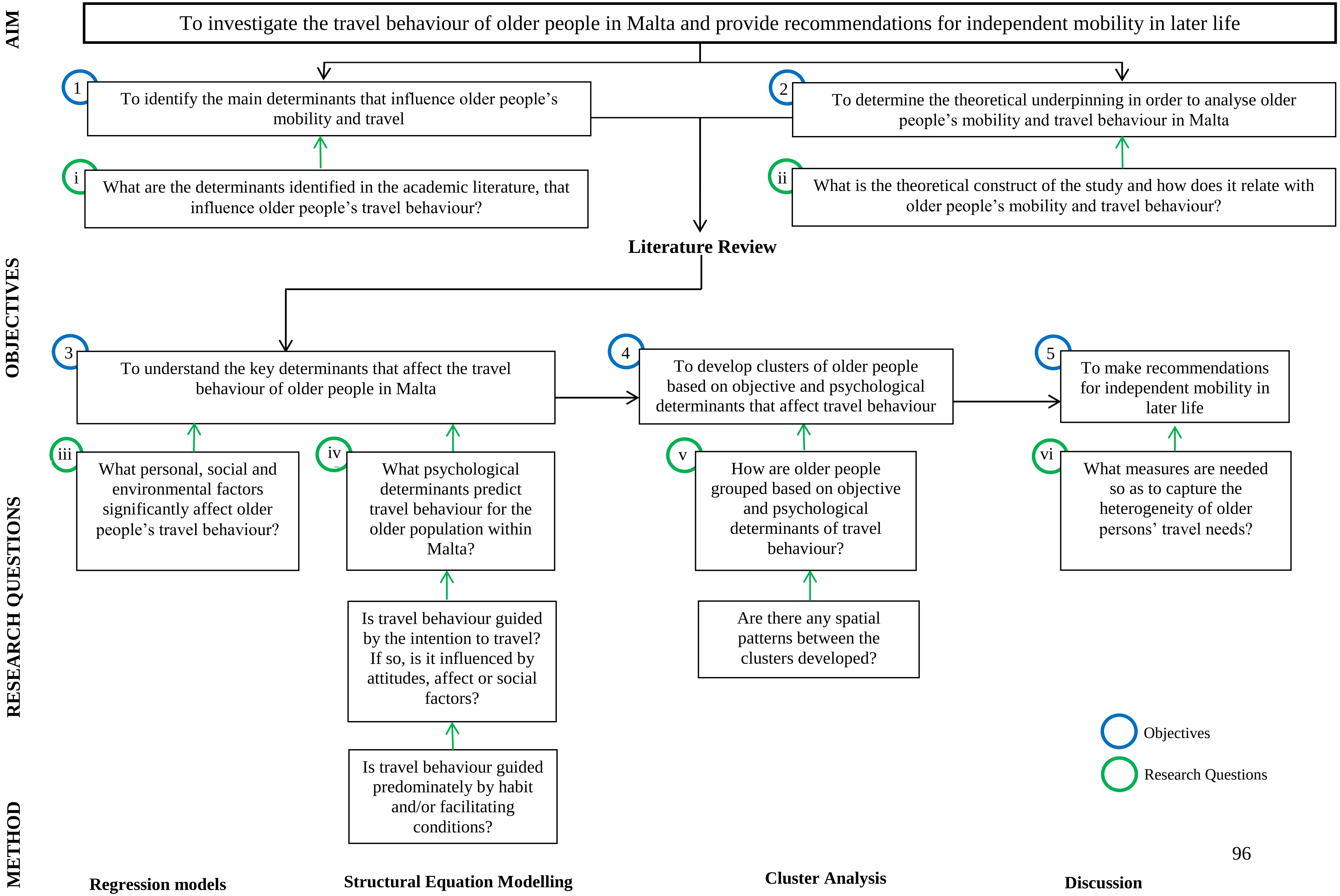

Figure 4.1: Structure of the Research Agenda

4.3 The Survey

The main data collection method was a questionnaire survey. The next sections describe how the survey was formulated, its format and its structure. A detailed explanation of the sample size follows. This section concludes with a description of the pilot study conducted prior to collecting the actual data.

4.3.1 Survey Format

The three main survey types used in social science research are self-completed surveys, face-to-face surveys and telephone surveys (Robson, 2011). Although self-completed surveys can be easier to obtain, for the purpose of this study the choice for such data collection was automatically excluded. Self-completed questionnaires are conducted either by post or online. Both such techniques were not feasible for older people. One main reason is the higher illiteracy rate among people in later life. In Malta, illiteracy rate ranged from 23.3% for people above 90 years to 10.3% for those between the age of 60 and 69 years (NSO, 2014b). This was mostly a result of the lower possibilities that older people had in the past to obtain good education levels. This would definitely have affected the response rate of self-completed surveys. Additionally, although technology usage is increasing among older people, internet use in Malta is still at its lowest rates amongst people over the age of 60 years (NSO, 2014b). This made online surveys unpractical for older people.

For these reasons the choice was between telephone and face-to-face surveys. As shown in Table 4.4, both methods have their own advantages and disadvantages. Nevertheless a telephone-based survey was considered as the most suitable approach for the present research. Although face-to-face surveys capture more the emotions of respondents, because of sampling, cost, and time issues, these were not practical for this research. Due to the large sample that was used in the study, the time required to contact older people by post or by telephone prior to the actual face-to-face encounter was not feasible.

Telephone Surveys	
Advantages	**Disadvantages**
Time-efficient	People who do own a telephone or are not in telephone directory are omitted
Cost-efficient	Difficulty in getting access to households that only rely on mobile phones
Good geographical coverage	Difficulty for people with hearing impairment
Easier to supervise	Survey cannot be long or complex
Offset Social Desirability	May achieve lower response rate than face-to-face interviews especially in sensitive questions
Anonymity of respondent	Cannot employ visual aids or engage in observations and reactions of respondents
	Difficulty to determine that the targeted individual is replying the phone
Face-to-face Surveys	
Advantages	**Disadvantages**
Higher response rate	Highest cost
Based on personal interaction	Geographical Limitations
Respondents can be observed	Social Desirability because of interviewer's presence
Can use visual aids	Measurement bias by interviewer

Table 4.4: Main advantages and disadvantages of telephone and face-to-face surveys (Adapted from Hox and Leeuw, 1994; Duffy et al., 2005; Lavrakas, 2008; Bryman, 2012; Szolnoki and Hoffman, 2013)

In addition to the above, telephone surveys were more convenient and less intrusive, and therefore ideal for the targeted population group. Telephone surveys appeared 'safer' compared to home visits which can create a higher sense of 'fear' among older people. Many more respondents are willing to answer a telephone call rather than letting an outsider inside their homes, which helped for a higher response rate. Like in face-to-face surveys, in telephone surveys the researcher can also make sure that the respondents understand well the question which leads to more accurate results (Brace, 2008). Although telephone surveys can exclude those individuals that do not own a telephone, such surveys have large scale accessibility (Liberty, 2009). The majority of people especially older ones have a telephone at home. Szolnoki and Hoffmann (2013) suggested that one way of minimising bias in telephone surveys is through larger samples.

Most limitations associated with telephone surveys were compensated in different ways in this research. For example, the sample population was obtained using the Electoral Register. Hence, the telephone surveys' limitation of not knowing who is answering the phone was minimised as calls were only made to households that had people above the age of 60 living in them. Any potential limitations associated with hearing impairments or with older people forgetting the options listed in the closed-ended questions were also overcome through repetition of the questions and/or through a louder voice. The succeeding section will now describe the structure of the questionnaire, followed by an explanation of the sample size used in this study.

4.3.2 The Questionnaire Structure

The questionnaire targeted objectives 3 and 4 of the study. Since the questionnaire was the primary data collection source in this study, it was carefully planned and designed for older people to understand the questions quickly. Most questions were closed-ended. Bryman (2012) explained that amongst the advantages of close-ended questions there are the ease of comparing answers, the ease for the researcher to process the data and the ease for the respondent to answer the question. Close-ended questions make it clearer for the respondent to understand what the question is asking. Nonetheless, with several of the close-ended questions, the option “Others” was listed for the respondents to have the space to communicate their thoughts. Through this option, they were allowed to voice their perceptions and opinions in a more open manner. Questions that were not close-ended only required short answers or listing, in order to avoid bias. The survey was intended for all types of older road users i.e. pedestrians, drivers and public transport users. Older people who were totally housebound could not answer most of the questions of the survey, and thus were automatically omitted.

The questionnaire was divided into two main sections. Corresponding with the main individual, social and environmental determinants of mobility in later life (discussed in Chapter 2) and the TIB framework (discussed in Chapter 3), the variables that were used in this research were those shown in Figure 4.2. Section A analysed the objective factors of travel behaviour and Section B analysed the TIB constructs vis-à-vis older people’s travel behaviour. More detail on each section is given in the following sections. The questionnaire is provided in Appendix B.

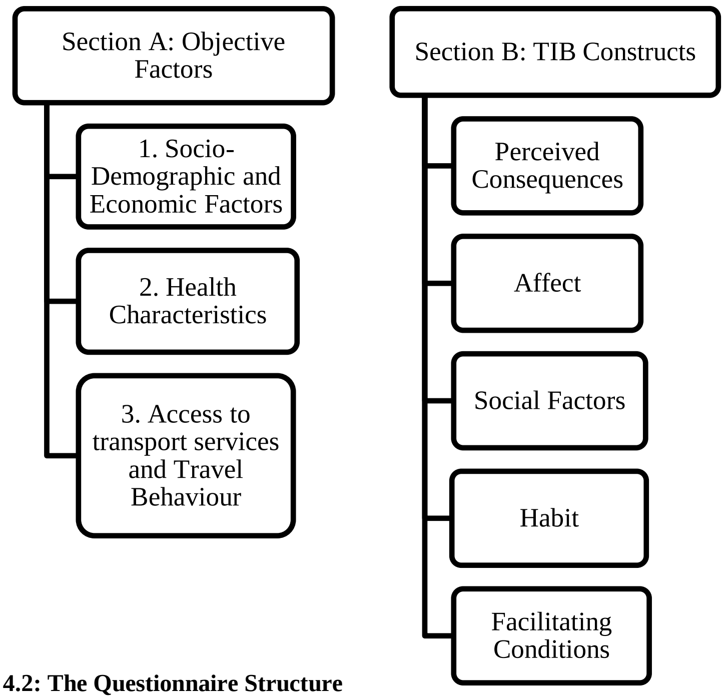

Figure 4.2: The Questionnaire Structure

Section A primarily targeted objective 3 and research question *iii* of the study: to understand the personal, social and environmental factors that significantly affect older people's travel behaviour (Figure 4.1). This section was divided into three sub-sections: Section 1 focused on the socio-demographic and economic characteristics; Section 2 focused on health characteristics; and Section 3 focused on the access to different transport modes and travel behaviour of older people (Figure 4.2). These three sub-sections were included in the questionnaire since these are factors that significantly impact older people's mobility and travel behaviour (as discussed earlier in Chapter 2). Such information was placed in the initial part of the questionnaire to minimise negative effects of fatigue that may impact later sections of the questionnaire (Brace, 2008).

For Section 1, the first two questions were related to the age and gender of individuals. Given the complexity and difficulty to define who is actually "old", the question concerning the age of respondents was left open-ended. In this way when analysing data, the dynamics of ageing could be clearer and more explicit than when grouping older people in age brackets (e.g. 60-69). Given the strong gender differences in mobility in later life (e.g. Siren and Hakamies-Blomqvist, 2006; Nordbakke, 2013), the questionnaire definitely needed to extract the gender of respondents. Moreover, several studies (e.g. Kim and Ulfarsson, 2004; Mercado and Newbold, 2009) found that the living arrangement of older people can strongly affect the way they travel. Thus, Section 1 of the questionnaire also had two questions related to the marital status and household type of older individuals. Education levels are also an important determinant of mobility (e.g. Kim, 2003; Hough et al., 2008) and thus a question on the educational status of older people was adapted from the International Standard Classification of Education 2011. In Section 2.5.2, the relationship between older people and their family members as well as the important role of social activities for older people's well-being were thoroughly discussed (see for example Gabriel and Bowling, 2004; Mollenkopf et al., 2004; Musselwhite and Haddad, 2010; Li and Loo, 2017). Therefore the questionnaire analysed whether there was someone assisting in the basic mobility needs of older people and whether they participated in any social activities.

With regard to Section 2 of the questionnaire (health characteristics), some issues that were considered were the use of medication and/or assistive devices. It is important to analyse impairments and medication collectively because as discussed by other researchers (e.g. Rantanen et al., 2001; Rantakokko et al., 2013) the effects of co-impairments are usually larger than just the total itself. Moreover, after the discussion on falls and use of assistive devices in old age and their effects on mobility limitations (e.g. Delbaere et al., 2004; Moniruzzaman et al., 2015), the questionnaire also analysed whether there were any falls within the past year and whether older people needed assistive devices for their travel. In a Likert Scale question from 1 to 5, older people also had to rate their self-perceived physical and mental health. Self-reported health data can be significantly associated with the actual diagnosis (Ernsth Bravell et al., 2011; Carlsson et al., 2012) and can serve as a simple and inexpensive tool for identifying those at high risk of future disability (Mänty et al., 2007). Siren and Haustein (2014) make reference to several studies which prove the reliability of self-reported behaviour and health in later life. Together with this, older people were also questioned about the main health issues that affect their outdoor mobility. This question was adapted from the International Classification of Functioning, Disability and Health (ICF). ICF is the WHO international standard to describe and measure health and disability (WHO, 2014).

In Section 3 (access to transport services and travel behaviour), the possession of driving licence and the access to a car in the household were analysed since they are major determinants of mobility in old age (e.g. Schwanen et al., 2001; Alsnih and Hensher, 2003). For car drivers, the age at which the driving licence was obtained was revealed so as to determine the amount of years driving. The non-drivers were asked whether they were drivers at a younger age and if so the reason why they stopped driving. This exposed the driving cessation problem discussed in Section 2.6.1.

Following discussions presented in Chapter 2 and given the aim of this study, older people were asked about their travel behaviour. This was done through their travel frequency and average daily travel time during the survey week, their mode choice and frequency of public transport use, whether they just travelled in familiar areas or not and their accompaniment. All respondents were to outline their main travel purposes and the respective mode of transport used. It should be acknowledged that although several studies (e.g. Mercado and Páez, 2009) used travel distance as an indicator of mobility in later life, given the context of the study this was not an ideal variable to use. Due to the small geographic size of Malta and the very short distances involved when travelling, this was replaced with the average travel time for the days in which older people travelled during the survey week. This was also much easier for older people to respond, since within the Maltese culture mobility is never expressed through the number of kilometres travelled.

Section B of the questionnaire survey primarily targeted objective 3 and research question *iv* of the study: to understand the psychological determinants that predict travel behaviour for the older population in Malta. In this section, psychological statements related to the TIB framework discussed in Chapter 3 were listed. This information evaluated the underlying motivations of older people's travel behaviour and together with information from Section A of the questionnaire formed the basis for the cluster analysis carried out as part of this study (Section 4.4.3). Each of the TIB's constructs was analysed through statements measured in a Likert Scale. This study used a five-point Likert Scale (Strongly agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1). Statements were written in the first person, so that it would be easier for older people to put themselves into picture. Some of the statements were negatively worded so that respondents did not fall into a pattern of continually agreeing with statements due to social desirability or fatigue (Saunders et al., 2009). When it came to the analysis these items were then reverse-coded.

All the Likert Scale statements were adopted from previous studies that used the TIB as their underpinning framework (e.g. Limayem et al., 2004; Domarchi et al., 2008; Galdames et al., 2011). The two statements concerning the habit construct were inspired from the Self-Reported Habit Index (SRHI) by Verplanken and Orbell (2003). This index measures the extent to which a particular behaviour is habitual through twelve items across a number of dimensions, including history of repetition, automaticity and lack of control (Darnton et al., 2011). Such index was also used in reduced versions in multiple transport studies (e.g. Erikkson et al., 2008; Thøgerson, 2009; Şimşekoğlu et al., 2015).

Section 1 and Section 2 of the questionnaire were both used to achieve objective 4 of the study: to develop segments of older people based on the objective and psychological determinants that affect their travel behaviour. This was done through cluster analysis, which will be described in detail in Section 4.4.3. Table 4.5 is a summary of the questionnaire. It gives an overview of the questions that were included and the scale at which they were measured.

		Section	Measurement Scale		
			Continuous	**Nominal Scale**	**Ordinal Scale**
Section A	**Objective Factors**	**1. Socio-Demographic and Economic Characteristics**	Age	Gender, Marital Status, Education, Household Type, Current Occupation, Person assisting you*, Participation in social activities*	
		2. Health Characteristics		Medication, Assistive Device*, Fall*,	Physical Health, Mental Health, Main health issues affecting outdoor mobility
		3. Access to Transport Services and Travel Behaviour	Years of driving, Distance to closest bus stop	Transport Mode Available, Previous car driving for non-drivers*, car availability, Access to *tallinja* Card, Travelling in familiar areas, Travel accompaniment, Travel Purposes and time of travel	Public transport use, Hours travelling per day, Number of trips per week
Likert Scale					
Section B	**Theory of Interpersonal Behaviour Constructs**	**Perceived Consequences Statements**			Safety, quality of life
		Affect Statements			Happiness, anxiousness, fear,
		Social Factors Statements			Self-concept, social norms, roles
		Habitual Statements			Automaticity, past behaviour, routine
		Facilitating Conditions Statements			Infrastructures, travel information, personal knowledge and skills, Safety and security
***Additional information should be given to the nominal answer**					

Table 4.5: Summary of the Questionnaire

4.3.3 Defining the Sample

The total number of older people in Malta, including those residing in institutions was 98,786 in 2011 (NSO, 2014b). A sample of this population was hence required in order to carry out the questionnaire survey. Probability sampling was used to obtain the sampled population. This is the sampling technique which is associated with survey research strategies, like the one in this study (Saunders et al., 2009). Probability sampling is a technique in which every case has the same accurate chance (non-zero probability) of being selected (Saunders et al., 2009; Bhattacherjee, 2012; Bryman, 2012). This means that in probability sampling there is always a random selection at some point in time. The three main types of probability sampling are random sampling, systematic sampling and stratified sampling. As will be further explained in this section the main sampling techniques used in this study were stratified and random sampling.

In order to address skewness in the data, the number of older people that lived in institutions (5,028 older people) was deducted (NSO, 2014b). This included older people living in all residential homes in Malta i.e. governmental, private and church institutions. These were excluded because they usually have their own travel arrangements and have reduced independent mobility. The total number of older people in Malta was therefore reduced to 93,758. Using a maximum margin of error of 5% and a 95% confidence level, the minimum required representative sample was 383. Yet, for a better representation of the older population in Malta, 500 people were surveyed.

In order to have a representation at national scale, surveys were carried out in all the six districts of Malta (Figure 1.1). The sample of older people per district was determined according to weights given to each district. Weighting was calculated according to criteria linked to the socio-economic, mobility and geographic characteristics of older people in each district. The data were obtained from secondary sources namely the Census of Population and Housing 2011 (NSO, 2014b), Statistics on Income and Living Conditions 2010 (NSO, 2012a), Lifestyle Survey 2007 (NSO, 2009b) and National Household Travel Survey 2010 (TM, 2010). For every indicator listed in Table 4.6, a rating from 6 to 1 was assigned in a descending manner, with the highest rank representing the top district for the respective criterion. Such rankings were summed up and the highest values were obtained for the Southern Harbour District (86), Gozo and Comino (79) and the Northern Harbour District (68) respectively.

Indicator	District						
	SH[1]	NH	SE	W	N	G	
Highest Older Population (excluding those living in institutions)	4	5	2	3	1	6	NSO (2014b)
Highest Population Density	5	6	4	2	3	1	NSO (2014b)
Highest Old Age Dependency Ratio	6	4	1	3	2	5	NSO (2014b)
Highest percentage of retired persons within the older population	6	2	4	5	1	3	NSO (2014b)
Highest percentage of older people with an illness	6	3	5	4	2	1	NSO (2014b)
Highest average Age (only people living in private households)	5	4	2	3	1	6	NSO (2014b)
Households with two adults at least one above 65 years	5	4	2	3	1	6	NSO (2014b)
Reference persons 60+	5	4	3	4	2	6	NSO (2014b)
Highest percentage of people whose main source of income is from old age benefits	5	6	1	3	2	4	NSO (2012a)
Activity limited by long-term illness, health problem/disability	3	6	2	1	4	5	NSO (2009b)
Lowest Driving Licence ownership 60 (males and females) 2010	6	4	3	1	2	5	TM (2010)
Longest distance to bus stop 2010	6	1	2	3	4	5	TM (2010)
No vehicle available within family 2010	6	5	3	1	2	4	TM (2010)
No internet transaction 2010	5	2	3	3	4	6	TM (2010)
Older people that have a disability which can affect their mobility	3	5	6	1	2	4	TM (2010)
Highest percentage of older people that did not travel as they were sick 2010	4	2	5	3	1	6	TM (2010)
Highest number of localities per district	6	5	4	3	2	6	
Total	**86**	**68**	**52**	**46**	**36**	**79**	

Table 4.6: Criteria used to work out sample weighting per district in Malta

Following this, the weighting percentage for each district with regard to the survey distribution was calculated and the number of surveys per district was established (Table 4.7).

[1] SH= Southern Harbour, NH=Northern Harbour, SE=South Eastern, W=Western, N=Northern, G=Gozo and Comino

	Rankings (Table 4.6)	Weight (%)	Number of surveys
Southern Harbour	86	23.43	117
Northern Harbour	68	18.53	93
South Eastern	52	14.17	71
Western	46	12.53	63
Northern	36	9.81	49
Gozo and Comino	79	21.53	107
Total	**367**	**100**	**500**

Table 4.7: Number of surveys conducted per district

The older people are very diverse and age is a key factor in this regard (Lord et al., 2011). Stratified sampling refers to an approach in which a population is first divided into subgroups on the basis of some key characteristics, and then eventually subjected to random or systematic sampling within that stratum (O'Brien, 1992). The strata is mutually exclusive where every element in the population is assigned to only one stratum. This type of sampling often improves the representativeness of the sample by reducing sampling error.

For the purpose of a better and more detailed analysis, age groups were divided into four cohorts: 60-69, 70-79, 80-89 and 90+. These were the basis of the stratified sampling. The sample of older people within each cohort per district was worked out as a ratio of the total number of older people within the respective age group in the respective district. In line with what was discussed for the national sample, the number of older people living in institutions per district (Appendix C) was deducted. In this manner only older people living in private households were surveyed. When all the older people were divided into age cohorts per district, random sampling was carried out in order to determine the sampled population. The localities within districts were also determined in a random manner. This produced a national geographic distribution at district level. Table 4.8 shows the sampled population by age group and district.

	60-69	70-79	80-89	90+	Total
Northern Harbour	50	29	12	2	**93**
Southern Harbour	63	35	17	2	**117**
South Eastern	45	17	8	1	**71**
Western	35	18	8	2	**63**
Northern	28	14	6	1	**49**
Gozo	56	32	17	2	**107**
Total	**277**	**145**	**68**	**10**	**500**

Table 4.8: Sample of the study by age and district

The latest Electoral Register for Malta (dated October 2015) was the source of information used to obtain the list of all older people per locality. For every locality, all the individuals with an Identification Number (ID card number) ending with 56 or less were noted. This type of selection process was chosen because in Malta the last two digits of the ID Card represent the year when the person was born. Hence all the individuals that were 60 years (born in 1956) or over were identified.

In order to compensate for non-responses, an extra 50 older people in each district were sampled from the Electoral Register. For every individual that refused to answer the questionnaire or did not answer the phone after three attempts, the random sampler in Microsoft Excel 2010 was run again within the corresponding age cohort and district. Then, the newly sampled respondent replaced the former one. The telephone numbers for the sampled older population were determined through an online telephone directory.

In order to achieve the targeted sample of 500 people, 713 households were called. There were 213 who refused to participate in the survey, resulting in a high response rate of 70%. Surveys were carried out throughout a four-month period from 1st June to 29th September 2016. Surveys were conducted throughout different times of the day so as to capture as much as possible the dynamics of older people's lifestyles. Each survey lasted on average 10 minutes. A detailed description of the sample of the study by age and gender is found in Appendix D.

Ethics approval for all the survey was obtained on the 5th May 2016 from the University of Malta Research Ethics Committee prior to the pilot data collection. All respondents were informed about the content of the study and were free to withdraw from the survey at any time. Ethical approval was needed due to the older population being a vulnerable group particularly for sensitive questions such as those related to physical and mental health. All responses were anonymous with the survey being written in both Maltese and English (Appendix B).

4.3.4 The Pilot Study

A pilot study representing 5% of the total sample size was carried out before starting the actual data collection. Twenty-five pilot questionnaires were conducted between the 18th and 25th May 2016 to ensure that the survey questions served the purpose of the research and that the correct data was obtained. A few modifications were done to the survey after the pilot study.

In Section A3 of the survey (Access to Transport Services and Travel Behaviour), the question concerning the average travel time for when older people travelled during the survey week (question 16 in Appendix B) initially followed the question dealing with public transport use. Older people misunderstood this question as just referring to the travel time when using public transport. Consequently, this was shifted following the question on the generic travel purposes and the respective modes of transport used. The pilot questionnaire survey also included a question on the average number of trips that older people did during the survey week. However, it was difficult for all respondents to remember such information and instead the average travel time was recorded. In the pilot survey, the current question concerning travel frequency was not included. Yet, it was highlighted by most respondents and was eventually added to the actual survey. For question 17 of the survey (Appendix B) considering the combination of modes that older people use to travel, the option "Other" was added since some of the pilot respondents listed a combination of modes that was not included in the initial list.

In Section B of the questionnaire dealing with the TIB psychological constructs, several statements were shortened or modified because they were quite difficult for respondents to follow. For example with reference to the *Perceived Consequences* construct, during the pilot study the first statement was "*My travel behaviour does not violate my ethics, reflects positively on my status and improves my quality of life*". After the pilot data collection this was changed to "*My travel behaviour improves my quality of life*". The second statement for this construct was also changed from "*I believe that my travel behaviour is safe and both me and society gain from this behaviour*" to "*I believe that my travel behaviour is safe for me and for the others*".

With regard to the statements dealing with the *Facilitating Conditions* construct, the current statement focusing on the effects of how other people in society affect the mobility of older people (Appendix B) replaced a statement which was specifically tackling safety and security issues (e.g. poor lighting, poorly exposed marking signs). The latter was redundant with the current statement focusing on transport infrastructures and was therefore not providing any new information.

4.4 Research Methods and Analytical Techniques

This section describes the research methods and techniques used to analyse the survey data. Discussions concerning the appropriateness of each method for this research and how data analysis was conducted are provided. Once the questionnaire data was collected, the results were inputted, checked and cleaned using IBM SPSS 21 Statistics software. Data was also numerically coded for the subsequent statistical analysis. In order to achieve objectives 3 to 5 of the study (refer to Figure 4.1) data was analysed in three main phases as shall be discussed in the subsequent three sections.

4.4.1 Descriptive Statistics and Regression Models

Descriptive statistics help to understand the most important characteristics of a data set and are critical to show the distribution of data (Brace et al., 2008). Although providing descriptive statistics was not one of the objectives of the study, they were fundamental to better understand the sample and the travel dynamics of older people in Malta. Given this, the key results from the descriptive statistics are presented in Chapter 5. Descriptive tables and graphs showing more detail are then attached in Appendix E.

Eventually, more complex statistical techniques, namely regression models followed. The regression models were needed to answer research question *iii* of the study (Figure 4.1), to understand what personal, social and environmental factors significantly affected older people's travel behaviour. In regression models, the outcome is determined from two or more predictors (Campbell and Campbell, 2008). The choice of the regression model depends on the type of variables included in the analysis. As explained earlier in Table 4.5, all travel behaviour variables in the survey were nominal and thus logistic regression was used. Binary logistic regression was used when the outcome variable had two variables; whilst multinomial logistic regression was used when the outcome had more than two categories (Field, 2013). Multinomial logistic regression is a multiple regression model that is used to predict the probability of category membership on a dependent variable based on multiple independent variables (Starkweather and Kay Moske, 2011). There were some variables (e.g. public transport use) that had an ordinal nature and therefore in these cases an Ordinal Logistic Model could have been used. This is the regression analysis which is used to predict an ordinal variable given one or more independent predictors. However multinomial regression was preferred over ordinal regression so as to estimate coefficients that capture the differences between all possible pairs of groups. Moreover, the Ordinal Logistic Model has several assumptions that have to be met. For all independent variables in this research, the assumption of the proportional odds was violated. This states that the effect of the independent variable on the ordinal dependent variable is uniform over all the levels or categories of the dependent variable (Norusis, 2011). Consequently the models' fit was inappropriate and therefore not used in the study.

These regression models did not determine the underlying motivators for the travel behaviour of older people. Since they just focused on the objective personal, social and environmental characteristics, the role of attitudes and other important psychological characteristics that affect decision making (as described in the TIB framework) were omitted. For these reasons, this gap was targeted through structural equation modelling which complemented the regression analysis.

4.4.2 Structural Equation Modelling

Structural Equation Modelling (SEM) was the main analytical technique used to answer research question *iv*. It was used to understand the psychological determinants that predict the travel behaviour of the Maltese older population.

SEM was used to test the predictive ability of the TIB framework and the causal relationships within the model. In this way the constructs that predict travel behaviour of older people and the relationships between them could be determined. Hoyle (1995) defined SEM as a comprehensive statistical modelling tool that analyses multivariate data that involve complex relationships between variables. SEM goes over the traditional regression models because it is a modelling technique that can handle multiple independent and dependent variables. It tests hypotheses about relationships among endogenous (dependent), exogenous (independent) and latent (unobserved) variables (Wothke, 2010). SEM is not an exploratory method but a confirmatory one where the validity of a hypothesised theoretical model is tested (Golob, 2003). It is the ideal tool to measure latent variables (e.g. attitudes) because it is very well suited to test psychological behaviour theories such as the TIB. Given the TIB structure and the possible relationships between its components, the use of SEM fitted perfectly in this study (Galdames et al., 2011). As Bryman (2012) explained, in behaviour sciences researchers often have to deal with theoretical constructs that cannot be observed directly. It is difficult to fit latent variables in discrete choice models, and SEM not only allows the detection of correlation between latent variables but also acknowledges the importance of each (Galdames et al., 2011).

SEM is commonly represented in path diagrams where each direct effect corresponds to an arrow in the diagram (Golob, 2003). Observed variables are represented in rectangles whilst latent variables are represented using circles (Suhr, 2006). Simultaneous to the testing of the model in itself, SEM also tests the extent to which the causal processes hypothesised by the model are consistent with the data. If the model "fits" the data, then it is accepted. Otherwise it is rejected (Carvalho and Chima, 2014). The two main elements of a SEM are the *Measurement Model* and the *Structural Model*. These are followed by the *Model Estimation* and *Model Fit*. A brief description of these assets is given in Table 4.9.

Structural Equation Model			
Measurement Model	**Structural Model**	**Model Estimation**	**Model Fit**
Multivariate regression model where all observations load onto the latent variables, their relationships, variances and errors	Key part of the structural equation model	Start values of the free parameters are chosen to generate an estimated population covariance matrix from the model	How well a hypothesized model 'fits' the data
Relationships between observed dependent variables and continuous latent variables	A part of the total hypothesized structural equation model, which includes both latent and indicator variables	Ensure, as much as possible, that the estimated covariance matrix of the model and the data are zero	Evaluating a structural equation model with goodness-of-fit indices
Whether items are appropriate for the latent constructs they are measuring	The degree to which latent variables directly or indirectly influence changes in the values of other variables in the model		

Table 4.9: The mains steps in a Structural Equation Model (Adapted from Golob, 2003; Carvalho and Chima, 2014)

The software used to work out the SEM was AMOS version 21 (used in conjunction with IBM SPSS software). This software was primarily used due to its user-friendliness when creating path diagrams. Following on from Table 4.9, some important procedures had to be followed in order to come up with the final model. These included 1) a reliability analysis, 2) a test of the measurement model and 3) the test of the structural model (Azzopardi et al., 2016). Such procedures were necessary to confirm that the various items included in the questionnaire were appropriate measures of their respective latent psychological constructs. The procedures followed to build the structural model (reliability analysis, the measurement model and the structural model) will be explained in detail when discussing the results in Chapter 6.

The first use of SEM in transport dates back to the 1980s when Den Boon (1980) used it in the context of a joint model of vehicle ownership in the Netherlands. Due to the complex nature of mobility, SEM was used in multiple travel behaviour and transport studies that considered psychosocial attributes (e.g. Gärling et al., 2001; Scheiner and Holz-Rau, 2007; Sakano and Benjamin, 2008). Even with regard to older road users, multiple studies used SEM to understand different perspectives of how older people travel (see Section 3.5). Additional examples are Mollenkopf et al. (2005) who through the MOBILATE Project used SEM to understand the complex factors that affected older people's quality of life in various countries; Delbaere et al. (2009) who analysed how falls and catastrophic thoughts about falls predicted mobility restriction in older people; Lucidi et al. (2014) who analysed the personality and attitudes which predicted risky driving among older drivers, and Wong et al. (2017) who analysed self-regulation among older drivers.

4.4.3 Cluster Analysis

Cluster analysis was used to achieve the fourth objective of the study, that to develop segments of older people based on objective and psychological determinants that affect their travel behaviour (Figure 4.1). Cluster analysis is used to identify homogenous groups of objects called clusters (Sarstedt and Mooi, 2014). In cluster analysis, homogeneity within the clusters and heterogeneity between the clusters are maximised (Hair et al., 2005). Cluster analysis does not identify a particular statistical model and no assumptions about the underlying distribution of the data are usually required (Norusis, 2011). Clustering is important because in society there are distinct groups of people that have fairly similar patterns of behaviour which can lead to similar world views. Clusters also show that combinations of the same factors can affect different groups of people in a diverse manner (Anable et al., 2006). Thus, in the transport domain, clustering is particularly important for policy makers to identify and evaluate which measures should be developed to target specific travel patterns and needs of different groups of people (Haustein, 2012; Mandl et al., 2013; Marin-Lamellet and

Haustein, 2015). This is particularly relevant for the older population who is one of the most heterogeneous population groups (Alsnih and Hensher, 2003). Thus, clusters allow decision makers to identify and evaluate opportunities for changing behaviours, such as increasing public transport use. Anable et al. (2006) explained that behavioural change is often the easiest for groups that are on the “margins” since their attitudes would be more prone to influence. When policies target these clusters they have higher chances of success.

The three main clustering techniques are 1) hierarchical methods, 2) k-means methods and 3) two-step clustering methods. The choice of method depends on the size of the data file and the type of variables included in the analysis. *Hierarchical techniques* refer to agglomerative clustering. In such a clustering technique, initially each object represents an individual cluster. Then objects are merged according to their similarity (Sarstedt and Mooi, 2014). Since the goal of cluster analysis is to form similar groups, *distance* is a measure of how far apart two objects are, while *similarity* measures how similar two objects are (Norusis, 2011). Hierarchical cluster analysis is usually represented using a dendogram. The latter is a visual representation of the distance level at which there is a combination of objects and clusters (Sarstedt and Mooi, 2014). Based on different criteria, the researcher chooses the point at which to ‘cut’ the dendrogram, and decides on the ideal number of clusters to use in the analysis.

In *k-means clustering*, observations are grouped into clusters in a way that each observation belongs to the cluster with the nearest mean, and *k* represents the number of clusters required. The desired number of clusters is specified in advance and the ‘best’ solution is chosen. After choosing the initial cluster centres, each observation is assigned to the nearest cluster (in terms of the smallest distance to the centroid). After finding the centroids of the formed clusters, distance to each subject is re-calculated and observations can be moved to other clusters they are closest to. The algorithm repeatedly reassigns cases to clusters and the same case can move from cluster to cluster during the analysis. This continues until the centroids remain relatively stable and the cluster means do not change much between the successive steps (Cornish, 2007). This clustering technique is usually used when large samples are involved (Sarstedt and Mooi, 2014).

In a large data file and when there is a mix of continuous and categorical variables, the *two-step cluster analysis* is generally recommended since the other clustering techniques are not appropriate for a mix in the types of variables (Norusis, 2011). Two-step cluster analysis has the advantage to group data based on any form of data measurement (e.g. binary, Likert or categorical) (Tkaczynski, 2016). This clustering technique was chosen in this research due to the large dataset involved (500) and due to the mix of continuous and categorical variables included in the analysis. The two-step cluster analysis is also the algorithm which automatically determines the number of clusters needed by examining the Bayesian Information Criterion (BIC) (Hsu et al., 2006; Tkaczynski, 2016). Thus, if the research is exploratory and the characteristics of the groups are known *a priori*, as in the case of this research, two-step cluster analysis is essential to provide the solution which determines the number of clusters that the data contain (Tkaczynski, 2016). In this case the researcher's judgement is not a determining factor when identifying the number of clusters, avoiding any potential bias. This clustering technique was also chosen because it enables the user to understand the importance of each variable in the cluster solution and how this may be statistically significantly different between the clusters. This is central when the user wants to understand how relevant a particular variable is to the total solution (Tkaczynski et al., 2015).

As the name suggests, the two-step clustering algorithm consists of two main steps. The first step consists of forming preclusters. This is done by a cluster feature tree in which the "leaves" represent distinct objects in the dataset (Sarstedt and Mooi, 2014). The preclustering step uses a sequential clustering approach. After it scans the data records individually, based on the distance measure, the algorithm decides if the current case should be merged with a precluster which was previously formed, or else start a new one. When the preclustering procedure is done, cases in the same precluster are treated as a single entity. The distance matrix size will then be dependent on the number of preclusters. The second step then involves the standard hierarchical clustering algorithm on the preclusters. The formation of clusters in a hierarchical manner allows the researcher to explore a range of solutions with different number of clusters (Norusis, 2011). When there is a mixture of continuous and categorical variables only the log-likelihood distance measure can be used. The distance between two clusters depends on the decrease in the log-likelihood when they are combined in a single cluster. The optimal number of clusters is based on either the Schwarz's Bayesian Criterion (BIC) or the Akaike Information Criterion (AIC).

In this study, clustering was carried out after data collection and therefore considered more variables than the traditional *a priori* clustering. In the latter approach groups from a population are chosen in advance of data collection based on known characteristics as socio-demographic factors (Anable, 2005; Anable et al., 2006). In *post-hoc* clustering (as in the case of this research), empirical investigation through multivariate statistical analysis is carried out to identify clusters based on the similarity of multiple variables. Thus, clusters are determined by the data itself and not by the researcher (Anable et al., 2006). As shall be explained in detail in Chapter 7, clusters were not only formed based on socio-demographic and psychological variables alone, but more importantly on how these factors integrated with the travel behaviour of older people. The objective (personal, social and environmental) and psychological (TIB constructs) variables included in the algorithm were chosen based on their importance in predicting travel behaviour in Chapters 5 and 6 respectively. All the variables included in the algorithm are clearly listed and explained in Table 7.1 in Chapter 7.

As shown in the research gap, to date only two studies that clustered older people included psychological variables in the algorithm (Haustein et al., 2008; Haustein, 2012). Anable et al. (2006) and Hunecke et al. (2010) stressed the importance of including psychological factors in segmentation in order to understand the "why" of behaviour providing information about the underlying processes. This is because although *a priori* methods can for example group people as *high car users* vs. *low car users* these two clusters may not be necessarily homogenous in terms of the motivation and attitudes of using the car. Thus, supporting earlier discussions, understanding the psychological profile of a cluster is essential for policy makers to understand their potential for change. In travel behaviour studies this is still considerably lacking since only few transport studies grouped people using psychological factors (e.g. Redmond, 2000; Anable, 2005; Hunecke et al., 2005). Anable (2005) developed six distinct psychographic groups with varying degrees of mode switching potential. This showed that different groups have to be serviced in different ways to optimise the chance of influencing mode choice behaviour. Anable's clusters proved that whilst the same behaviour can take place for different reasons, the same attitudes can also lead to different behaviours.

Two-step clustering is quite a recent phenomenon yet it was used in several studies from different fields, including transport (Cerin et al., 2007, Chang and Yeh, 2007). When analysing the association between access to destinations and walking for transport, Cerin et al. (2007) used two-step cluster analysis to identify groups of Census collection districts in Adelaide with similar land use profiles. Chang and Yeh (2007) used two-step clustering to classify motorcyclists' behaviour to different levels of risk within different risky behaviour types in Taipei metropolitan areas. Other domains where two-step clustering was used are tourism (Tkaczynski et al., 2015), health (e.g. Mclernon et al., 2012) and psychology (e.g. Fillman et al., 2013). Griffin et al. (2014) used two-step cluster analysis to group older people based on their health lifestyles and to analyse the association of these lifestyles with biological and psychological states as well as socio-economic indices. Most of the studies discussed in Section 2.7 that clustered older road users (e.g. Hildebrand, 2003; Haustein, 2012, Siren and Haustein, 2013) used the k-means clustering algorithm. To the author's knowledge, no studies dealing with the field of ageing in transport have ever used two-step cluster analysis.

4.5 Conclusion

This chapter has specified the research design, the data collected and the research methods used to fulfil the overall aim of the study. The philosophical outlook of the study was mostly influenced by the post-positivist approach because although it focused on quantitative methods it acknowledged the fact that external factors exist and that it was impossible to uncover all the truth about older people's mobility. Given this, the study followed a deductive approach. This chapter also clearly explained the aim, objectives and research questions of the study. Such objectives necessitated a research strategy that allowed for the collection of primary data relating to the travel behaviour of older people in Malta. Telephone surveys were considered to be the most suitable approach to collect such data.

The research methods employed to analyse the data were also addressed. These included descriptive statistics, regression models, structural equation modelling and cluster analysis. An explanation of why such methods were chosen was provided in this chapter. The following chapter (Chapter 5) is the first of three chapters presenting the findings of this research. It focuses on the personal, social and environmental characteristics that affected the travel behaviour of older people. Through structural equation modelling Chapter 6 then evaluates the underlying psychological factors that affect mobility in later life. This is followed by Chapter 7 which groups older people into clusters based on their travel behaviour. All such findings are then discussed holistically in Chapter 8.

CHAPTER 5

THE PERSONAL, SOCIAL AND ENVIRONMENTAL DETERMINANTS OF TRAVEL BEHAVIOUR

5.1 Introduction

This chapter seeks to understand the personal, social and environmental factors that significantly affect older people's travel behaviour (objective 3, research question *iii*). Personal factors relate to socio-demographic characteristics, health factors and access to transport services. Social factors refer primarily to social networks, living arrangement and the participation of older people in different social activities. Environmental factors refer to the district where older people live and the distance to the nearest bus stop. Travel behaviour is discussed from four main perspectives: travel purposes and patterns, modal choice, travel frequency and travel time.

The chapter is divided into two main parts. In the first part, an overview of the descriptive statistics concerning older people's travel behaviour is given. The second part of the chapter addresses nine regression models developed to understand the personal, social and environmental determinants that predict travel behaviour in later life. Conclusions are drawn at the end of the chapter.

5.2 Descriptive Statistics

Descriptive statistics help to understand the most important characteristics of a data set (Brace et al., 2008). They are also critical to show the distribution of data. This chapter highlights the key descriptive statistics most relevant to the results presented. For ease of understanding, Table 5.1 shows the number of older people by age group and gender per district. The small number of the over-90s participants was still included in the descriptive statistics as shown in the upcoming figures in this chapter. The detailed descriptive statistics graphs and tables are found in Appendix E.

<table>
<tr><th colspan="2"></th><th>Northern Harbour</th><th>Southern Harbour</th><th>South Eastern</th><th>Western</th><th>Northern</th><th>Gozo</th><th>Total</th></tr>
<tr><td rowspan="2">60-69</td><td>Males</td><td>24</td><td>17</td><td>22</td><td>14</td><td>6</td><td>19</td><td>102</td></tr>
<tr><td>Females</td><td>26</td><td>46</td><td>23</td><td>21</td><td>22</td><td>37</td><td>175</td></tr>
<tr><td rowspan="2">70-79</td><td>Males</td><td>9</td><td>12</td><td>5</td><td>3</td><td>3</td><td>5</td><td>37</td></tr>
<tr><td>Females</td><td>20</td><td>23</td><td>12</td><td>15</td><td>11</td><td>27</td><td>108</td></tr>
<tr><td rowspan="2">80-89</td><td>Males</td><td>5</td><td>4</td><td>2</td><td>4</td><td>0</td><td>3</td><td>18</td></tr>
<tr><td>Females</td><td>7</td><td>13</td><td>6</td><td>4</td><td>6</td><td>14</td><td>50</td></tr>
<tr><td rowspan="2">90+</td><td>Males</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>4</td></tr>
<tr><td>Females</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td rowspan="2">Total</td><td>Males</td><td>39</td><td>34</td><td>29</td><td>22</td><td>9</td><td>28</td><td>161</td></tr>
<tr><td>Females</td><td>54</td><td>83</td><td>42</td><td>41</td><td>40</td><td>79</td><td>339</td></tr>
</table>

Table 5.1: Sample of older people by age and gender per district

5.2.1 Mode Choice and Travel Purposes

The rate of non-drivers amongst the sampled population was overall higher (62.6%) than that of drivers (37.4%). The gender imbalance in the sample was a key factor in this regard because from all the drivers, 70.1% were males and only 29.9% were females. Although irrespective of gender, the number of drivers decreased with age, the percentage of male drivers was always higher than that of females for all age groups (Figure 5.1). Of the non-drivers who responded to the survey, 14.4% used to drive. From these, 67% were females. The main reasons for driving cessation were health limitations (36%), the perceived traffic and parking difficulties (31%), fear (11%) and reliance on relatives (7%).

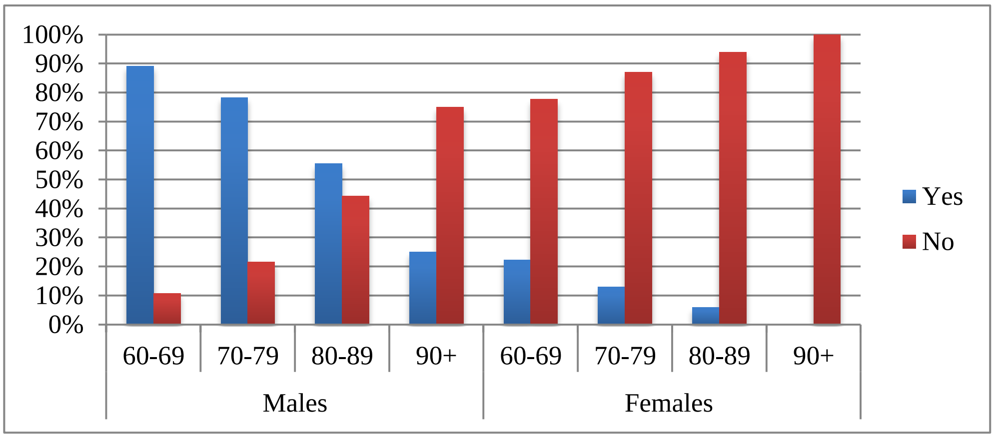

Figure 5:1: Driving by age and gender

A low public transport usage was very evident amongst the older people. Just over 37% used public transport infrequently, followed by 34.8% who never used it. Differences between genders were also noticed (Figure 5.2). For frequent bus users the percentage of females exceeded that of males. Correspondingly, the percentage of males who never used public transport exceeded that of females. However when a Mann-Whitney Test was conducted to analyse the correlation between gender and public transport use, this resulted to be insignificant (p-value=0.127). Moreover, whilst for females, public transport use decreased with age, for males the pattern was not that linear (Figure 5.2). This was supported by Kruskal Wallis Correlation Tests which showed that whilst for females the older the age the lower was the public transport use (p-value =0.000), for males the relationship between age and public transport usage was not statistically significant (p-value=0.369).

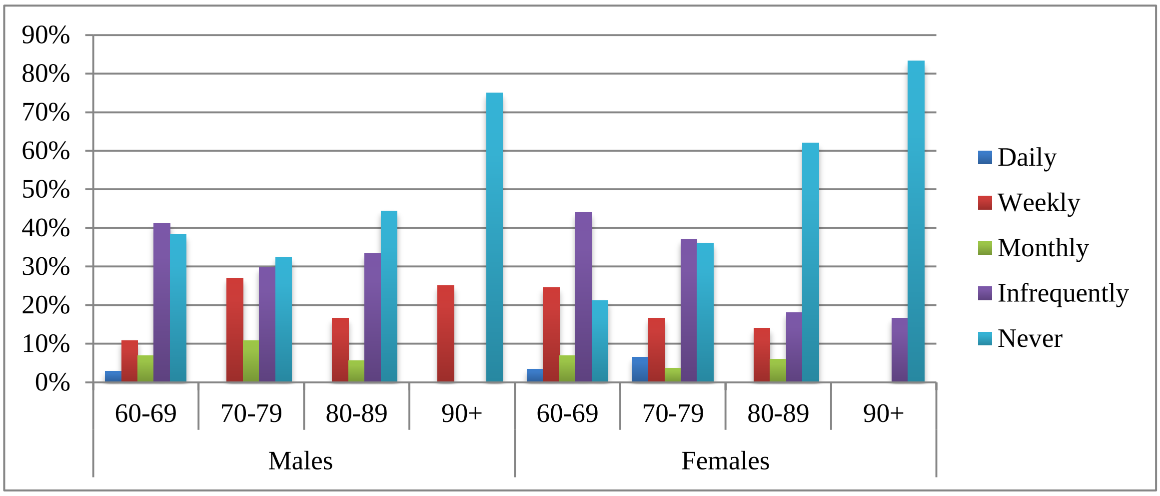

Figure 5.2: Public transport use by age and gender

The highest percentage of drivers (43.3%) used public transport in an infrequent manner, or else did not use it at all (41.2%). On the other hand, 23.6% of the non-drivers used public transport weekly compared to only 10.2% who were drivers. This showed that public transport usage was the highest amongst the non-drivers, meaning that these can potentially be captive-users (Figure 5.3). This was complemented by a Mann-Whitney Statistical Test which showed that for both genders, the correlation between driving and public transport use was statistically significant (p-value=0.001 for females and 0.007 for males).

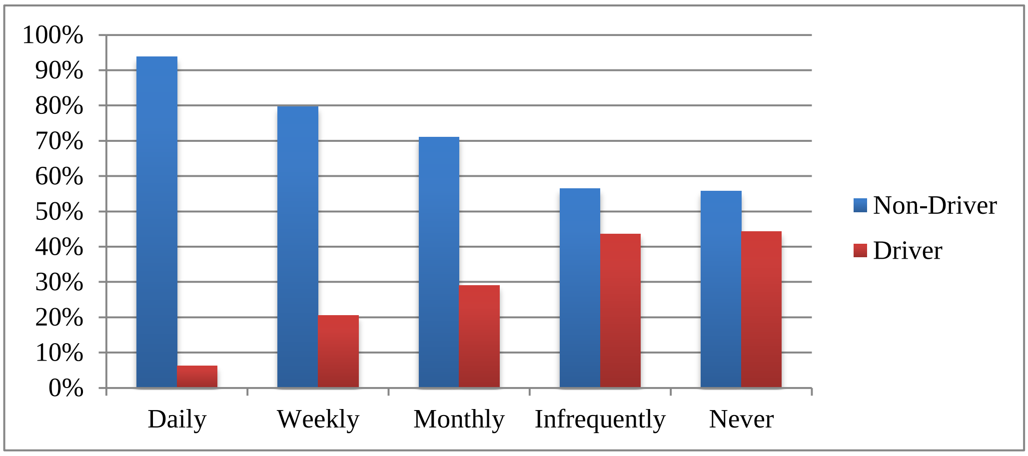

Figure 5.3: Public transport use by whether older people were drivers or not

When considering the combination of modes used by older people, overall the highest percentage of males (22.4%) travelled as drivers, pedestrian and infrequent public transport users. On the other hand, females travelled mostly as pedestrians, passenger and infrequent public transport users (25.1%) (Table E.1 in Appendix E). Non-driving males were usually frequent bus users, whilst non-driving females were mostly pedestrians and passengers. Further information on the combination of modes that older people used is found in Tables E.1 and E.2.

Table 5.2 lists the main travel purposes that older people travelled for. The top five were shopping, recreation, medical care, visiting relatives and attending church services. Informal discussions with older people showed that recreational travel purposes were mostly carried out with other family members (e.g. a drive with the car, a walk along the promenade or a lunch/dinner in a restaurant). Only a very small percentage (27%) of the sample participated in organised social activities (e.g. volunteer organisations, sports, craft work etc.). The situation was worse for older males (24% of the males vs. 28% of the females). Informal discussions occurred because several older people elaborated on the responses that they gave in the closed-ended questions. Thus, although they were not part of the scientifically designed survey, such discussions still provided essential information that helped to clarify certain responses, as in the case of recreational travel purposes.

Travel Purpose	%	Travel Purpose	%
Shopping	**28.7**	Did not go out	0.4
Recreation	**22.2**	Voluntary Work	0.4
Medical Care	**16.0**	Errands in Rabat Gozo	0.4
Visit Relatives	**12.0**	Educational	0.2
Church	**7.6**	Take/pick grand children from school	0.3
Errands	2.4	Religious Activities	0.2
Work	2.2	Errands in Sliema	0.2
All the reasons above	4.7	Gozo	0.2
Errands in Valletta	1.4	Activities organised by the Local Council	0.1
Other	0.6	No Information given	0.1

Table 5.2: Most common travel purposes for older people

Travel purposes differed by age and gender (see Figure E.1 in Appendix E). One of the main outputs for this was that whilst females (particularly the older-old) travelled more for shopping and to attend church services, males travelled significantly more for recreational purposes, especially after 70 years (following retirement). For medical purposes and to visit relatives there was quite a balance between genders. Whilst older people mostly walked to go shopping and to go to church, they used their cars (as drivers for males and as passengers for females) to travel for recreation purposes and to visit relatives. Public transport was considerably used by both genders to access medical care at Malta's General Hospital, Mater Dei. Further information on the modes of transport used for each respective travel purpose by gender is found in Appendix E (Tables E.3 and E.4). Older people (particularly females) travelled considerably more for utilitarian reasons (see Figures E.2-E.4).

5.2.2 Travel Range and Travel Accompaniment

Generally, older people preferred to travel just in familiar areas (Figure E.5). As shown in Figure 5.4, this increases with age for both genders. Yet, the percentage of females travelling in just familiar areas was consistently higher than that of males. For example in the 60-69 group, whilst 15.7% of the males travelled in just familiar areas, 24.2% of the females did the same.

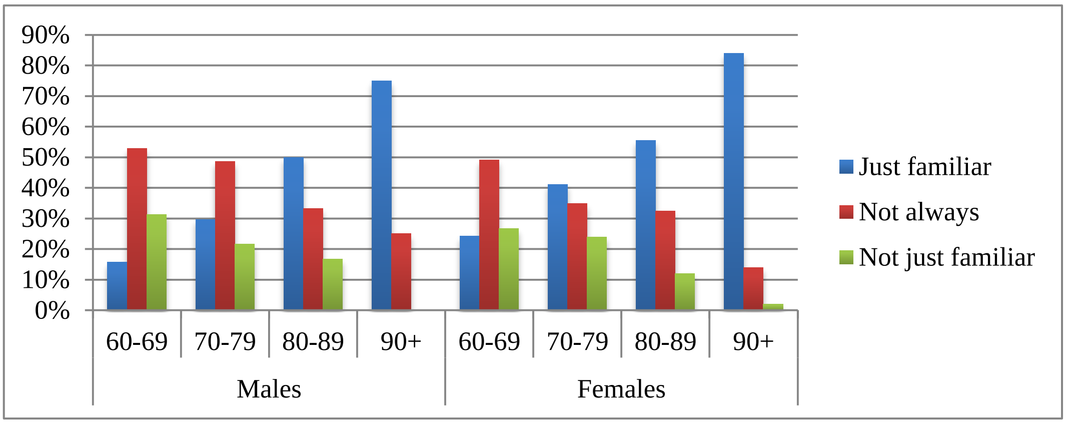

Figure 5.4: Travel range by age and gender

Moreover, almost 50% of the older respondents in the study claimed that their travel accompaniment depended on the circumstances (Figure E.6). Nevertheless, when analysed by gender, statistics showed that older females travelled more accompanied by others than males (Figure 5.5). Such situation was more accentuated as the age of older females increased. Correspondingly, the percentage of older males travelling alone was significantly higher than that of females. For males there was no clear pattern between age groups with regard to their travel accompaniment.

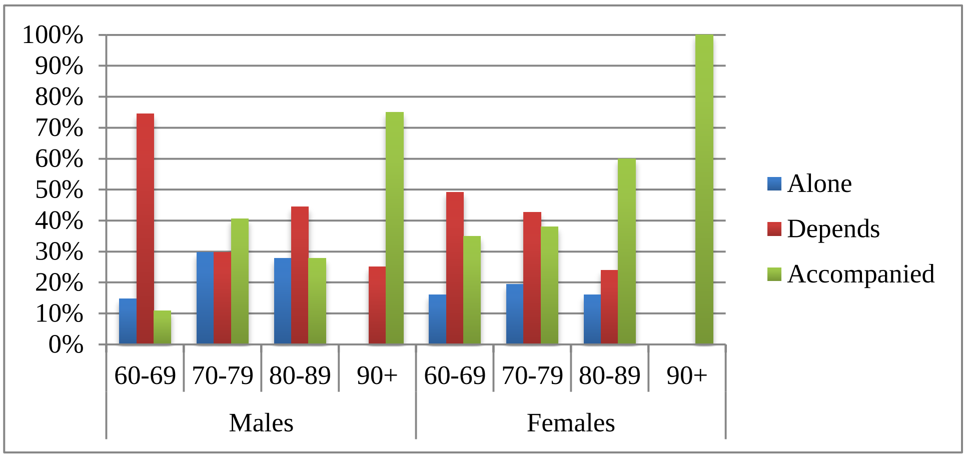

Figure 5.5: Travel accompaniment by age and gender

When linking travel range and travel accompaniment, Figure 5.6 shows that the highest percentage (42%) of the older people who travelled accompanied by others travelled in just familiar areas, highlighting their mobility disadvantage. Such trend applied mostly to older males (Figure E.7). For females, statistics confirmed that they preferred to travel accompanied by others irrespective of their travel range (Figure E.8).

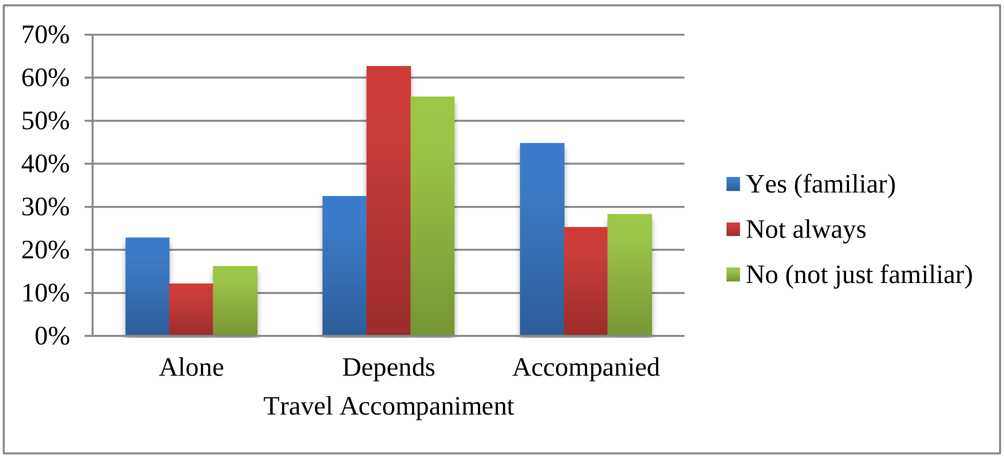

Figure 5.6: Travel range vs Travel Accompaniment for all older people

5.2.3 Travel Frequency and Travel Time

The descriptive statistics concerning the travel frequency of older people during the survey week showed that 50% of them travelled on a daily basis (Figure E.9). However, the percentage of older people not travelling at all increased with age. For all age groups, older males travelled considerably more on a daily basis when compared to females (Figure 5.7). Travel frequency also varied by mode choice (Figure E.10). The main output in this regard was that when older people were drivers they had a higher travel frequency than those who were either passengers or pedestrians.

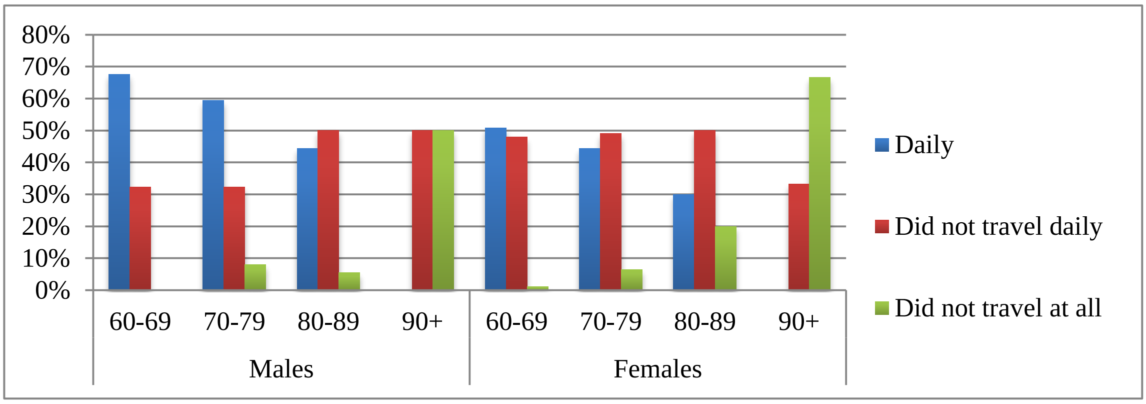

Figure 5.7: Travel Frequency during survey week by age and gender

Overall, the most common (52%) travel time for the days in which older people travelled during the survey week was of less than two hours. This was followed by another 37% who travelled between two to four hours (Figure E.11). As shown in Figure 5.8, travel time decreased with age, showing a decline in the overall mobility. Nevertheless, for those travelling for less than two hours, the discrepancy between age groups was quite minimal. Older males, particularly the younger-old, had longer travel times than females (Figure 5.8).

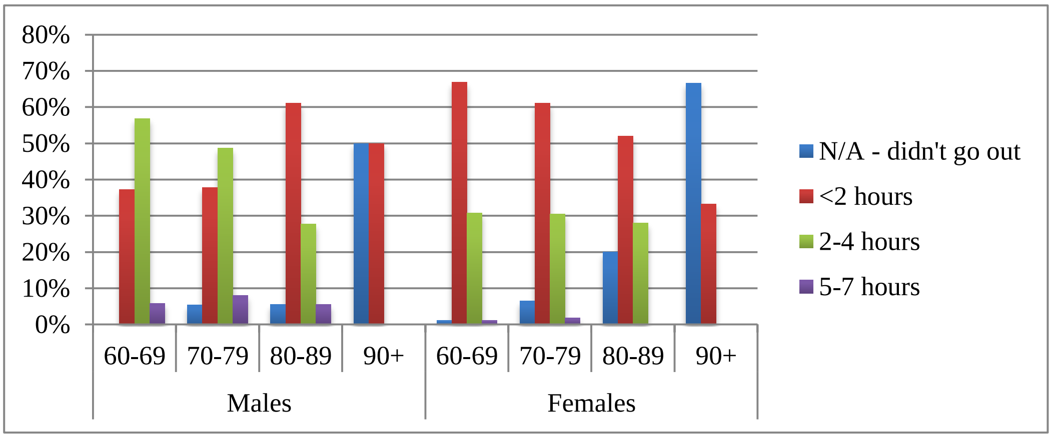

Figure 5.8: Daily travel time by age and gender

Ultimately, when linking the travel time with travel frequency, Figure 5.9 shows that most older people travelled for less than two hours irrespective of their travel frequency. This is quite reasonable considering the short distances in Malta. For older people who travelled daily during the survey week, the percentage difference between those travelling for less than two hours and those travelling between two to four hours was not as large as that for those who did not travel daily. This indicated the higher mobility levels of those who travelled on a daily basis. Further information on how the relationship between travel frequency and travel time differed by age and gender is described in Appendix E (Tables E.5 and E.6).

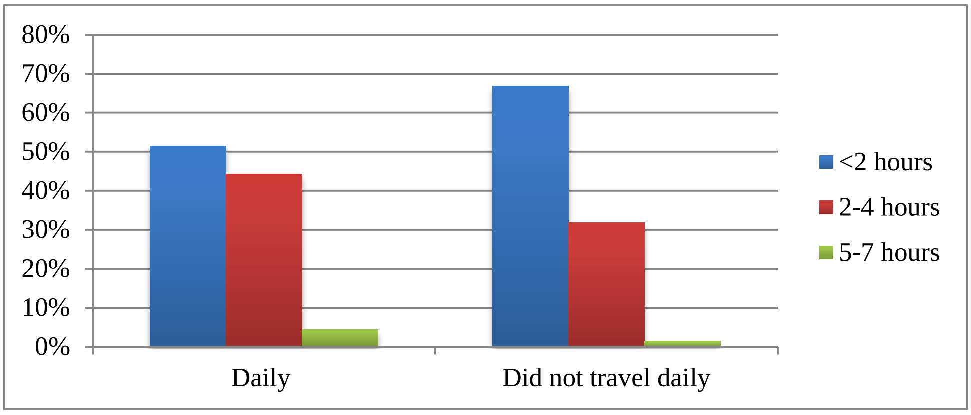

Figure 5.9: Travel time vs travel frequency for all older people

5.3 Regression Models

The descriptive statistics focused primarily on how mobility in later life differed based on demographic factors (age and gender). It is now important to understand the personal, social and environmental factors that significantly affected older people's mobility. Since travel behaviour was mostly expressed through categorical variables, binary logistic and multinomial logistic regression models were used to achieve such objective. As explained in Chapter 4, when the model involved a prediction of group membership that had only two categories, binary logistic regression was used. When the prediction was related to group membership with more than two categories, multinomial logistic regression was used. In logistic regression models there is always a reference category, meaning that all standardised regression coefficients (β) are interpreted in relation to a specific category.

5.3.1 Variables included in the Modelling Procedure

The dependent variables used in this study to define older people's travel behaviour and their respective categories are listed in Table 5.3. Nine regression models were developed and numbered for ease of reference.

Model Number	Dependent Variable	Categories
1	Driver or not	Yes/No
2	Travel Range (familiar areas)	Yes/No/Depends
3	Travel Accompaniment	Alone/Accompanied/Depends
4	Public Transport Use	Daily/Weekly/Monthly/Infrequently/Never
5	Travel frequency	Daily/Did not travel daily/Did not travel at all
6	Travel Time	Did not travel/<2 hours/ 2-4 hours/5-7 hours
7	Total Number of Travel purposes	0-1/2-3/4+
8	Number of Utilitarian Travel purposes	0-1/2-3
9	Number of Discretionary Travel purposes	0-1/2-3

Table 5.3: Dependent variables (travel behaviour indicators) used in the regression models

Table 5.4 shows the independent variables (indicated with an "X") that were used in each respective model. In line with what was discussed in Chapter 2, these variables ranged from personal, social and environmental factors. In certain circumstances some dependent variables were also used as independent variables. In order to better understand the travel range, travel frequency, travel time and travel accompaniment of older people it was important to understand their car and public transport use. For this reason the variables *driver/not* and *public transport use* were also used as independent variables in the respective models.

On the other hand, the variable *distance to bus stop* was only used as an independent variable to understand public transport use and whether older people were drivers or not. Such variable was not related with any of the other travel behaviour variables and as such skewed the results. The variable *cars in the household* was not included in the prediction of whether older people were drivers or not since this question just targeted the non-drivers. In Models 7 to 9, which analysed the factors that predicted the number of travel purposes, the variables *driver/not*, *cars in the household* and *public transport use* were not inputted. This was done since in the respective survey question (Appendix B), respondents stated their preferred mode of transport for every travel purpose. Hence, inputting the variables *driver/not* and *public transport use* for these three models would have made the results unrealistic and potentially biased. The variable showing the combination of modes that older people used (survey question 17) was inputted in every model but was insignificant for each of them. Since there were two other variables measuring mode choice (*driver/not* and *public transport use*) there were several redundancies between these variables. Additionally, this variable consisted of too many categories (23) which made the results unrealistic. It was therefore omitted from the models' analysis.

	Model number	1	2	3	4	5	6	7	8	9	
	Dependent variable	Driver or not	Travel Range	Travel Accompaniment	Public transport use	Travel Frequency	Travel Time	Number of Travel Purposes	Utilitarian Travel Purposes	Discretionary travel purposes	
											Categories in Independent variable
Independent variables	District*	X	X	X	X	X	X	X	X	X	Southern Harbour/Northern Harbour/North/South Eastern/West/Gozo
	Gender**	X	X	X	X	X	X	X	X	X	Males/Females
	Age**	X	X	X	X	X	X	X	X	X	Continuous (60+)
	Marital Status**	X	X	X	X	X	X	X	X	X	Single (Single, Separated, Widow)/Married
	Education**	X	X	X	X	X	X	X	X	X	No Schooling/Primary/Secondary/Tertiary
	Household**	X	X	X	X	X	X	X	X	X	Single-household/Multi-member
	Occupation Status**	X	X	X	X	X	X	X	X	X	Work/Housewife/Inactive or unemployed/Retired
	Personal Assistance**	X	X	X	X	X	X	X	X	X	Yes/No
	Social Activities***	X	X	X	X	X	X	X	X	X	Yes/No
	Physical Health**	X	X	X	X	X	X	X	X	X	Bad (ratings 1 and 2)/Neutral (rating 3)/ Good (ratings 4 and 5)
	Mental Health**	X	X	X	X	X	X	X	X	X	Bad (ratings 1 and 2)/Neutral (rating 3)/ Good (ratings 4 and 5)
	Medicine**	X	X	X	X	X	X	X	X	X	Prescribed/Over the counter/No Medicine
	Fall **	X	X	X	X	X	X	X	X	X	Yes /No
	Assistive Device**	X	X	X	X	X	X	X	X	X	Yes/No
	Driver or not**		X	X	X	X	X				Yes/No
	Cars in household (non-drivers)**		X	X	X	X	X				No cars/1-2 cars/3-4 cars/5-6 cars/Driver
	Public transport use**		X	X		X	X				Frequent/Infrequent/Non-bus users
	Distance to bus stop*	X			X						Continuous (in minutes)
	*Environmental Factors				** Personal Factors				***Social Factors		

Table 5.4: Independent variables used in each of the nine regression models

5.3.2 Models' Results

The following sections will now discuss the nine travel behaviour models individually. Only the variables that resulted to be significant are listed in the sections below. Nonetheless, the insignificant variables also revealed relevant information on travel behaviour, and these are further discussed in Chapter 8. In order to make sure that no significant independent variables were omitted, the full forced entry method was used for every model discussed. This means that all predictors were inputted simultaneously in the model. However, the stepwise method (inputting predictors in a hierarchical method based on significance) was also tested to verify the results for each model. Irrespective of the method used, the same variables resulted to be significant.

In the model results in the next sections, the "B" column represents the standardised regression coefficients interpreted in relation to the categories. It shows to what extent the independent variables affect the dependent variable. A positive coefficient means that the respective variable has a positive impact on utility and hence reflects a higher probability of choosing the alternative to which it is applied. In a negative coefficient, the variable has a negative impact on the utility, meaning a greater probability of choosing the designated reference category. The "Exp (B)" column represents the "odds ratio", which is an indicator of the change in odds resulting from a unit change in the predictor. The "p-value" column represents the level of significance of that relationship. For every model, the Cox and Snell's R^2 and Nagelkerke's R^2 value area also reported. Such values are a version of the coefficient of determination for logistic regression. The Nagelkerke's R^2 is a variation on Cox and Snell's R^2 since it overcomes the problem that this statistic has of not being able to reach its maximum value (Field, 2013). For example a Cox and Snell's value of 0.403 and Nagelkerke's value of 0.549 means that between 40% and 55% of the dependent variable is explained by the model.

Model 1: Driver or not

Since the variable *Driver or not* was a dichotomy (Yes or No), Binary Logistic Regression was used. From all the variables inputted in the model (Table 5.4), the only ones that resulted to be significant are listed in Table 5.5 in chronological order.

Since this was a binary logistic regression, the model could not permit string variables and each variable had to be numerically coded. A binary regression correlates the 1s with 1s. Participants were coded as 1 if they were drivers and as 0 if they were non-drivers. The same coding was also applied for gender (1=females; 0=males), and for assistive device (1=yes; 0=no). In order to avoid confusion with the 1s and 0s, the “Categories” column in Table 5.5 explains the categories for which the statistical comparison was made.

Model 1: Driver or not							
Predictor	**Categories**			**Model Results**			
			B	S.E.	Exp (B)	p-value	
Gender	Females	Males	-3.178	0.325	0.042	0.003	
Occupation	Work	Retired	1.419	0.48	4.132	0.003	
	Work	Housewife	2.051	0.49	7.778	0.000	
	Work	Inactive	2.544	0.79	12.728	0.001	
Age			-0.077	0.019	0.926	0.000	
Assistive Device	Yes	No	-0.746	0.315	0.474	0.018	
Reference category: Driver Fit of model = 0.000 (p-value<0.05) Cox and Snell’s R^2=0.403; Nagelkerke’s $R^{2=}$0.549							

Table 5.5: Review of significant variables (in chronological order) predicting whether older people were drivers or not

Older males were more likely to be drivers than females (B=-3.178). For females the odds of being a driver when compared to not being a driver was 95.8% lower (Exp (B)=0.042). Such findings correlated with the national statistics discussed in Chapter 1, showing the higher number of older male drivers when compared to older females. With regard to the occupation status of older people, the model showed that those who worked had a higher tendency to be drivers than older people who were housewives, retired or inactive. The highest discrepancy was between those who worked and those who were inactive (B=2.544). Such finding was quite reasonable since older people who work, would normally require travelling by car since they can be more restricted in time when compared to other groups. Moreover, the majority (97.4%) of older people who worked were between 60 and 69 years, and being a “younger-old” was one key reason for the high driving rate.

Age was indeed the third most critical factor that significantly predicted whether older people were drivers or not. As age increased the probability of being a driver decreased (B=-0.077). The odds ratio (0.0926) showed that for every one year increase in age, the odds of being a driver reduced by 7.4%. Finally, the model also confirmed that for older people with an assistive device, the likelihood to be a driver reduced (B=-0.746). The odds for older people with assistive devices to be drivers was almost 50% lower than for those who did not have any assistive device. Such finding was quite expected since assistive devices are usually associated with physical limitations that constrain driving. What should be highlighted from this model is that all the factors that significantly predicted driving were related primarily to the personal individual factors and not to the social or environmental characteristics (Table 5.5). This will be discussed in further detail in Chapter 8.

Model 2: Travel Range

Phillips et al. (2013) discussed how older people prefer to travel in areas which they are familiar with since these usually act as a comfort zone making them feel more secure. This section explores the factors that significantly predict whether older people travelled just in familiar areas or not. Since the dependent variable consisted of three categories (*Yes/No/Not always*), multinomial regression was used. The reference category of the model was *Yes (Travel just in Familiar area)* in order to better understand older people's disadvantage in terms of travel range. From all the variables inputted in the model (Table 5.4), the significant predictors for the travel range of older people (in chronological order) were the following:

1. Age (p-value=0.000)
2. District (p-value=0.000)
3. Gender (p-value=0.000)
4. Education (p-value=0.001)
5. Fall in previous year (p-value=0.006)

Since multinomial regression is worked out using reference categories, for the significant variables which had three or more categories (*District* and *Education*) the test was carried out multiple times, each time altering the reference category. This process was repeated until all the dependent variables' categories were analysed in a pairwise manner. The model results are summarised in Table 5.6.

The determinant which affected mostly the range of travel for older people was their age. The older the age the higher was the probability to travel just in familiar zones. The odds of travelling *just* in familiar areas (rather than *not* travelling in familiar areas) increased by 9.3% for every additional year (Exp (B)=0.936). Complementing Model 1, this revealed that the older the individuals got, the less they drove and hence the more restricted was their travel range. Furthermore, with an increase in age, the necessities to travel in unfamiliar areas may decrease.

Model 2: Travel Range							
Travel Range	**Predictor**	**Categories**		**Model Results**			
				B	**S.E.**	**Exp (B)**	**p-value**
Not always (Do not always travel in familiar areas)	**Age**			-0.066	0.017	0.936	0.000
	District*	SH	G	1.1019	0.355	2.769	0.004
		NH	G	.880	0.374	2.411	0.019
		SE	G	2.755	0.466	15.725	0.000
		W	G	.954	0.465	2.597	0.040
		N	G	1.260	0.438	3.524	0.004
		SE	NH	1.875	0.472	6.523	0.000
		W	SE	-1.801	0.540	0.165	0.001
		N	SE	-1.496	0.502	0.224	0.003
		SH	SE	-1.737	0.438	0.176	0.000
		NH	SE	-1.875	0.472	0.153	0.000
	Gender	Males	Females	1.184	0.270	3.267	0.000
	Education	Secondary	No Schooling	1.099	0.426	3.002	0.010
		Secondary	Primary	.898	0.280	2.455	0.001
	Fall	No Fall	Fall	0.702	0.313	2.017	0.025
No (Do not just travel in familiar areas)	**Age**			-0.094	0.022	0.910	0.000
	District	SE	G	1.497	0.546	4.470	0.006
		W	G	1.743	0.459	5.717	0.000
		W	SH	1.276	0.461	3.584	0.006
		SE	NH	1.265	0.579	3.542	0.029
		W	NH	1.511	0.484	4.530	0.002
		SE	N	1.751	0.730	5.758	0.016
		W	N	1.997	0.687	7.365	0.004
	Gender	Males	Females	1.088	0.317	2.969	0.001
	Education	No Schooling	Tertiary	-2.409	0.955	0.090	0.012
		Primary	Tertiary	-1.422	0.635	0.241	0.025
		Secondary	No Schooling	1.909	0.786	6.749	0.015
		Secondary	Primary	0.935	0.334	2.548	0.005
	Fall	No Fall	Fall	1.214	0.462	3.366	0.009
*District code: SH- Southern Harbour; NH-Northern Harbour; SE-South Eastern; N-North; W-West; G-Gozo							
Reference category: Yes (Travel Just in Familiar Areas) Fit of the model = 0.000 Cox and Snell's R^2=0.332 Nagelkerke's R^2=0.378							

Table 5.6: Review of significant variables in regression analyses predicting the travel range of older people

Quite surprisingly, the model found that there was a spatial distribution in the results because the district where older people resided significantly predicted their range of travel. As shown in Table 5.6, within the South Eastern and Western districts older people had a higher probability of *not* travelling in familiar areas when compared to those living in other districts (e.g. B=1.511 when the Western region was compared to the Northern Harbour). On the other hand, the district that showed a significantly higher probability of older people travelling *just* in familiar areas was Gozo. In fact, the South

Eastern and Western regions had a higher probability of older people not travelling in familiar areas when compared to Gozo (B=1.497 [South Eastern], B=1.743 [Western]). The small size of the island of Gozo could be a key factor in this regard. It is much easier for older people living there to just travel in familiar areas, given that all the localities are very close to each other. Further research on the underlying causes of such spatial differences is needed.

With regard to gender, this model showed that when comparing those that travelled *only* in familiar areas with those that *did not* travel in familiar areas, the odds for females was almost three times more likely than that of males (Exp (B)=2.969). Since the number of older male drivers was significantly higher than that of females, males had a higher possibility to travel longer distances even in unfamiliar areas due to the sense of independence and freedom associated with the car.

The level of education among older people was the fourth variable that significantly predicted their travel range. The coefficients shown in Table 5.6 all showed that the lower the level, the higher the tendency of older people to travel *just* in familiar areas. As expected, the highest discrepancy was that between those with no schooling and those with tertiary education (B=-2.409), whilst the lowest was that between those with secondary and primary education (B=0.935). The closer the levels of education, the smaller were the differences in terms of travel range. This could be a result of higher confidence levels associated with higher levels of education. When older people have low levels of education they may face more difficulties during their journeys due to different reasons such as literacy problems. Consequently, they may feel safer to travel just in familiar areas where they can feel more confident with their abilities.

Ultimately, whether older people suffered from a fall in the past year also significantly predicted their travel range. For older people who did not suffer from a fall, the odds to *not always* travel in familiar areas (rather than travelling *just* in familiar areas) were three times higher than the odds for those who suffered from a fall (Exp(B)=3.366). Falls create a large sense of fear amongst older people and can also restrict their mobility levels.

Model 3: Travel Accompaniment

Figure 5.6 showed the positive relationship between travel range and travel accompaniment of older people. Consequently, this section will now explore the main factors that predict whether older people tended to travel accompanied by others or alone. Since the dependent variable consisted of three categories (Alone/Accompanied/Depends) the multinomial regression was used. The reference category in the model was *Always travelled accompanied by others* to better understand the vulnerabilities of older people. In chronological order, the significant factors that predicted older people's travel accompaniment were the following:

1. Driver/Not (p-value=0.000)
2. Age (p-value=0.000)
3. Marital Status (p-value=0.000)
4. Fall (p-value=0.003)
5. Social Activities (p-value=0.0007)
6. Occupation status (p-value=0.031)
7. Physical Health (p-value=0.037)
8. Public transport use (p-value=0.039)

The model results are listed in Table 5.7. Whether older people were drivers or not was one of the primary factors predicting older people's travel accompaniment. The non-drivers travelled less by themselves (B=-1.614), which means that drivers had a higher possibility to travel alone. This was quite expected since the non-drivers had to rely more on others to travel, particularly for longer distances. This supported perfectly the descriptive statistics (see also Figure E.10).

With regard to age, the model found that for every one year increase the odds that older people travelled always accompanied rather than alone increased by 5.2% each year (Exp(B)=0.948). Such findings supported the previous two models which found that the older individuals got, the higher the probability for them to *not* drive and to travel in *just* familiar areas. All this showed that they felt more secure to travel with other people as they got older.

Model 3: Travel Accompaniment							
Travel Accompaniment	**Predictor**	**Categories**		**Model Results**			
				B	**S.E.**	**Exp (B)**	**p-value**
Alone	**Driver/Not**	Non-drivers	Drivers	-1.614	0.374	0.199	0.000
	Age			-0.053	0.022	0.948	0.018
	Marital Status	Single	Married	2.310	0.361	10.0771	0.000
	Social Activities	Yes	No	0.829	0.347	2.290	0.017
Depends	**Driver/Not**	Non-drivers	Drivers	-1.678	0.294	0.187	0.000
	Age			-0.066	0.017	0.936	0.000
	Marital Status	Single	Married	0.652	0.314	1.919	0.038
	Fall	No	Yes	0.658	0.317	1.931	0.038
	Occupation Status	Inactive	Work	-2.560	0.947	0.077	0.007
		Inactive	Retired	-1.307	0.601	0.271	0.029
		Inactive	Housewife	-1.642	0.610	0.388	0.007
	Physical Health	Bad	Good	-0.948	0.393	0.387	0.016
		Neutral	Good	-0.622	0.262	0.537	0.018
	Public transport use	Frequent	Never	0.927	0.328	2.526	0.005
		Frequent	Infrequent	0.614	0.303	1.847	0.043

Reference category: Always travelled accompanied by others
Fit of the model = 0.000
Cox and Snell's R^2=0.310
Nagelkerke's R^2 = 0.356

Table 5.7: Review of significant variables in regression analyses predicting travel accompaniment of older people

The model also found that the marital status in later life was the third most significant predictor. The odds that older people who were single (single, separated, widow) travelled alone rather than accompanied was ten times more likely than the odds for those who were married (Exp(B)=10.0771). Such findings were quite reasonable since they showed that when older people were married they travelled more accompanied (in most cases by their spouses) than those who were either single, separated or widowed. Therefore, although this same model showed that with an increase in age there was a higher tendency that older people travelled accompanied, it was also true that as age increased there was a higher possibility for older people to become widowed (and thus single). In this study, the percentage of single respondents increased from 14.8% in the 60-69 group to 32.4% in the 70-79 group, to 51.5% in the 80-89 group and to 70% in the 90+ group. In this case, the older they got the higher was the probability for them to travel alone. Nonetheless, one should also remember that when older people widow, a considerable percentage of them tend to travel with other family members, primarily their adult children (and thus accompanied). Still, married older people had a higher tendency to travel accompanied. One key reason for this is that when married they tend to travel more as passengers (particularly women).

A fall in the previous year also resulted to be a significant predicator for travel accompaniment in later life. Results basically show that when older people suffer from a fall (both indoors and outdoors) they tend to have heightened fears to travel alone and thus the probability to travel accompanied by others is higher. This complemented Model 2 which also found that when older people suffered from a fall they tended to travel more in familiar areas only. This study showed that as age increased the percentage of older people who suffered from a fall increased significantly too (12.6% for the 60-69 group to 40% for the 90+ group; p-value=0.002). Hence, the older they got, the higher the probability that they have suffered from a fall and that they travelled always accompanied.

The odds that older people who participated in social activities travelled alone rather than accompanied was almost three times as much as the odds for those who did not participate in social activities (Exp(B)=2.290). One possible explanation for this could be that older people who participate in social activities tend to be healthier (Dahan-Oliel et al., 2010), which increases their ability to travel alone. The model showed that the occupation status of older people also significantly predicted travel accompaniment. The category that stood out the most was that of inactive/unemployed people.

In this study, all older people who were inactive or unemployed were within the younger-old cohorts (6.5% for the 60-69 group and 0.7% for the 70-79 group). Inactive older people had a higher probability to travel accompanied by others when compared to the other groups (Table 5.7). As expected, the highest discrepancy was between inactive/unemployed people and those who worked (B=-2.560). One important explanation for this was the significant relationship between the occupation status of older people and their driving rate. Whilst 74.4% of the older people who worked were drivers, only 26.3% of those who were inactive/unemployed drove a car. This association was statistically significant (p-value=0.000) when analysed in a Chi-Square Test. Thus, one could argue that since there was a higher probability for inactive older people to be non-drivers, then as confirmed by this same model, there was also a higher tendency for them to rely on others to travel.

Moreover, 74.4% of the older people who worked ranked their physical health as *good* (4 and 5), with only 26.6% of those who were inactive who did so. This was linked with the fact that older people's perception of their physical health was also a significant predictor in this model. Table 5.7 shows that those ranking their health as *bad* had a higher probability to travel accompanied when compared to those who ranked it as *good*. Thus, being inactive or unemployed with negative physical health perceptions led older people to travel more accompanied by others rather than alone.

It is important to highlight that physical health perceptions were statistically correlated with two other variables that predicted travel accompaniment. Firstly, the physical health ranking was statistically linked with the age of respondents. The older they got, the lower they ranked their physical health. The percentage of older people ranking their health as *good* reduced from 71.5% in the 60-69 group to 30% for the 90+ group (p-value=0.000 in a Chi-Square Test). This supported the argument that the older individuals got, the weaker was their physical health. Consequently, their ability to travel alone decreased. Secondly, the physical health rating was also significantly correlated with whether older people were drivers or not. Fifty-eight per cent of the non-drivers ranked their physical health as *good*, compared to 71.1% of the drivers who did so. This proved to be a statistically significant correlation (p-value=0.004 in a Chi-Square Test). So, the better health status of drivers was another reason that increased their probability to travel alone.

Ultimately, Model 3 also revealed that public transport use was a significant predictor for the travel accompaniment of older people. The odds for frequent bus users to have a travel accompaniment which varies based on the circumstances rather than always needing to be accompanied by someone was 2.5 times higher than that of the non-bus users (Exp (B)=2.526). Therefore when using the bus frequently, older people travelled more alone than those who were infrequent or non-bus users (and thus use other modes of transport). This could be explained through two main reasons. Firstly, the descriptive statistics showed that as age increased public transport use decreased (Figure 5.2). Thus, a high percentage (over 50%) of the non-bus users were older-old people who preferred (or needed) to always travel accompanied by others. As proven by this model, the frequent bus users were younger in age, and thus their probability to travel alone was significantly higher. Secondly, a significant percentage of those who participated in social activities were frequent public transport users (25.9%). Correspondingly, a high percentage of those that did not participate in any activity were non-bus users (39.7%). This relationship was statistically significant in a Chi-Square Test conducted (p-value=0.001). Hence, since this model found that those who participated in social activities tended to travel more alone, it supported the fact that a higher percentage of them were frequent bus users.

Model 4: Public Transport Use

In order to better understand mode choice for older people and to also support what was discussed in the descriptive statistics and in Model 1, it was important to analyse the significant variables that predict public transport use among older people. Given the considerable low public transport patronage (Figure 5.2), the reference category of the model was of *Never using public transport*. This provided a better understanding of the factors that inhibited older people from using public transport. In a chronological order these were:

1. Number of cars available in household (p-value=0.000)
2. Age (p=value=0.000)
3. District (p-value=0.001)
4. Occupation Status (p-value=0.002)
5. Social Activities Participation (p-value=0.002)
6. Personal Assistance (p-value=0.007)

These variables and their respective model results are shown in Table 5.8. The number of cars available in the household was the main factor predicting public transport use. Drivers had a significantly lower use of public transport than the non-drivers. The most common correlation was between drivers and non-drivers with no cars available at all (Table 5.8). Yet, being a driver was also statistically different from non-drivers with cars available. For example, the odds for non-drivers with 3-4 cars available to use public transport weekly rather than never was three times more likely than the odds for drivers (Exp(B)=3.708). There were significant correlations even between the non-drivers themselves, depending on the number of cars available. For example, the odds that non-drivers with no cars available used public transport on a weekly basis rather than never was six times greater than the odds for the non-drivers with 3-4 cars available (Exp(B)=6.077). This shows that when the non-drivers had cars available to them, the probability to not use public transport was high. It can therefore be concluded that captive bus users were those who used public transport the most due to no other alternatives available (Mifsud et al., 2017).

Model 4: Public Transport Use							
PT Use	Predictor	Categories		Model Results			
				B	S.E	Exp (B)	p-value
Daily	Number of cars available	0	Driver	3.117	1.171	22.571	0.008
		0	1-2	2.845	0.876	17.225	0.001
	District	NH	G	2.774	1.124	16.028	0.014
		W	G	2.701	1.28	14.89	0.035
		N	G	3.321	1.232	27.678	0.007
	Occupation	Housewife	Work	-2.084	1.059	0.124	0.049
Weekly	Number of cars available	0	Driver	3.115	0.707	22.534	0.000
		1-2	Driver	1.378	0.38	3.967	0.000
		3-4	Driver	1.311	0.539	3.708	0.015
		0	1-2	1.737	0.677	17.225	0.001
		0	3-4	1.804	0.771	6.077	0.019
	Age			-0.06	0.021	0.942	0.004
	District	SH	G	2.381	0.537	10.814	0.000
		NH	G	2.471	0.570	11.837	0.000
		SE	G	2.431	0.576	11.371	0.000
		W	G	1.832	0.622	6.244	0.003
		N	G	1.650	0.693	5.206	0.017
	Occupation	Retired	Work	1.572	0.719	4.815	0.029
	Participation in Social Activities	Yes	No	1.02	0.335	2.773	0.002
	Personal Assistance	Yes	No	-1.357	0.431	0.257	0.002
Monthly	Number of cars available	0	Driver	2.097	0.917	8.144	0.022
	Age			-0.073	0.03	0.929	0.015
	District	NH	G	1.709	0.714	5.521	0.017
		W	G	1.469	0.745	4.344	0.049
	Participation in Social Activities	Yes	No	1.094	0.454	2.985	0.016
Infrequently	Age			-0.074	0.017	0.928	0
	District	SH	G	0.962	0.343	2.618	0.005
		NH	G	1.247	0.367	3.481	0.001
	Occupation	Retired	Work	1.036	0.429	2.817	0.016
		Housewife	Work	1.217	0.482	3.378	0.012
		Inactive	Work	1.608	0.737	4.991	0.029
	Participation in Social Activities	Yes	No	0.954	0.278	2.595	0.001
	Personal Assistance	Yes	No	-0.654	0.29	0.52	0.024
Reference Category: Never use public transport Fit of the model=0.000 (p-value<0.05) Cox and Snell's R^2=0.331 Nagelkerke's R^2=0.356							

Table 5.8: Review of significant variables in regression analyses predicting older people's public transport use

Similar to the previous models, age was also a significant factor for public transport use. For every one year increase the odds that older people used public transport on a weekly basis rather than never decreased by 5.8%. A similar pattern was recorded for monthly and infrequent use of public transport (Table 5.8). This means that as age increased the probability to travel both as drivers (Model 1) and as public transport users decreased.

Surprisingly, unlike for Model 1, the district where older people resided was the third most important predictor for public transport use. As evident from Table 5.8, the district which significantly differed from the others was Gozo, since there were no significant relationships between the five districts in the island of Malta. In Gozo public transport was used significantly less by older people. For example, the odds that older people residing in the Western district used public transport on a monthly basis rather than never using it was four times more likely than the odds for those living in Gozo (Exp(B)=4.344). Model 2 found that older people in Gozo travelled more in just familiar areas, which might mean that they preferred to walk rather than using public transport. Yet, this spatial pattern is not very explicit and requires further investigation.

The occupation status of older people was the fourth factor that significantly predicted public transport use. When compared to older people who worked, housewives used public transport significantly less on a daily basis rather than never using it (B= -2.084). Yet, the model also found that workers had a higher probability than those who were retired, housewives or inactive to never use public transport rather than using it on a weekly or infrequent manner (Table 5.8). Thus, the model did not show that older people who worked were high public transport users. It showed that when comparing the frequency of use, workers who used public transport had a higher probability than the other groups to use it on a daily basis, probably for commuting. The argument that older people who worked tended to be non-bus users was supported in this model. This reinforced what was discussed in Model 1 where workers had a higher tendency to be drivers.

Unlike Model 1, this model showed that participation in social activities significantly predicted public transport use in later life. Those who participated in social activities used public transport more frequently than those who did not. For example, the odds for those who participated in social activities to use public transport weekly rather than never was almost three times more likely than the odds for those who did not participate in any activity (Exp (B)=2.985). Since older people who participate in social activities tend to be healthier (Leyden, 2003), they may feel more confident to use public transport. This supported Model 3 which showed that participation in social activities was associated with older people having a higher physical health rating who preferred to travel alone.

Ultimately, the model showed that older people with personal assistance used public transport less than those who did not require any assistance (e.g. B=-1.357 when comparing weekly use with never). Such finding was mostly related with the age of respondents. The percentage of older people having personal assistance increased from 11.9% for the 60-69 group to 23.4% for the 70-79 group, to 29.4% for the 80-89 group and to 90% for the 90+ group. This incremental increase was highly significant in a Chi-Square Test (p-value=0.000). Therefore, since personal assistance increased with age, both factors simultaneously led to a lower public transport use.

Model 5: Travel Frequency

This section will identify the key predictors for the observed travel frequency among the older population. The dependent variable was made up of three categories (*Daily/Did not travel daily/Did not travel at all*), and thus multinomial regression was used (Table 5.9). The reference category of the model was to *Travel daily during the survey week* since this reflected the highest mobility levels of older people. The significant factors affecting the travel frequency for older people were:

1. Age (p-value=0.000)
2. Physical Health (p-value=0.000)
3. Driver or not (p-value=0.000)
4. Personal Assistance (p-value=0.000)
5. Social Activities Participation (p-value=0.000)
6. District (p-value=0.001)
7. Fall (p-value=0.021)

Similar to the previous four models, age was the primary factor predicting travel frequency. With every one year increase in age, the odds that older people did not travel at all rather than travelling on a daily basis increased by 17% (Exp(B)=1.170). The strong link between the physical health and age of participants was also evident in this model, because physical health was the second highest variable which predicted travel frequency. For example, the odds for older people who ranked their physical health as *neutral* to not travel at all rather than daily during the survey week was ten times as much the odds for those who ranked it as *good* (Exp(B)=10.224). Thus, the frequency of travel was significantly higher when older people ranked their physical health as *good*.

Model 5: Travel Frequency							
Travel Frequency	**Predictor**	**Categories**		**Model Results**			
				B	**S.E.**	**Exp (B)**	**p-value**
Did not travel at all	**Age**			0.157	0.037	1.170	0.000
	Physical Health	Bad	Good	3.115	0.786	22.531	0.000
		Neutral	Good	2.325	0.784	10.224	0.003
	Personal Assistance	Yes	No	2.496	0.610	12.130	0.000
	Social Activities	Yes	No	-3.547	1.212	0.029	0.003
	District*	SH	G	2.228	0.894	9.282	0.013
		N	SH	-3.267	1.195	0.038	0.006
		N	NH	-2.567	1.230	0.077	0.037
		N	SE	-2.739	1.347	0.065	0.042
	Fall	No	Yes	-1.605	0.590	0.201	0.007
Did not travel daily	**Physical Health**	Bad	Good	1.238	0.426	3.449	0.004
	Driver or not	No	Yes	1.031	0.214	2.805	0.000
	District	SE	G	1.421	0.356	4.140	0.000
		SH	SE	-0.990	0.349	0.372	0.005
		NH	SE	-0.995	0.364	0.370	0.006
		W	SE	-1.090	0.394	0.336	0.006
		N	SE	-1.438	0.435	0.237	0.001
*District code: SH- Southern Harbour; NH-Northern Harbour; SE-South Eastern; N-North; W-West; G-Gozo							
Reference category: Travelled Daily during survey week Fit of the model = 0.000 Cox and Snell's R^2=0.317 Nagelkerke's R^2 = 0.385							

Table 5.9: Review of significant variables in regression analyses predicting older people's travel frequency

Models 3 and 4 showed that older drivers travelled more alone and used public transport significantly less. Yet, Table 5.9 shows that for the non-drivers, the odds to *not* travel daily rather than daily was almost equal to that for drivers (Exp(B)=1.031). This small discrepancy means that a considerable percentage of those who did not drive still travelled on a daily basis. Nonetheless, Table 5.2 showed that shopping was the travel purpose that older people travelled most for. This was usually done on foot or as passengers. Attending mass (the fifth common travel purpose for older people) was also mostly done on foot. Hence, this explained why a significant number of the non-drivers still travelled on a daily basis.

As expected, the model revealed that older people with personal assistance travelled less than those who did not have any type of assistance. For example, the odds for those who had personal assistance to not travel at all rather than to travel on a daily basis was 12 times more likely than the odds for those who did not have any assistance (Exp (B)=12.130). Such finding was linked with the physical health rating of older people. From all those who rated their physical health as *good*, 67.8% did not have any personal assistance (p-value=0.000 with a Chi-Square Test). Thus, older people with good perceptions about their physical health (and usually with no personal assistance) had a higher travel frequency. Corresponding with previous discussions in Models 3 and 4, participation in social activities was positively linked with the travel frequency of older people (Table 5.9). Therefore, participation in social activities is an indication of more independent living with higher travel frequencies.

Travel frequency also tended to be predicted by the district in which older people resided. Those living in Gozo and in the South Eastern district had a higher probability to travel on a daily basis (Table 5.9). When comparing such findings with Model 2, one could conclude that older people from the South Eastern district had higher mobility levels since they travelled more on a daily basis and in areas which they were not just familiar with. On the other hand, although older people from Gozo tended to travel more on a daily basis they mostly did so in just familiar areas. Despite this, such patterns are not very clear and further research is required. Ultimately, in line with Models 2 and 3, a fall in the previous year was the sixth predictor of travel frequency in later life. Older people who did not suffer from any fall had lower probabilities to not travel at all rather than to travel on a daily basis (B=-1.605).

Model 6: Travel Time

As discussed in Section 2.2, several studies used the distance travelled by older people as an indicator of their mobility levels (see for example Mercado and Páez, 2009). Given the small size of Malta, distance is not a good proxy to measure mobility, and in this study this was replaced by the average daily travel time of older people (see Chapter 4 for more detail). Consequently, this section will discuss the determinants that significantly predict the average travel time for the days in which older people travelled during the survey week. As explained in Chapter 4, this question in the survey was related to the travel frequency discussed in the previous section. Since the dependent variable consisted of four categories (*Did not go out, <2 hours, 2-4 hours, 5-7 hours*) multinomial regression was used. The reference category for the model was *<2 hours* because this was the most common travel time for older people. In chronological order, the variables that significantly predicted travel time in later life were:

1. Personal Assistance (p-value=0.000)
2. Public Transport Use (p-value=0.000)
3. Social Activities Participation (p-value=0.000)
4. Assistive Device (p-value=0.001)
5. Age (p=0.004)
6. Driver or not (p-value=0.010)
7. Gender (p-value=0.021)

The significant variables and the model results are listed in Table 5.10. Although some of the results obtained from this model were similar to the previous one (Model 5), there were also several differences. One of these was actually the order of the significant predictors. In this model, whether older people had personal assistance or not was the main predictor. For example, when older people had personal assistance their probability to travel for two to four hours was lower than to travel for less than two hours (B=-0.719). As expected, older people with personal assistance had a lower travel time for the days in which they travelled when compared to those who did not have any form of personal assistance (and thus were healthier).

Additionally, the model found that generally, the travel time for older people who used public transport tended to be higher. For example, the odds for frequent bus users to have a daily travel time of between two and four hours rather than less than two hours was four times more likely than that for non-bus users (Exp(B)=4.081). Such findings should however be interpreted with caution. The fact that frequent bus users had a longer travel time did not mean that they travelled for longer distances than the infrequent or non-bus users. One key factor for this was the longer travel time associated with bus use when compared to the car. As discussed earlier, the average travel time by bus in Malta is on average 34 minutes longer than that by car (TM, 2016a).

Model 6: Travel Time							
Travel time	**Predictor**	**Categories**		**Model Results**			
				B	**S.E.**	**Exp (B)**	**p-value**
Did not go out	Personal Assistance	Yes	No	1.804	0.560	6.072	0.001
	Assistive device	No	Yes	-1.463	0.519	0.232	0.005
	Age			0.109	0.032	1.115	0.001
2-4 hours	Personal assistance	Yes	No	-0.719	0.320	0.487	0.025
	Public Transport Use	Frequent	Non-bus	1.406	0.307	4.081	0.000
		Infrequent	Frequent	-1.280	0.274	0.278	0.000
	Social activities	Yes	No	0.813	0.235	2.254	0.001
	Assistive Device	No	Yes	0.574	0.266	1.776	0.031
	Driver/Not	No	Yes	-0.884	0.289	0.413	0.002
	Gender	Males	Females	0.683	0.282	1.979	0.015
5-7 hours	Public Transport	Infrequent	Frequent	-1.686	0.758	0.185	0.026
	Social Activities	Yes	No	1.590	0.586	4.906	0.007
	Gender	Males	Females	1.829	0.811	6.227	0.024

Reference category: <2 hours
Fit of the model = 0.000
Cox and Snell's R^2=0.330
Nagelkerke's R^2 = 0.386

Table 5.10: Review of significant variables in regression analyses predicting older people's travel time

The participation in social activities was also a significant determinant for the travel time of older people. Those who participated in some type of social activity tended to have a longer daily travel time. For example, the odds for those who participated in social activities to have a travel time between two to four hours rather than less than two hours was twice as much as the odds for those who did not participate in any social activity (Exp(B)=2.254). This complemented the previous models (Models 3, 4 and 5) which confirmed the positive correlation between participation in social activities and mobility in later life.

For those older people who had an assistive device, the probability of not going out was actually higher. They also had a higher possibility to have a lower travel time. For example, the odds for older people without assistive device to travel for two to four hours rather than for less than two hours was almost twice as much as that for those who had an assistive device (Exp(B)=1.776). One main reason for this is that assistive devices can be associated with health difficulties that may limit mobility. Such results supported the findings of Model 5. Both models showed that when older people had personal assistance or an assistive device their probability to not travel was higher.

Once again, age was a significant predictor for the daily travel time during the survey week. Whilst for the other models age was the first or second most significant predictor; in this case it was ranked fifth. This means that the effect of age on travel time was lower than it was for the other travel behaviour variables (Models 1-5). Table 5.10 shows that the significant correlation involved older people who did not go out. For every one year increase, the odds for older people to not travel rather than to have a daily travel time of less than two hours increased by 11.5% (Exp (B)=1.115). There were no significant relationships for older people who actually travelled during the survey week. This means that although age was a significant predictor affecting travel frequency (Model 5), it did not affect the travel time. This supports the argument presented in Figure 5.9, where irrespective of their travel frequency most older people still travelled for less than two hours.

Another output of the model was that the non-drivers had a lower probability to travel between two to four hours rather than for less than two hours when compared to drivers (B=-0.884) (Table 5.10). This complemented previous studies which showed that older drivers travelled for longer distances than the non-drivers (e.g. Mercado and Páez, 2009). This also supported the previous argument with regard to the longer travel times associated with public transport use.

Finally, the model showed that gender was the last factor that significantly predicted the travel time of older people. The odds for males to travel between five and seven hours rather than for less than two hours was six times more likely than that for females (Exp(B)=6.227) (Table 5.10). Although with a much smaller discrepancy, the model also found that the odds for males to travel between two to four hours rather than for less than two hours was almost twice as much as that for females (Exp(B)=1.979). One key reason for this was revealed in Model 1, which demonstrated that gender was the second most significant variable predicting whether older people drove or not. Therefore, one could conclude that due to the higher probability of males to be drivers, their travel time (and the respective travel distance) tends to be longer. It should however be noted that gender was the last significant factor predicting travel time, and thus its effect was significantly less than that discussed in Models 1 (*driver/not*) and 3 (*travel range*).

Model 7: Number of Travel Purposes

Apart from analysing just the demographic characteristics of travel purposes, it was equally important to understand the factors that predict the total number of purposes that older people travelled for. This was a good indication of their mobility levels since for example, an older person who travelled for shopping, recreation and to visit relatives tended to be more mobile that another one who just attended church services.

For this reason, Model 7 analysed the factors that significantly predicted the number of travel purposes that older people mentioned in question 15 of the questionnaire (Appendix B). In order to make the model more robust, the dependent variable was divided into three categories (*0-1 travel purpose, 2-3 travel purposes, 4+ purposes*) and multinomial regression was used. As explained in Section 5.3.1, given the structure of the question, the independent variables concerning mode choice (*driver/not, cars in the household* and *public transport use*) were not included in this model. In most cases older people used a mix of modes for different travel purposes. Thus, including these variables in the model would have led to inaccurate interpretations. Since the highest percentage of older people travelled for 2-3 purposes, this was the reference category used in the model.

The significant factors predicting the number of travel purposes were:

1. District (p-value=0.000)
2. Assistive Device (p-value=0.000)
3. Physical Health (p-value=0.000)
4. Social Activities (p-value=0.000)
5. Education (p-value=0.001)
6. Household Type (p-value=0.003)

The significant variables and the model results are listed in Table 5.11. The district where older people resided was the primary factor predicting their total number of travel purposes. Older people living in Gozo had the lowest probability to travel for a high number of travel purposes. For example, the odds of older people from the Southern Harbour district to travel for 4+ purposes rather than for 2-3 purposes was twice as much as that for older people living in Gozo (Exp(B)=2.069). On the other hand, the district which significantly had a higher number of travel purposes when compared to the others was the Western region. For example, the odds of older people from the Western region to travel for 4+ travel purposes rather than for 2-3 purposes was three times more likely than the odds for those living in the Southern Harbour (Exp(B)=3.428). To some extent the findings of this model could be correlated with that of Model 2. Older people from Gozo who tended to travel more in just familiar areas, had a lower number of travel purposes. On the other hand, older people from the Western region who tended to travel more in unfamiliar zones had a higher number of travel purposes. Yet, such a conclusion is not totally affirmative and requires further research.

Model 7: Number of travel purposes							
No. of travel purposes	Variable	Categories		Model Results			
				B	S.E.	Exp (B)	p-value
4+ travel purposes	District*	SH	G	0.727	0.342	2.069	0.034
		NH	G	0.971	0.346	2.6640	0.005
		W	G	1.959	0.398	7.092	0.000
		W	SH	1.232	0.370	3.428	0.001
		W	NH	0.988	0.373	2.687	0.008
		W	SE	2.196	0.455	8.990	0.000
		W	N	1.371	0.457	3.940	0.003
		SH	SE	0.964	0.404	2.622	0.017
		NH	SE	1.208	0.415	3.346	0.004
	Physical Health	Bad	Good	-1.301	0.490	0.272	0.008
		Neutral	Good	-0.679	0.262	0.507	0.010
	Social Activities Participation	Yes	No	0.696	0.244	2.005	0.004
	Education	Secondary	No Schooling	0.906	0.432	2.474	0.036
		Secondary	Primary	0.727	0.252	2.069	0.004
	Household type	Single-member	Multi-member	-0.981	0.318	0.375	0.002
0-1 travel purpose	District	NH	G	-1.481	0.701	0.227	0.034
	Assistive Device	No	Yes	-1.342	0.398	0.261	0.001
	Physical health	Bad	Good	1.286	0.511	3.618	0.012
		Neutral	Bad	-1.100	0.541	0.333	0.042
	Social Activities Participation	Yes	No	-1.483	0.656	0.227	0.024
	Education	Primary	No Schooling	-1.502	0.505	0.223	0.003
		Secondary	No Schooling	-1.366	0.540	0.255	0.011
*District code: SH- Southern Harbour; NH-Northern Harbour; SE-South Eastern; N-North; W-West; G-Gozo							
Reference category: 2-3 travel purposes hours Fit of the model = 0.000 Cox and Snell's R^2=0.273 Nagelkerke's R^2 =0.331							

Table 5.11: Review of significant variables in regression analyses predicting total number of travel purposes

Supporting previous discussions (particularly Model 6), Table 5.11 also shows that older people with no assistive devices had a higher probability to travel for more purposes than those who needed some sort of assistive device. This reinforced the argument that assistive devices could limit mobility in later life. One factor which was statistically related with whether older people had an assistive device or not was their physical health perception. For example, the model found that the probability for older people who ranked their health as *bad* to travel for 4+ purposes rather than for 2-3 purposes was lower than for those who ranked it as *good* (Exp(B)=-1.301).

Once again, the model showed that older people who participated in social activities had a higher probability to travel for more purposes. For example, as shown in Table 5.11, the odds for older people who participated in social activities to travel for 4+ purposes rather than for 2-3 purposes was twice as much as that for older people who did not participate in social activities (Exp(B)=2.005). Interestingly, similar to Model 2 which found that levels of education predicted travel range, levels of education also predicted the number of travel purposes that older people travelled for. Lower levels of education resulted in a lower number of travel purposes. For example, the odds for older people with secondary level of education to travel for 4+ purposes rather than for 2-3 purposes was twice as much as the odds for those with primary levels of education (Exp(B)=2.069). More remarkably was the difference between those not travelling at all (or just for one purpose) and those travelling for 2-3 purposes. Older people with no schooling had a higher probability to travel for just one purpose (or not at all) than those with primary and secondary levels of education.

Unexpectedly, the model showed that the last significant variable predicting the total number of travel purposes made by older people was their household type. As shown in Table 5.11, the probability for older people living in a single-member household to travel for 4+ purposes rather than for 2-3 purposes was lower than for those living in multi-member households (B=-0.981). This means that the latter tended to have a higher number of travel purposes. As shown from previous studies (e.g. Spinney et al., 2009), one possible reason for this is that when older people live with other family members, they may have more travel commitments and necessities. Model 7 was quite generic and did not distinguish the types of purposes that older people travelled for. This will be dealt with in the next two models.

Model 8: Utilitarian Travel Purposes

Siren et al. (2015) discussed the importance of distinguishing between utilitarian and discretionary travel purposes among older people. Following on from Model 7, it is important to distinguish the factors that predict the number of utilitarian and discretionary purposes respectively. Since both utilitarian and discretionary travel purposes ranged from 0 to 3, for simplification reasons these were grouped as 0-1 and

2-3 purposes. Consequently, Binary Logistic Regression was used for both models. In this case, the reference category was 0-1 travel purposes in order to better understand the factors that resulted in low mobility levels.

In chronological order, the variables that significantly predicted the number of utilitarian purposes were:

1. Marital Status (p-value=0.000)
2. District (p-value=0.004)
3. Occupation Status (p-value=0.014)
4. Assistive Device (p-value=0.02)

The model results are listed in Table 5.12.

Model 8: Number of Utilitarian purposes						
Predictor	**Categories**			**Model Results**		
			B	**S.E.**	**Exp (B)**	**p-value**
Marital Status	Married	Single	0.938	0.219	2.555	0.000
District*	SH	G	0.723	0.291	2.061	0.013
	NH	G	0.861	0.310	2.366	0.005
	SE	G	0.663	0.329	1.941	0.043
	W	G	1.453	0.366	4.277	0.000
	W	SH	0.730	0.351	2.075	0.038
	W	SE	0.790	0.384	2.203	0.040
	W	N	0.928	0.426	2.530	0.029
Occupation	Work	Retired	1.471	0.455	4.356	0.001
	Work	Housewife	1.379	0.463	3.972	0.003
	Work	Inactive	1.475	0.646	4.369	0.022
Assistive Device	Yes	No	-0.5814	0.225	0.604	0.025
*District code: SH- Southern Harbour; NH-Northern Harbour; SE-South Eastern; N-North; W-West; G-Gozo						
Reference Category: 0-1 travel purpose Fit of model = 0.000 (p-value<0.05) Cox and Snell's R^2=0.109 Nagelkerke's R^2 =0.147						

Table 5.12: Review of significant variables in regression analyses predicting the number of utilitarian travel purposes

The marital status of older people was the most significant predictor. Older people who were married travelled for more utilitarian purposes than those who were single (single, widowed, and separated). The odds for married older people to travel for 2-3 utilitarian purposes rather than for 0-1 was more than twice as likely as that for single older people (Exp(B)=2.555). In this study there was a high correlation between the marital status and the household type of older people (71.5% of the single older people lived in a single-member household and 98.9% of the married older people lived in multi-member household; p-value=0.000). This finding could be linked with Model 7 showing that when older people were married they needed to travel for more utilitarian purposes given the different necessities and commitments in their household.

The district where older people resided predicted the number of utilitarian travel purposes. Corresponding with Model 7, Gozo was the district in which older people travelled less for utilitarian reasons when compared to the other districts. The highest discrepancy was between the Western and Gozo districts. The odds for older people from the Western district to travel for 2-3 utilitarian purposes rather than for none (or for just one) was four times greater than the odds for those living in Gozo (Exp(B)=4.277).

As expected, the occupation status of older people was the third most significant factor predicting their number of utilitarian purposes. This is because going to work is a main utilitarian purpose in itself, particularly for the 60-69 age group. Consequently, the model showed that for older workers the probability to travel for utilitarian purposes was significantly higher. The largest discrepancy was between older people who worked and those who were inactive/unemployed. The odds for older people who worked to travel for 2-3 utilitarian purposes rather than for 0-1 purpose was four times more likely than that for inactive/unemployed older people (Exp(B)=4.369).

Finally, the model also found that the presence of an assistive device predicted the number of utilitarian purposes. In line with the previous models, an assistive device reflected negatively on the number of utilitarian reasons that older people travelled for. The probability for older people with no assistive device to travel for 2-3 utilitarian purposes rather than for none (or for just one) was significantly higher (Table 5.12). Such finding corresponded with the results of Model 7, in that the presence of an assistive device did not just affect utilitarian purposes per se but the total number of travel purposes in general (that is mobility).

Model 9: Discretionary Travel Purposes

As a continuation of the previous model, this section describes the factors that significantly predict the number of discretionary purposes that older people travelled for. Different results emerged when compared to Model 8. As shown in Table 5.13, in a chronological order, the significant variables were:

1. District (p-value=0.000)
2. Education Level (p-value=0.001)
3. Physical Health (p-value=0.001)
4. Occupation Status (p-value=0.002)
5. Social Activities (p-value=0.002)
6. Assistive Device (p-value=0.005)
7. Fall (p-value=0.011)
8. Mental Health (p-value=0.036)

Similar to Model 8, district was the main predictor affecting the number of discretionary travel purposes. Nevertheless, the results of this model were quite different. In this case, the district where older people had the lowest probability to travel for discretionary reasons was the South Eastern district. For example, the odds for older people from the Southern Harbour district to travel for 2-3 discretionary purposes rather than for 0-1 was more than three times higher than that for those living in the South Eastern district (Exp (B)=3.470). Such pattern was quite a random one when compared to the previous models. On the other hand, the Western region was once again the district with the highest probability for older people to travel for discretionary reasons. For example, the odds for older people from the Western district to travel for 2-3 discretionary purposes rather than for 0-1 purpose was almost three times more likely than the odds for those living in the Northern Harbour (Exp(B)=2.820). This demostrated that older people living in the Western region travelled for a higher number of travel purposes (both utilitarian and discretionary ones).

The level of education of older people was also a significant predictor. Higher levels of education resulted in a higher probability to travel for more discretionary purposes. For example, the odds for older people with a tertiary level of education to travel for 2-3 discretionary purposes rather than for 0-1 purpose was five times more likely than the odds for older people without any schooling (Exp(B)=5.243). These findings complemented Model 7. Utilitarian travel reasons were not specifically affected by the level of education of older people.

Model 9: Discretionary Purposes						
Predictor	**Categories**			**Model Results**		
			B	**S.E.**	**Exp (B)**	**p-value**
District*	NH	G	0.964	0.327	2.621	0.003
	SE	G	-0.909	0.397	0.403	0.022
	W	G	2.000	0.417	7.932	0.000
	NH	SH	0.628	0.318	1.875	0.048
	W	SH	1.665	0.405	5.287	0.000
	SH	SE	1.244	0.387	3.470	0.001
	NH	SE	1.873	0.409	6.506	0.000
	W	NH	1.037	0.408	2.820	0.011
	W	SE	2.909	0.484	18.347	0.000
	N	SE	1.162	0.462	3.195	0.012
	W	N	1.748	0.486	5.742	0.000
Occupation Status	Housewife	Retired	0.800	0.253	2.225	0.002
	Housewife	Inactive	2.314	0.811	10.114	0.004
Assistive Device	Yes	No	-0.767	0.273	0.464	0.005
Physical Health	Good	Bad	1.519	0.434	4.567	0.000
	Neutral	Bad	1.043	0.449	2.838	0.020
Social Activities	No	Yes	-0.738	0.239	0.478	0.002
Education	Secondary	No Schooling	1.298	0.398	3.662	0.001
	Tertiary	No Schooling	1.657	0.567	5.243	0.003
	Tertiary	Primary	1.137	0.460	3.116	0.014
	Secondary	Primary	0.778	0.255	2.176	0.002
Fall	Yes	No	-0.750	0.294	0.472	0.011
Mental Health	Bad	Good	1.204	0.574	3.335	0.036
* District code: SH- Southern Harbour; NH-Northern Harbour; SE-South Eastern; N-North; W-West; G-Gozo						
Reference Category: 0-1 travel purpose Fit of model = 0.000 (p-value<0.05) Cox and Snell's R^2=0.247 Nagelkerke's R^2 =0.330						

Table 5.13: Review of significant variables in regression analyses predicting the number of discretionary travel purposes

For discretionary purposes, older people's physical health perceptions were a significant predictor. As expected, older people with positive physical health perceptions travelled for more discretionary reasons. The odds for older people with *good* physical health perceptions to travel for 2-3 purposes rather than for 0-1 purpose was more than four times more likely than the odds for those who ranked it as *bad* (Exp (B)=4.567). Opposing this is that physical health perceptions were not a significant predictor for the number of utilitarian travel purposes. This could be explained through the fact that since utilitarian purposes have an "obligatory" nature, older people might have needed to travel for such purposes irrespective of their physical health status. On the other hand, for discretionary reasons, the need to travel was optional.

Although the occupation status of older people also predicted the number of utilitarian purposes (Model 8), in this model results were different. Since in this case the focus was on discretionary reasons, older people who worked did not result in any significant correlations. In this model, housewives were more likely to travel for a higher number of discretionary purposes than older people who were retired and/or inactive. The highest discrepancy was between housewives and inactive/unemployed older people (Exp(B)=10.114). The latter may face financial limitations that may limit their discretionary travel purposes. A lower discrepancy was noticed between housewives and retired people, because they both might would have free time to travel for such purposes (Table 5.13).

Participation in social activities is a main discretionary travel purpose in itself. As a result, this variable was a significant predictor in this model. As expected, older people who participated in social activities were more likely to travel for a higher number of discretionary purposes than those who did not (B=-0.738 when comparing those who did not participate in social activities with those that did). This supported all the previous models (Models 3-7) which showed the positive correlation between participation in social activities and mobility in later life. Reasonably, this variable did not prove to be significant in Model 8 which discussed utilitarian travel purposes.

Once again, the presence of an assistive device resulted to be a significant determinant for the number of discretionary purposes. Older people who had an assistive device were less likely to travel for discretionary reasons (B=-0.767). When compared to Model 7, this model had two additional significant variables that predicted the number of discretionary purposes. These were whether older people suffered from a fall in the previous year and their mental health perception.

As shown in Table 5.13, older people who suffered from a fall in the previous year were less likely to travel for 2-3 discretionary purposes rather than for 0-1 purpose (B=-0.750) when compared to those who did not suffer from any fall. Once again, the "obligatory" nature of utilitarian trips explains the fact why a fall in the previous year was not a significant predictor in Model 8. On the other hand, when older people suffered from a fall in the previous year, they chose to travel less for discretionary reasons. This supported Models 2 and 5 which both highlighted the negative repercussions of a fall on older people's mobility.

Ultimately, this model showed that older people's perception of their mental health was the last significant predictor. This was quite surprising since this variable was not significant in any of the previous eight models. Even more surprising was the fact that older people who ranked their mental health as *bad* were more likely to travel for discretionary purposes than those ranking it as *good*. Older people might have travelled for more discretionary purposes (namely recreational ones and visits to friends/family) in order to feel better from a psychological point of view. This is because mobility (namely for recreational purposes) helps to improve the well-being of older people (Musselwhite and Haddad, 2010).

5.4 A Synthesis of the Models

Table 5.14 is a summary of the nine travel behaviour models and the respective significant determinants. For each model, the significant predictors are numbered based on their significance (in chronological order). This means that for example for Model 1 (whether older people were drivers or not), the four significant variables (gender, occupation status, age and assistive device) were ranked based on their significance. The primary significant factor was always ranked as 1, the second most significant as 2 and so on. The order of the independent determinants in Table 5.14 (in column 1) is based on the number of times that they resulted to be a significant predictor in the nine models discussed in this chapter. This means that age was the variable that was the most significant throughout the travel behaviour models, followed by district, participation in social activities, occupation status and so on. The most important significant determinants for mobility in later life are in the top rows of Table 5.14 (shaded in red). Subsequently, Table 5.15 is a synthesis of how each determinant affected the respective travel behaviour indicator.

Model Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Driver/Not	**Travel Range**	**Travel Accompaniment**	**Public Transport Use**	**Travel Frequency**	**Travel Time**	**Number of Travel Purposes**	**Utilitarian Travel Purposes**	**Discretionary Travel Purposes**
Age	3	1	2	2	1	5			
District		2		3	6		1	2	1
Social Activities			5	5	5	3	4		5
Occupation	2		6	4				3	4
Assistive Device	4					4	2	4	6
Physical Health			7		2		3		3
Fall		5	4		7				7
Gender	1	3				7			
Driver/Not			1		3	6			
Education		4					5		2
Personal Assistance				6	4	1			
Marital Status			3					1	
Pt brief			8			2			
Cars in household				1					
Household Type							6		
Mental Health									8
Medicine									
Distance to bus stop		N/A	N/A		N/A	N/A	N/A	N/A	N/A

Table 5.14: A summary of the significant determinants for each travel behaviour model

Predictor	Description
Age	As age increased the probability to be drivers and to use public transport decreased
	As age increased older people travelled more in just familiar areas and were accompanied by other people
	As age increased older people travelled less frequently
District	Older people from Gozo travelled more in just familiar areas. Those living in the South Eastern and Western districts travelled more in unfamiliar areas. Older people from the South Eastern District travelled more on a daily basis.
	Older people from Gozo used public transport less frequently
	Older people from Gozo and the Western districts had the lowest and highest number of utilitarian purposes respectively
	Older people from the South Eastern and Western districts had the lowest and highest probability to travel for discretionary purposes respectively
Social Activities	Older people who participated in social activities travelled more alone rather than accompanied
	Older people who participated in social activities used public transport more frequently
	Older people who participated in social activities travelled more frequently and had longer travel times
	Older people who participated in social activities had a higher probability to travel for discretionary purposes
Occupation Status	Older people who worked had a higher probability to be drivers
	Older people who were inactive/unemployed were more likely to travel accompanied by others
	Older Workers had a higher tendency to either use public transport on a daily basis or never use it
	Older people who worked travelled more for utilitarian purposes whilst housewives and retired people travelled more for discretionary purposes
Assistive Device	Older people with an assistive device had a lower possibility to be drivers
	Older people with an assistive device had a higher possibility not to go out, and to have lower travel time when they do
	Older people with an assistive device travelled for less purposes (utilitarian and discretionary)
Physical Health	Older people had a higher probability to travel accompanied by others when their physical health status was low
	Older people had a lower travel frequency and a lower number of travel purposes (particularly discretionary ones) when their physical health status was low
Fall in previous year	Older people who suffered from a fall in the previous year travelled more in just familiar areas and always accompanied by others
	Older people who suffered from a fall in the previous year had a lower travel frequency and travelled for less discretionary purposes
Gender	Males had a higher tendency to be drivers
	Females travelled more in just familiar areas and had lower travel times
Driver/Not	Drivers travelled more alone rather than accompanied
	Drivers had a higher travel frequency and travel time
Education	Lower education levels led older people to travel more in just familiar areas
	Higher education levels increased the number of travel purposes (particularly discretionary ones)
Personal Assistance	Older people who had personal assistance had a lower public transport use, lower travel frequency and lower travel time
Marital Status	Married older people travelled more accompanied by others than single older people (single, separated, widow)
	Married older people travelled more for utilitarian purposes
Public Transport	Frequent bus users travelled more alone rather than accompanied by others
	Frequent bus users had longer travel times
Cars in households	Drivers and non-drivers with a high number of cars available to them used public transport less frequently (or never)
Household type	Older people living in multi-member household had a higher number of travel purposes
Mental health	Lower perceptions on mental health led to a higher number of discretionary purposes

Table 5.15: A summary of how each determinant affected older people's travel behaviour

5.5 Conclusion

The purpose of the nine regression models discussed in this chapter was to understand the main objective factors that affected travel behaviour of older people in Malta. Results showed that the three main predictors were age, participation in social activities and district, representing a mix of personal, social and environmental factors respectively. Other objective determinants such as occupation status and physical health also resulted to be important determinants for different travel behaviour indicators in later life. Whilst for most determinants (e.g. age and participation in social activities) the effect on travel behaviour was quite linear, for others (e.g. district) it was not very explicit.

The discussion on how the findings of this chapter relate with the body of literature will continue in Chapter 8. The latter will also discuss the factors that were *not* significant predictors of travel behaviour because they also revealed important information that should be taken in consideration by transport policy makers. Complementing this chapter, Chapter 6 will now discuss the psychological determinants of travel behaviour. This will provide a holistic understanding of both the objective and psychological factors that affected how older people in Malta travelled.

Chapter 6

THE PSYCHOLOGICAL DETERMINANTS OF TRAVEL BEHAVIOUR

6.1 Introduction

Chapter 6 seeks to evaluate the psychological determinants that predict the older population's travel behaviour in Malta (objective 3, research question *iv*). To achieve this, tests were conducted using the socio-psychological theory developed by Triandis (1977), the Theory of Interpersonal Behaviour (TIB). This complements the results presented in Chapter 5 which discussed the objective determinants of travel behaviour in later life. In this way, a holistic insight into the determinants of mobility in old age is provided.

Section 3.4.1 showed that the TIB has been utilised as the framework for various studies in different sectors, including transport. Nonetheless, it has never been used as the underppining theory for older people's mobility studies. Consequently, apart from understanding the psychological determinants that affect travel in later life, this chapter also tests whether the TIB is applicable and fits the objectives of this research. The analysis in this chapter wants to build on and contribute to the growing body of research analysing psychological determinants of travel in old age.

This analysis was based on Section B of the questionnaire (Appendix B) which consisted of statements reflecting the TIB constructs in transport which older people had to rate on a five-point Likert Scale. A description of the method used to test the theoretical framework is provided in Sections 6.2. In Section 6.3, a test of the measurement model for the TIB is reported. The results of the structural model are discussed in Section 6.4. Conclusions are then provided at the end of the chapter in Section 6.5.

6.2 Testing the Theoretical Framework

The theoretical framework was tested against the data using structural equation modelling (SEM) in AMOS (v21) software. A detailed explanation of the reasons for using SEM has been provided in Section 4.4.2. SEM is a flexible multivariate statistical modelling technique which is used to specifically test the structural validity of hypothesised theoretical models (Golob, 2003). The two key steps in SEM are the measurement model and the structural model, which together show the extent to which the causal processes hypothesised by the theoretical framework are consistent with the observed data. If the model "fits" with the data then the hypothesised relationships (and thus the overall theoretical framework) are accepted; if the fit is not acceptable, then the model is rejected (Byrne, 2009).

Similar to the multinomial logistic regression models discussed in the previous chapter, the independent variables (the psychological constructs) were used to predict group membership that was represented through the travel behaviour indicators discussed in Chapters 4 and 5. For ease of reference, each of the statements representing the TIB constructs in Appendix B was assigned a code during the analysis. These are listed in Table 6.1 below, and represent the exogenous variables in the structural model.

TIB Construct	Code	Statement (brief) in questionnaire
Perceived Consequences	Perceived Consequences 1	*My travel behaviour improves my quality of life*
	Perceived Consequences 2	*My travel behaviour is safe both for me and for the others*
Affect	Affect 1	*My travel behaviour makes me feel happy*
	Affect 2*	*I am always anxious when travelling due to fears of falling, fears when crossing the road, fears when parking my car or fears when encountering main intersections*
Social Factors: Self-Concept	Self-Concept 1	*I feel that I am still fit for my travel behaviour and would feel bad if I do not stick to it*
	Self-Concept 2*	*It is appropriate for me to adopt different compensation techniques in my travel behaviour*
Social Factors: Social Norms	Social Norms 1	*My family/friends agree and with my travel behaviour*
	Social Norms 2	*Health Professionals agree with my travel behaviour*
Social Factors: Roles	Roles 1	*My travel behaviour is associated with my roles in my family*
	Roles 2	*My travel behaviour is associated with my roles in other institutions*
Intention	Intention 1	*I intend to stick to my travel behaviour in the future*
	Intention 2	*I will stick to my travel behaviour in the future*
Habit	Habit 1	*My travel behaviour is automatic for me. Sometimes I stick to my travel behaviour without actually needing to do it*
	Habit 2*	*I try to modify my travel behaviour as much as possible and do not feel any weird when I do it*
Facilitating Conditions	Facilitating Conditions 1	*It is easy for me to travel with the infrastructure & travel information available*
	Facilitating Conditions 2*	*The way other people behave in the road environment makes my travel more difficult (e.g. the way they drive)*
* Reverse-coded		

Table 6.1: The exogenous variables (TIB constructs) used in the model

The endogenous variable, travel behaviour, was expressed through the six indicators listed in Table 6.2. These reflected the same categorical travel behaviour indicators discussed in the previous chapter. AMOS software uses assumptions to work with data on a continuous scale (Byrne, 2009). Thus, in order to avoid bias as much as possible the dependent variable was also converted into a continuous scale. For simplification purposes, each travel behaviour indicator was converted in a binary format (0-1) (Table 6.2). All the ones (1s) reflected a positive and an independent mobility characteristic (e.g. being a driver), whilst all the zeros reflected a negative or restricted mobility characteristic (e.g. always needing to travel accompanied by somebody). Adapted and inspired from the Sickness Impact Profile (SIP-68) used by Delbaere et al. (2009), an aggregated score was worked out for the travel behaviour endogenous variable. For every respondent all the 1s for the respective six indicators (Table 6.2) were summed up. Given that they were all measuring aspects from the travel behaviour of older people, all indicators were quite related to each other. The aggregated score for all respondents ranged from 0 to 6. The higher the score the better the mobility of older people.

Endogenous Variables	
Travel Behaviour Indicator	**Categories**
Driver or not	1 = Driver; 0= Not Driver
Travel Frequency	1= Daily; 0= Not daily or not at all
Travel Time	1= >=2 hours; 0= <2 hours
Travel Range	1= Not just in familiar areas; 0 = Just in familiar areas
Travel Accompaniment	1= Not always accompanied or alone; 0 = Always accompanied
Discretionary Travel Purpose	1=2-3 purposes; 0= 0-1 purpose

Table 6.2: The endogenous variables (travel behaviour indicators) used in the model

The choice for the 1 and 0 to represent each travel behaviour indicator was not arbitrary but was based on the descriptive statistics and the regression models presented in Chapter 5. Models 1, 2 and 6 clearly showed that being a driver reflected positively on several aspects of mobility. The role of context was essential with regard to the travel time and travel frequency indicators. This is because although long travel time can be a negative perspective of mobility due to origins and destinations being located far away from each other, this was not the case for this research. In Malta, most of the urbanised area is located within a ten-minute walk from a town centre (TM, 2016a). Thus, given the short distances involved to travel, a long travel time is a reflection of better mobility levels. This was justified in Model 6 which showed that older people who had personal assistance or used a mobility device had a significantly lower travel time than those who did not. Moreover, older people participating in social activities had longer travel times. This also reflected positively on their mobility.

Model 5 showed that age and physical health were the two main predictors for travel frequency, since the young and healthy travelled more on a daily basis. Moreover, both drivers and those participating in social activities had significantly higher probabilities of travelling on a daily basis. This argument was also supported in the descriptive statistics (Figure E.10 in Appendix E). Such results justified why travelling daily and for more than two hours were marked as 1 in Table 6.2. Existing literature (e.g. Findlay and McLaughlin, 2005; van der Meer, 2008) and the case study results on travel range and travel accompaniment showed that when older people just travelled in familiar areas and always needed accompaniment to travel, they had limited mobility (marked as 0 in Table 6.2).

In terms of travel purposes the model only included travelling for discretionary reasons (Model 9 in Chapter 5) since these journeys reflect positively on the mobility and well-being of older people (Davey, 2007; Siren et al., 2015). Travelling for more utilitarian reasons (e.g. medical care, shopping) is not necessarily a reflection of good mobility levels since such purposes are obligatory. The model did not include public transport data because as shown in the descriptive statistics, public transport use was very low amongst the entire sample. Moreover, the association between public transport use and older people's mobility was very unclear and created uncertainties in the model. In most cases, due to the high car dependence, frequent bus use reflected transport disadvantage in later life (Model 4 in Chapter 5). So, given the dichotomous structure of the travel behaviour indicators (Table 6.2), it was unclear as to whether public transport use in Malta could be regarded as a positive or negative characteristic of older people's mobility. Thus, it was excluded from the model to provide accurate results.

6.3 Testing the Measurement Model

The measurement model is the first step in SEM. It is a multivariate regression model which describes the relationship between the observed dependent variable and the continuous latent variables (Muthén and Muthén, 2010). It is important to test the measurement model since it shows to what extent the various items in the questionnaire are appropriate for the latent construct that they should be measuring. In this study, this was carried out to test whether the psychological statements in Section B of the questionnaire (Appendix B) were appropriate measures of the respective TIB constructs. The measurement model is divided into three main steps: 1) Reliability Analysis 2) Exploratory Factor Analysis (EFA) and 3) Confirmatory Factor Analysis (CFA).

6.3.1 Reliability Analysis and Mean Rankings

Reliability analysis reflects the internal consistency of measures. Internal consistency refers to how closely related a set of items are as a group (Field, 2013). One of the most common methods to test reliability is through the Cronbach's Alpha (Cronbach's α) (Cronbach, 1951), which ranges from 0 to 1. The former refers to no correlations and therefore no internal consistency, whilst a 1 refers to a perfect correlation and complete internal consistency (Bryman, 2012). In order to have a reliable scale, the Cronbach's α value has to be larger than 0.7 (George and Mallery, 2003; Field, 2013; Azzopardi et al., 2016). In this study, reliability analysis was used to analyse whether the questionnaire items consistently reflected the TIB construct that they were measuring. As explained in Section 4.3.2, some of the statements were negatively worded so that respondents would not fall into a pattern of continually agreeing with statements due to social desirability or fatigue. These were reverse coded prior to the analysis. Table 6.3 shows the Cronbach's α for every construct in the study.

TIB Constructs	Cronbach's α	TIB Constructs	Cronbach's α
Perceived Consequences 1	0.779	Norms 1	0.753
Perceived Consequences 2		Norms 2	
Affect 1	0.81	Habit 1	0.863
Affect 2		Habit 2	
Self-Concept 1	0.839	Intention 1	0.827
Self-Concept 2		Intention 2	
Roles 1	0.099	Facilitating Conditions 1	0.85
Roles 2		Facilitating Conditions 2	

Table 6.3: Reliability Analysis for the TIB psychological constructs

As clearly shown from the table, all the questionnaire items except from *Roles* had a satisfactory internal consistency since all their Cronbach's α exceeded the 0.7 threshold value. This showed that for every construct (e.g. *Affect*) the two statements (*Affect 1* and *Affect 2*) in the questionnaire were really measuring that respective psychological variable. The *Roles* construct had a very weak Cronbach's Alpha since the two statements in the questionnaire concerning this factor opposed each other (Appendix B). The first statement related to how travel behaviour was affected by the roles that older people had in their family, whilst the second statement was related to the roles that older people had in other institutions primarily in employment. Results showed that when travel behaviour was mostly affected by roles in the family it was then not affected by those in other institutions, and vice-versa. This showed that when older people gave the utmost priority to their family roles they preferred not to have significant roles in other entities. The wording of these two statements could have been an important factor in this lack of internal consistency. Hence, the *Roles* construct was excluded from the analysis.

Together with the Cronbach's α, the respective means designed to tap into the latent psychological constructs in the TIB were worked out (Table 6.4). The Friedman's Test was conducted to significantly compare the mean ranking for every psychological construct. This is the non-parametric alternative to the one-way ANOVA which tests for differences between groups when the dependent variable being measured is ordinal (Field, 2013; Camilleri, 2017). Given that each construct had two Likert-Scale statements (ordinal data) this test had to be used. Consistent with the TIB, higher mean scores for the psychological constructs reflected positive viewpoints towards mobility. Since items were measured on a five-point Likert Scale all mean scores ranked from 1 to 5.

TIB constructs	Mean	p-value	TIB constructs	Mean	p-value
Perceived Consequences 1	4.12	0.401	Norms 1	4.39	0.859
Perceived Consequences 2	4.09		Norms 2	4.35	
Perceived Consequences Average	**4.11**		**Social Norms Average**	**4.37**	
Affect 1	3.57	0.001	Habit 1	3.46	0.000
Affect 2	3.44		Habit 2	3.72	
Affect Average	**3.51**		**Habit Average**	**3.59**	
Self-Concept 1	3.5	0.000	Intention 1	4.34	0.000
Self-Concept 2	3.1		Intention 2	4.05	
Self-Concept Average	**3.30**		**Intention Average**	**4.20**	
Roles 1	3.85	0.000	Facilitating Conditions 1	2.97	0.002
Roles 2	3.31		Facilitating Conditions 2	2.84	
Roles Average	**3.60**		**Facilitating Conditions Average**	**2.91**	

Table 6.4: Mean rankings and Friedman's Test p-value for all TIB constructs

As shown in Table 6.4, the three constructs that had the highest mean score were *Social Norms* (4.37), *Intention* (4.20) and *Perceived Consequences* (4.11). This showed that for the overall sample, there was a considerably high agreement from family members/friends and health professionals (doctors) for the way older people travelled. This was supported with the fact that older people had positive intentions for their future. Due to their high car dependence and healthier lifestyles, the current older population's intentions for the future are much more positive. Older people's ranking on how their travel behaviour affected their quality of life (*Perceived Consequences 1*) was very positive (4.12), which showed the positive impact of mobility on older people's well-being. The sample of the study (Section 4.3.3) was one factor that affected such findings. Due to the higher percentage of younger-old people, it was reasonable that overall there were positive attitudes and intentions as well as positive social agreements for the way older people travelled. This supported earlier discussions (Section 2.5.1) which showed that age usually acts in a negative manner on older people's mobility.

On the other hand, the lowest mean ranking was recorded for *Facilitating Conditions* (2.91), *Self-Concept* (3.30), *Affect* (3.51) and *Habit* (3.59). This clearly showed that older people were very dissatisfied with the current transport infrastructure in the Maltese road environment (*Facilitating Conditions 1* – average of 2.97). Moreover, they remarked that they were affected negatively by other people's behaviour on the road (e.g. when driving or when using public transport). This suggested that improvements in the Maltese road infrastructure are necessary as well as a change in society's attitudes and behaviours towards older people. These will be discussed in further detail in Chapter 8.

Subsequently, the mean rankings showed that although the sample was mostly composed of younger-olds, respondents did not have a very high self-concept. This means that they did not really think positively about their capabilities in the road. This was complemented by the low ranking for emotions, indicating that overall they felt anxious and were not happy during their travels (*Affect 2* - 3.44). One key reason for such figures was the gender imbalance in the sample (Appendix D). Several studies in Section 2.5.1 (e.g. McNamara et al., 2013) as well as the regression models presented in Chapter 5 (particularly Models 1, 2 and 6) explained that older females feel more insecure in the road environment with higher levels of fear and anxiety. As a result they compensate and self-regulate more for their limitations. Thus, having a higher percentage of female respondents (67%) could have affected the mean ranking for this psychological construct. This gender discrepancy could also have been a factor in the low mean ranking for *Habit* (3.59). This is because studies discussed in Section 3.4.2 (e.g. Turcotte, 2012) clearly showed that older males have higher habitual travel behaviour practices than females. Despite this, the low *Habit* mean ranking (Table 6.4) immediately gave an indication that older people did not consider their mobility as very habitual.

In order to understand in more detail the dynamics within each TIB psychological construct, the Friedman's Statistical Test was carried out to compare the mean ranking scores between the two respective statements. As shown in Table 6.4, this resulted insignificant for *Perceived Consequences* (p-value=0.401) and *Social Norms* (p-value=0.859). This means that the average ranking for the two respective statements for each of these two constructs was comparable and did not differ significantly. Thus, when older people thought that their travel behaviour improved their quality of life (*Perceived Consequences 1*) they also perceived it as safe for them and for others (*Perceived Consequences 2*). Correspondingly, the insignificant p-value for *Social Norms* showed that there was consistency between how family/friends (*Social Norms 1*) and health professionals (*Social Norms 2*) thought about the older respondents' travel behaviour. This was an indication that the family members' pressure was actually truthful since it complemented that of health professionals.

On the other hand, Table 6.4 also showed a statistically significant difference between the mean rankings for all the other constructs. For example, with regard to *Self-concept*, older people's need to adopt compensation techniques (*Self-concept 2* – 3.1) was significantly higher than their perception on how fit they were for their travel behaviour (*Self-concept 1* – 3.5). Another example was that although both statements for the *Intention* construct had positive rating, the statement dealing with how older people *intend* to stick to their travel behaviour in the future (*Intention 1* – 4.34) was statistically significantly higher than that dealing with their *certainty* to stick to the current travel (*Intention 2* – 4.05). This showed that although older people intended to continue with their current mobility in the future, they acknowledged that such intention depended on other circumstances such as their health.

6.3.2 Exploratory Factor Analysis (EFA)

In addition to assessing how closely related the items are as a group, it is also important to confirm the suitability of the individual items in relation to the psychological constructs that they are designed to measure. In order to do so, EFA and CFA are needed.

EFA is used to uncover complex patterns and identify the number of latent psychological factors underlying the dataset (Yong and Pearce, 2013). It is used when the researcher is concerned with describing a large number of variables in a smaller number of unobserved (latent) factors (Dugard et al., 2010). In this research, it was used to analyse the factorial validity of the data related to the TIB psychological constructs, and identify the number of latent dimensions underlying the data collected. Kaiser Meyer Olkin (KMO) and Bartlett's test of sphericity were computed to measure the sampling adequacy and establish the presence of a latent structure. The KMO value, which shows the relative compactness of the correlations, was 0.618, which exceeded the 0.5 threshold value. The Bartlett's test of sphericity, which analyses whether the correlation matrix is significantly different from the identity matrix, had a p-value of 0.000 (less than the 0.05 level of significance) (Young and Pierce, 2013; Azzopardi et al., 2016). These two results indicated that EFA was important to reveal a latent structure within the data.

EFA was carried out with SPSS using Principal Component Analysis with Varimax Rotation. This orthogonal rotation of the factor axes made it easier to identify each observable variable with a single factor. Since no prior assumptions were made about the structure of the data, the number of factors to be extracted was not pre-determined. The Kaiser's eigenvalue greater than 1 rule (Kaiser, 1960) identified seven underlying factors, which perfectly supported the seven TIB constructs. Table 6.5 shows the factor loadings for each construct. Factor loadings refer to the regression coefficient of a variable for the linear model that describes the latent variable (Field, 2013). A threshold value of 0.4 is suggested for factor loadings when the sample size exceeds 150 observations (Stevens, 2002; Field, 2013). As evidently shown in the table, all constructs were well above this threshold. Hence, all items only measured the construct that they were supposed to. For example, Component 1 clearly relates to the *Habit* construct since the two item measures (*Habit 1* and *Habit 2*) loaded heavily on it (0.925 and 0.932) and weakly on the other components. For simplification purposes, factor loadings smaller than 0.3 are not shown in the table. Such analysis concluded that there were seven underlying latent variables in the data collected.

	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Habit 2	.932						
Habit 1	.925						
Facilitating Conditions 2		.932					
Facilitating Conditions 1		.917					
Self-concept 2			.919				
Self-concept 1			.899				
Intention 2				.922			
Intention 1				.884			
Affect 2					.904		
Affect 1					.888		
Perceived Consequences 2						.890	
Perceived Consequences 1						.877	
Norms 1							.884
Norms 2							.854
Extraction Method: Principal Component Analysis Rotation Method: Varimax with Kaiser Normalization							

Table 6.5: Exploratory Factor Analysis

6.3.3 Confirmatory Factor Analysis (CFA)

Following the EFA, CFA was needed to test the extent to which the observed variables represented the smaller number of latent constructs. CFA confirms both the number of the underlying dimensions of the factors as well as the pattern of the factor loadings obtained at the EFA (Azzopardi et al., 2016). In fact, CFA is used when the researcher already has information regarding the underlying structure of the data based on prior research (Hair et al., 2005). The seven-factor CFA model was fitted to the whole sample. The model parameters were estimated and eventually the model fit was checked. The chi-square value did not satisfy its threshold criterion. With 56 degrees of freedom, the chi-square value (84.747) yielded a p-value of 0.008, which implied that the specified CFA model was not supported by the sample variance-covariance matrix. Nonetheless, the chi-square statistic inflates substantially with large sample sizes and is not useful for large data sets (Schumacker and Lomax, 2004). With regard to the goodness-of-fit indices, different studies (e.g. Hu and Bentler, 1999; Mac Callum et al., 1996; Klein, 2005) explained that a good fit is achieved if the Confirmatory Fix Index (CFI) ≥ 0.95, the Root Mean Square Error of Approximation (RMSEA) ≤ 0.06, the Goodness Fit Index (GFI) ≥ 0.90 and the Normed Fit Index (NFI) ≥ 0.95. All of the fit indices in the CFA model did not exceed these thresholds since the respective values were: CFI=0970, RMSEA=0.052, GFI=0.961, NFI=0.951. All the parameter estimates were significant ($p<0.001$).

Figure 6.1 shows the CFA path diagram and the corresponding standardised estimates of the model. It shows the interactions between the seven dimensions and their relationship with the 14 observed items (2 per each construct). All the standardized factor loadings exceeded the 0.7 threshold (Hair et al., 2005), indicating that the latent factors strongly affected the observed variables. This showed that all statements were appropriate measures for the psychological constructs under study.

For most constructs, Figure 6.1 shows that one statement (from the two per construct) had a higher factor loading for the measured dimension. For example, with regard to *Social Norms*, *Norms 1* (pressure from family/friends) had a lower factor loading (0.74) than *Norms 2* (pressure from health professionals) (0.83). This shows that the *Social Norms* construct was more affected with how health professionals perceived the older person travel behaviour compared to that of their family and friends. Another example was the *Perceived Consequences* construct, where *Perceived Consequences 1* (how older people saw their travel behaviour affecting their quality of life) had a higher factor loading (0.84) compared to *Perceived Consequences 2* (how older people perceived the safety of their travel behaviour) (0.76). The covariance between each of the latent constructs (double sided arrows in Figure 6.1) was also considerably low showing that each of the constructs stood well on its own.

Such factor loadings together with the fit indices satisfying their threshold criteria indicated that the model fitted the data well. Once the CFA confirmed the latent structure, the structural model was fitted to analyse the relationships between the latent variables of the TIB.

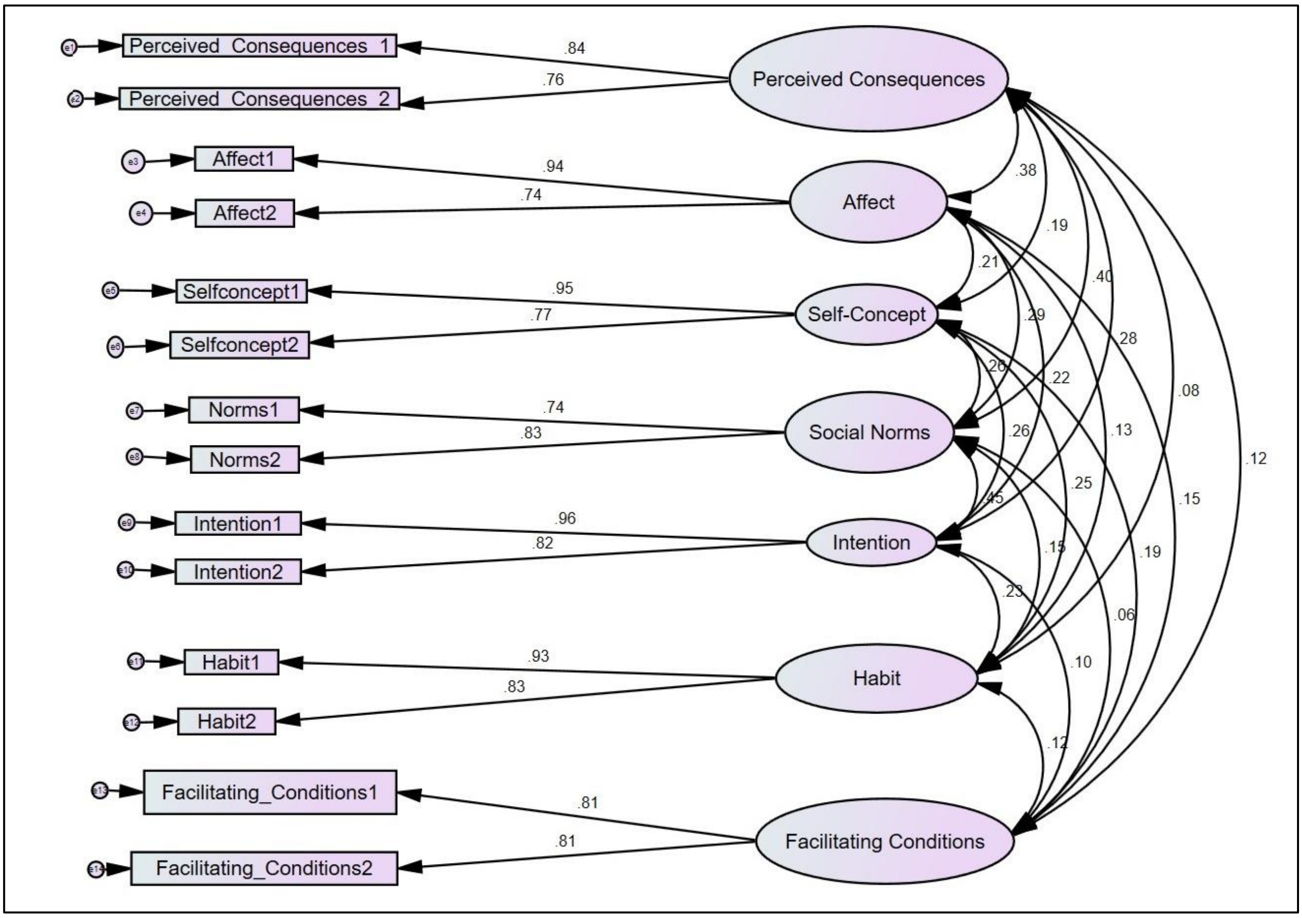

Figure 6.1: Confirmatory Factor Analysis for the latent variables within the TIB framework (showing standardised estimates)

6.4 The Structural Model

6.4.1 The Model Formation

Following the confirmation that the listed items were appropriate measures for the TIB constructs, the last procedure involved the structural model tests. Such model shows *direct* and *total* effects. Direct effects represent the degree to which one variable directly impacts the other (represented by standardised path coefficients β), whilst total effects refer to the sum of all the direct and indirect effects acting on a variable (represented by explained variance R^2) (Golob, 2003). The latter explains whether changes in one variable are due to changes in other variables in the model or due to external factors.

The Structural Model basically involves regression analysis between the latent variables. The model parameters were estimated through a Maximum Likelihood Estimation (MLE) procedure. This is one of the most common estimation methods used in SEM (Lei and Lomax, 2005). MLE is based on the assumption that the observed variables are measured on a continuous scale and that the data is normal. However in social sciences this is very difficult since psychological constructs are usually measured on Likert Scales. Although ordinal data which applies MLE can lead to potential biased parameter estimates, this bias becomes much smaller as the number of categories increase. Several studies that used MLE with ordinal data showed that the bias diminished significantly as the number of categories increased to five, as was the case with this study. The parameter estimates were still accurate and did not result in any bias in the fit indices or standard errors (Finney and Di stefano, 2006; Rhemtulla et al., 2012). When MLE is used with ordinal data (five or more categories) it even demonstrates to be robust to moderate non-normality and to the violation of the multivariate normality assumption (Finney and Di Stefano, 2006; Iacobucci, 2010; Rhemtulla et al., 2012).

Following the MLE and the model assumptions in AMOS, multivariate normality was tested. In order to do this, AMOS has a function of showing the Mardia's multivariate kurtosis (Mardia, 1970) and its critical ratio. Outliers are shown through the respective Mahalanobis squared distances (in standard units) of the observation's vector from the sample means' vector for all variables (Gao et al., 2008). AMOS lists the top 100 observations with the highest Mahalanobis d-squared distance. A multivariate outlier is a case which has a Mahalanobis distance greater than the critical distance specified typically by a $p<0.001$ (Tabachnick and Fidell, 2006). The larger the distance, the higher the contribution of an observation (an outlier) for the Mardia's multivariate kurtosis, meaning a departure from multivariate normality. Thus, outliers need to be removed to decrease Mardia's multivariate kurtosis, achieve normality in the data and retain the assumption of linearity (Gao et al., 2008).

When the critical ratio of Mardia's multivariate kurtosis is of 1.96 or less this means that there is non-significant kurtosis and thus the non-normality is not significant. This makes the sample multivariate normally distributed at the 0.05 level of significance (Mardia, 1970; Bian, 2011). Given this, the test of normality was run in AMOS and all the observations that had a $p1$ value of less than 0.05 were analysed and eventually removed from the model. These were influential outliers since the correlations between the variables for these observations were significantly different when compared to the rest of the dataset. Forty-seven outliers were removed, reducing the sample to 453 older people. Following this, the critical ratio for the measurement model was of 1.927. By doing this, the univariate skewness and kurtosis for all variables were close to zero and equal/smaller than 1. This showed that multivariate kurtosis was good enough to assess multivariate normality and that the estimates of the reduced sample were unbiased. This also indicated that the assumptions regarding multivariate normality were met. Deleting observations can result in the loss of model power in the interpretation of results and thus should be balanced (Gao et al., 2008). This was the case for this study since only 9.4% of the observations were removed. The same model was re-run using other estimation techniques (e.g. Bayesian model fitting, Unweighted Least Squares, Scale-Free least squares, Asymptotically distribution-free). These demonstrated relatively constant results and thus showed the robustness of the MLE.

After such modifications, the Chi Square value for the structural model (1.777) had a p-value of less than 0.5 (0.000). This result was accepted due to the large sample size (Azzopardi et al., 2016) and due to the favourable results obtained from the goodness-of-fit indices. The latter were all within the criteria threshold (CFI=0.978; RMSEA-0.041; GFI=0.962; NFI=0.951). All these results showed that the SEM model fitted the data.

6.4.2 Model Results

As shown in Figure 6.2, based on the TIB framework, the dependent variable (travel behaviour) was regressed on *Intention*, *Habit* and *Facilitating Conditions*. In turn, *Intention* was regressed on the constructs of *Perceived Consequences*, *Affect* and *Social Norms*. One sided arrows show the impact of one variable on another, whilst double sided arrows show the covariance between variables. The explained variance of a construct represents the proportion of variance that can be explained by the constructs that are related to it. Variance values (R^2) are written in brackets. These show to what extent the changes in the respective construct are the direct result of changes in the other constructs of the model and not by any external influence.

The analysis showed that the causal structure underlying the TIB was supported by the data. All structural paths proposed by the model had a positive and significant relationship ($p<0.05$). This means that perceived consequences, affect, self-concept and social norms all significantly affected older people's intention to continue with their travel behaviour. The model also found that the intention to engage and the habits based on this behaviour were significant in predicting older people's actual travel behaviour.

Although with the lowest impact, the model also supported the TIB framework with regard to the effect of facilitating conditions on behaviour.

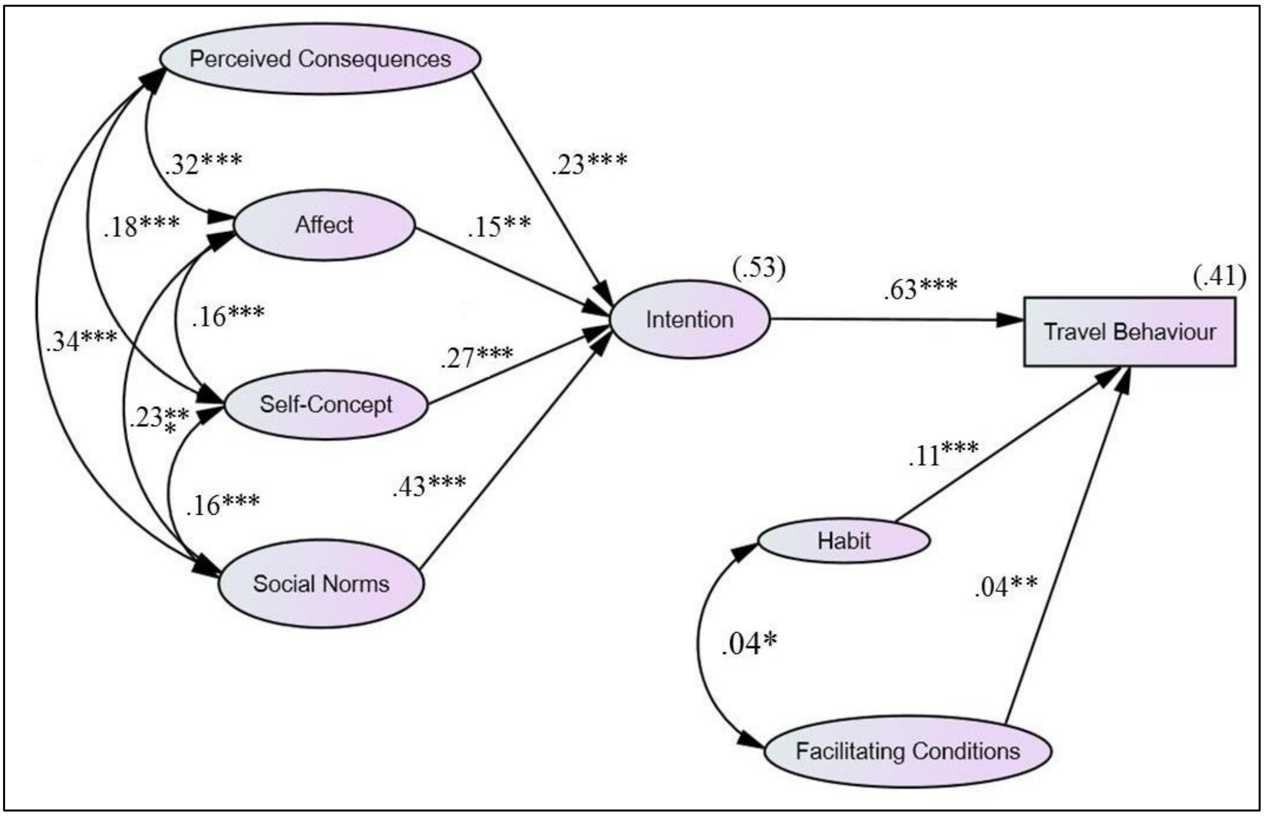

Figure 6.2: The Standardised Coefficients for the structural model. Values in parenthesis represent the variance (*p<0.001;**p<0.05; *p>0.05)**

It is important to understand people's intentions because in several circumstances, intentions are more effective than behavioural measures as they capture people's mindset (Day, 1969). In this study, the intention of older people with regard to their future travel had a very strong positive association with their actual travel behaviour (β=0.63, p<0.001). An increase in the intention score augmented the likelihood of a positive travel behaviour (a higher score based on Table 6.1). This was quite reasonable since intention is related to one's commitment to travel. It is the outcome of a mental process that leads to an action and transforms motivation into behaviour (Jang et al., 2009).

In turn, 53% (R^2=0.53) of the variance in intention was explained by the TIB constructs *Perceived Consequences*, *Affect*, *Self-concept* and *Social Norms*. From these four, the strongest predictor was the *Social Norms* that older people had from the people surrounding them, either their family and friends or health professionals (β=0.43, p<0.001). The unstandardized coefficients in the model showed that when the social norms scale went up by 1 that of intention went up by 0.23, meaning that the social surrounding of older people in Malta had the highest weight on how they intend to continue travelling in the future. This is quite realistic in Malta, primarily due to its small geographic size and its social fabric in which family ties are very strong (NSO, 2014b). A study conducted in 2012 assessing the needs of the 75+ older people in Malta showed that irrespective of age and gender, the highest majority of them was able to see or hear from three to more than nine relatives on a very regular basis (DHIR, 2012). Moreover, the CFA model (Figure 6.1) showed that pressure from health professionals had a higher weight in defining the social norms of older people in Malta. This means that in most cases, suggestions given by the doctor were well considered by the older respondents in this study.

After social norms, the most important determinant that affected the future intentions of older people was their *Self-Concept* (β =0.27, p<0.001). This means that although this construct had one of the lowest mean rankings, it was then strongly associated with older people's intentions. This was quite expected since it showed that the more older people believed in themselves and the more they perceived themselves as fit for their travel behaviour, the more positive were their future intentions. When older people self-perceive themselves as in control over their life they offset some negative impacts of immobility (Mollenkopf et al., 2004). The unstandardized coefficient in the model showed that when the self-concept scale went up by 1, that of intention increased by 0.07. This was also related to the compensation techniques that older people usually adopt to counterbalance their potential limitations when travelling. The positive coefficient confirmed that when older people felt that they were fit and did not need compensation techniques (e.g. travel during nice weather, do not travel during the day etc.), they had more positive intentions for the future.

Following *Social Norms* and *Self-Concept*, the *Perceived Consequences* (β=0.23, p<0.001) and the *Affect* towards their travel behaviour (β=0.15, p=0.026) also significantly predicted older people's intentions for their future travel. The unstandardized coefficient showed that when the *Perceived Consequences'* scale went up by 1, that of intention increased by 0.13. With regard to the emotions of older people when travelling, the unstandardized coefficient showed that when the *Affect*'s scale went up by 1, that of intention increased by 0.06. This means that although the emotions towards travel behaviour (e.g. happiness, anxiousness) were a significant predictor for their intention, they had the lowest effect when compared to the other three constructs.

It is also worth noting that older people usually experience different phases in later life which affect their emotional status and potentially their travel (Waara and Stjernborg, 2010). Moreover, Model 2 (Chapter 5) found that suffering from a fall in the previous year was one of the significant predictors affecting the travel range of older people. This is because a fall in later life is usually associated with a high sense of fear and anxiety. All this shows that several factors throughout the life-course of people, particularly those during their older age can strongly affect their emotions in the transport environment. Automatically, as shown in this model's results, these will then affect their intentions for future travel. This is because affect is usually closely associated with older people's well-being (Jang et al., 2009).

As shown in Figure 6.2, all the four antecedents of intention were statistically correlated to each other. The strongest covariance was between the *Perceived Consequences* (attitudes) and *Social Norms* of older people ($r=0.34$, $p<0.001$). Social pressure can strongly affect older people's attitudes towards their mobility and vice-versa. This showed that when family members/friends saw their older relatives with positive attitudes towards their mobility, they were more motivated to have positive influences on such mobility. *Perceived Consequences* also had a high covariance ($r=0.32$, $p<0.001$) with older people's *affect*. Hence this covariance showed that with positive attitudes towards mobility, older people also had positive emotions i.e. they were happier and less anxious when travelling.

These emotions were significantly correlated with the *Social Norms* of older people ($r=0.23$, $p<0.001$). Social pressure was not only affected by older people's attitudes but also by how they felt with their travel. Such emotions correlated with social norms also because when older people knew that they had the "consensus" from their family members, friends and doctor, they tended to travel happier and with less anxiety. Another significant covariance was that between *Perceived Consequences* and *Self-Concept* ($r=0.18$, $p<0.001$). These co-variances supported what was conceptualised by the TIB, since *Perceived Consequences*, *Affect*, *Self-Concept* and *Social Norms* altogether predicted the intention towards behaviour. In this study, co-variances were all statistically significant (p-value<0.05).

Based on the TIB framework, travel behaviour was also directly regressed with *Habit*. The positive coefficient of the relationship ($\beta=0.11$, $p=<0.001$) showed that an increase in the habit score augmented the likelihood of positive travel behaviour (higher score in Table 6.1). However, the association was not a very strong one. This was actually seen from the smaller coefficient that *habit* had when compared to *intention* ($\beta=0.63$, $p=<0.001$). Older people were mostly cognitively guided on how they travelled. The behaviour of an individual is usually determined by conscious and unconscious needs which together create the motivation for behaviour (Maslow, 1954). For simplification purposes, and due to the low association between habit and travel behaviour, the interaction effect between habit and intention was not included in the model. Other studies using the TIB as their framework (e.g. Boyd and Wandersman, 1991; Bamberg and Schmidt, 2003; Limayem et al., 2004), also slightly revised the TIB and regressed habit directly with the respective behaviour instead of analysing the interaction between habit and intention. This allowed a better evaluation of the importance of each individual variable in the TIB model.

As previously highlighted, having a higher percentage of females (67%) in the total sample could have been one factor that led to the weak association between habit and travel behaviour. Since women in European countries have a lower access to the car and use the car less continuously than males, they tend to develop weaker travel habits (Matthies et al., 2002). As discussed in Section 2.5.1 (e.g. Siren and Hakamies-Blomqvist, 2005) older females tend to travel for more practical reasons than males (e.g. to chauffer their family or friends). Their behaviour may depend more on the different circumstances that arise rather than on habitual practices. Thus, the higher percentage of females in the sample could also have affected the results from this regard. Moreover, analysing travel behaviour from a generic perspective rather than focusing specifically on mode choice (Section 6.2) could also have led to the lower impact of habit. This is because habit is mostly related to mode choice (Section 3.4.2). All these issues will be discussed in further detail in Chapter 8 when the findings of this study will be discussed in relation to the body of literature.

Section 6.3.1 clearly showed that transport infrastructures and other people's behaviour in the road made older people's travel more difficult. The *Facilitating Conditions* construct was the lowest ranked (2.91) among all psychological constructs discussed (Table 6.4). Based on the TIB framework, *Facilitating Conditions* were regressed directly with the travel behaviour. For simplification purposes, they were not included as a moderator between *Habit* and *Intention*. When using the TIB framework to understand behavioural factors that predicted internet abuse and non-work related computing at work, Woon and Pee (2004) as well as Pee et al. (2008) also regressed facilitating conditions directly with behaviour (and not as a moderator between intention and habit). Supporting the earlier discussion on habit, such simplification in these studies still provided meaningful results as in the case of this research. The positive significant relationship shown in Figure 6.2 (β=0.04, p=0.042) showed that when conditions were actually "facilitating" (e.g. good transport infrastructures, good travel information) older people tended to have more positive and independent mobility. This supported the discussion in Section 2.5.3 on the environmental factors that affect mobility in later life. Yet, this was the construct with the lowest effect on older people's travel behaviour. This was also evident from the high p-value indicating that the association was almost insignificant. This will be discussed in more detail in Chapter 8. Unlike the antecedents of *Intention*, *Habit* and *Facilitating Conditions* were not correlated with each other (r=0.04, p=0.507). This supported the TIB which states that habit and facilitating conditions are separate predictors of behaviour.

Overall, *Intention*, *Habit* and *Facilitating Conditions* explained 41% of the variance in *Travel behaviour* (R^2=0.41) with *Intention* being the strongest predictor. When the model was tested again omitting the effects of *Habit* and *Facilitating Conditions* on *Travel behaviour*, the variance (R^2) just increased from 0.41 to 0.45. This showed that intention was a better predictor for travel behaviour when it acted as the sole antecedent, supporting the argument that older people's behaviour was mostly cognitively guided.

Chapter 5 and this chapter showed that psychological determinants do not act in isolation but are well affected by demographic and socio-economic factors. Hence, it would be interesting if future studies could include simultaneously the objective and psychological determinants of travel in the SEM model. Separate models that distinguish older people by age and gender could also be developed. Given the multiple effects that gender had on various travel behaviour indicators, it is also recommended that future studies have an equal sample of males and females so as to avoid any bias in the results caused by gender imbalance.

6.5 Conclusion

The results showed that all the TIB variables had a positive significant impact on travel behaviour and the model fitted the data. Older people's travel behaviour was motivated primarily by their intentions which were mostly affected by their social norms and self-concept. Results also indicated that cognitive thinking had a higher effect than automatic travel. The antecedent that had the smallest effect on travel behaviour was the facilitating conditions. This was primarily related to the difficulties that older people encountered in the road due to inappropriate transport infrastructures (e.g. pavements, road signage) and other people's behaviour (e.g. the way they drive). A detailed discussion on how the model's findings relate with the body of literature and on their implications to policy is presented in Chapter 8.

To date, there are no studies that used the TIB framework to analyse older people's mobility, and this chapter was exploratory in its nature. Yet, the findings still added insights to older road users' psychology. The two additional variables of the TIB over the TPB (*Affect* and *Habit*) both had a significant impact on older people's travel behaviour. Therefore, despite not being commonly used in transport studies, the theory indicated the importance of adopting alternative viewpoints.

By analysing the psychological determinants of travel in later life, the findings of this chapter complemented those in Chapter 5. Given the high motorisation rate, the very high population density and the ageing society in an under-researched case study (Malta), these results provide transport policy makers a wider picture regarding the motivations for how older people travel. Any recommendations for transport policy would benefit from an understanding of whether older people's travel behaviour is predominantly guided by objective factors, their intentions, habitual practices and/or facilitating conditions around them.

Such insights could also be applied to other societies. By knowing what motivates older people to travel, policy makers could develop services that meet their needs and expectations, and thus such results could also be used to maximise older people's travel motivations. For example, an individual's affect towards travel behaviour could be outside the ability of policy makers to alter. However they can work on providing facilities that improve older people's emotions when travelling (e.g. a safer environment which reduces fear and anxiety). Additionally, this chapter also found that older people's travel behaviour was under a strong normative control where family members and health professionals created normative expectations for older people's travel. Hence, when policy makers intervene in improving mobility in later life, they should also target this aspect. After such an understanding, the next chapter will now use this information to develop clusters of older people that acknowledge the heterogeneity of travel in later life.

CHAPTER 7

CLUSTERS OF OLDER PEOPLE

7.1 Introduction

This chapter seeks to achieve the fourth objective of the study, to determine clusters of older people based on objective and psychological determinants that affect travel behaviour. In this respect, clusters were developed based on the travel behaviour of older people and the objective and psychological determinants affecting their travel. Section 7.2 describes the clustering algorithm and explains the techniques used to validate the clusters. Following this, Section 7.3 is divided into three main sub-sections to explain the personal, psychological and travel behaviour profile of the clusters developed. Conclusions are then provided at the end of the chapter.

7.2 Two-Step Clustering – A Description

Cluster analysis is an exploratory statistical tool which develops clusters of individuals or objects based on their similarities of specific characteristics. This is done by maximising homogeneity within the clusters and heterogeneity between the clusters (Hair et al., 2005). Given the heterogeneity of the travel behaviour in old age, Section 2.7 discussed various ways how older people were grouped in clusters in the body of literature so as to identify target groups for specific transport measures. Complementing this, this chapter will group older people in Malta to understand how mobility varies among this demographic group and what type of measures are needed for specific sub-groups of older people (discussed in Chapter 8). Two-step clustering analysis was used. As discussed in Chapter 4, this is the only clustering algorithm that should be used when there are both continuous and categorical variables (Norusis, 2011).

The regression models (Table 5.14, page 156), showed that from all the sixteen predictors of travel behaviour, there were some which were more important than others. Given this, the top eight objective predictors (half of all the predictors) were used in the cluster analysis. These included age, district of residence, participation in social activities, occupation status, presence of assistive device, physical health, fall in previous year and gender (Table 7.1). With regard to the psychological determinants of travel behaviour (Chapter 6), all the TIB constructs used in the model except from *Facilitating Conditions* were included in the cluster analysis. These included *Attitudes*, *Affect*, *Social Norms*, *Habit* and *Intention* (Table 7.1). *Facilitating Conditions* were not included due to their limited effect in predicting travel behaviour (Chapter 6). For every psychological variable the two statements defining each construct were used (see Section B of questionnaire survey in Appendix B). Since the psychological Likert Scale statements were treated as continuous variables in the structural model in Chapter 6, for consistency purposes they were also considered as continuous variables in the cluster analysis. Other studies that used two-step clustering and included ordinal variables (e.g. Likert, Bi-polar scales) also treated such information as continuous (Tkaczynski, 2016, Hsu et al., 2006, Griffin et al., 2014). For verification purposes, the cluster analysis was also tested using the psychological constructs as categorical variables. The same clusters emerged, and thus the psychological variables were treated as continuous in order to be consistent with Chapter 6 and with previous research.

In addition to the independent variables, the dependent travel behaviour indicators were also included in the cluster analysis. Following on from the regression models (Chapter 5), these included travel range, whether they were drivers or not, whether they had travel accompaniment, public transport use, travel frequency, travel time and the total number of travel purposes (Table 7.1). The number of utilitarian and discretionary travel purposes was not included in the cluster analysis since the structure of the question was creating redundancies with the generic total number of travel purposes. Nonetheless, such differences in the type of travel purposes were still analysed separately, as shall be seen towards the end of this chapter.

The clusters in this study were therefore based on the objective and psychological determinants of travel behaviour of older people. In this manner, clusters were not only grouped based on socio-demographic and psychological variables alone, but more importantly on how these factors integrate and affect their travel behaviour.

Personal (Objective) Variables with Description		**Psychological Variables (Five-point Likert Scale)**	**Dependent Travel Behaviour Variables with Description**	
Age	Continuous variable	Perceived Consequences 1	Travel Range	Not just in familiar areas/not always/ Just in familiar areas
Gender	Male/Female	Perceived Consequences 2	Travel Accompaniment	Alone/Depends/Always Accompanied
District	SH, NH, SE, W, N, G*	Emotions 1	Public Transport Use	Daily/weekly/monthly/ infrequently/never
Participation in Social Activities	Yes/No	Emotions 2	Number of cars available	No cars available/ 1-2 cars/3-4 cars/5-6 cars/Driver
Occupation	Work/Housewife/ /Inactive ed/Retired	Self-Concept 1	Travel Frequency	Daily/Did not travel daily/Did not travel at all
Assistive Device	Yes/No	Self-Concept2	Travel Time	Did not travel at all/<2 hours/2-4 hours/5-7 hours
Physical Health	Good/Neutral/Bad	Social Norms 1	Number of Travel Purposes	0-1/2-3/4+
Fall in previous year	Yes/No	Social Norms 2		
		Intention 1		
		Intention 2		
		Habit 1		
		Habit 2		
*SH=Southern Harbour, NH=Northern Harbour, SE=South Eastern, W=West, N=North, G=Gozo				

Table 7.1: The variables included in clustering algorithm

Since there was a mix of continuous and categorical variables, the log-likelihood distance measure criterion was used. The distance between the two clusters depended on the decrease in the log-likelihood when they were combined into a single cluster. Cases were assigned to the cluster that yielded the largest log-likelihood. The algorithm also automatically standardized all the variables. Due to differing scales among the variables, this ensures that one variable does not dominate the cluster solution. The algorithm was set up to specify the number of clusters automatically based on the Schwarz Bayesian Criterion (BIC). Smaller values of the BIC mean better models, and thus the smallest BIC represent the “best” cluster solution (Norusis, 2011). Ratios of BIC changes and ratios of distance measures are analysed to determine the best number of clusters. Based on Table 7.2, a three-cluster solution was chosen because it had one of the smallest BIC (15005.17) value, with a relatively large ratio of BIC change (0.503) and of distance measure (1.89).

Auto-Clustering				
Number of Clusters	Schwarz's Bayesian Criterion (BIC)	BIC Change[a]	Ratio of BIC Changes[b]	Ratio of Distance Measures[c]
1	16304.36			
2	15439.72	-864.64	1	1.558
3	15005.17	-434.55	0.503	1.89
4	14933.33	-71.833	0.083	1.435
5	14985.02	51.681	-0.06	1.037
6	15046.73	61.716	-0.071	1.223
7	15158.44	111.706	-0.129	1.157
8	15300.54	142.098	-0.164	1.012
9	15444.93	144.395	-0.167	1.041
10	15596.78	151.845	-0.176	1.039
11	15755.57	158.794	-0.184	1.173
12	15940.38	184.805	-0.214	1.013
13	16127.06	186.685	-0.216	1.051
14	16320.91	193.848	-0.224	1.121
15	16530.04	209.128	-0.242	1.031
a. The changes are from the previous number of clusters in the table.				
b. The ratios of changes are relative to the change for the two cluster solution.				
c. The ratios of distance measures are based on the current number of clusters against the previous number of clusters.				

Table 7.2: The Cluster Selection with BIC Value

7.2.1 Validation of Clusters

The resulting clusters were validated based on four criteria as defined by Tkaczynski (2016). These validation criteria and the respective results within this study are explained in Table 7.3.

Norusis (2011) explained that outliers can influence the formation of clusters and make them less homogenous. The two-step cluster analysis can check for outliers and create an outlier cluster that contains all cases that do not fit well with the rest. Data was checked for such outliers and similar clusters emerged with similar characteristics and significance levels. Thus, the whole sample was retained.

Moreover, the two-step clustering algorithm is based on the assumption that continuous variables have a normal distribution and categorical variables have a multinomial distribution. In this study, not all the variables followed such assumptions. However, it is rarely the case that such assumptions are met. Since cluster analysis only involves a descriptive follow-up with no hypothesis testing and calculation of observed significance levels, it is perfectly acceptable to cluster data that does not meet the assumptions of best performance (Norusis, 2011).

	Validation Criteria	Cluster Solution in this study
1	Silhouette measure of cohesion should be greater or equal to 0. A silhouette measure of cohesion greater than 0.2 is the best, indicating a fair separation distance between clusters	Silhouette measure in this study was 0.2.
2	Variables should be statistically significant between clusters	Variables were statistically significant between clusters.
3	Variables with a predictor importance of less than 0.2 could be included but responses to these variables will be similar between clusters. There is no rule of thumb on how variables are eliminated from cluster solution.	The clustering algorithm was re-run without variables that had a predictor importance of less than 0.2. The same clusters emerged with same characteristics and significant levels. Thus, all variables were kept in the algorithm.
4	The final solution may depend on the order of cases in the file. The sample should be divided into two and results are compared with the final solution. If the same clusters are found in the final solution and in its subsample with similar characteristics, then validation is confirmed.	Cases were ordered randomly. The total sample (500) was divided into two and the same cluster analysis was conducted. Subsamples were compared with each other and with the whole sample and all the three cluster solutions were stable and comparable.

Table 7.3: The cluster validation criteria and the cluster solution in the study (Adapted from Hair et al., 2005; Norusis, 2011; Tkaczynski, 2016)

7.3 The Clusters

The cluster solution yielded three clusters. Each cluster was profiled in terms of its shared personal (objective), psychological and travel behaviour characteristics. The three clusters developed are listed and labelled below, each with an acronym that was used for simplification purposes. The respective size of each cluster is listed in parenthesis.

1. The *Complacent and Autonomous Younger-Old* (*CAYO*) (38.6%)
2. The *Slightly Restrained Younger-Old* (*SRYO*) (55.4%)
3. The *Pessimistic Limited-Mobility Older-Old* (*PLMOO*) (6%)

The cluster sizes were a reflection of the sample size used for the study. As explained in Chapter 4, the older-old (80+) represented a very small percentage of the total sample, and thus the smallest cluster (6%) was a result of the lower number of participants in this age range. Although they are increasing at a fast rate, the older-old also represent the smallest number in the overall older population in Malta. Other studies applying cluster analysis on older people's mobility behaviour (e.g. Hildrebrand, 2003) also displayed similar clusters. The size of the smaller cluster was 4% (*Granny Flats*) when compared to 39% of the largest one (*Affluent Males*) (Hildrebrand, 2003). When using two-step cluster analysis to identify groups of census collection districts with similar land use profiles in Adelaide, Cerin et al. (2007) also discovered clusters with a very small number of cases. This resulted in a large difference in the ratio between the smallest (10) and largest (100) cluster.

The top five variables that had the highest predictive importance and were the most relevant in defining the three clusters were travel time, travel frequency, gender, number of cars in household and occupation status. This means that the key variables that defined the clusters were mostly related to the socio-demographic and travel characteristics of older people. In line with what was discussed in Chapter 6, the psychological variables that were most important in the formation of clusters were intention, social norms and self-concept. These will be discussed in further detail in the following sections.

The differences between the emergent clusters were tested and compared using the Kruskall Wallis Test for continuous variables (due to the lack of normality in the data) and the Chi-Square Test for categorical variables. The respective significance test was conducted with the cluster number as an independent variable and the respective variables as dependent categories. Most variables were significantly different between the three clusters. There were very few variables that did not differ significantly. Yet, such insignificant difference still revealed important information about older people, which will be explained and discussed later. Other studies which used the two-step clustering algorithm also had variables that were not statistically significant between the clusters and revealed important information (e.g. Hsu et al., 2006; Ulstein et al., 2007).

The following sections will explain the profile of the three clusters based on their personal (objective) (Section 7.3.1), psychological (Section 7.3.2) and travel behaviour (Section 7.3.3) characteristics. Apart from the variables included in the cluster analysis (Table 7.1), additional variables included in the regression and SEM models in Chapters

5 and 6 respectively, will also be discussed for a better understanding of the cluster profile.

7.3.1 The Personal (Objective) Profile

As previously highlighted, gender was one of the main predictors that defined the different clusters. Males were over-represented in the *CAYO* cluster whilst females were over-represented in the *SRYO* and in the *PLMOO* clusters (p-value=0.000) (Table 7.4). With regard to the average age, as the name of the clusters suggests, the main difference was between the younger-old and the older-old. Supporting what was discussed in Section 2.3, Alsnih and Hensher (2003) used the age of 75 to distinguish the younger-old and older-old seniors since this was the age when health started to deteriorate. When analysing the difference between older people themselves, Boschmann and Brady (2013) also divided older people in the 60-64 group (pre-retirement), the 65-74 group (younger-old), the 75-84 group (older-old) and the 85+ (high longevity). The average ages for the *CAYO* and the *SRYO* were of 68.37 and 70.09 years, respectively. These represented the younger-old clusters. On the other hand, the average age for the *PLMOO* was of 81.2 years, representing the older-old cluster.

The Kruskal Wallis Test showed that the mean age differed significantly even between the two younger-old clusters (p-value=0.011). This is because the *SRYO* had a higher percentage of older people that were within the 70-79 years (35%) when compared to the *CAYO* (20.7%). Inversely, the latter cluster had a higher percentage of older people between the age of 60 and 69 years (69.9%) when compared to the *SRYO* (50.2%). As expected, the mean age difference between the two younger-old clusters and the older-old one was also statistically significant (p-value=0.000). Such mean age difference between the clusters was not surprising given that age was the predictor that affected most of the travel behaviour indicators in Chapter 5 (Table 5.14, page 156).

Nonetheless, despite the age difference between clusters, it is worth noting that the *PLMOO* had a considerable percentage (36.7%) of members that was between 60 and 79 years. Correspondingly, the *CAYO* and *SRYO* clusters also had a substantial percentage of older-old members (9.3% and 14.17% respectively). This supported the fact that age was not one of the top five predictors in the clusters' formation.

Irrespective of the age, there were older-old people who travelled in a similar manner as the younger-old and vice-versa.

	Clusters		
	CAYO (%)	*SRYO* (%)	*PLMOO* (%)
Average Age	68.37	70.09	81.20
Gender (Females %)	22.3	98.6	76.7

Table 7.4: Age and gender for each of the three clusters

Table 7.5 shows how the occupation status of older people varied between the three clusters. What was the most interesting to note was the difference in the percentage of older people who worked and those who were inactive or unemployed. Given their age, there was a zero percentage of older people who worked (or else were unemployed) in the *PLMOO* group. On the other hand, there was a significantly higher percentage of older people who worked in the *CAYO* cluster (16.6%) when compared to the *SRYO* cluster (2.5%). Correspondingly, the percentage of older people who were retired was higher (79.3%) in the former cluster when compared to the *SRYO* (31%). Once again, the gender difference was a key factor in this discrepancy since the number of males in Malta who work is significantly higher than that of females (NSO, 2014b). Such situation is even more accentuated among older people.

In the case of inactive and unemployed older people, higher percentages were recorded for the *SRYO* (5.1%) when compared to the *CAYO* (2.6%). This is an indication that unemployment (and lower income levels) could be one factor affecting negatively the mobility of this cluster. Model 1 in Chapter 5 showed that the occupation status was an important determinant for whether older people drove or not. Those who worked had a higher probability to be drivers, and as highlighted in Section 7.3, being a driver (and the respective number of cars available in the household) was a key predictor for the formation of clusters. Thus, the link between occupation status and driving was one major reason for the *SRYO* to have limited mobility. This will be discussed further in Section 7.3.3.

Whilst the differences in the occupation status between the two younger-old groups were significant (p-value=0.000), those between the *SRYO* and the *PLMOO* were not (p-value=0.121). Since these two clusters were mostly composed of females, this lack of significant difference showed that the main variations in the occupation status were mostly because of gender and not because of age. The participation of older people in social activities was considerably low for all older people in the study (Table 7.5). As expected, given the vulnerabilities associated with older-old age, percentages got even lower for the *PLMOO*.

		Clusters		
		CAYO (%)	*SRYO* (%)	*PLMOO* (%)
Occupation status	Work	16.6	2.5	0
	Housewives/Priest	1.6	61.4	50
	Inactive/Unemployed	2.6	5.1	0
	Retired	79.3	31.0	50
	Participation in Social Activities	27.5	29.2	3.3

Table 7.5: Occupation status and participation in social activities for each of the three clusters

As shown in Table 7.6, whilst 76.2% of the *CAYO* reported *good* physical health (ranked 4 and 5), the *SRYO* were weaker because 59.2% ranked their physical health as *good*. The percentage of older people who perceived their physical health as *bad* (1 and 2) in the *SRYO* cluster was also significantly higher (11.2%) when compared to the *CAYO* (3.1%). This difference between these two clusters was statistically significant (p-value=0.000). This showed that the differences in the physical health between the two younger-old clusters could be an important factor affecting their travel behaviour. Similar results were obtained in the regression models (Chapter 5) where physical health was a significant predictor for travel accompaniment, travel frequency and the number of discretionary travel purposes that older people travelled for. As expected, for the *PLMOO*, the physical health status was significantly worse than that of the other two clusters (p-value=0.000).

Correspondingly, the three clusters displayed significant differences for the use of assistive devices and for whether older people suffered from a fall in the previous year. No significant difference was observed between the two younger-old groups with regard to the presence of an assistive device (p-value=0.830) since both clusters had a considerably low percentage (Table 7.6). Hence, although the *SRYO* reported a lower physical health status, there were no major differences with regard to the use of assistive devices. The same could not be stated for whether they suffered from a fall in the previous year (Table 7.6). The difference between the *CAYO* and *SRYO* was indeed statistically significant (p-value=0.000). This shows that although both clusters consisted primarily of younger-old individuals, the *SRYO* suffered more falls when compared to the *CAYO*. This corresponded with the better physical health status recorded in the latter cluster. The *PLMOO* had the highest percentages of members with an assistive device (66.7%) and of those who suffered from a fall in the previous year (46.7%). Such figures showed statistically significant differences from the other two clusters (p-value=0.000 for both combinations when analysing assistive device; p-value=0.009 when analysing the *SRYO* vs. *PLMOO* and p-value=0.000 when analysing *CAYO* vs. *PLMOO*). This reflected the lower health status associated with this cluster.

		Clusters		
		CAYO (%)	*SRYO* (%)	*PLMOO* (%)
Physical Health	Bad (1 and 2)	3.1	11.2	56.7
	Neutral (3)	20.7	29.6	30
	Good (4 and 5)	76.2	59.2	13.3
	Presence of assistive device	21.8	20.9	66.7
	Fall in Previous Year	4.1	24.5	46.7

Table 7.6: Health characteristics for each of the three clusters

Finally, the differences between the three clusters with regard to the district where older people lived were not statistically significant (p-value=0.218). One possible reason for this lack of spatial difference could be the small geographic size of the islands. Yet, this might also be due to other factors, such as the small sample of the study. This clearly means that such concept needs further investigation in the future.

Other Personal Factors

Other personal (objective) factors for which data was collected but not included in the cluster analysis were marital status (and household type), education levels, personal assistance, medicine intake and perceived mental health. Such variables were still analysed in order to provide further information.

As shown in Table 7.7, with regard to the marital status of older people, the key difference was between the two younger-old groups and the older-old cluster (p-value=0.000 for all the combinations between the three clusters). The *PLMOO* group had a significantly higher percentage of widows/widowers when compared to the other two groups, which had the highest percentages of married older people. This was quite expected, indicating that the older one gets the lonelier s/he may become and thus may depend more on others for basic travel needs. Older females tend to rely substantially on their husbands for their mobility and the loss of their partner can cause considerable changes in the way they travel (Hough et al., 2008). Marital status was also identified as an important predictor for the travel accompaniment of older people in Model 3 (Chapter 5).

Table 7.7 also shows that there were significant differences between each of the three clusters with regard to their education levels (p-value=0.000). The *CAYO*, composed mostly of younger-old males, was the cluster with the highest education levels. This was followed by the *SRYO* and *PLMOO* respectively. As shall be explained later, the three clusters showed that higher education levels were associated with higher mobility levels. Nevertheless, the education level of older people was neither among the important variables in the clusters' formation nor was it among the top travel predictors discussed in Chapter 5 (see also Table 5.14, page 156).

		Clusters		
		CAYO (%)	*SRYO* (%)	*PLMOO* (%)
Marital Status	Single	10.9	8.7	6.7
	Married	78.8	73.6	46.7
	Separated	2.1	0.4	0
	Widow	8.3	17.3	46.7
Education	No Schooling	6.7	10.8	43.3
	Primary	20.2	46.9	43.3
	Secondary	59.6	39.7	13.3
	Tertiary	13.5	2.5	0

Table 7.7: Marital status and education levels for each of the three clusters (not included in cluster analysis)

The physical health status of the three clusters discussed in Section 7.3.1 was further supported with additional information regarding the health conditions of older people (Table 7.8). The *CAYO* had the lowest percentage of older people with personal assistance (13.5%) followed by the *SRYO* (17.3%). On the other hand, having an average age of almost 82 years, the *PLMOO* had the highest share of older people with a person assisting them (73.3%). Such difference was significantly different from the two younger-old groups (p-value=0.000). The positive health status of the *CAYO* was also reflected in their intake of medicines. This cluster had the highest share of older people that took no medicines at all (37.8%). This percentage was significantly higher than that of the *SRYO* of whom only 17% did not take any medicines (p-value=0.000). On the other hand, the absolute majority (96.7%) of the *PLMOO* took prescribed medicines (p-value=0.000). Older people's perceptions on their mental health were also analysed between the clusters. However no significant differences emerged. This complemented earlier discussions where older people were more aware of their physical limitations when compared to mental characteristics.

		Clusters		
		CAYO (%)	*SRYO* (%)	*PLMOO* (%)
	Personal Assistance	13.5	17.3	73.3
Medicine	Prescribed	59.1	79.8	96.7
	Over the counter	3.1	3.2	3.3
	No Medicine	37.8	17.0	0.0
Mental Health	Bad (1 and 2)	3.1	3.2	10.0
	Neutral (3)	8.3	7.9	6.7
	Good (4 and 5)	88.6	88.8	83.3

Table 7.8: Other health characteristics for each of the three clusters (not included in cluster analysis)

7.3.2 The Psychological Profile

As previously explained, the clusters also represented the psychological determinants of older people's travel behaviour. This was necessary in order to obtain a wider picture of what really affects the way older people travel. Since none of the variables had a normal distribution, the Kruskall Wallis Test was used as a non-parametric test to compare the significant pairwise differences between the three clusters (Table 7.9). Similar to what was done for the personal (objective) characteristics of the clusters, although *Facilitating Conditions* were not included in the cluster analysis (due to their low predictive power), they were still analysed and will be discussed later on. The scores were plotted onto a star chart to better show how the psychological outlook towards travel behaviour varied between the three clusters (Figure 7.1).

	CAYO* vs *PLMOO	***SRYO* vs. *PLMOO***	***CAYO* vs *SRYO***
Psychological Constructs	**p-value**		
Perceived Consequences 1	0.000	0.000	0.063
Perceived Consequences 2	0.000	0.000	0.450
Affect 1	0.004	0.000	0.064
Affect 2	0.044	0.000	0.001
Self-concept 1	0.000	0.000	0.001
Self-concept 2	0.034	0.000	0.000
Social Norms 1	0.000	0.000	0.065
Social Norms 2	0.000	0.000	0.078
Habit 1	0.004	0.000	0.002
Habit 2	0.006	0.001	0.365
Intention 1	0.000	0.000	0.002
Intention 2	0.000	0.000	0.019

Table 7.9: The pairwise significance (p-value) between the three clusters

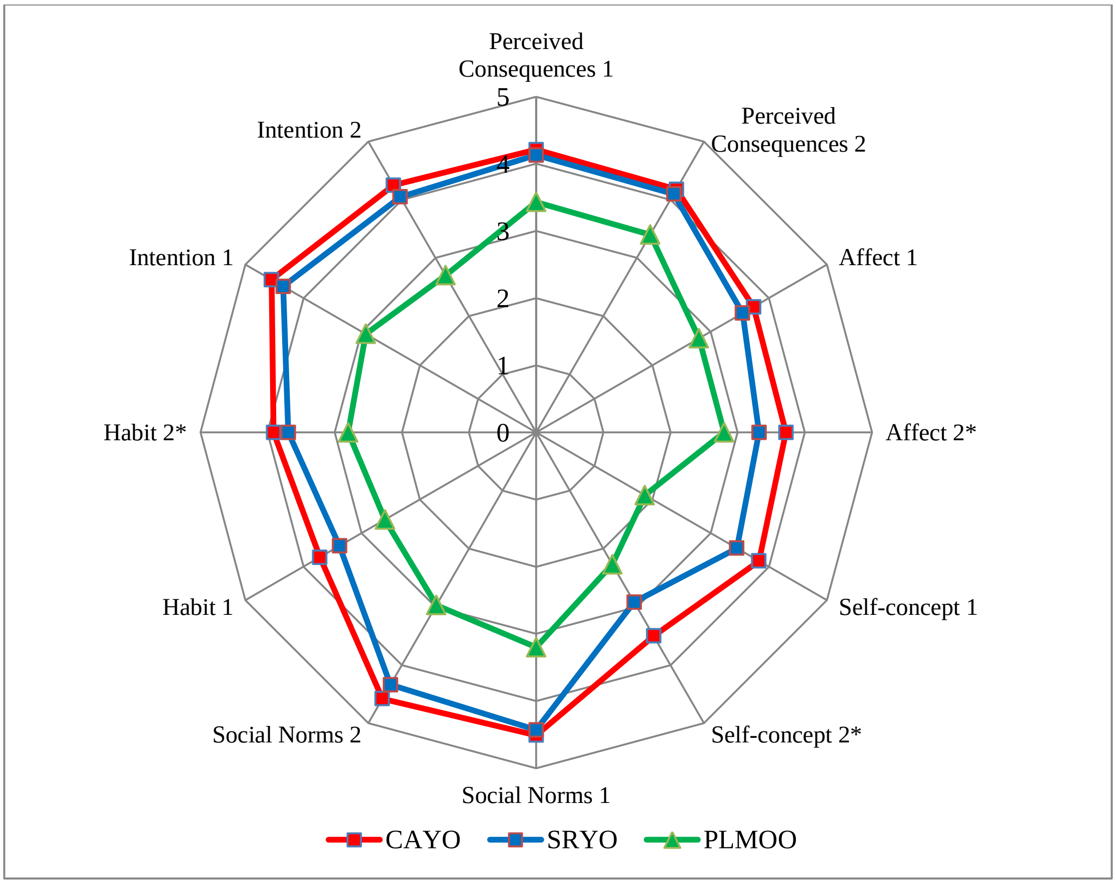

Figure 7.1: Star chart showing mean factor score for each psychological construct per cluster

As regards to the perceived consequences that older people thought of with respect to their travel behaviour, although the ranking for the *SRYO* was slightly lower than that of the *CAYO*, the difference between the two younger-old clusters was not statistically significant (Table 7.9). This showed that *both* younger-old clusters felt that their travel behaviour improves their quality of life and that the way they travelled was safe (Figure 7.1). On the other hand, the *PLMOO* had a lower mean score for both indicators in this construct (Table 7.10), which differed significantly from the two other clusters (p-value=0.000). This showed that the older-old were quite neutral on the thought that their travel behaviour improves their quality of life and that it is safe for themselves and for others. Due to an older age, they may feel that it is not their travel behaviour which improves their quality of life but maybe other factors related to their medical conditions (as discussed in Section 7.3.1).

Code	Statement's brief in questionnaire	Clusters		
		CAYO	*SRYO*	*PLMOO*
Perceived Consequences 1	Travel behaviour improves quality of life	4.21	4.13	3.43
Perceived Consequences 2	Travel behaviour is safe	4.18	4.1	3.4

Table 7.10: Mean scores for the "Perceived Consequences" construct for each of the three clusters

Interesting variations emerged between the three clusters when emotions towards travel behaviour were analysed. A statistically significant difference was found even between the two younger-old clusters. As shown in Figure 7.1 and Table 7.11, the *CAYO* had the highest mean score for emotions towards their travel behaviour. Being more healthy and independent, the members of this cluster were those who felt most happy and suffered less anxiety due to fears such as when navigating main intersections. The *SRYO* had lower scores (Table 7.11). What is interesting to highlight is that whilst the difference between the two younger-old groups in terms of happiness was not statistically significant (p-value=0.064), the difference in terms of anxiety was significant (p-value=0.001). This showed that the *SRYO* (composed mostly of younger-old females) was significantly more anxious in the road than the *CAYO* cluster (composed mostly of younger-old males). This was also a reflection of the personal characteristics discussed in Section 7.3.1 (e.g. lower health status, higher percentage of falls in the previous year). These tend to increase the limitations of older people in the transport environment and can also contribute to make them more anxious.

As shown in Table 7.11, with regard to the *PLMOO*, the mean score for emotions towards travel behaviour was significantly low. This differed significantly from the two younger-old clusters (Table 7.9). Since this group suffered from various personal limitations (e.g. low health status, had an assistive device etc.) they had several mobility problems which made them unhappy and anxious when travelling. Unhappiness is also usually caused because of unrealised mobility (Luiu et al., 2017), where older people desire to have different mobility patterns that are not possible due to various problems. Being the most vulnerable, it was realistic that this cluster had the highest fears when travelling.

Code	Statement's brief in questionnaire	Clusters		
		CAYO	*SRYO*	*PLMOO*
Affect 1	Travel behaviour makes me happy	3.74	3.55	2.8
Affect 2*	Travel behaviour makes me anxious	3.72	3.32	2.8
*Reverse-coded				

Table 7.11: Mean scores for the "Affect" construct for each of the three clusters

With regard to the social norms affecting older people's intentions towards their travel behaviour, the *CAYO* cluster recorded the highest values (Table 7.12). Although for the *SRYO* mean scores were slightly lower, the difference between these two clusters was not statistically significant (Table 7.9). The mean scores for the *PLMOO* were significantly lower. The mean score for family and friends' agreement was of 3.2 whilst that of health professionals was of 2.97 (Table 7.12). Such rankings were indeed statistically different from the other two younger-old groups (Table 7.9). Such values are rather worrying since they might indicate a behaviour which family members, friends, and particularly health professionals do not approve. Thus, their travel behaviour (discussed in detail in Section 7.3.3) could be unsafe both for themselves and for other people in the road environment.

Code	Statement's brief in questionnaire	Clusters		
		CAYO	*SRYO*	*PLMOO*
Social Norms 1	Family/friends agree with my travel behaviour	4.51	4.43	3.2
Social Norms 2	Health professionals agree with my travel behaviour	4.58	4.34	2.97
Self-concept 1	Still fit for my travel behaviour	3.83	3.45	1.87
Self-concept 2*	I need to adopt different compensation techniques	3.5	2.92	2.27
*Reverse-Coded				

Table 7.12: Mean scores for the "Social Norms" and "Self-Concept" constructs for each of the three clusters

When compared to the social norms, the mean rankings for the self-concept of older people were generally lower (Table 7.12). As expected, the *CAYO* felt that they were fit for their travel behaviour and would feel bad if they do not stick to it (3.83). Although also composed of younger-old people, the *SRYO* had a lower ranking (3.45) which differed significantly from that of the *CAYO*. This was quite expected given the personal limitations discussed in Section 7.3.1. Gender issues could also have played an important role in this regard. This supported earlier discussions (in Chapter 2) which argued that males have a higher self-esteem than females in the road environment and behave accordingly. Unsurprisingly, the *PLMOO* did not feel fit at all for their travel behaviour (1.87), and differed significantly from the two younger-old groups (Table 7.9). This explained better the previously discussed unhappiness and anxiety of this cluster.

Significant differences between the three clusters also emerged with regard to the compensation techniques that older people adopt in the transport environment. The *CAYO* felt they needed the least compensation techniques due to their good health and mobility levels (Table 7.12). The ranking for the *SRYO* was significantly lower than that of the former cluster, indicating that younger-old females compensated more in the way they travelled. As expected, the *PLMOO* were those who compensated most in their travel behaviour. Such findings linked to what was discussed previously for the social norms of this cluster. Since the *PLMOO* was the cluster with the lowest social agreement, such high ranking for their compensation techniques confirmed that the older-old actually did try to reduce their limitations in the road environment. Nonetheless, such techniques might not have been enough for the family members and health professionals to agree with. This could either mean over-protection from family members, or else that the compensation techniques are not effective enough.

For the habit construct, a very important one within the TIB, there were also significant differences between each of the three clusters. As shown in Table 7.13, for the *CAYO*, the average mean score for travel behaviour habit was of 3.72. They also had a considerable low ranking with regard to how much they try to modify their travel behaviour (3.91). The travel behaviour of the *SRYO* was statistically less habitual than that of the *CAYO* (Table 7.13). This showed that the latter cluster, composed mostly of fit and healthy younger-older people with the highest mobility levels, had a travel behaviour which was more habitual and automatic than that of the other younger-old group. Being slightly vulnerable (e.g. lower health status, more unemployment), the *SRYO* might have needed to adapt more to the different circumstances that arise rather than sticking to habitual travel behaviour.

The gender difference between the clusters might have been a key determinant in this regard because as highlighted in the previous chapters, younger-old males (*CAYO*) usually stick to habitual travel behaviour more than younger-old females (*SRYO*) (e.g. Siren and Hakamies-Blomqivist, 2004; Oxley and Charlton, 2009 – see Sections 2.5.1 and 2.6.1). One reason for this is the different lifestyle between the genders. The percentage of younger-old males who worked was significantly higher than that of females (Section 7.3.1). Thus, their more "stable environment" could have exemplified their habitual behaviour. Moreover, as shall be discussed later on, the modes of transport that the younger-old used for their travel purposes were an essential factor which affected travel habits. The difference between the two younger-old clusters regarding the modifications that they do to their travel behaviour was not statistically significant (p-value=0.365). This showed that irrespective of the previously discussed differences in travel habits, both younger-old clusters did not like to change their travel behaviour much.

Code	Statement's brief in questionnaire	Clusters		
		CAYO	*SRYO*	*PLMOO*
Habit 1	Travel behaviour is automatic	3.72	3.38	2.6
Habit 2*	I try to modify my travel behaviour as much as possible	3.91	3.69	2.8
*Reverse-coded				

Table 7.13: Mean scores for the "Habit" construct for each of the three clusters

For the *PLMOO*, both statements in the Habit construct differed significantly from the younger-old clusters (Table 7.9). The mean ranking for the automaticity in their travel behaviour was significantly low (2.6), and they also claimed that they usually modify their travel behaviour (2.8) (Table 7.13). This reflected earlier discussions on the changing environments with increasing age. The common vulnerabilities and health limitations associated with the older-old made it more difficult for them to stick to a habitual behaviour. The health limitations of this cluster (Section 7.3.1) made them mostly dependent on others and as a result, they might not have been able to stick to habitual practices but had to rely on other people's schedules and lifestyles. Moreover, older-old people are not usually restricted with specific time schedules (e.g. work commitments), and thus may be easier for them to modify their travel patterns.

Ultimately, older people's intentions to continue with their travel behaviour in the future also differed significantly between the three clusters. As shown in Table 7.14, the *CAYO* had the highest mean scores. These differed significantly from the *SRYO*'s rankings, which means that although both clusters were composed of younger-old people, the future intentions of the *CAYO* were significantly more positive (p-value=0.002). Given their positive attitudes, emotions, social norms and self-concept they were convinced that they will be able to continue following their same travel behaviour in the future. Once again, the personal limitations of the *SRYO* (discussed in Section 7.3.1) and the gender difference could have been key factors for their lower future intentions. Nonetheless, the overall high ranking for the two younger-old clusters showed that they were not so willing to change their travel behaviour in the future. Expectedly, for the *PLMOO*, the mean scores for their future intentions were very low (Table 7.14) and differed significantly from the two younger-old groups (p-value=0.000 for both clusters). Due to their older-old age and the associated vulnerabilities, it was not possible for them to have positive intentions for their future. This further explained and supported the lower habitual behaviour of this cluster. Transport policy makers should work specifically in order to make travel by this cluster a better experience. This will be discussed in further detail in Chapter 8.

Code	Statement's brief in questionnaire	Clusters		
		CAYO	*SRYO*	*PLMOO*
Intention 1	I intend to stick to my travel behaviour in the future	4.55	4.35	2.93
Intention 2	I will stick to my travel behaviour in the future	4.25	4.05	2.7

Table 7.14: Mean scores for the "Intention" construct for each of the three clusters

Other Factors

Although not included in the cluster analysis, it was also interesting to analyse how the facilitating conditions differed between the clusters. There were no significant differences between any of the three clusters with regard to how other people's behaviour in the road affected their travel. The mean rankings for all clusters were very low (2.86 for the *CAYO*, 2.87 for the *SRYO* and 2.43 for the *PLMOO*). This lack of significant difference showed that irrespective of the discussed variations in older people, it was very difficult for *all* of them to travel in Malta based on how other people usually behave (e.g. the way they drive, how they behave in public transport and so on).

On the other hand, there were significant differences between the clusters with regard to the ease of travel using the available infrastructure and travel information (e.g. complicated signs, position of bus stops, security issues, online travel information etc.). The mean ranking for the *CAYO* was of 3.15 whilst that for the *SRYO* and the *PLMOO* was of 2.91 and 2.43 respectively. The difference between the two younger-old clusters as well as that between the *CAYO* and the *PLMOO* was statistically significant (p-value=0.044 and p-value=0.003 respectively). This showed that between the two younger-old clusters, the *SRYO* had significantly more difficulties with the transport infrastructures and travel information available. Apart from the higher health limitations of this cluster (Section 7.3.1), the variation in the modes of transport that older people used could also have been critical in this regard. This will be discussed in further detail in the next sections.

As expected, the *PLMOO* had the highest difficulties with regard to the transport infrastructure and travel information available (mean ranking of 2.43). What is worth nothing is that despite the age difference, the mean ranking between the *SRYO* and the

PLMOO was not statistically significant (p-value=0.085). Since these two clusters were mostly composed of females, this confirmed that gender was more important than age in affecting the difficulties that older people faced in the road environment.

Finally, one should note that the two additional TIB constructs over the TPB, *affect* and *habit*, displayed significant differences between the three clusters. In some cases there was also a statistically significant difference between the two younger-old groups. This supported the theoretical framework chosen for this study (Chapter 3) and reinforced the discussion presented in Chapter 6 regarding the applicability of the TIB for this research and for other studies focusing on older people's mobility.

7.3.3 The Travel Behaviour Profile

Following a deeper understanding of the personal (objective) and psychological determinants of the three clusters, it was necessary to understand their actual travel behaviour. In line with previous chapters, the travel behaviour determinants that shall be discussed in this section are mode choice, travel range, travel accompaniment, travel frequency, travel time and the number of travel purposes that older people travelled for (also divided by utilitarian and discretionary travel).

Modes of Transport

The three clusters differed significantly with regard to the main modes of transport that they used for their basic travel needs. As shown in Table 7.1, the cluster analysis procedure included the variables dealing with whether older people were drivers or not (and the respective number of cars available in the household) and public transport use. Nonetheless in question 17 of the questionnaire (Appendix B), data concerning all modes of transport that older people use was also gathered. Since such question was also showing information on mode choice, it was not included in the cluster algorithm because it created redundancies with the other two variables (*drivers/not* and *public transport use*). Yet, this was then analysed separately and will be discussed in this section.

Figure 7.2 shows the absolute majority of the *CAYO* were drivers and infrequent public transport users (72%). This was followed by another 10.4% within this cluster who were drivers and frequent public transport users. This immediately reflected the high mobility levels of this cluster. This high percentage of drivers in the *CAYO* cluster further explained their higher habitual travel behaviour (Section 7.3.2). As highlighted in the previous chapters, driving is strongly associated with habitual practices (see Sections 2.4.1 and 3.4.2 for further information).

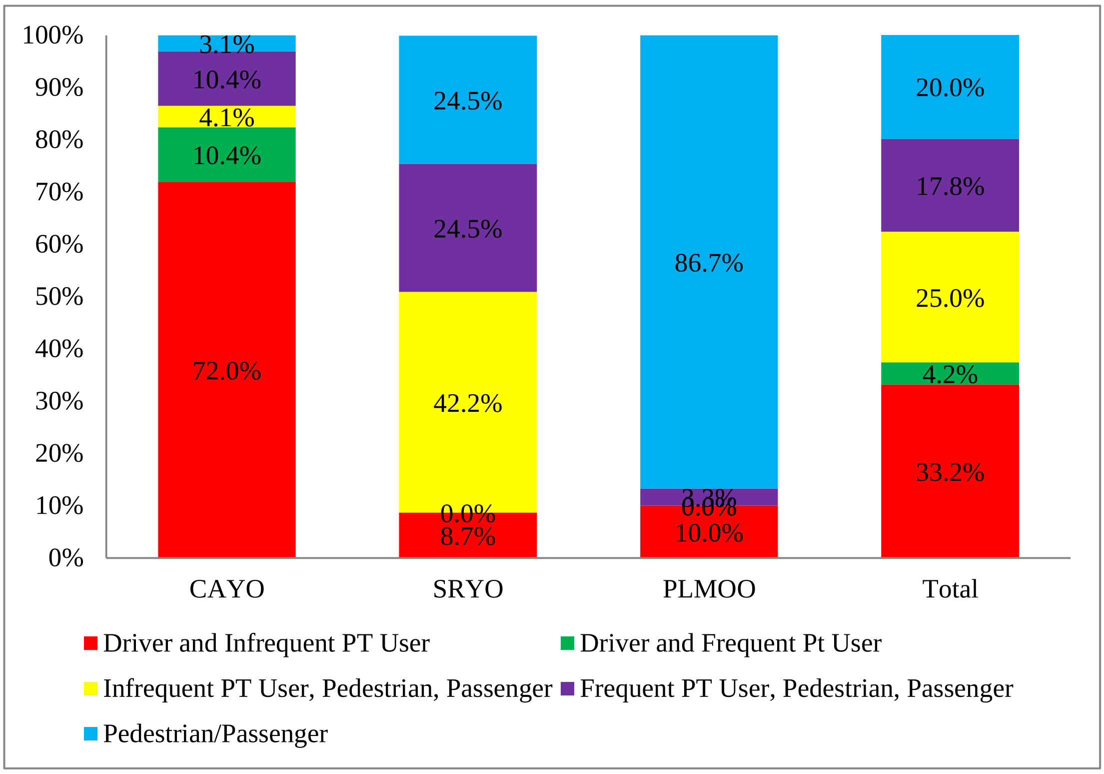

Figure 7.2: Mode choices for the three clusters compared to the total average

Contrastingly, the percentage of drivers in the *SRYO* was considerably low (8.7%). In this cluster, the highest percentages of younger-old people were infrequent public transport users, pedestrians and passengers (42.2%) (Figure 7.2). This was followed by 24.5% who did not drive but used public transport in a frequent manner, indicating potential captive bus use. Interestingly, another 24.5% of the *SRYO* travelled only on foot and as passengers. This showed that despite the “young” age of this cluster, a considerable percentage of its members had limited mobility and depended on other people to travel longer distances. This was a reflection of the *SRYO*’s personal and psychological limitations discussed in the previous sections. Such finding supported the results of Model 1 in Chapter 5 where gender was the first significant predictor for whether older people were drivers or not. Since the *CAYO* was composed primarily of younger-old males, this was one key reason for such an imbalance in the percentage of drivers. The difference in mode choice between the two younger-old clusters was statistically significant (p-value=0.000).

With regard to the *PLMOO*, Figure 7.2 shows that only a very small percentage were drivers (10%) and frequent public transport users (3.3%). Once again this reflected the regression models presented in Chapter 5 which found that age was a very important predictor for both driving and public transport use. The absolute majority of this cluster (86.7%) travelled as pedestrians and passengers only. This reflected their restricted mobility and dependence on other people. Unsurprisingly, the mode choice of the *PLMOO* was statistically different than that of the other clusters (p-value=0.000 for both clusters). When comparing the three clusters with the total average (Figure 7.2), the main findings that emerged were that firstly, the *CAYO* had a much higher percentage of drivers and infrequent public transport users than the total average, and secondly that the *SRYO* had a significantly higher percentage of infrequent public transport users, pedestrians and passengers than the total average. Thirdly, the *PLMOO* had a significantly higher percentage of older people who travelled just as pedestrians and passengers than the total average.

Number of Cars Available

In order to understand mode choice better, one variable that was included in the cluster analysis was the number of cars available in the household. This is a very important characteristic of mobility and in fact was one of the main predictors in establishing the clusters (Section 7.3). Figure 7.3 shows that overall, although the percentage of drivers was considerably low (37%), the majority of older people (92.6%) had a car available to them. Only 7.4% were totally transport disadvantaged since they neither drove nor had they any car available.

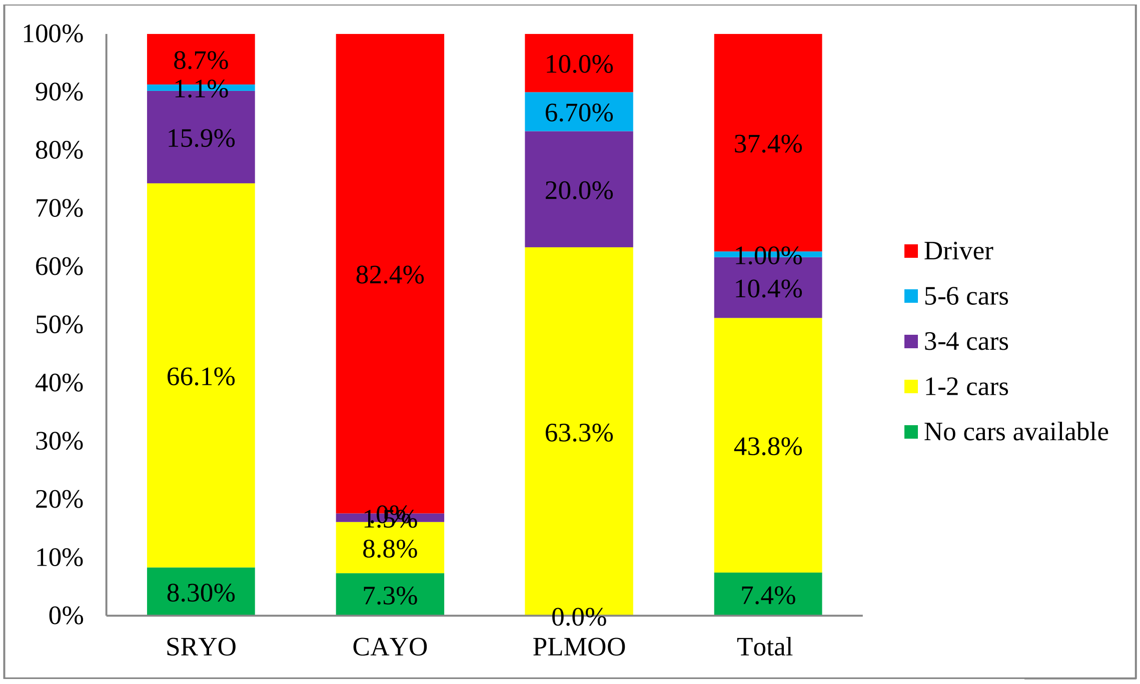

Figure 7.3: Number of cars available for the three clusters compared to the total average

From the small percentage of non-drivers in the *CAYO* cluster, 8.8% had one or two cars available to them and another 1.5% had three or four cars available. This reflected their higher mobility levels because if they did not drive they could still rely on others for lifts. Only 7.3% did not drive and did not have any cars available. What was interesting is that although the percentage of drivers was lower for the *SRYO*, the percentage of non-drivers with at least one car available to them was significantly high (83.1%). A similar situation emerged for the *PLMOO* since 90% of them had at least one car available. Thus, although the *SRYO* and the *PLMOO* were mostly public transport users, pedestrians and passengers, most of them had a car available to them. Nonetheless, it should be highlighted that having a car available does not mean that you can travel as much as you want since the dependence on other people is still considerable. Older people may find it quite difficult to ask for lifts even from close family and friends since this can reduce their amount of travel (Davey, 2007).

Whilst the number of cars available for the *CAYO* was statistically different from the *SRYO* and the *PLMOO* (p-value=0.000 for each cluster), the association between the *SRYO* and the *PLMOO* was not (p-value=0.090). Once again, this was primarily caused by gender differences. Moreover, the number of cars available for the non-drivers was quite similar irrespective of the age. Given the household size of 2.6 people per household in 2016 (Eurostat, 2017e) and the high motorisation rate in Malta (Chapter

1), having one or two cars available is the most reasonable. Yet, one should not exclude the fact that 17% and 26.7% of the *SRYO* and *PLMOO* respectively had more than three cars available to them. This is a considerable percentage and once again reflects the high car ownership, low public transport use and tight family culture in Malta (NSO, 2014b).

Public Transport Use

A more detailed analysis into the public transport use of the three clusters revealed interesting differences. In line with Figure 7.2, Figure 7.4 shows how the majority of the *CAYO* were drivers that used public transport in an infrequent manner (32.6%) or else did not use it at all (39.9%). Given that they were mostly drivers, only a very small percentage of them used public transport on a daily (3.1%) or weekly basis (17.6%). Supporting what was discussed previously, despite the high discrepancy in the percentage of drivers between the *CAYO* and *SRYO*, the percentage of public transport use were quite similar. Only 3.6% and 20.9% of the *SRYO* used public transport on a daily and weekly basis respectively. Over 40% used it in an infrequent manner and 26.4% never used public transport. This reflected the low public transport use among the *SRYO* despite the lack of drivers. Such differences made the association in terms of public transport use statistically significant between the two younger-old clusters (p-value=0.037). This further reinforced the argument of the *SRYO* relying on other people for lifts rather than using public transport. It also provided a better explanation for the fact that the *SRYO* were not very happy with their travel behaviour and travelled in a less habitual manner than the *CAYO* (Section 7.3.2).

With regard to the *PLMOO*, Figure 7.4 shows that none of the members in this cluster used public transport on a daily basis, and only 3.3% used it weekly. The absolute majority (96.7%) did not use public transport or used it in an infrequent manner. Such a high percentage reflected the difficulties that such cluster had in using public transport. They travelled mostly as pedestrians or passengers (Figure 7.2). The personal and psychological profiles of such cluster (Sections 7.3.1 and 7.3.2) were key reasons for such low public transport use. They were also very dissatisfied with the transport infrastructure available in the Maltese transport system. Consequently, the public transport use of the *PLMOO* differed significantly from that of the two younger-old clusters (p-value=0.000 when compared with the *SRYO* and p-value=0.001 when compared with the *CAYO*).

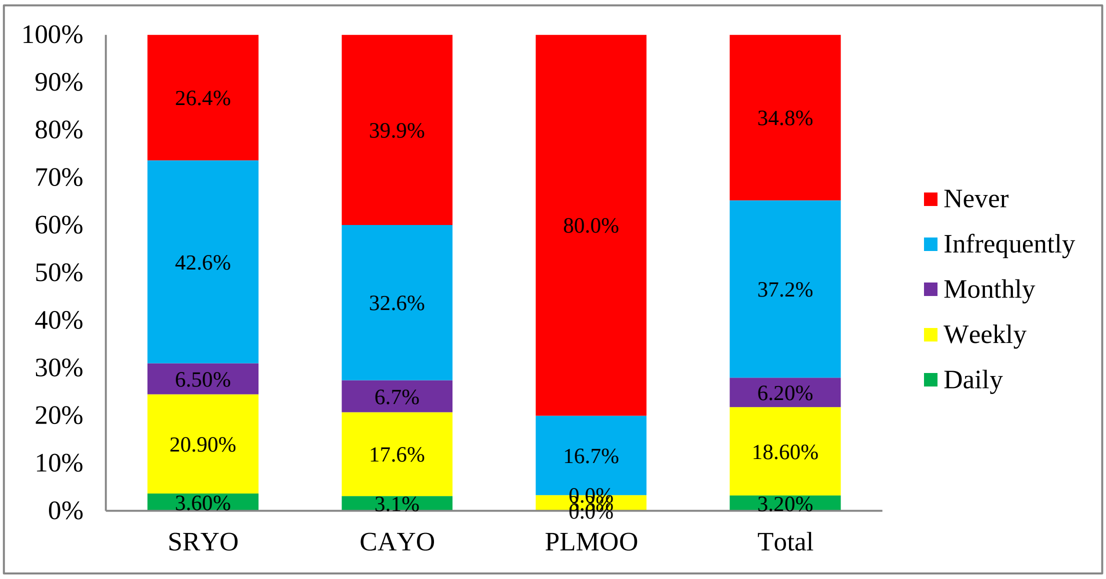

Figure 7.4: Public transport use for the three clusters compared to the total average

Travel Range and Travel Accompaniment

After understanding the mode choices of the three clusters, it was essential to understand how this related with their travel range and travel accompaniment. Figure 7.5 shows that there were significant differences in the travel range between the three clusters. A very low percentage of the *CAYO* travelled just in familiar areas (18.7%). This contrasted sharply with 57% of the *SRYO* and 83.3% of the *PLMOO*. This supported the argument that the older the age, the more older people travel for just short distances in familiar areas (see Section 2.3.1).

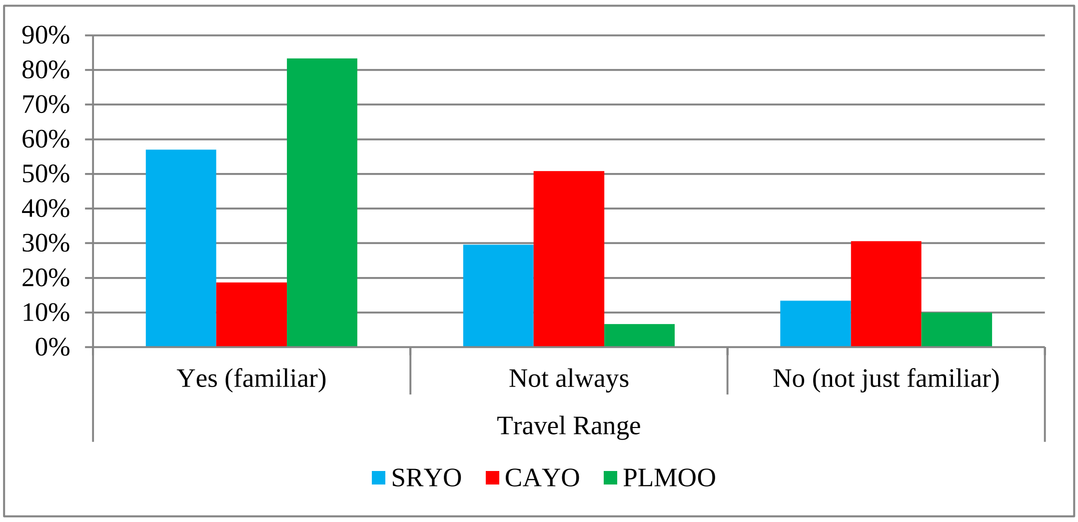

Figure 7.5: Travel range for each of the three clusters

Once more, this reflected the significant effect of gender between the two younger-old clusters. The *SRYO* were limited in their travel range despite their younger age. Apart from different reasons associated with their personal (objective) and psychological profile (Sections 7.3.1 and 7.3.2), the mode choices of this cluster were also critical in this regard. Figure 7.2 showed that the *SRYO* travelled mostly as public transport users, pedestrians and passengers. Hence, the distance that they could travel for was more limited when compared to the *CAYO* who were mostly drivers. This could also indicate that although overall the *SRYO* used public transport considerably more than the other two clusters, they still used it mostly to travel just in familiar areas. Due to the limitations and the mode choices of the *PLMOO*, it was not surprising that this was the cluster with the highest percentage of members (83.3%) who travelled just in familiar areas. This is usually a result of the sense of safety that familiar areas provide older people with (Phillips et al., 2013).

All such differences made the associations between the three clusters statistically significant (p-value=0.000 between the *SRYO* and the *CAYO*; p-value=0.000 between the *CAYO* and the *PLMOO*; p-value=0.014 between the *SRYO* and the *PLMOO*). The higher p-value between the two clusters composed primarily of females (*SRYO* and *PLMOO*) showed that except from age, gender was an essential determinant for the travel range of older people. This perfectly supported the results of the regression models in Chapter 5, which found age and gender as key determinants in this regard.

Significant differences between the three clusters could also be observed with regard to travel accompaniment. As expected, the *PLMOO* had the highest percentage of members (93.3%) that always needed to be accompanied by someone else in order to travel (Figure 7.6). This means that although this cluster had the highest percentage of members who were widowed, these people still needed others in order to travel. This contrasted sharply with 16.6% and 40.4% of the *CAYO* and the *SRYO* respectively. Therefore, despite several limitations, the *SRYO* were not completely mobility-dependent on others and could afford to travel alone (despite this being primarily in just familiar areas). This reflected the fact that 24.5% and 42.2% of the members in this cluster used public transport in a frequent and infrequent manner respectively. It also complemented the results of Model 4 in Chapter 5 which found that older people who used public transport in a frequent manner tended to travel alone more often.

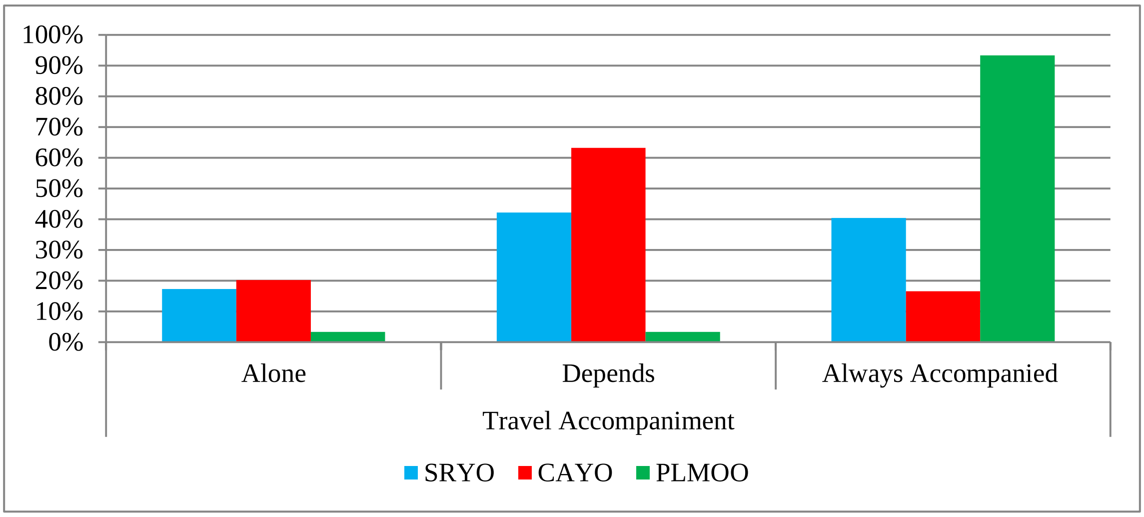

Figure 7.6: Travel accompaniment for each of the three clusters

Model 3 in Chapter 5 showed that the two top factors affecting the travel accompaniment of older people were whether they were drivers or not and age. This was reflected in the clusters since the *CAYO*, who were mostly male drivers, managed to travel more independently without relying on others. Moreover, the higher dependence with age was very evident for the *PLMOO*. The three clusters differed significantly in terms of their travel accompaniment (p-value=0.000 for each of the three clusters).

Travel Frequency and Travel Time

As explained in Section 7.3, travel frequency and travel time were the two most important predictors in the clusters' formation. As explained in the previous chapters, given the very small size of Malta, distance was not the ideal indicator to measure mobility and instead the average travel time was utilised to measure the extent to which older people travelled. This was accompanied by the travel frequency within the survey week.

Ninety per cent of the *PLMOO* members did not travel during the week when the survey was conducted (Figure 7.7), reflecting the lack of mobility for this cluster. This contrasted sharply with the two younger-old clusters where only 0.7% and 0% of the *SRYO* and the *CAYO* respectively did not travel at all during the survey week. Consistent with the higher mobility levels of the *CAYO*, Figure 7.7 shows that the highest percentage (68.4%) of this cluster travelled daily, contrasting with 43% of the *SRYO* who did so. One reason for such difference was that a considerable percentage of the *CAYO* were older male workers, contrasting with the *SRYO* who were mostly housewives (Section 7.3.1). Thus, work commitments were a key reason for the *CAYO* to travel more on a daily basis. A detailed overview of the travel purposes per cluster will be given in the following sections.

Moreover, Model 5 in Chapter 5 showed that age, physical health and being a driver were the first three predictors affecting the travel frequency of older people. The effect of age on travel frequency could be seen from the major differences between the younger-old clusters and the *PLMOO*. As previously explained, the two younger-old clusters also differed in their physical health and in their mode choices. Thus, the simultaneous effect of all these factors better explained the variations in travel frequency between the two younger-old clusters. Figure 7.7 shows that the highest percentage of the *SRYO* did not travel daily during the week of the survey (56.3%). This contrasted with 31.6% of the *CAYO* who did so. Hence, although the travel frequency of the *SRYO* was not as high as that of the *CAYO*, it was not bad either. Yet, it is also evident that there is still room for improvements. The travel frequency differences between each of the three clusters were all statistically significant (p-value=0.000 between each of the three clusters).

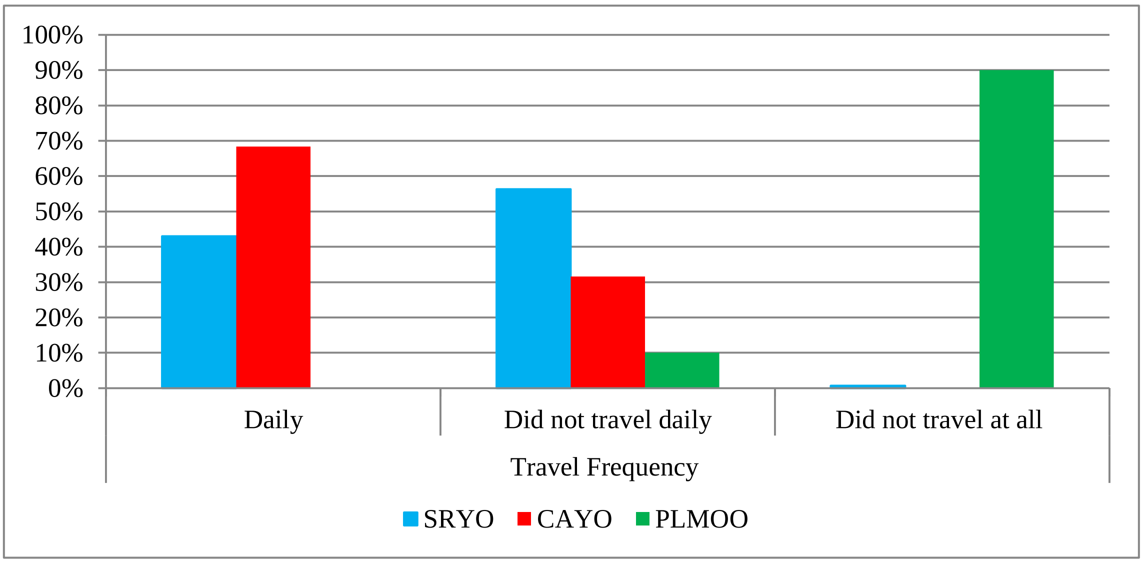

Figure 7.7: Travel frequency during the survey week for each of the three clusters

The higher mobility levels of the *CAYO* were also reflected in their travel time for the days when they travelled during the survey week. The highest percentage of members within this cluster (56%) travelled between two to four hours contrasting with only 26.4% of the *SRYO* who did so (Figure 7.8). As explained in the previous chapters, given the short distances in Malta, this travel time was considerably high and reflected good mobility levels. This also complemented the previous discussion on the higher travel range of the *CAYO* being mostly drivers. In Chapter 5, Model 6 found that gender was a significant predictor of travel time. Thus, the gender difference between the two younger-old clusters also played a significant role.

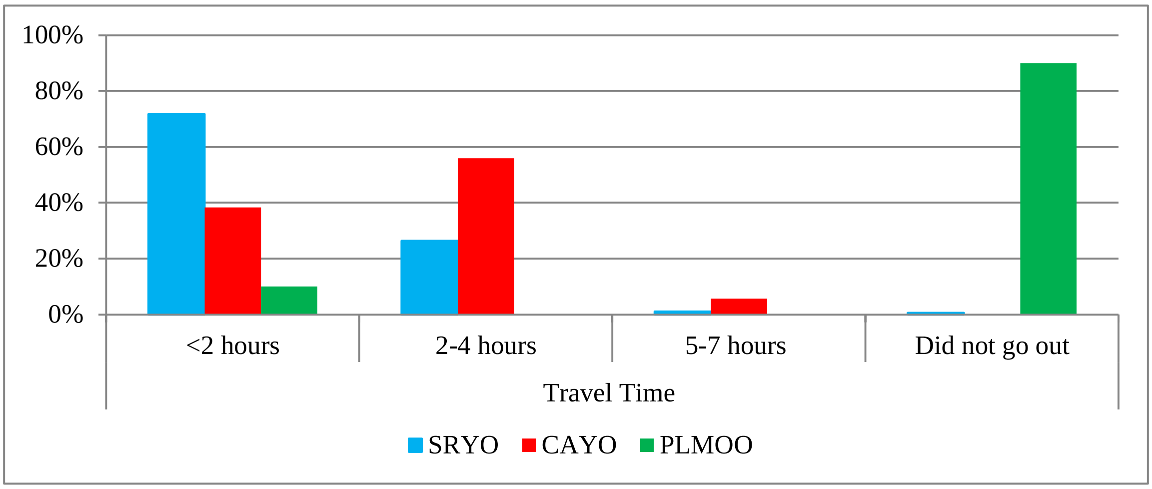

Figure 7.8: Travel time for days of travel during the survey week for each of the three clusters

Nonetheless, Figure 7.8 also shows that a considerable percentage (26.4%) of the *SRYO* had a travel time of between two to four hours. Model 6 in Chapter 5 explained that public transport use was the second most important significant determinant for travel time. Older people who used public transport more frequently tended to have a longer travel time. This was due to the longer times associated with bus use when compared to the private car (Chapter 1). Thus, given that the *SRYO* used public transport relatively more, their long travel time could also be explained from this respect. Yet, given that a considerable percentage of the *SRYO* were pedestrians and passengers, their most common travel time was less than two hours (71.8%). This supported the findings of Model 6 (Chapter 5), which showed that physical health, gender, and driving were all key significant determinants for travel time. The 10% of the *PLMOO* that travelled did so for less than two hours. Once again, Model 6 (Chapter 5) found that age was a significant determinant of travel time. The three clusters differed significantly between each other (p-value=0.000 between each of the three clusters).

The Number of Travel Purposes

Question 15 in the questionnaire (Appendix B) targeted the travel purposes that older people travelled for in a typical week. Given the structure of the question, older people could mention as many travel purposes as they wanted. In line with what was discussed in Model 7 (Chapter 5), for clarity and simplification reasons, such travel purposes were divided into three: 0-1 travel purpose, 2-3 travel purposes and 4+ purposes. Figure 7.9 shows that the highest overall percentage of older people travelled for two to three purposes per week. The major difference between the clusters was with regard to those travelling for just one purpose (or not travelling at all). Over 60% of the *PLMOO* travelled for just 0-1 travel purpose compared with just 3.2% and 4.7% of the *SRYO* and the *CAYO* respectively. In fact, the association between this cluster and the two younger-old ones was statistically significant (p-value=0.000 for both clusters).

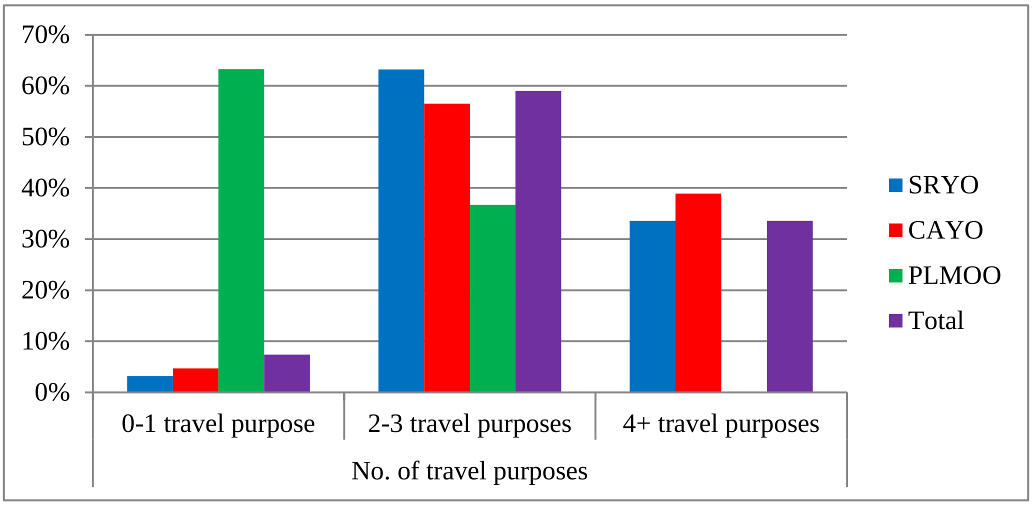

Figure 7.9: Number of travel purposes for the three clusters compared with to total average

With regard to the two younger-old clusters, Figure 7.9 shows that the *CAYO* was the cluster that travelled for the highest (4+) number of purposes (38.9%). Yet, the discrepancy between this cluster and the *SRYO* was not so large because 33.6% of the latter cluster also travelled for more than four purposes. This was complemented with similar high percentages of younger-old people travelling for two to three purposes. Consequently, the association between the two younger-old clusters was not statistically significant (p-value=0.312). This could be the result of two main factors. Firstly, given the way the question was structured, it could have resulted in a standard number of purposes that older people mentioned, which could not have always been a true reflection of reality. Respondents could have just listed two or three purposes for time reasons during the telephone survey. Secondly, since the generic number of travel purposes was considered, this did not distinguish whether travel was for utilitarian or discretionary reasons. Thus, the total number of travel purposes that older people travelled for could sometimes be a misleading indication of mobility levels. For this reason, travel purposes were divided into utilitarian and discretionary reasons.

Utilitarian and Discretionary Travel Purposes

Figure 7.10 shows that overall the highest percentage of older people in Malta travelled for utilitarian reasons (e.g. shopping, medical reasons). For utilitarian travel, the difference between the two younger-old clusters and the *PLMOO* cluster was statistically significant (p-value=0.000 for both clusters). This is because 83.3% of the *PLMOO* travelled for 0-1 utilitarian travel purpose compared with 39.7% and 40.4% of the *SRYO* and *CAYO* respectively who did so (Figure 7.10). Such figure was also significantly higher that the percentage for the total sample (42.6%). This indicated that when the *PLMOO* travelled, they did so mostly for utilitarian reasons (e.g. medical care). The higher mobility of the younger-old clusters could then be seen from the fact that there was a higher percentage of them who travelled for two to three utilitarian purposes. As shown in Figure 7.10, such percentages were very balanced and indeed the association with utilitarian purposes for the two younger-old clusters was not statistically significant (p-value=0.878).

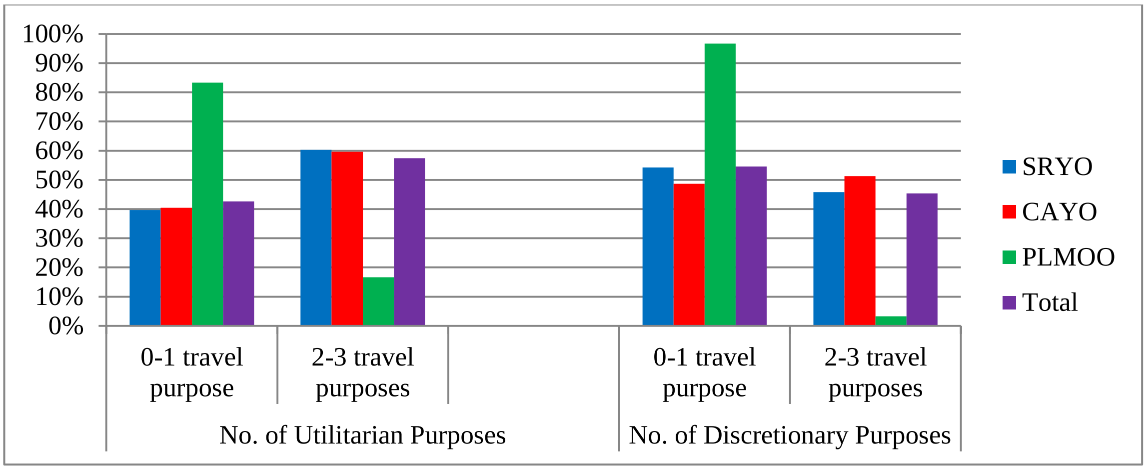

Figure 7.10: Number of utilitarian and discretionary travel purposes for the three clusters compared to the total average

A more accentuated pattern emerged with respect to discretionary travel purposes. Over 96% of the members in the *PLMOO* cluster travelled for 0-1 travel purpose and only 3.3% travelled for two or three purposes. Such percentages were very different from the total sample's figures (Figure 7.10). On the other hand, although the overall percentage of younger-old people travelling for discretionary purposes was lower than that for utilitarian travel, the percentage was still considerably high (45.8% for the *SRYO* and 51.3% for the *CAYO*). Such percentages showed that whilst for utilitarian travel the *SRYO* travelled for more purposes than the *CAYO*, for discretionary reasons the situation was reversed. This confirmed that the higher mobility levels associated with the *CAYO* were also linked with this cluster travelling more for discretionary reasons.

Nevertheless, this difference between the two younger-old clusters was quite marginal and the association between the groups was also not significant (p-value=0.245). Such a lack of statistical difference was a result of three main factors. Firstly, Models 8 and 9 in Chapter 5 found that there were other factors (e.g. marital status, district, education) not included in the cluster analysis algorithm (or else included but resulted not to be important) that affected the number of utilitarian and discretionary travel purposes. Secondly, as previously highlighted, the way the question was structured could also have affected the results. For both utilitarian and discretionary travel the generic number of purposes was considered without distinguishing the type of purpose (e.g. shopping, recreation). Thus, it was not possible to analyse any potential differences between the clusters with regard to the specific types of purposes. Thirdly, since older people usually travel with others (particularly for discretionary reasons), listing just the number of purposes was obscuring any potential demographic differences in how and why they travelled for the respective purpose.

Due to such limitations, a cross-tabulation of the first travel purpose mentioned in question 15 of the survey (Appendix B) per cluster was created (Table 7.15). The first travel purpose was used since this represented the most common reason for which older people travelled. Table 7.15 clearly shows the higher percentage of older people travelling for utilitarian purposes. Although both younger–old clusters travelled mostly for shopping, the percentages were different. A significantly higher percentage of the *SRYO* (73.3%) travelled primarily for shopping when compared to the *CAYO* cluster (43%). Moreover, whilst for the *SRYO* the second most common travel purpose was attending church services (13.7%), for the *CAYO* shopping was followed by 19.7% who travelled for all sorts of reasons and by 14% who travelled for recreation. This contrasted sharply with the *SRYO* since only 5.4% stated that they travelled for all sorts of reasons. The percentage of those travelling for recreational purposes was also very low (5%).

		Clusters		
		SRYO (%)	*CAYO* (%)	*PLMOO* (%)
Travel Purposes	All reasons above	5.4	19.7	0.0
	Church	13.7	2.1	13.3
	Medical Care	1.4	2.6	26.7
	Recreation	5.1	14.0	20.0
	Shopping	73.3	43.0	23.3
	Visit Relatives	1.1	4.7	0.0
	Work	0.0	10.9	0.0
	Education	0.0	0.5	0.0
	Errands	0.0	1.0	0.0
	Voluntary Work	0.0	0.5	0.0
	Do not go out	0.0	0.0	16.7

Table 7.15: Most common travel purpose for each of the three clusters

Another contrasting difference between the two younger-old clusters was for those travelling to work. Complementing what was discussed in Section 7.3.1, whilst 10.9% of the *CAYO* stated that commuting to work was their primary travel purpose, 0% of the *SRYO* did so. Two important reasons for such difference were gender and the modes of transport used. Having a significant higher percentage of younger-old male drivers, the *CAYO* travelled more for discretionary reasons. On the other hand, the higher percentage of non-driving younger-old females in the *SRYO* travelled mostly for utilitarian purposes. Such differences were statistically significant (p-value=0.000).

Table 7.15 shows that the highest percentage of the *PLMOO* travelled for medical care (26.7%) followed by another 23.3% who travelled for shopping. Interestingly, 20% of this cluster also stated that they travel mostly for recreation. Nonetheless it is equally important to highlight that 16.7% of this cluster stated that they did not go out at all, and another 13.3% who just listed attending church services as their main travel purpose.

This section supported the previous discussion with regard to the travel range of older people. Section 7.3.3 showed that the *SRYO* and the *PLMOO* clusters travelled significantly more in just familiar areas when compared to the *CAYO* cluster. Table 7.15 explained this better because it showed that the members of both clusters travelled mostly for shopping and to go to church, and thus did not need to travel far. On the other hand, since the *CAYO* travelled mostly for all sorts of reasons and for recreational purposes, it made sense that most of them did not just travel in familiar areas.

With regard to the travel frequency and travel time of older people, Table 7.15 reinforced the mobility disadvantage of the *SRYO* when compared to the *CAYO*. It was previously explained that the *SRYO* did not travel daily and usually travelled for less than two hours. Now, it was shown that that the absolute majority of this cluster (73.3%) travelled mostly for shopping and to attend church services. Thus, in most cases, when they travelled they did so mostly for utilitarian reasons. Such purposes also explained their short travel time. Adding on the previous discussion regarding the common daily travel for the *CAYO* cluster, Table 7.15 revealed that they did so for all types of travel purposes namely recreation, shopping and to go to work. This also explained their longer travel time. With regard to the *PLMOO*, it was found that the highest percentage of its members did not go out and when they did, this was not on a daily basis. This section now explained that when they *did* actually go out, they did so mostly for medical care, to go shopping and to go to church only.

7.3.4 A Synthesis of the Clusters

Following a two-step cluster analysis in SPSS, three clusters were developed: the *Complacent and Autonomous Younger-Old* (*CAYO*), the *Slightly Restrained Younger-Old* (*SRYO*) and the *Pessimistic Limited-Mobility Older-Old* (*PLMOO*). These represented the travel behaviour of older people together with their personal (objective) and psychological determinants. A synthesis of the three clusters is listed in Table 7.16.

Cluster	Description
CAYO	Younger-old males (average age of 68.4 years) who are either workers or retired with a good health status. They have a low participation rate in social activities. They have positive attitudes towards their travel behaviour and have positive social norms from their surrounding family, friends and health professionals. They are happy with the way they travel and feel fit without the need of any compensation techniques. Overall they have a habitual travel behaviour with positive intentions for their future. They are mostly drivers who use public transport in an infrequent manner. Their travel range is not restricted and they do not need to be accompanied by others to travel. They usually travel on a daily basis with a travel time of between two to four hours. They travel for all sorts of reasons, for shopping and for recreational purposes. They are not happy with the transport infrastructures around them and with how other people behave in the transport environment.
SRYO	Younger-old females (average age of 70.1 years) who are mostly housewives. Their health status is overall stable but not very good. They have a low participation rate in social activities. Although they tend to have positive attitudes towards their travel behaviour, they are often anxious and not very happy with the way they travel. Overall, they have positive social norms from their surrounding family, friends and health professionals. They do not have a high self-concept and usually adopt some type of compensation techniques in their travel. Their behaviour is not very habitual and although they have positive intentions for the future, the latter are usually weaker than those of the *CAYO*. They are mostly infrequent public transport users, pedestrians and passengers. Being mostly non-drivers, public transport is mostly used in a captive manner with a preference to rely on others as passengers. They usually travel in just familiar areas and prefer to be accompanied by others. Uusally they do not travel on a daily basis and when they do they mostly travel for less than two hours. Their most common travel purposes are shopping and going to church. They are very dissatisfied with the transport infrastructures around them and with how other people behave in the transport environment.
PLMMO	Older-old females (average age of 81.2 years) who are mostly housewives. They have a bad health status, and usually need personal assistance. They have a very low participation rate in social activities. They have negatives attitudes towards their travel behaviour and are not happy with their mobility levels. Given their limitations, they have negative social norms from their surrounding family, friends and health professionals. They have a very low self-concept and need to adopt several compensation techniques when they travel. Their behaviour is not habitual and they tend to have negative intentions for their future. They usually rely on others to travel and hence travel mostly either as pedestrians or as passengers with very low public transport use. They travel only in familiar areas and in most cases need to be accompanied by others. They have a very low travel frequency and when they travel they mostly do so for less than two hours to go to church, shopping or to access medical services. They suffer from unrealised mobility.

Table 7.16: Synthesis of the three clusters developed

7.4 Conclusion

The greatest difference between the personal (objective) factors that defined the clusters was the gender profile. The *CAYO* was primarily dominated by younger-older males whilst the two other clusters were mostly composed of older females. The health status of the clusters explained some of the major differences between the younger-old and the older-old clusters. Yet, there were also significant differences between the two younger-old clusters, with the *SRYO* having a weaker health profile. No spatial differences emerged between the three clusters.

Significant differences between the clusters were also evident for the psychological determinants of travel behaviour. Variations did not only emerge between the younger-old clusters and the older-old one, but also between the two younger-old clusters. For example, the *SRYO* was significantly more anxious and insecure in the road than the *CAYO*. Such situation was further accentuated for the *PLMOO*. The transport infrastructure in Malta and the way other people behaved in the road made travel more difficult for *all* older people.

Ultimately, the chapter thoroughly described the travel behaviour of the three clusters. Very significant differences were evident with regard to their mode choices. Despite this, the majority of older people in all the clusters had at least one car available to them. In fact, despite the significantly lower percentage of drivers, both the *SRYO* and the *PLMOO* still did not use public transport in a frequent manner but preferred to travel as passengers. The implications of such clusters for transport policy will be discussed in further detail in the following chapter. They will also be compared with other clusters developed in the body of literature.

CHAPTER 8

DISCUSSION

8.1 Introduction

Following on from the previous three chapters which presented the main findings of the research, this chapter will now discuss the results and compare them to the body of literature. The purpose of such discussion is to understand more deeply how such study relates to previous findings and acknowledges the areas that need a better understanding. Given this, the chapter is divided into three main sections: Sections 8.2 and 8.3 discuss the objective and psychological determinants of mobility in later life (in relation to Chapters 5 and 6 respectively) and Section 8.4 discusses the clusters of older people (in relation to Chapter 7). This will be followed by a discussion on the relevance of this research within the Maltese transport policy context in Section 8.5. Ultimately, Section 8.6 discusses a list of recommendations for independent mobility in later life in Malta.

8.2 The Objective Determinants of Travel Behaviour

In several instances the findings of this study presented in Chapter 5 complemented the body of literature. For example, shopping was the most popular purpose that older people travelled for (e.g. Collia et al., 2003; Su et al., 2009). Moreover, as age increased, the probability to travel both as drivers and as public transport users decreased. Supporting previous discussions (e.g. Davey, 2007; Kim, 2011), this indicated a general decline in mobility with age. The older they got, older people travelled more in *just* familiar areas. This reinforced previous discussions (e.g. Jianxi and Zhenshan 2015) which showed that the older an individual gets, the less comfortable s/he may feel when not travelling in familiar zones. An increase in age was also associated with more older people *not* travelling at all. As discussed by Lord et al. (2011), this showed that irrespective of several external factors, mobility of older people decreases with age. Nevertheless, it is worth noting that although age was the main factor affecting most travel behaviour indicators it did not do so in the same manner. For example, whilst age was the primary variable affecting the travel range and travel frequency of older people (Models 2 and 5), it was the fifth most significant variable predicting their daily travel time (Model 6).

One important factor highly linked with the age of respondents was their health status. The negative repercussions of a fall in later life (e.g. Siren and Hakamies-Blomqvist, 2009; Delbaere et al., 2009) were evident in this study since those who suffered from a fall in the previous year had a lower travel frequency and a shorter travel range. Moreover, Moniruzzaman et al. (2015) discussed that although assistive devices aim to improve mobility in later life, they can also cause difficulties in mobility and limit older people from travelling. This was also the case in this study since for those older people who had an assistive device, the probability of not going out was actually higher.

This study clearly found that older males had higher mobility levels than females. One key reason for this was that they were more likely to be drivers. Females also travelled more in *just* familiar areas and had shorter travel times. Complementing previous discussions (Section 2.5.1), authors such as Charlton et al. (2003), Siren and Hakamies-Blomqvist (2006), Rosenbloom (2006) and Turcotte (2012) highlighted the female mobility disadvantage in later life. The common lack of self-confidence and higher fears of older females in the road (e.g. Choi et al., 2013; Meng and Siren, 2015) play an important role in restricting females to travel only in familiar areas. Amongst the non-drivers that used to drive in the past, over 60% were females. This corresponded with what was discussed also by Davey (2007) and Siren and Haustein (2013) who found that not only do older females drive less than males, but when they drive, they tend to stop long before males.

The body of literature showed that overall public transport use is quite low among the older population (Sections 2.2 and 2.4). Unfortunately, this study complemented such findings with very low public transport use among older people in Malta. The 2013 Eurobarometer survey (European Commission, 2014), placed Malta third from seven countries (after Cyprus and France) where at least three out of ten people never used public transport. Malta also came the last country in terms of satisfaction levels with punctuality and reliability in public transport services. Although females tend to be more “transport disadvantaged” (Lucas et al., 2001), unlike for driving, gender did not affect public transport use in Malta. Sustaining other studies discussed in Sections 2.4 and 2.5.1 (e.g. Schmöcker et al., 2008; Cao et al., 2010) this study also found that when a car was available in the household, public transport use tended to be lower. This finding reinforced the argument that the bus in Malta is mostly used by captive users, and that it is not yet an adequate alternative to the car even for non-drivers.

Several studies (e.g. Hough et al., 2008; Meléndez et al., 2009; Kim, 2011) found that higher education levels are usually positively associated with mobility in later life. In this research, older people with lower education levels had a shorter travel range. Model 9 also found that older people with higher education levels tended to travel for more discretionary purposes. Section 2.5.2 highlighted the positive effect that participation in social activities has on mobility in later life (e.g. Gabriel and Bowling, 2004; Spinney et al., 2009). This was also very evident in this study since it had a constant positive effect throughout different models (Models 3-7, 9) in Chapter 5.

Whilst the effect of most variables was quite linear, the effect of the district where older people lived was not. The district that differed mostly was Gozo. The models showed how the behaviour of Gozitan older people was more conservative as they travelled more in just familiar areas, used less public transport, and had a lower number of travel purposes. On the other hand, older people from the Western district had higher mobility levels since together with the South Eastern they travelled more in unfamiliar areas and had a higher number of travel purposes. This supported the fact that in various ways, including land use patterns and transport systems, Gozo is different from Malta (Chapter 1). Yet, this was not scientifically proven and more research is needed in this regard.

Apart from all the variables that were significant to the respective models discussed in Chapter 5, it is also important to highlight those variables which were *not* significant. For example, contrasting with what was discussed in Section 2.5.3 with regard to the effect of geographic context on mode choice, in Malta there were no spatial factors affecting older people's decision to drive. This is very realistic given the high car ownership throughout the islands (NSO, 2017). This was supported by the fact that even several other important variables (e.g. family structure, education levels, health perception etc.) were not significant predictors for older people’s decision to drive. With regard to public transport use, the non-significant determinants were gender, marital status, household type, education level, perception of physical and mental health, medicine intake, fall in previous year, presence of an assistive device and distance to bus stop. From these, the two most interesting ones were older people's perception on their health status and the distance to bus stop.

Although public transport use decreased with age, and those who had a person assisting them used it less, older people's perceptions of their health did not affect their decision to use this mode. This complemented Chan et al. (1998) who found that the ability to use public transport did not influence the older persons' perception of health in Singapore. Findings were quite similar for driving because although older people with an assistive device drove less, health perceptions did not affect their driving decision. This was supported by the fact that physical health was only the sixth determinant that affected travel behaviour of older people (Table 5.14, page 156). Moreover, contrasting with research from other contexts discussed in Section 2.5.3 (e.g. Schmöcker et al., 2008; Su et al., 2009; Hess, 2012), proximity to bus stops did not affect public transport use, despite 81.8% of the older people living within less than five minutes from a bus stop. This further complemented the study by Mifsud and Attard (2013) which found that proximity to bus stops did not affect public transport use and was not identified as a barrier to public transport use by older people in Malta.

Chapter 6 supported the understanding about the objective determinants of mobility by thoroughly discussing the psychological factors that predicted travel behaviour. These will be discussed in the next section.

8.3 The Psychological Determinants of Travel Behaviour

Overall, older people had positive intentions for their future. This complemented Siren and Haustein's (2013; 2016) discussion concerning the baby-boomers' positive viewpoints for the future. As defined by the TIB, the intention towards travel behaviour predicted the actual behaviour. The highest effect on older people's intentions was from their social surrounding. As explained in Chapter 6, one reason that justifies such finding could be the very small geographic size of Malta. Due to such context and the culture within the island, families are very close. Formosa (2013) found that six out of ten grandmothers and half of the grandfathers provide childcare for their grandchildren. Moreover, when older people have children living nearby (as in the case of Malta) they tend to rely considerably on them for their mobility needs (Truong and Somenahalli, 2011). They can also become closer to their family member as a result of lifts sharing (Musselwhite and Shergold, 2012). Consequently, the opinions of family members were given significant importance by older people in Malta. Such findings were not completely surprising given the fact that Mediterranean countries have been usually considered as "familiastic" countries. In actual fact, Calzada and Brooks (2013) made reference to different studies (e.g. Reher, 1998; Bettio et al., 2006) which highlighted the important role of Mediterranean "familism" when explaining the demographic and social policy distinctiveness in Southern Europe. Calzada and Brooks (2013) also found that the Mediterranean region had higher levels of family solidarity and familism when compared to other European regional contexts and Liberal (EU countries only) regime types. The notion of care work remains a family responsibility in the Mediterranean nations (Naldini, 2003). Using longitudinal data from the SHARE (Survey of Health, Ageing and Retirement in Europe) database, Kohli et al. (2009) discussed that with regard to the social connectedness of older people in the Mediterranean regions family relations were very high, with informal (non-kin) social relations being lower than in other welfare states. Strongly complementing the findings of this study, the importance of social norms in Malta was also visible in Satariano and Curtis' (2018) study. They found that health and well-being of people living in Malta were strongly influenced by social determinants, particularly social norms involving the roles of extended family, family honor, traditional attitudes towards marriage, gender roles and religious beliefs.

The results of this also study also supported previous research (e.g. Lindstrom-Forneri et al., 2007; Nikitas et al., 2011) which revealed that social norms had a significant impact on older road users (Section 3.4.3). The former found that perceived social pressures were important to influence older drivers' intentions to change their driving behaviour. The latter showed that social norms were influential on older people's road charging behaviour. Van Holle et al. (2015) also showed that in Belgium high recreational walking among older people was found when there were high walkability, positive self-efficacy and positive social norms.

As Watson et al. (1988) explained, positive affect is related to different factors such as the degree to which an individual is involved in society, his/her social contacts and his/her social participation, whereas negative affect is typically related to feelings such as anxiety and worry. Table 6.4 (page 165), showed that emotions were quite negatively ranked by older people in Malta particularly with regard to the anxiety associated with their behaviour. This could be a result of the personal and objective characteristics (e.g. gender, lack of social activities participation etc.) discussed in Chapter 5. Nonetheless the very low mean rankings for transport infrastructures in Malta (Section 6.3.1) clearly indicated that the road environment could also have an important role in how older people feel when travelling (e.g. heightened fear of falling). When discussing travel intentions in the senior tourism market in Taiwan, Jang et al. (2009) revealed that although both positive and negative affective states had significant impacts on travel motivation, only positive affect was related to future travel intentions. Although from a different domain, this supported what was discussed in this research's model because although with a relatively low impact (β=0.15), emotions were significantly and positively related to older people's future travel intentions.

Results also showed that habit had a lower impact on travel behaviour when compared to intention. Despite several studies highlighting the importance of habit when analysing mobility (e.g. Gardner and Abraham, 2008), other research (e.g. Bamberg et al., 2003a) discussed that even during a routine, human behaviour is always regulated to different extents by cognitive efforts. Additionally, in most cases, past travel choices contribute to the prediction of later behaviour when circumstances remain relatively stable. Older people (particularly females) may suffer from several health limitations which considerably reduce their travel stability. Abrupt changes such as breaking a hip, contracting an infection or requiring surgery can strongly affect the way they travel and therefore once again habitual patterns may be limited. Moreover, retirement is a phase in life which causes a lot of instabilities and changes to mobility (Schoenduwe et al., 2015). Given the several dynamics in old age, this could have been an additional factor why travel behaviour was not strongly dominated by habit in this research.

Nevertheless, this does not mean that habit did not have any influence on travel behaviour. Given that it was a positive significant predictor, it makes it an important aspect to study in future research. Verplanken and Aarts (1999) explained that once habits are developed they can be generalised in different situations. The theoretical knowledge on how together with intention habit influences the performance of goal-directed behaviour is limited (Bamberg and Schmidt, 2003). In the field of ageing, such studies are still lacking.

The low rankings associated with the facilitating conditions in Malta (Table 6.4, Page 165) supported two important phenomena discussed in Sections 2.6 and 2.8. Firstly, is that the transport infrastructure can create multiple difficulties to older people's mobility putting them at a double disadvantage. Secondly, is the fact that older people may feel very vulnerable due to other people's behaviour in the road. A case in point was the study by Aguiar and Macário (2017) which revealed that older drivers can easily feel intimidated by other aggressive drivers. Despite this, as shown by the case study model, the impact of such factors on older people's travel behaviour was minimal (β=0.04). All this means that in Malta, although negatively ranked, transport infrastructures and other people's road behaviour did not affect much how older people travelled. As discussed by Finlayson and Kaufert (2002) in Section 2.6.2, one key reason for this is that sometimes older people may get used to their context, and although the surrounding environment may provide them with limitations it does not affect their travel. Continuous perceived risks tend to have less influence than unpredicted risks on mobility in later life. Morevoer, as argued by Davey (2007) many older people develop a sense of resignation to various limitations, and such attitude leads to an understatement of the transport difficulties. Therefore, although older people may accept the problems with the transport infrastructure, it does not mean they do not exist or should not be improved.

Ultimately, it should be noted that the variance for *Travel Behaviour* (R^2=41%) was quite a sizable percentage. This clearly reinforced the argument presented in this research (particularly in Chapter 3) that psychological factors are key determinants of older people's travel behaviour. Even the variance for *Intention* (R^2=0.53) revealed that the TIB constructs predicted well older people's intentions. However, such percentages also showed that there were clearly other factors which affected the travel behaviour of older people. These were mostly discussed in the regression models conducted in Chapter 5. When grouping older people based on objective and attitudinal factors, Haustein (2012) explained that objective constraints were of higher significance than personal attitudes for the *Captive Car Users* and *Captive Public Transport Users*. Thus, older people's intentions for the future could also have been affected by other factors such as their health status. This is also because several of the psychological variables that proved to be the most significant in the model are usually also affected by socio-economic factors. For example, social norms might really indicate the response of family, friends and health professionals to real-life health limitations that may affect how older people travel. In fact, as discussed in Chapter 7, when older people had several health limitations, their future intentions were not very optimistic.

8.4 Cluster Analysis

Chapter 7 presented the results of the cluster analysis. Three main clusters were established to better describe the differences (and similarities) between groups of older people. As previously explained, cluster analysis is important to identify the groups of older people that can potentially change their travel behaviour, and understand how different people react to different interventions. For example, Shrestha et al. (2016) discussed how important public transport requirements for ageing societies applied (or not) to each of the GOAL clusters discussed in Section 2.7. Anable et al. (2006) explained that the greatest potential for behaviour change is often for clusters at the margins, which should be the most important target for policy makers. In this study, the *Slightly Restrained Younger-Old* (*SRYO*) was such marginal cluster.

Chapter 7 showed that gender was an essential factor that defined the clusters' formation. Supporting previous studies (e.g. Charlton et al., 2003; D'Ambrosio et al., 2008), the *Complacent and Autonomous Younger-Old* (*CAYO*), mostly composed of younger-old male drivers, had the highest self-esteem and were convinced to be able to continue following the same travel behaviour in the future without any willingness to change it. The *SRYO* (composed mostly of younger-old females) compensated more in the way they travelled. This sustained other studies (e.g. D'Ambrosio et al., 2008; Meng and Siren, 2015) which discussed that usually females self-regulate their road behaviour more than older males do. This cluster was significantly more anxious in the road than the *CAYO*, reflecting the common insecurities, fears and limitations of older females in the road environment (e.g. Choi et al., 2003; McNamara et al., 2013; Musselwhite, 2015).

The high intentions of the *CAYO* to continue driving in the future may lead to an inability to recognise potential limitations associated with age. Such drivers, particularly when getting older, may have limitations (e.g. physiological ones) which they do not acknowledge due to their strong willpower to continue driving. Of course, this leads to several safety implications both for themselves and for other road users. The high car usage of the *CAYO* cluster also contributes to the increasing congestion problem in the islands and therefore efforts targeting this cluster should be made to encourage modal shift towards more sustainable modes of transport.

Strongly contrasting with the *CAYO*, the *Pessimistic Limited-Mobility Older-Old* (*PLMOO*) had negative emotions towards their mobility and negative intentions for their future. This was quite natural due to the vulnerabilities associated with older-old age that tend to increase difficulties in the road environment (Holley-Moore and Creighton, 2015). Transport policy makers should work specifically for this cluster, not only to provide the older-old with alternative modes of transport (e.g. door-to-door services) that can make their travel a better experience, but also to improve their attitudes and emotions towards mobility.

Nevertheless, transport policy makers should also focus on the *SRYO* who *also* had a significantly higher percentage of infrequent public transport users, pedestrians and passengers than the total average (Section 7.3.3). Passengers are those that have the least participation scores when compared with those who drive, walk and use public transport (Dahan-Oliel et al., 2010). Therefore, more transport opportunities should be provided to these two groups of older people in order to improve their independent mobility. Improvements in the public transport service could encourage the *SRYO* to use this mode further quite easily, given that they had a need for such services and were more willing to change their travel behaviour. Yet, given the continuous increase in the number of female drivers, a question arises on how such behaviour may change in the near future.

The absolute majority of the *PLMOO* (90%) did not travel at all in the week when the survey was conducted. Hence, transport policy makers need to understand more deeply the causes for such unrealised mobility and provide solutions in order to minimise it. The objective and psychological determinants of travel behaviour discussed in Chapters 5-6 were an important starting point in this regard.

8.4.1 The Malta Clusters within the Body of Literature

Section 2.7 reviewed the literature about clusters of older people within the transport environment. This section will discuss how the three clusters developed in this research relate to this body of literature. Since all studies used different variables in their cluster analysis, it is difficult to exactly compare the clusters. Each cluster was specifically defined based on the context of the study and the variables used. Nonetheless, several similarities could still be noticed. The clusters developed by Shergold et al. (2015) and Ravulaparthy et al. (2012) listed in Table A.1 were not discussed in this chapter since the variables they used for the clusters' formation were not specifically related to transport but to technology and subjective well-being respectively.

As shown in Figure 8.1, the *CAYO* cluster was similar to most of the clusters that Haustein and Siren (2015) referred to collectively as *Affluent Mobile Drivers*. Such clusters were mostly composed of younger-old males who drive their car and do not consider any other alternative. They usually still work, have good mobility levels and have very optimistic views about their abilities. What was slightly contrasting between the *CAYO* and the other clusters listed in Figure 8.1 was the low participation in social activities amongst the Maltese younger-old males. Additionally, although the *CAYO* were happy with their travel behaviour, they were not happy with the transport infrastructures around them. The use of technology among the members of this cluster was not discussed since such data was not collected in this research. In most cases, the corresponding clusters to the *CAYO* such as the *Happily Connected* (Mandl et al., 2013) and the *Affluent Mobiles* (Haustein, 2012) had positive attitudes and use of technology.

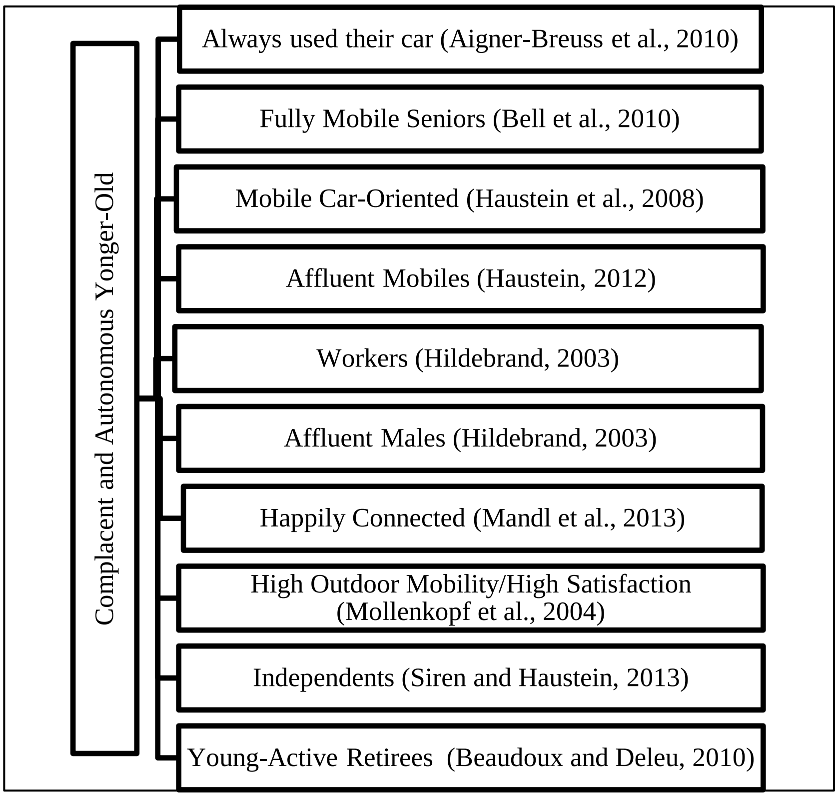

Figure 8.1: The corresponding clusters in the body of literature for the Complacent and Autonomous Younger-Old

Figure 8.2 shows that the *SRYO* related with seven other clusters discussed in Section 2.7. It was mostly composed of younger-old females who did not drive and thus relied on others (as passengers) and on public transport for their basic mobility needs. Public transport was mostly used in a captive manner. The members of this cluster did not have severe health problems but their health was self-perceived as worse than that of the *CAYO*. Although there were several similarities with other clusters in the body of literature (Figure 8.2), some differences should also be highlighted:

- Although the *Slightly Physically Impaired* (Bell et al., 2010) were satisfied with their health, 29.6% and 11.2% of the *SRYO* ranked their health as *Neutral* and *Bad* respectively. Only 40.8% ranked their health as *Good*.
- Whilst the *Captive Public Transport Users* (Haustein, 2012) were mostly older-old, the *SRYO* was mostly composed of younger-old females, which makes the situation more worrying.
- Whilst the *Captive Public Transport Users* (Haustein, 2012) were mostly members who lived in single-households and had higher social norms to use public transport this was not the case for the *SRYO*. The household type did not have a major impact in the clusters' formation, and given the generally low public transport use in Malta social norms did not encourage that. They were captive public transport users primarily due to not driving.
- Although the *Granny Flats* (Hildebrand, 2003) had similar characteristics to the *SRYO*, in their case household size was important as they mostly lived with their children. This was not the case in this research.
- Whilst the *Retirees in Declining* (Beaudoux and Deleu, 2010) used collective public transport more than the car and had trouble to use special transport services, the *SRYO* were mostly infrequent public transport users, pedestrians and passengers.
- The *Mobility Impaired* (Hildebrand, 2003) were quite old, had a low car ownership in household and had a high disability rate. This was not the case for the *SRYO* cluster.

Apart from these differences, the *SRYO* supported very well the clusters listed in Figure 8.2. For example, corresponding with the *Low outdoor mobility/still satisfied with mobility* cluster identified by Mollenkopf et al. (2004), the *SRYO* also had lower mobility levels and although they were not completely happy with the way they travelled they were not totally dissatisfied either. They got used to depending on others and on alternative modes for their basic mobility needs. More information on these clusters could be found in Tables 2.1 in page 49 and A.1 in Appendix A.

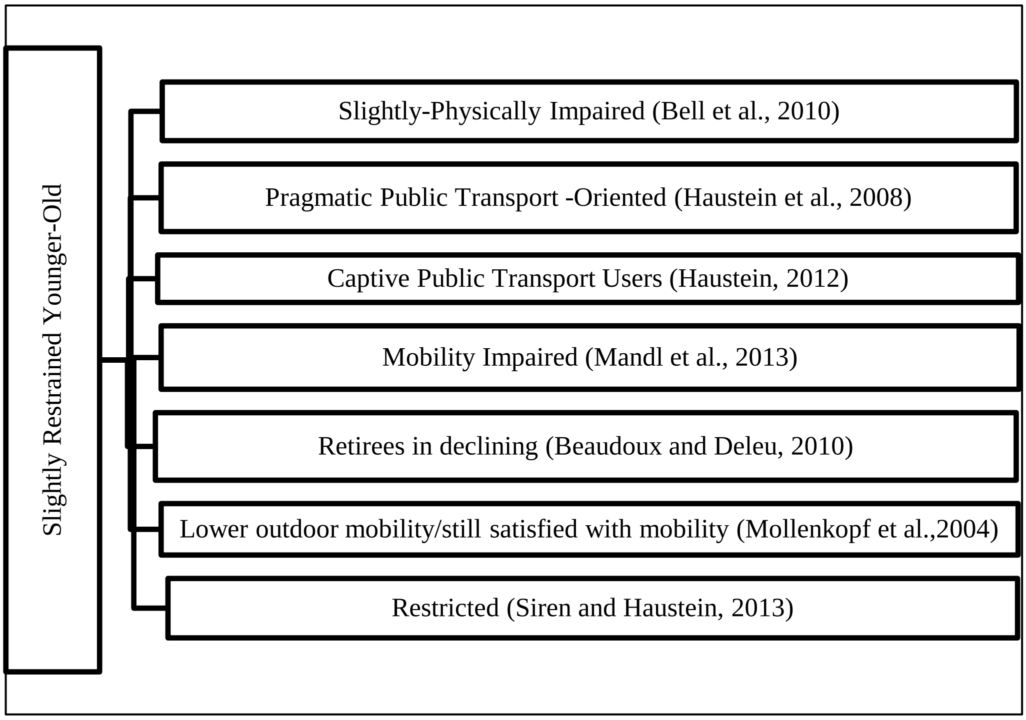

Figure 8.2: The corresponding clusters in the body of literature for the Slightly Restrained Younger-Old

As shown in Figure 8.3, the *PLMOO* cluster was related to six other clusters discussed in Section 2.7. These were mostly older-old females who, due to age limitations, had very limited mobility levels for which they were not happy or optimistic about. Overall, all the clusters shown in Figure 8.3 had such basic characteristics. With respect to the *Captive Car Users* by Haustein (2012), it should be highlighted that the *PLMOO* were captive to the car as passengers and not as drivers. Moreover, the *Highly Physically Impaired Seniors* (Bell et al., 2010) and the *Restricted* Group (Aigner-Breuss et al., 2010) both had a considerable use of public transport. This was not very much the case for the *PLMOO* who travelled mostly as passengers, pedestrians or with specialised modes of transport. As otherwise explained by Mandl et al. (2013) (the *Care-Full*) and Mollenkopf et al. (2004) (*Low outdoor mobility/Unsatisfied with mobility*), this cluster had a high level of unrealised mobility which made it members unhappy with the way they travelled.

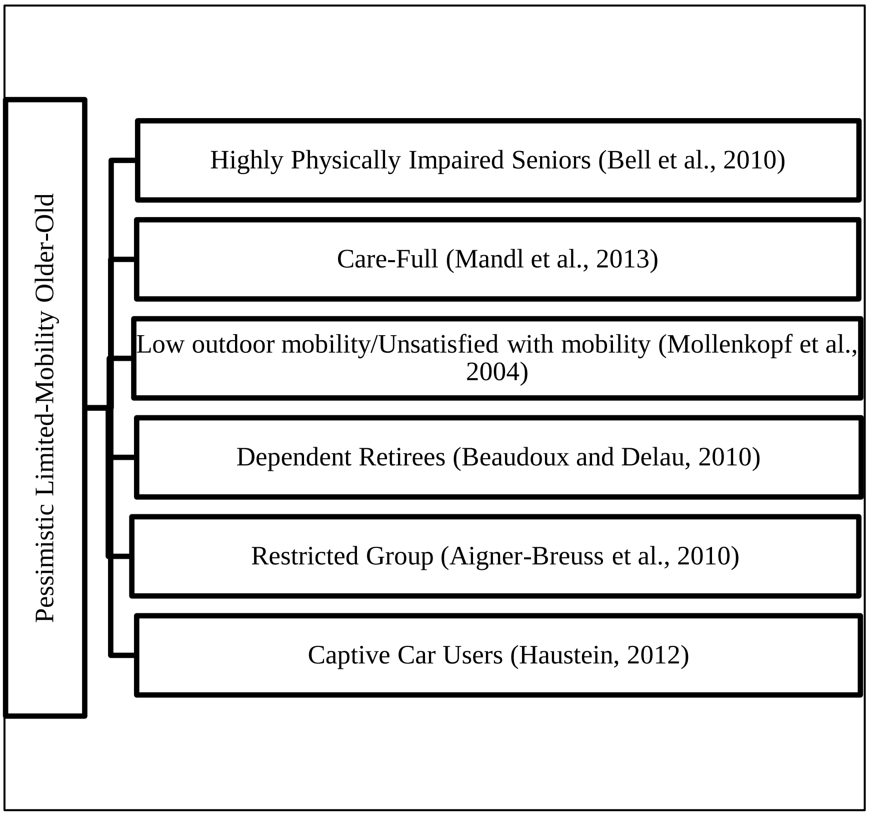

Figure 8.3: The corresponding clusters in the body of literature for the Pessimistic Limited-Mobility Older-Old

The previous discussion revealed that there were other clusters in the body of literature (Section 2.7) that did not relate with any of the three clusters developed in this study. Most of these clusters are those which Haustein and Siren (2015) grouped under the general heading of *Mobile Multi-Modal Seniors*. These are shown with an asterisk symbol (*) in Table 8.1. Such clusters were mostly composed of younger-old people who were flexible and used different modes of transport. They chose the most sustainable mode based on the situations and on their environmental concerns. This was actually the only group that included cycling. Given the variables included in the cluster analysis of this study (Section 7.2), some of these clusters could not be compared. This is due for example, to the modal split in Malta and the exploratory nature of this study, where environmental norms and cycling were not included. Therefore clusters such as the *Bike-Oriented* and the *Eco-Friendly Public Transport Oriented* as identified by Haustein et al. (2008) were not represented.

Name of Cluster	Author (s)
Selective Car Users*	Aigner-Breuss et al. (2010)
Restricted Mobiles	Haustein et al. (2008)
Self-Determined Mobiles*	
Bike Oriented*	
Eco-Friendly Public Transport Oriented *	
Self-Determined Mobiles*	Haustein (2012)
Mobile Widows	Hildebrand (2003)
Disable Drivers	
Fit as a Fiddle	Mandl et al. (2013)
Oldie but Goodie*	
Hole in the Heart	
Medium Outdoor Mobility/High mobility Satisfaction *	Mollenkopf et al. (2004)
Flexibles *	Siren and Haustein (2013)

*These clusters were collectively grouped as the *Mobile Multi-Modal Seniors* by Haustein and Siren (2015)

Table 8.1: List of clusters from the body of literature that did not relate with any of the three clusters in this research

Moreover, the clusters marked with an * in Table 8.1 did not correlate with any of the three clusters in the study because of the high car ownership in Malta which affect mode choice among older people. The latter were either high car users (as drivers or as passengers) or else travelled mostly on foot; with public transport being used primarily in a captive manner. This is quite worrying since such inflexibility can lead to immobility if the respective mode of transport could not be used anymore. As shown from the discussion above the most "flexible" of the three clusters was the *SRYO*. Yet, their flexibility was not very explicit.

The *Fit as a Fiddle* (Mandl et al., 2013) had similar characteristics to the *CAYO*. Nonetheless, they were quite young in age as they were between 50 to 59 years. Since the sample of this study started from 60 years, this cluster was automatically omitted. The *Mobile Widows* (Hildebrand, 2003) could also relate to the *CAYO* to some extent. This is because although the latter was mostly composed of males there were also some younger-old females who travelled in a similar manner. However, these were not necessarily household-head widows because most of them were still married. For this reason, the connotation between the two clusters was not strong enough.

The *Disabled Drivers* (Hildebrand, 2003) were mostly older-old females who were drivers due to a disability that affected their mobility. Given the low percentage of older female drivers in Malta (Chapter 1) this cluster did not feature within this study. Nonetheless, this should not be excluded in the future given the significant increase in older female drivers. The *Restricted Mobiles* (Haustein et al., 2008) had a high percentage of older people who drove (51.5%) and who travelled on foot (36.3%).

Unfortunately, and as previously highlighted with regard to the inflexibility of older road users in Malta, in most cases when they drove they did not tend to walk much. Thus, this cluster was not very representative within the Maltese context.

Ultimately, although the *Hole in the Heart* cluster (Mandl et al., 2013) was somehow similar to the *SRYO*, there were quite some differences as well. Similar to the *SRYO* they participated in limited social activities, public transport use was challenging, depended on others for lifts and travelled mostly for utilitarian reasons. However this cluster was composed of people aged between 50 and 57 years who were considerably younger than the sample of this study (60+). Moreover, the *Hole in the Heart* cluster had a weaker health status than that of the *SRYO*, and were strongly limited in the activities they could participate in due to mental and physical problems. Although the health status of the *SRYO* was weaker than that of the *CAYO*, they were not restricted as much from their mobility due to health limitations.

This means that overall the three clusters of the study fitted well within the body of literature and corresponded to other older road users' clusters previously developed. This also reflected the reliability of the approach used in this study. Nonetheless, due to survey format and contextual factors, there were also other clusters in the body of literature that did not reflect the Maltese older population.

8.5 The Relevance of this Research within the Maltese Transport Policy

Given the research problem and the findings presented in Chapters 5 to 7, it is important to deliberate on how such research relates to Maltese transport policy. Siren and Haustein (2015) explained how across the European Member States, there are several variations with regard to the practices concerning the management of older drivers. For driving licence renewal purposes, the medical assessment varies between countries. Most countries require a statement from a General Practitioner whilst others require further detail, such as a 'Dementia Test' in Denmark, and a physical and physiological assessment in Portugal, Romania, Slovakia, and Spain. In line with what was explained in Chapter 1 and with what Johnson et al. (2017) also captured in their study, the driving license renewal process in Malta is still based simply on age (70 years).

However, results from this study showed that health was not a significant determinant for older people to drive or not. It was also explained how older people usually compensate for their limitations when travelling. Thus, such factors should also be considered and added when analysing older people's driving ability. This perfectly supports what was discussed in the GOAL action plan (Hoedemaeker, 2013) which calls for driving screening and assessment programmes that develop a criterion on whether someone is still capable to drive. This is essential to understand how older drivers self-regulate and adapt themselves to declining driving skills and what training programmes are needed. Older drivers should be assessed based on their behaviour in the road and not just on their medical portfolio.

In 2016, Transport Malta published the first *National Transport Strategy 2050* (TM, 2016a), which sets out the longer-term goals for the Maltese transport system. This was supported by a *Transport Master Plan 2025* (TM, 2016b) that focuses on the short to medium term measures. Table 8.2 lists the six strategic goals of the strategy with the respective targets that Malta has committed to, and explains their relevance to older people's mobility. In addition to this, the strategy also outlines eight guiding principles which set out the strategic direction for transport policy in Malta. Amongst these is the need for an integrated approach between land use and transport as well as the need for more education as a tool for behaviour change. Another guiding principle in the strategy calls for more research and innovation. This further emphasises the need for such study in Malta.

The *Transport Master Plan 2025* identifies a number of transport operational objectives in a more detailed manner so as to work towards the six strategic goals of *the National Transport Strategy 2050*. Table 8.3 lists some of the objectives which are mostly related to an improvement in older people's mobility. This shows that if thought through properly, when policies work on improving the mobility of older people (e.g. through improvements in accessibility, social developments, reduction in car use, improvements in road safety, increase in provision of sustainable alternatives, improvements in the quality of the environment etc.) they will bring about improvements for everyone. Thus, such policies are not only required to improve mobility in later life but to improve accessibility and mobility for the general society.

Strategic Goal	Simplified version of the Targets (2030 & 2050) cross-referenced with Strategic Goals	Relevance to older people's mobility
Transport to support Economic Development	Increase in length of TEN-T Core and Comprehensive Networks; Increase in bus average speed	Older people's mobility is improved if public transport operates in a faster and more efficient manner.
Transport to promote Environment & Urban Sustainability	Reduce greenhouse gas emissions and lower average age of passenger cars	Older people live healthier lives with cleaner air and environment.
Transport to provide Accessibility and Mobility	Encourage mode shift from car to public transport use	Reduce traffic in town centres and improve the quality of the public realm that supports cohesion and social participation. Public transport is an essential tool for older people to remain independent.
Transport to support Social Development and Inclusion	Reduce percentage of population living more than 15 minutes from a bus stop	Although proximity to bus stops is not an issue for older people, this facilitates their access to use public transport.
Transport to be Safe and Secure	Reduce grievous injuries and fatalities	Road traffic casualties involving older people increased dramatically throughout the years. Safer conditions would also encourage the use of active mobility.
Transport to work towards Public Health	Increase mode share of non-motorised trips	Active travel has several positive effects on older people's mobility and well-being.

Table 8.2: The six strategic goals of the National Transport Strategy 2050 and their relevance to older people's mobility (Adapted from TM, 2016a)

Road Transport Operational Objectives	Public Transport Operational Objectives
A long-term strategic transport planning and design	Improve the service quality and modal share along strategic routes and between major strategic nodes in the Inner Harbour region
A reduction in car use in busy areas	Improve physical accessibility to public transport
A reduction in the impact of vehicles (social environment and economic)	Improve the quality of the environment at primary and secondary public transport hubs
Better provision of sustainable alternatives	Improve the supply of alternative forms of scheduled public transport
Improvement in road safety through better research, education and enforcement	
An efficient traffic management to optimise use of existing infrastructure	
Improvement in effectiveness of road transport enforcement and regulations	

Table 8.3: Some of the operational objectives outlined by the Transport Master Plan 2025 which are relevant to older people's mobility (Adapted from TM, 2016b)

8.6 Suggestions for More Independent Mobility

Within this context of Maltese transport policy and following objectives 1 to 4 in this research, this section will now address the fifth and last objective: *To make recommendations for independent mobility in later life*. A number of recommendations are made in light of the research findings. Given the high car ownership in Malta and the continuous increase in the number of older drivers, the first suggestion will tackle measures that can help reducing the driving habit on the island.

8.6.1 Reduce the Car Use Habit

It is evident that the high car ownership in Malta has several negative implications which do not just affect the older population. Therefore, although habit did not yet prove to be the prime factor affecting travel behaviour in later life, driving habit is a key priority that should be considered in any Maltese transport policy. Strong efforts should be made by both the government and community organisations to discuss mobility beyond the private car. Thus, this study contrasts with what was discussed in Section 2.8, where different researchers (e.g. Musselwhite et al., 2015; Cui et al., 2017) suggested that older people should be encouraged to keep on driving as much as possible to retain their independence. As shall be discussed in the following sections, most interventions in Malta should focus on reducing car use and encourage the use of alternative modes of transport.

Verplanken and Wood (2006) explained that there are two main types of habit change interventions: 1) *Downstream interventions* that provide information input at points when habits are vulnerable to change (e.g. moving home, changing jobs) and 2) *Upstream interventions* that occur before habit performance which disrupt old environmental cues and establish new ones. Whilst downstream interventions try to ease the existing negative habits, upstream interventions aim to prevent such habits from forming (e.g. taxes to prevent car use, policies that encourage walking or alternative modes). Transport policies should not only use information to alter the existing patterns but should also provide new information for new behaviours to be maintained (Verplanken and Wood, 2006; Thomas et al., 2016). In order for this to happen, immediate positive feedback for the new behaviours should be provided (Ouellette and Wood, 1998).

With regard to the Maltese older road users, policies should focus particularly on upstream interventions because they are those that mostly target social norms and contextual factors (Verplanken and Wood, 2006). A case in point is the improvement in availability and efficiency of the bus networks. Downstream interventions are usually less successful because due to the repetitive-based expectations associated with habit, people are usually insensitive to minor changes in their performance contexts. A disruption in the environmental context is essential to break habits (Section 3.4.2), and therefore downstream interventions (e.g. information campaigns) should be paired with changes in the living environment (e.g. transport infrastructure is redesigned). Verplanken and Wood (2006) referred to such initiatives as “downstream-plus-context-change” interventions. Governments should also work for “practice-based interventions” which intentionally change contextual factors that enable negative practices such as excessive car-dependance. Such interventions do not just target individual behaviours, but focus on modifying the practice of a large group of people by (dis)integrating and altering the diverse elements (Shove, 2010).

With reference to the older population, car-breaking habits interventions should target specific phases in life, including retirement. This should be accompanied by appropriate knowledge on public transport services that can help to reduce the misconceptions that drivers usually have regarding non-car alternatives (Gardner and Abraham, 2008). Şimşekoğlu et al. (2015) discussed how campaigns that challenge car use habit should put more emphasis on the positive aspects of public transport to increase its desirability. For example, highlighting the safety benefits of public transport (less probability of accident involvement) can encourage older people to use this mode more often.

Providing information is one essential way to educate people and motivate them to change their habitual practices. This is because when certain behaviours are performed regularly they do not necessarily have to be habitual. For example, whilst driving can be habitual to go to work it usually involves decision making when travelling for leisure purposes. This is particularly the case for older people who tend to travel for more leisure purposes compared to other demographic groups (Section 2.5.2). Thus, many daily activities are still open to change through downstream interventions (Verplanken and Wood, 2006). In such policies and campaigns, any stakeholder whose practices contribute to the collective and normative coding of different modes of mobility should be considered. For example, retailers can play a role in reducing car-use habit in later life since older people travel mostly for shopping purposes.

Kose (2012) highlighted the multiple difficulties that older people encounter when carrying heavy shopping bags which lead them to use the car. Although online shopping is possible, he discussed how older people would usually still want to physically see the product that they are going to buy (e.g. fresh vegetables). Thus, Kose (2012) explained that in a local city bus in Japan, a half-price fare discount was provided to older people who showed their driving license to the bus driver. Another incentive in Japan was to provide a free or discounted home delivery for older shoppers who used public transport to suburban hyper-markets. This study showed that after walking, most older people went shopping by car (as drivers or passengers) (Table E.3 in Appendix E). Thus, given that in Malta there are currently multiple large supermarkets located in the periphery of towns (all encouraging car use), such incentives could be very helpful to discourage older people from driving to go shopping. Other needed disincentives to discourage overall car use in Malta (e.g. economic disincentives such as parking fees) would of course also be a motivator for older people to reduce their car use.

8.6.2 Understand the Psychological Characteristics of Travel Behaviour

Habit is just one psychological factor that can affect travel behaviour. The social psychological approach adopted in this research has demonstrated the importance for policy makers to acknowledge individuals' psychology when understanding mobility. Following the TIB framework used in this study, transport policies should account for, or at least control for, the attitudes, emotions, habits and social norms that affect older people's travel decisions. For example, it is important for transport policy makers to understand whether older people are "forced" or "happy" to use the transport services available to them.

Another factor which stresses the importance of psychological factors in older people's mobility was the discussion presented for the two younger-old clusters. The *CAYO* and the *SRYO* both used public transport infrequently. Yet, as previously discussed, the *SRYO* had a much lower habitual behaviour and thus could be influenced by public transport policies more easily. Nonetheless, on the other hand, the *CAYO* had more positive attitudes and emotions which can reflect positively on their mobility and help in potential behaviour change. This means that transport policies dealing with mobility in later life should also have specific time-frame goals. This is because whilst the *SRYO* cluster is more malleable to change, the *CAYO* cluster is more resistant and need longer-term policies.

The results of this study showed that older people's travel behaviour was under a strong normative control, where family members and health professionals created high normative expectations. Thus, when policy makers intervene to improve mobility in later life they should also consider the possible implications of social norms. Due to such pressures, transport policies should target all the population so that family members can influence their older relatives in a positive way. For example, when discussing the reduction of driving for older people in the metropolitan areas of Queensland, Liddle et al. (2004) explained that awareness raising talks and brochures were targeted towards current drivers, a group programme and handbook for retiring drivers, and a website for health professionals and family members. This is because support to family members and carers is equally important (Peel et al., 2002).

Interventions targeting the ecological norms of people should be implemented in early stages of life when travel mode habits are not that distinct (Matthies et al., 2002). With preventive policies targeting younger generations who still have relatively higher mobility capabilities, there is also a much higher chance that travel is then improved in old age and that the probability of developing negative habitual practices is reduced. Currently, interventions in Malta focus mostly on economic and material incentives (e.g. price, time, comfort). They do not tackle "soft" social incentives such as social support or social roles. As shown from this research, the imposition of others (e.g. physicians) could strongly affect how older people behave and it also has a strong impact on the sense of control over one's abilities. Therefore, health professionals should be trained to guide older people on the most sustainable modes of transport that they should use and on their abilities to use multiple modes of transport. With reference to the Social Practice Theory (Reckwitz, 2002) discussed in Section 3.2, together with the immediate social norms from family and friends, it is also essential for policy makers to acknowledge the social pressures that older people usually have from a much greater scale. These usually result from their social practices and contextual factors to which they may not be necessarily aware on a day-to-day basis. Modifying and improving social practices can help to improve the mobility of older people.

8.6.3 Acknowledge the Gender Differences in Mobility

The study revealed a strong gender imbalance in the way older people travelled, with females being strongly disadvantaged. Apart from mobility issues, two factors that could have affected this are the culture norms and the values of Catholicism linked with the *marianismo* concept. The latter refers to the historic view of females being submissive and passive with the complete acceptance of the male as a dominant figure (Rivera-Marano, 2000).

The understanding of how public transport use in Malta varies by gender in later life is also still very unclear (Section 8.2.1). For males even the relationship between age and public transport use did not prove to be significant. Thus, when policies target behaviour in later life they should acknowledge such differences and cater for the different needs based on gender. More specific research is needed on public transport use among older males so as to come up with better solutions that attract them to such mode of transport. Given the significant increase in female older drivers in Malta, it is also essential that future policies consider the potential change in older females' habitual travel practices. Yet, as discussed in Section 2.5.1, this concept is still very uncertain due to the male-dominant culture associated with driving (e.g. Siren and Hakamies-Blomqvist, 2005; Rosenbloom, 2006). This is particularly relevant for Malta given the fact that the study found that public transport was not primarily used by choice users. This calls for improvements in the public transport service which will be discussed in the next section.

8.6.4 Improve the Public Transport Service to cater for the Needs of Older People

Policies that discourage car use should also "reward" people who use public transport. Rewarding does not necessarily have to be through financial means but also in the form of regular, reliable and affordable services that meet the needs and requirements of older people. European Commission (2014) showed that the Maltese population was the most dissatisfied from all European member states with the current public transport service. With regard to the provision of information, Malta was the only member state which had more people who were dissatisfied (32%) than satisfied (31%). Even with regard to the satisfaction levels with passengers' amenities, together with Italy, Malta was the only country where dissatisfaction was higher than satisfaction (31% versus

48%). Unfortunately, Malta was also at the top with respondents that were the least satisfied with available public transport routes (35%) and with passenger security on public transport (42%). Contrasting with such negative characteristics, Malta was amongst the top three countries (together with Luxembourg and Austria) where respondents were satisfied with the price of public transport (61%). This shows that the public transport system offers several challenges to all the population and not just to the older people.

Currently, although bus stop density along Malta's bus routes is very high, only 22% have shelters and 5% have real-time information (TM, 2016a). In fact, Mifsud and Attard (2013) showed that for older bus users in Malta, the main difficulties were long waiting times, lack of comfort on bus stops and inaccessible travel information. Thus, improvements are needed in public transport with regard to the above mentioned issues. This should be complemented with improvements in accessibility and bus stop infrastructures as well as with friendly and helpful bus drivers. As part of the AENEAS Project, bus driver training was provided in Salzburg and Donostia to improve the experience of older people on public transport. Bus driver training is also helpful to reduce the travel-related injuries among older people using public transport (Fiedler and Fenton, 2011; Broome et al., 2010; O'Neill, 2016).

Over 80% of the older people in this study lived within five minutes' walk of a bus stop and accessed bus stops mostly on foot. So, although proximity is not an issue (Mifsud and Attard, 2013; Mifsud et al., 2017), the comfort on bus stops and the surrounding infrastructures is. Unfortunately walkability level in Malta's road is still very low (TM, 2016a). Hence, short and medium term measures are required to upgrade the islands' walking environment and make it more age-friendly. Improvements are not just needed to increase public transport use but also to increase the use of this active mode of transport among older people. Improvements in basic walking facilities (e.g. street lighting, well maintained pavements, equally spaced benches, non-skiddy roads etc.) can strongly increase confidence and walking among older people (Section 2.8). Apart from the enhancements in the public transport operations, other initiatives developed in other countries may be tested for their effectiveness in Malta. For example, as part of the AENEAS project, training on new ticketing machines was provided to older people in Krakow, whilst training on the use of online travel planners was provided in Munich.

The travel information provided should not just be up-to-date but also provided in an accessible and age-friendly manner. One of the aims of the GOAL project was to identify the requirements for effective travel information and social media use to help older people plan and complete their journeys safely (Hoedemaeker, 2013). Although technology use among older people is increasing there is still a considerable percentage of people who do not use the internet and other technological resources (NSO, 2016a). In this case other techniques such as dedicated TV programmes and customised information leaflets distributed to households should be considered. The potential for individual marketing within the communities is also a possible measure to increase awareness and encourage a modal shift (Brog and Erl, 2000).

Bus-buddy programmes could also be developed in Malta (see for example Aging Network Volunteer Resource Center, 2017; SCOA, 2017). Such programmes are voluntarily run, where through volunteers older people are taught how to use the bus. In Schuyler County, a social approach to the training called *Transit and Tea* was used. This oriented older riders to the schedules, routes and general protocols of bus ridership. In addition to the training, the Bus-Buddy volunteer regularly rode the transit route at different times of the day to answer commonly asked questions, to promote the Bus-Buddy service, to provide riders with directions and to ask survey questions to improve the service. These volunteers make travelling on public transport much easier and thus increase older people's confidence in using such modes of transport alone.

8.6.5 Introduce New Flexible Transport Services in Malta

Given the flexibility associated with car use, improvements in the scheduled public transport may not be enough (Newbold et al., 2005). Demand responsive transport can better handle multiple stop trip-chains in later life (Li et al., 2012). Consequently, older people in Malta should also be provided with flexible transport opportunities which are currently not commonly available on the islands. Flexible Transport Services (FTS) are a form of public transport which operates between a regular scheduled bus service with a fixed timetable and route on one hand, and the door-to-door service offered by taxis on the other hand (Brake et al., 2004). FTS, especially if shared, offer flexibility in the routes, timings and door-to-door services, and can compete with and reduce private car use (Finn, 2012). When compared with traditional public transport, FTS have several benefits such as better physical accessibility, better timing, better access to services and better "stigma" (Mulley et al., 2012).

FTS are usually provided on a small-scale basis (Finn, 2012). For example, in Cheshire East, demand responsive transport services (e.g. *D&G Little Bus, Shopmobility Service*) (Cheshire East Council, 2017) are provided as an alternative mode of transport for older people so that they may access basic services for shopping and health care. In this case all journeys are pre-booked. The more flexible older people are with their journey times the more they can be served with such services. Broome et al. (2012) analysed the effect of the replacement of a fixed public transport service with a flexible one in Harvey Bay (Australia). Over an eight-month period from when the flexible service was introduced, the usage by older people approximately doubled and the satisfaction levels with the flexible bus service significantly increased. This showed that flexible bus transport was essential to help older people meet their transport needs.

Despite this, it is acknowledged that FTS also have limitations such as their high cost to run in the long-term. Also, when booking is required, services are not on-demand. Some schemes even prioritise certain travel purposes (e.g. medical trips) and thus still reduce the type of activities that older people can participate in (Atkins, 2001). Another key drawback of FTS is that generally older people are not very well informed about such services (Davey, 2007; Broome et al., 2012). Positive and effective advertising is required to change the attitudes of the younger-old who may associate these transport services with the "weak" older-old (Glasgow and Blakely, 2000). As is the case for all public transport modes, males may also see such services as "feminised" and may not want to use them (Ahern and Hine, 2012).

Further research should analyse the costs and benefits of such flexible services in different socio-cultural contexts, including Malta. Unfortunately, in Malta, specialised transport services are only offered to older people with severe health limitations when they need to go to island's general hospital (Mater Dei Hospital). The only demand-responsive transport service offered to older people and people with disabilities was launched on the 1st November 2017 in the locality of Cospicua. This service is provided for free by the Local Council and operates using an electric vehicle. However, to date, it is only available for trips within the same locality three times a week. No other demand-responsive transport services are offered in other localities for older people to access their basic needs (e.g. shopping). In Malta such services should target mostly the *SRYO* and the *PLMOO* clusters. Given the lack of participation in social activities in Malta, it would also be useful if FTS are provided for both discretionary and utilitarian trips.

8.6.6 Introduce Training Courses and Informal Seminars to Older Road Users in Malta

In line with previous discussions and recommendations, it is a fact that safe driving is essential for older people to remain independent. This study showed that although health was an issue which had an impact on mobility levels in later life, physiological changes were not a major predictor for older people's mode choice in Malta. Older people were also more aware of their physical health limitations rather than mental ones. Hence, given older people’s high intentions to continue driving, re-training programmes should be provided. This helps older people to recognise their potential limitations and adapt accordingly through classroom instruction or on-road training (e.g. *55 Alive/Mature Driving*, *Coaching Mature Drivers*) (Molnar et al., 2013). Driver training programmes should also prepare older people for the transition from the car to other modes (TRACY, 2013). As discussed in Section 2.8, one key drawback of such courses if provided on a voluntary basis is that older drivers may think that they do not need such help and therefore do not participate. Making them compulsory upon renewal of the driving licence is one way of improving road safety among older people. Despite the rapid increase in older drivers in Malta, such courses are still not available.

Section 2.8 also explained that seminars where older people can communicate with other older people in an informal environment are critical because peer learning makes older people feel more at ease at improving their independent mobility (Musselwhite, 2010). By understanding the benefits of using alternative modes of transport, even from experiences of others, older people can be encouraged to use these modes of transport further. Given that retirement is a habit-discontinuity phase in life, these seminars should be provided particularly to older people who are about to retire. At this stage in life, such seminars should not only highlight safety when driving but also incentivise older people to use public and active transport. Such process applies particularly to the *CAYO* who are the most resistant to change.

In Malta there are currently 21 Active Ageing Centres and another six which are run in collaboration with Local Councils and other entities (that focus on life-long learning).

Such centres currently cover various topics that intrigue older people such as health, safety and well-being. Including transport seminars among these topics would be extremely useful to help older people remain mobile in a sustainable way.

8.6.7 Introduce Volunteer Driving Schemes in Malta

Given the small size of the island and the high car dependence, volunteer driving schemes in Malta could be a good alternative to driving which can also increase social inclusion among older people (Section 2.8). Such schemes proved to be successful in different car-dependent contexts such as the Beverly Foundation Volunteer Driving in the United States (Beverly Foundation, 2007). The National Volunteer Transportation Centre (A Community Transportation Association of America Initiative) has over 700 volunteer driver programmes in its database and provides different useful services such as online courses for volunteer drivers. The latter are also recruited following specific criteria in order to ensure the safety of older passengers (NVTC, 2015). In this way, older people could get around when they have limited driving ability or cannot access other transport services.

This could potentially work for the two main target groups in Malta, the *SRYO* and the *PLMOO*. Females tend to use such schemes more than males since they are more willing to accept lifts from others (Rosenbloom, 2006). On the other hand, given the emotions that males usually attach with car driving, the *CAYO* may be encouraged to apply to be recruited as volunteer drivers themselves if they are still fit to drive. In this way, although they will still keep on driving their car, they will be simultaneously giving lifts to other older people. Unintentionally, they will also be gaining more knowledge about the scheme. Tuokko et al. (2007) discussed how once older drivers became aware of volunteer driving programmes, they were more likely to consider a change in their driving behaviour than those who were not.

Unfortunately, although in Malta a number of services are offered to the older population (e.g. meals on wheels) very few are related to mobility. In November 2017, in Sliema (a main shopping hub in Malta), electric foldable mobility scooters were launched for a pilot project called "Volunteer Sliema". The latter is a partnership between SOS Malta and CORE Platform and supported by Sliema Local Council and St. James Hospital (a private hospital). The project wants to promote the mobility of older people and those with a disability since it enables access to health care and essential services, as well as engagement in leisure and community activities. Following the success of this pilot project in Sliema, other local councils in Malta should work on implementing such transport services. This service might also encourage older people to participate in more social activities as they interact with others in their community.

8.6.8 Increase the Older Population's Participation in Social Activities

Despite the positive impact that participation in social activities has on older people (Section 5.2.1), only 27% of the sample participated in some type of social activity. One reason for this could be the fact that quite often older people spend their leisure time mostly indoors, such as watching television or reading (Schwanen et al., 2001). Moreover, when older people get older, they travel mostly in just familiar areas with any social activity being located just in close proximity to their residence (see Section 2.2.1). Informal discussions with older people during the surveys also revealed that for recreational purposes they preferred to travel with their family members (e.g. by going for a walk along the promenade or by having lunch together in a restaurant). Nonetheless, this does not justify the fact that most older people in Malta did not participate in any social activity, which might reflect negatively on their well-being.

Despite the goals of Malta's *National Active Ageing Policy 2014-2020*, which encouraged participation in social activities, this study has shown that this is still a challenge. Different institutions from various sectors (e.g. transport, health, sports, voluntary work, employment entities, governmental departments etc.) should coordinate and provide more opportunities for older people to travel for discretionary reasons and participate in social activities. As highlighted by Musselwhite (2017), more needs to be done to ensure that discretionary travel needs are met in later life, especially for those without a car. He discussed that community transport providers are essential in this regard, to also help reduce older people's common feeling of being a burden on family and friends.

The role of Active Ageing Centres is critical in this respect. These Centres can also increase the number of activities organised outdoors, in an attempt to raise awareness of the benefits of active transport within the community. Walking tours, for example, help older people to remain physically and mentally healthy as well as increase their recreational activity.

Older people should also be encouraged to participate in other types of social activities including volunteering. In 2013 a Non-Governmental Volunteer Organisation called *Grandparents Malta* was established. It works to improve the well-being between grandparents and their grandchildren through collective activities benefiting themselves and their community. In order for older people to be further motivated to participate in such activities, the respective transport services that facilitate their movement (e.g. organised transport) should always be available. In order to improve this situation and provide specific services, future studies should be undertaken to understand the type of social activities older people engage in and their respective travel patterns.

8.6.9 Improvements in the Facilitating Conditions for Older Road Users

As already indicated in Sections 8.2-8.3, *facilitating conditions* (the way other road users behave in the road and the role of transport infrastructures) were ranked very low by all older people irrespective of the clusters. Such results showed that the Maltese transport system is creating difficulties for all older people, irrespective of whether they are younger-old or older-old.

Strong campaigns are required to improve road safety for vulnerable groups, including heavier enforcement to ensure safer driving, particularly with the significant increase in injury accidents over the past years. Between 2010 and 2015, the number of road traffic casualties that involved older people (60+) in Malta increased from 115 to 269, representing a 134% increase. Such increase was higher for older males (+139%) than for older females (+109%) (NSO, 2012b-2017). In addition, the transport infrastructure needs to ensure safe and secure access. The common illegal parking at bus stops in Malta can have negative impacts on bus boarding and alighting (TM, 2016b). Such illegal activities should be monitored and penalised more severely. Raising awareness among the general public on how they should behave around older people would also be very helpful.

Improvements in the transport infrastructure around Malta are also needed. A focus on prioritising space for pedestrians and other active modes of transport was a common concern among the older people surveyed for this study. Maltese pavements are very difficult due to several obstacles caused by discontinuous and damaged footpaths, ramps or obtruding steps. Older people complained about the overall lack of maintenance of pavements which caused anxiety and a fear of falling. Such inappropriate infrastructure can cause community severance in the road and lead to several psychological barriers that hinder mobility. It can also cause social exclusion and a lack of participation in community activities (TM, 2016a). Consequently, older people should be treated as important stakeholders when planning transport measures, particularly those related to walking and active travel.

Although priority should be given to walking and public transport, it is equally important that the transport infrastructure designed for drivers (e.g. road signs, lighting etc.) is well maintained and adapted to the needs of older people (e.g. through large fonts on road signs). This does not only improve safety in the road for the older drivers themselves but for the whole population. All transport infrastructures need to be resilient and developed in a way to meet the required standards and specifications. Such standards need to be reviewed constantly and be developed in the light of dynamic developments in technology, engineering and research (TM, 2016a). Given the essential role that walking has for older people’s well-being, the planning and location of important services as health centres, groceries and recreational activities in each town centre is critical.

As suggested by TM (2016a), Malta needs to strongly improve its integration between transport and land use planning. Since the 1980s, urban sprawl increased significantly in Malta and travel distances became longer and more complex. Such complexity in travel behaviour has made the provision of public transport services as an alternative to the car more challenging. Given the small size of the island, if transport and spatial planning are integrated, walking can easily become the obvious mode choice for short trips. In order for this to happen however, it is important to understand the motivators for how older people travel. This further guides the well-needed link between urban planning and mobility, which helps to increase active mobility for older people with different physical and mental capabilities. When improving active lifestyles for older people, health care costs can also be reduced. Therefore, as the TRACY project suggested, it would be very useful if a European guidance on age-friendly road and street design is developed.

8.6.10 Improve the use of Technology to help Older People in their Mobility

Section 2.8.1 discussed how different smartphone apps and online sources can help older people in their travel planning (particularly when using public transport). Moreover, ITS is increasingly becoming important in dealing with the mobility of older people. For example, in the Czech Republic, Schmeidler and Fencl (2016) discussed how older people were a major market for In Vehicle Information Systems (IVIS) and Advanced Driver Aid Systems (ADAS). Although they discussed some disadvantages of such innovations, Schmeidler and Fencl (2016) explained that they can help older people in different ways, primarily through a reduction in their level of uncertainty about their journeys. The GOAL action plan (Hoedemaeker, 2013) highlighted the importance of assessing the impact and potential of in-car technology for older drivers to improve safety and comfort. Moreover, further studies are required on the role of autonomous cars in Malta in order to analyse their potential impact on older people's mobility. It is essential to understand the attitudes that older people in Malta have towards such technology because they may feel that they are "weak" if they use autonomous cars and thus may reject such innovation.

Although the *National ITS Action Plan 2013-2017* was recently published in Malta, the use of ITS is still in its very early stages, particularly with regard to the needs of the older population. For example, there is no specific discussion on intelligent traffic lights or crossings that cater for the slower walking speeds of older people (e.g. the puffin crossings in the UK). Real-time data concerning the conditions of the road could help older people to adapt their behaviours accordingly. If this is integrated concurrently with public transport travel information (TM, 2016c) it could also encourage mode shift by making public transport use easier. It is fundamental to educate older people on such innovations (Section 2.8.1). Together with media resources, such knowledge could also be provided at the Active Ageing Centres distributed around Malta. Therefore, it would be helpful if future studies could analyse how Maltese older people react to ITS and how it can improve their well-being.

8.6.11 Potential Barriers for the Implmenetation of some of the Suggestions

In order for the suggestions presented to be fruitful, the main institutions in Malta have to come together and integrate aspects related to mobility and later life. Marolda (2013) suggested that transport policies should work in a closer collaboration with other policies such as those from the health sector. Nevertheless, when discussing equity in public transport use, Bajada et al. (2016) pointed out that in Malta transport policy is still fragmented between the different institutions within the government. These are namely the Planning Authority, Transport Malta and the Ministry for Transport, Infrastructure and Capital Projects. They argued that such fragmentation may lead to a lack of integration in land transport policy that focuses particularly on older people's mobility in Malta.

Besides the *National Transport Strategy in Malta 2050*, an important recent document published in 2015 by the Planning Authority is the *Strategic Plan for the Environment and Development* (SPED). This replaced the 1990 *Structure Plan* and is the official document which addresses the spatial development issues for the Maltese Islands. Nonetheless, although this document highlights visions for sustainable development, it is quite vague and does not provide tangible guidance to government or developers in how to measure the extent and quality of development. In line with previous discussions, Malta is still giving priority to car use (and parking) instead of working on improving streetscapes. Although such lifestyle imposes high external costs to the island (Attard et al., 2015), the national progress in this regard is quite slow.

Despite the increasing attention on active ageing, Malta still lacks in having a clear insight on how older people travel. Thus, congruent to one of the action plans presented by the GOAL project (Hoedemaeker, 2013), it would also be useful if a database on older people's walking behaviour (and possibly even about other modes of transport) is developed in Malta. This will be essential to provide the respective safe infrastructure, particularly for walking. The TRACY project (TRACY, 2013) highlighted that a harmonisation of travel surveys that establish a European overview of the older population's transport needs would be very useful. Unfortunately to date, except from TRACY, Malta was not yet included in any of the European projects dealing with older people's mobility (Chapter 1). This was surely a barrier that inhibited the attainment of further knowledge on how to improve mobility in later life.

Given the strong reliance on car use in Malta, one main barrier to implement some of the recommendations discussed in this chapter is the car-dependent culture per se. Thus, as previously discussed, one key factor which is needed to minimise this issue is education. This should not only focus on older people, but should particularly target the younger generations to help them develop a more sustainable mindset on their travel behaviour. This can be a critical influence on the way people travel as they get older.

8.7 Conclusion

This chapter discussed the findings of this research in view of the existing body of literature and the case study. It is evident that whilst for some aspects of older people's mobility Malta is similar to other cities, in other more specific aspects it is not.

Within the context of Maltese transport policy, multiple recommendations on how to improve mobility in later life were provided. These mainly focused on reducing car driving and providing alternatives that cater for the needs of older people. However, given the important role that the car has for older people's quality of life and well-being, other suggestions concerning car use were also discussed (e.g. volunteer driving schemes). This chapter reinforced the relevance of this research since it showed that the study findings provide essential input to policy makers to determine mobility needs in later life in Malta. The following chapter will conclude this research by summarising the main findings, highlight the limitations of the study and provide suggestions for future work.

CHAPTER 9

CONCLUSION

9.1 Introduction

The final chapter discusses the significance of this research. In Section 9.2, the key findings of the study are summarised in the context of the objectives, research questions and the overall aim of the thesis. The contributions of the research to knowledge are then discussed in Section 9.3. Ultimately, Section 9.4 addresses the limitations of the study and provides suggestions for future research.

9.2 Summary of Findings

The objectives (1-5) and research questions (i-ix) were used to guide the aim of the thesis "**To investigate the travel behaviour of older people in Malta and provide recommendations for independent mobility in later life**"

Objective 1: To identify the main determinants that influence older people's mobility and travel.

Research Question i) ***What personal, social and environmental factors significantly affect older people's travel behaviour?***

A review of literature was conducted in Chapter 2 to identify the main factors that affect how older people travel. Following the multilevel conceptual ecological model (Sallis et al., 2008) these determinants were grouped under three main headings: individual/personal, social and environmental factors. Individual factors included age, retirement, gender, health, education, income, driving licence possession and car ownership. The social factors discussed were social networks, living arrangement and the importance of participation in social and leisure activities in later life. With regard to the environmental factors, the effects of the neighbourhood design, geographic context and access to public transport on older people's mobility were discussed.

Chapter 2 showed that mobility tends to decline with age, particularly when there are several health limitations. Older women are more disadvantaged than males since they usually drive less, and when they do so they stop earlier than men. Different case studies also found that higher education and income levels as well as car ownership are positively linked with mobility in later life. As a result, driving cessation is usually a trauma for older people. It was also evident that good social networks particularly with regard to family members are important determinants for travel behaviour in old age. In most cases, the larger the social networks, the more older people tend to travel.

With regard to the environmental factors, Chapter 2 discussed that a high-density environment with mixed land uses usually encourages walking and reduces car use amongst older people. As a result, older people living in rural and suburban areas tend to be more disadvantaged. Usually, these use their car more since they have to travel for longer distances with insufficient public transport services. Access to public transport is also a key determinant for older people's mobility since proximity to public transport stops and higher density of services tend to encourage its use. Following these findings, the important roles of context and policies were highlighted since these can be a travel determinant in themselves. In fact, due to the different contexts of research, some studies which contrasted the general trends were also discussed.

In order to better understand the travel behaviour of older people, the main difficulties that they face as drivers, pedestrians and public transport users were also outlined. These range from difficulties when driving at intersections, when crossing the road, when following road markings, when using public transport services and when trying to understand travel information (if available). Due to such limitations, different ways how older people usually compensate for such problems (e.g. drive during the day only, do not drive in bad weather, take longer times to execute a manoeuvre etc.) were also pointed out.

Ultimately, given the complexity in how older people travel, Chapter 2 reviewed different studies which clustered older people based on different variables namely socio-demographic and economic factors, attitudes and their mobility characteristics. This provided a clear understanding that older people are not just "mobility impaired" but a much wider picture is needed to understand the diversity of their needs. The chapter concluded with several suggestions based on previous studies on how the mobility of older people could be improved. These ranged from training courses to older drivers; improvements in public transport; education and social support regarding transport alternatives; and improvements in active modes of transport.

The review of literature raised a number of important points relevant to the research, particularly with regard to the items that were to be included in the data collection to achieve the aim of the study. It was also important to provide a clearer understanding of what strategies could be implemented in Malta, an under-researched case study, to improve independent mobility in later life. This was a key foundation to achieve objective 5.

Objective 2: To determine the theoretical underpinning in order to analyse older people's mobility and travel behaviour in Malta

Research question ii) ***What is the theoretical framework of the study and how does it relate with older people's mobility and travel behaviour?***

Chapter 3 discussed the theoretical underpinning of the study, the psychological Theory of Interpersonal Behaviour (TIB) (Triandis, 1977). A review of literature dealing with the psychological determinants of travel behaviour in later life was conducted and put within the context of the TIB. The latter explains that one key determinant of behaviour is the **intention** to do it. Different studies discussed in Chapter 3 indicated that intention is critical in later life since it is a main factor which motivates older people to travel. The theory states that intention is affected by four main determinants: *perceived consequences (attitudes)*, *affect*, *social norms* and *roles*. Positive **attitudes** can strongly affect how older people perceive their future, and in old age these can also overcome health limitations when travelling. Several studies also showed that the **social surrounding** of people can have a strong influence on the way they travel. This is mostly related to their family, friends and health professionals. Linked with the difficulties that older people encounter in the road environment, Chapter 3 also discussed that some common **emotions** when travelling in later life are anxiety, fear, insecurity and lack of freedom. The **roles** that older people have in society, such as grandparents, voluntary workers or employed individuals automatically affect their intentions and ways of travel. The TIB also states that any behaviour is not just determined by the intention to do it but also by habitual practices and by other facilitating conditions. This perfectly complements travel behaviour studies since the role of **habit** has been discussed considerably in the body of transport literature, particularly with regard to mode choice. Despite this, other studies found that in the transport sector cognitive factors have a higher weight than habits, particularly in unstable environments. Irrespective of their intentions, the **facilitating conditions** around older people directly affect their travel behaviour. As shown in Chapter 2, older people have different abilities and can face several barriers which automatically affect the way they travel (e.g. inappropriate transport infrastructure, lack of travel information, lack of knowledge etc.).

Objective 3: To understand the key determinants that affect the travel behaviour of older people in Malta

Chapters 5 and 6 investigated the wide range of factors that affect the travel behaviour of older people in Malta. This was divided into objective and psychological factors respectively.

Research question iii) ***What personal, social and environmental factors significantly affect older people's travel behaviour?***

In Chapter 5 regression models were used to determine the personal, social and environmental factors that significantly affect older people's travel behaviour in Malta. Based on the body of literature, travel behaviour was defined through a number of indicators: driving, travel range, travel accompaniment, public transport use, travel frequency, travel time, number of travel purposes, number of utilitarian travel purposes and number of discretionary travel purposes. Overall the top three predictors that most affected the way older people travelled were age (personal factor), district (environmental factor) and participation in social activities (social factor). These were followed by the occupation of older people; whether they had an assistive device; their physical health perception; whether they suffered from a fall in the previous year and gender.

With regard to the ***personal factors***, findings showed that as age increased, the probability to drive and to use public transport decreased and older people tended to travel less frequently and in just familiar areas accompanied by others. Supporting the literature, this study found that gender was an important factor since males had a higher tendency to be drivers and females travelled more in just familiar areas with a lower travel time. In line with this, older people who worked had a higher probability to be drivers. Whilst older workers travelled more for utilitarian purposes, housewives and retired people travelled more for discretionary reasons due to the availability of leisure time. On the other hand, inactive/unemployed older people were more likely to travel accompanied by others, reflecting their mobility disadvantage.

Other personal issues that affected mobility were those related to the health of older people. When they perceived their physical health as *bad* they travelled mostly accompanied by others with a lower travel frequency and a lower number of discretionary purposes. Moreover, when they suffered from a fall in the previous year, older people had a shorter travel range and preferred to be accompanied by others. They also had a lower travel frequency and travelled for less discretionary purposes. Overall drivers preferred to travel alone, reflecting the sense of independence associated with driving. Older people who used public transport in a frequent manner were mostly independent (travelled alone) and younger in age. Nevertheless, when older people drove a car or had a car available (when they were non-drivers) they used public transport significantly less or never. This reflected the high percentage of captive older bus users in Malta.

With regard to the ***social factors*** affecting mobility, the results showed that when older people needed personal assistance from other individuals for their daily needs, not only they had a lower travel frequency and travel time but also a lower public transport use. The marital status and household type were not major determinants for older people's travel in Malta. This is because the marital status just affected their travel accompaniment and number of utilitarian purposes. When older people were married they travelled more accompanied by others than those who were single. Married older people also tended to travel for more utilitarian purposes. This corresponded with the fact that when older people lived in a multi-member household they had a higher number of travel purposes. Enhancing the findings of previous studies, the results found that when older people participated in social activities they travelled alone more rather than accompanied, showing their higher sense of independence. They also used public transport more often, travelled more frequently and had longer travel times. All such factors confirmed that participation in social activities reflected positively on mobility in later life. Nevertheless, the study also revealed that the percentage of older people who participated in social activities was very low, which is not a very good sign on the quality of life of the older population in Malta.

The two determinants which were considered in terms of ***environment factors*** were the district where older people lived and their average distance to the closest bus stop. The latter did not affect their public transport use or any other travel behaviour indicator. Having over 80% of older people living within five minutes of a bus stop did not have any impact on public transport use. This was the determinant which completely contrasted the existing literature discussed in Chapter 2. With regard to the district where older people lived, although it was amongst the top significant determinants, Gozo and the Western region stood out in the analysis. Older people who lived in Gozo had a higher probability to travel just in familiar areas, used public transport less frequently and had the lowest number of utilitarian travel purposes. This showed that overall older people who lived in Gozo had a more limited mobility when compared to those living in Malta. On the other hand, older people who lived in the Western district had the highest possibility to travel in unfamiliar areas and had the highest number of both utilitarian and discretionary travel purposes. Despite these trends, the pattern of how the district affected mobility was not explicit and requires further analysis.

Research questions iv) *What psychological determinants predict travel behaviour for the older population within Malta? Is travel behaviour guided by the intention to travel? If so, is it influenced by attitudes, affect or social factors? Is travel behaviour guided predominately by habit and/or facilitating conditions?*

The second part of Objective 3 was answered in Chapter 6. The TIB framework was tested vis-à-vis older people's mobility in Malta using Structural Equation Modelling (SEM). The TIB framework was consistent with the data. Older people's travel behaviour was motivated primarily by their intentions. Supporting the body of literature, results showed that the more positive older people's intentions were, the higher their mobility levels. Their intentions were mostly affected by their social norms and self-concept. One key reason for such result is the context and the culture of the study since family ties in Malta are very strong and the opinions of family members are given significant weight by older people. The social norms provided by family members were also consistent with those provided by health professionals.

The self-concept of older people had the second major impact on their future travel intentions. The more older people perceived themselves as "capable" and "fit", the more positive were their future intentions. Correspondingly, the model also confirmed that when older people had positive attitudes and emotions when travelling, they had higher intentions for their future. The four TIB constructs (perceived consequences, affect, self-concept, social norms) predicted 53% of the variance in intention. Although this was a significant percentage, it also showed that there were other factors as the state of their health which determined their future intentions.

Based on the TIB, the travel behaviour of older people was also regressed directly with habit. The positive coefficient of the relationship showed that an increase in the habit score augmented the likelihood of positive travel behaviour. However this correlation was not as strong as that of intention. A stable environment is what strengthens habits to form. In later life, usually starting from retirement, lifestyles may not be very stable but depend on several circumstances that arise (e.g. health limitations). Females also tend to have lower habitual patterns than males. Thus, such characteristics (combined with the gender imbalance in the sample) were factors which affected the lower habitual impact on older people's mobility.

Ultimately, following the TIB, the structural model in Chapter 6 also regressed facilitating conditions directly with travel behaviour. This was the construct that had the lowest mean ranking by older people, meaning that they were dissatisfied with the transport infrastructures and travel information available as well as with how other people behaved on the road. However, the impact of such construct on older people's travel behaviour was very minimal. This was an indication that despite being dissatisfied, older people got used to their context and adjusted to the existing infrastructures. Certainly, this is not a good way to handle the problem. Some older people show complacency and a sense of hopelessness towards the problems they face, and this usually leads to an underestimation of the transport difficulties.

When combined together, intention, habit and facilitating conditions explained 41% of the variance in travel behaviour. Although this was quite a sizeable percentage, this reinforced the argument presented in research question *iii*, that there are several personal, social and environmental factors that together with psychological characteristics determine how older people travel.

Objective 4: To develop clusters of older people based on objective and psychological determinants that affect travel behaviour

Research Question v) ***How are older people grouped based on objective and psychological determinants of travel behaviour? Are there any spatial patterns between the clusters developed?***

Using a two-step cluster algorithm, three clusters of older people were developed: the *Complacent and Autonomous Younger-Old* (*CAYO*), the *Slightly Restrained Younger-Old* (*SRYO*) and the *Pessimistic Limited-Mobility Older-Old* (*PLMOO*). These were based on the travel behaviour of older people and their personal (objective) and psychological determinants. Older people cannot be treated as one whole group. Thus, developing clusters helps transport policy and decision makers to thoroughly understand the specific needs by cluster and have target-groups when developing interventions.

With regard to the personal (objective) determinants, the gender profile was the main factor that revealed the greatest difference between the clusters. The *CAYO* was mostly composed of younger-older males whilst the two other clusters were mostly females. Although the *CAYO* and *SRYO* were both composed of younger-old people, the average age of the *SRYO* (70.09) was statistically higher than that of the *CAYO* (68.37). The *PLMOO* represented the older-old cluster with an average age of 81.2 years. The health status of the clusters showed clear differences between the younger-old and the older-old. Nevertheless, the health status also varied significantly between the two younger-old clusters. The *SRYO* had a weaker health profile and also suffered more from a fall in the previous year. All the three clusters had very low participation rates in social activities. The highest percentage was that of the *SRYO* (29%), followed by 27.5% and 3.3% for the *CAYO* and *PLMOO* respectively. There were no spatial differences between the clusters because the variations concerning the district where older people lived were not statistically proven.

Significant differences between the clusters also emerged with regard to the psychological determinants of travel behaviour. The two younger-old clusters had positive attitudes towards their travel behaviour contrasting with the *PLMOO* who were quite pessimistic. This indicated that it was age that mostly affected their attitudes and not gender. With regard to the emotions that older people had when travelling, significant differences did not only emerge between the younger-old clusters and the older-old one, but also between the *CAYO* and *SRYO*. The latter was significantly more anxious in the road. Due to their older age, such situation was further accentuated in the *PLMOO* cluster. Supporting this, the three clusters also differed in terms of their self-concept. Given their younger age and healthier lifestyles, the *CAYO* were those who felt the most fit and that they did not require much compensatory techniques in the road environment. This contrasted with the two other clusters, particularly with the *PLMOO*. Whilst overall both younger-old clusters claimed that their family members, friends and health professionals agreed with their travel behaviour (social norms), the ranking for the *PLMOO* was quite low.

The *CAYO* displayed the highest habitual travel behaviour which differed significantly from the other two clusters. One key reason for this was that this cluster was mostly composed of younger-old male drivers. The *PLMOO* had the least habitual behaviour. Apart from being mostly composed of females, a key reason for this was the instability in lifestyle associated with older-old age. Ultimately, all clusters showed that the transport infrastructure in Malta and the way other people behaved in the road made their travel more difficult.

Finally, Chapter 7 described the travel behaviour of the three clusters. The most evident differences emerged with regard to their mode choice. The *CAYO* was mostly composed of drivers and infrequent public transport users. The *SRYO* had higher public transport use when compared to the *CAYO* but frequent bus users were mostly non-drivers. On the other hand, the absolute majority of the *PLMOO* was pedestrians and passengers. Irrespective of such differences, the majority of older people in the three clusters had at least one car available to them. In actual fact, despite the significant lower percentage of drivers, both the *SRYO* and the *PLMOO* still did not use public transport frequently but relied on the car (as passengers) for their mobility needs. Given their mode choice and their personal and psychological profile, the *SRYO* and the *PLMOO* were those who travelled mostly in just familiar areas and preferred to travel accompanied by someone. This was more accentuated in the *PLMOO* cluster, who in most cases needed assistance from others to travel.

On the other hand, the *CAYO* could easily travel alone. The higher mobility level of the latter cluster, primarily resulting from the fact that they were drivers, was also reflected in their higher travel frequency and travel time. The *SRYO* did not always travel daily and when they did, this was mostly for less than two hours. The immobility levels of the *PLMOO* were reflected in the very high percentage of its members that did not travel during the survey week. The *SRYO* travelled mostly for shopping purposes and to attend church services. The *PLMOO* travelled mostly for medical purposes, for shopping and to attend church services. On the other hand, the *CAYO* travelled mostly for all sorts of purposes listed, for shopping and for recreational purposes.

9.2.1 Policy recommendations

The consideration of objectives 1 to 4 enabled the last objective and research question to be addressed.

Objective 5: To make recommendations for independent mobility in later life.

Research questions vi) *What measures are needed so as to capture the heterogeneity of older persons' travel needs?*

In Chapter 8, a number of recommendations were made in light of the research findings. Given the high car ownership in Malta recommendations started on how car-breaking habit interventions should target specific phases in life. One such important phase is retirement. This should be accompanied by efforts that promote public transport use and increase its desirability (e.g. by highlighting its safety benefits when compared to car use). The provision of information is also critical in this regard combined with disincentives to use the car.

The approach adapted in this research showed that transport policy makers in Malta should account for the psychological factors that affect older people's travel decisions. For example, whilst the *SRYO* were more malleable to change, the *CAYO* were more resistant and needed longer-term policies. Since social norms had the highest impact on older people's travel intentions, transport policies in Malta should also consider such factors. Younger people should also be addressed so as to influence their older relatives in a positive way. Health professionals should also be trained to guide older people to transition to more sustainable modes of transport, and at the same time maintain their mobility. The research findings clearly demonstrated that transport policy makers in Malta should work specifically on motivating older males to walk and use public transport and to reduce the mobility disadvantage of older females. Given the significant increase in female older drivers, it is also essential that future policies consider the potential change in older females' habitual travel practices.

As previously highlighted, the older population using public transport in Malta still face multiple problems. Amongst other factors, it was suggested that bus driver training could be introduced and that travel information should be developed in a more age-friendly manner. Walkability should also be improved not only to increase public transport use but also to encourage older people to use active modes of transport.

Recommendations were also discussed with regard to the introduction of new demand-responsive transport services which in Malta are not provided. Given the very low participation rate in social activities among the older population, it would also be very useful if these transport services are not just provided for utilitarian reasons but also for discretionary ones. Due to their mobility limitations, the two main target groups for such an initiative would be the *SRYO* and *PLMOO*. Safe driving is fundamental for older people to remain independent. It was recommended that in Malta training and refresher courses are made obligatory upon the renewal of licence. This would apply primarily to the *CAYO* who are those most resistant to change.

Volunteer driving programmes could also be another solution that help older people to retain their independent mobility. These would specifically target the *SRYO* and the *PLMOO*. Members of the *CAYO* cluster could also be recruited as volunteer drivers. This service may encourage older people to participate more in social activities. Given the scientifically proven benefits of participating in social activities in later life, different stakeholders from various sectors (e.g. health, sports, voluntary work etc.) should coordinate between themselves to provide more opportunities for older people to travel for leisure purposes. This supports the active ageing propaganda that most developed countries (including Malta) have.

Stronger educational and enforcement campaigns are needed to make travel for older people safer and easier. Transport policy makers (particularly in Malta) should start giving priory to active modes of transport and not to vehicles. If transport and spatial planning authorities collaborate more effectively, walking has the most obvious potential to become the mode choice for short trips in Malta.

9.3 Contributions to Knowledge

Inevitably, a single case study cannot entirely account for the numerous interconnecting factors that shape older people's travel behaviour. However, this research did provide a number of valuable contributions to knowledge.

9.3.1 Data from an Under-Researched Case Study

Following a case study approach, the thesis gave a thorough understanding of *how* and *why* older people travel in Malta. As discussed in the previous chapters, older people's mobility is being given significance importance in the body of literature and hence knowledge from under-researched case studies as Malta is strongly needed. Malta is amongst the countries in Europe facing severe transport impacts as well as the most rapid increase in its older population. As shown from Chapters 2 and 3, to date most studies dealing with older people's mobility were based in major cities (e.g. London, Stockholm), and research focusing on island states (particularly in the Mediterranean region) is still lacking. Thus, this thesis strongly filled the gap from that regard.

In line with the Social Practice Theory discussed in Section 3.2, it was shown that the role of context played an important part when interpreting the findings. This confirmed that not all findings can be generalised and that it is an asset to have research dealing with different contexts, including that of island states. For example, from the total 60+ population in Malta in 2011, 4% had a non-Maltese citizenship. From these, 3% were British with the other 1% having other countries' citizenship (e.g. Italians, Bulgarians and Somali). Thus, the latter might also face additional language barriers when accessing the public transport services.

Nonetheless, the study did support previous research in many ways. Important trends such as the gender mobility differences in later life were not unique to the Maltese context. Therefore, this showed how research in new case studies is fundamental to 1) better understand how older people travel varies in different contexts and 2) to understand general trends that should always be considered and dealt with irrespective of the context. Such two factors are essential for best practices in policy transfer. Therefore, although the results of this study should not be treated as a "one-size fits all" they can be transferrable to other locations, particularly those with similar geographic and cultural characteristics to Malta (as discussed in Section 8.3 regarding the importance of familism and social norms in the Mediterranean region). This is also because the methods used to collect and analyse the data are not specifically related to the Maltese case study.

9.3.2 A Wider Understanding of the Psychological Factors that Determine how Older People Travel

Rather than focusing exclusively on the role of personal, social and environmental factors (covered in Chapter 5), the research also took a socio-psychological approach to examine how older people travel. Building on other studies which analysed the psychological factors affecting individual aspects of mobility in later life (e.g. mode choice, road charging, driving violation) this study broadened the approach. Inspired by Meyer et al. (2014) and given the exploratory nature of the research, psychological determinants did not just focus on mode choice but dealt with mobility in a more generic manner. Mobility was understood holistically from various perspectives (e.g. mode choice, travel range, travel time, travel accompaniment, travel purpose etc.). The study discussed both the objective and psychological determinants of travel so as to have a thorough picture of how they interact together and affect mobility. This approach is significant for decision makers since understanding the motivations underlying *why* older people behave in certain ways is inevitably a vital element to initiate behavioural change.

9.3.3 The Application of the Theory of Interpersonal Behaviour in a New Context and Research Area

The research made important contributions to the theoretical understanding. As the breadth of literature discussed in Chapter 3 showed, while the TPB has applied empirical evidence in support of its use in travel behaviour research, to the author's knowledge this was the first study that used the TIB in older people's mobility research. The findings showed that all variables had a positive significant impact and the model was consistent with the data. Thus, despite the theory not being commonly used in transport studies, this indicated the importance of adopting an alternative viewpoint afforded by the TIB. The two main additions of the TIB over TPB, affect and habit, both confirmed to be significant and consistent with the data. Moreover, to date, most studies that used SEM in older people's mobility studies did so through an analysis of objective determinants only. When psychological factors were considered, individual aspects of mobility (e.g. falls, driving) were studied. The way SEM was used to analyse psychological determinants for older people's mobility in Malta provided contributions in this regard.

9.3.4 Addition to Knowledge on the Clusters of Older People

As highlighted by Haustein and Siren (2015) in their review paper dealing with clusters of older people, to date the only study that specifically focused on older people's mobility and included their attitudes when developing clusters was that by Haustein (2012) in the German federal state of North Rhine-Westphalia. This thesis contributed to such knowledge because the three clusters developed did not just reflect the socio-demographic factors of older road users but also their psychological characteristics. In addition to this, based on the TIB, this research included different and additional variables, namely that of habit. Therefore, the three clusters developed also provided information to transport policy makers on how habitual the travel behaviour of older people was. This is essential for Maltese transport policy given the current lack of knowledge on how older people travel.

9.4 Limitations of the Study and Suggestions for Future Work

Chapters 8 and 9 highlighted the significance of this study from different perspectives. By analysing an under-researched case study, this thesis provided important information regarding older people's mobility which is not only a fundamental contribution to policy, but that can also be transferrable to other case studies. Consequently, the relevance of the research within the Maltese and international policy context was discussed and several suggestions for more independent mobility were provided.

Nevertheless, as any other research, this study also had its limitations, which most of them can also serve as suggestions for future work. Despite the thoroughness of the travel behaviour determinants discussed in Chapter 5, it is acknowledged that some other factors were not discussed based on the choice of determinants explained in Section 2.5. Some of these determinants include dog ownership (e.g. Haustein, 2012), weather conditions (e.g. Hjorthol, 2013), transport costs (e.g. Su and Bell, 2009) and other transport characteristics as road conditions, parking spaces, traffic congestion and accessibility (e.g. Klöckner and Blöbaum, 2010). Therefore, whilst this study focused primarily on the objective determinants related to the older individuals per se, future studies in Malta should also focus on other factors specifically related to the transport environment. This is particularly needed given the low rankings that older people in this study gave to the transport infrastructure in Malta. It would also be interesting to analyse whether the high number of tourists using public transport in Malta deters the local older people from using the service. This would also give a better understanding of the case study and its applicability to other societies.

Chapter 5 showed that although the district where older people lived was an important significant predictor, the spatial patterns were not very explicit. As previously explained, the main finding that emerged was that older people in Gozo had limited mobility. However, with regard to the five districts in Malta no clear patterns emerged. Even in Chapter 7, the district where older people lived was not a significant predictor in the clusters' formation, and in fact the three clusters did not have any spatial difference. Despite this, secondary sources (e.g. NSO, 2014b) show that there are differences in other economic indicators between the north and south of Malta, which could also have implications on mobility. One factor that could have affected such findings was the way the sample was calculated. After the stratified sampling based on the six districts, older people included in the study were chosen in a random manner from the respective localities (Section 4.3.3). Thus, this could have potentially omitted information with regard to important specifics by locality. Given the small size of Malta, future studies could focus on a representative sample per locality (and not just by district) to provide more useful information that explains the potential spatial differences in mobility.

Although travel purposes were analysed in the data, not much detail was provided on how mode choice differed based on specific travel purposes. This was primarily due to the way the question in the survey was structured, and that the collected information intended to be exploratory and not specifically related to just travel purposes. Previous literature (Chapter 2) showed that the reasons why older people travel strongly affect the modes of transport that they use. Hence, it is suggested that future research in Malta will analyse in more detail the travel purposes of older people by mode and the resultant implications on both themselves and society. In line with this and, in order to have a more realistic picture of how older people in Malta travel, it is also necessary to better understand trip chaining in later life. Recently, this has been of great interest in academic studies dealing with older people's mobility. Due to lifestyle changes, trip chains and tour complexity of older people are expected to increase in the future.

On the other side of the spectrum, future studies in Malta should also focus more specifically on unrealised mobility. As clearly shown from the cluster analysis, particularly in the *PLMOO*, there are older people who would like to travel but cannot do so due to various limitations. This is expected to increase given the ageing of the older population in itself. So, whilst this study focused primarily on realised mobility, future work to understand the reasons why some older people *do not* travel is equally important to understand their mobility needs and provide accordingly.

It should also be acknowledged that although the TIB framework proved to be fit for this study, it was the only theory which was tested. The structural model in Chapter 6 was solely based on the TIB with very minimal adaptations. No comparisons with other theories were made to see whether these were also consistent with the data. The main reasons for this were the available time resources and the exploratory nature of the study. Given that no similar research has ever been conducted in Malta, and since it was the first time the TIB was used in such research area, the first step was to understand whether this psychological theory was relevant to the topic and the case study. Future studies should therefore also compare different psychological theories, and maybe combine some of them in order to have a more holistic understanding of the mobility determinants in later life. Based on the TIB, future work may also include the interaction between habit and intention when predicting older people's travel behaviour. This would produce a clearer picture of the effect of each construct on each other and on travel behaviour.

This study followed a quantitative approach. Although important exploratory findings emerged, future research should also be supported by qualitative techniques such as interviews or focus groups. This would permit the researcher to build a deeper relationship with the respondents and thus obtain more detailed information about their travel behaviour. This is particularly important when analysing latent themes as the psychological variables included in this study. Moreover, inevitable time and cost constraints meant that it was only possible to sample older people within a short period of time. Hence, it would be very useful if longitudinal work could be conducted in the future so as to understand how the determinants discussed in this thesis change over time. This would give a good understanding of the stability of mobility and of how ageing affects travel.

In the last years, interest in the new research field in transport called “mobility biographies” has increased considerably. This explains how travel behaviour changes based on key events in the life span of an individual (e.g. having children, retirement, death of spouse). In ageing populations such as in Malta, it is fundamental for policy makers to understand the impact of life-course on individuals and the resulting needs and expectations in later life. Future research focusing on mobility-biographies would definitely complement and better explain the findings of this study.

Ultimately, a key recommendation for future research in Malta is to have a comparison with the younger population. This is fundamental for several reasons. First, it would provide a better understanding of whether younger people would respond differently to the TIB constructs and to the objective determinants discussed in this study when compared to older people. Second, it would also be interesting to analyse what clusters of road users would emerge if younger people were to be included in studies focusing on mobility in Malta. Lastly, a comparison with younger people would also clarify what results are most important for policy and decision making. In this way, the policy implications of the findings presented would be clearer.

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APPENDICES

Appendix A: Clusters of Older People

Appendix B: Questionnaire Survey

Appendix C: Number of Older People in Residential Homes

Appendix D: Description of Sample by Age and Gender

Appendix E: Descriptive Statistics

Appendix A: Clusters of Older People

Study	Age & Case Study	Variables used for clusters' formation	Clusters	Description
Aigner-Breuss et al. (2010)	55+ Ruralists (Austria)	Car Use	*Selective Car Use*	55-65 years, married, high income, drivers, public transport to travel to work, errands on foot, some use of bicycles, voluntary work, strong use of technologies
			Always used their cars	66-73 years, married, average finance, mostly drivers or else passengers, no alternative to car
			Restricted group	74+ years, mostly women, live alone, low income, no car licence, errands on foot and public transport, no use of technology
Bell et al. (2010) SZENAMO PROJECT	62-95 Austria: Vienna, Burgenland	Health, household structure, employment	*Fully mobile seniors*	Working, <70 years, active, preferred car as transport mode, assess possibility to leave home and drive a car, multi-member household, leave home frequently
			Slightly physically impaired seniors	Retired, older age group, satisfied with health state, hardly suffered from physical impairments, preferred walking and cycling, multi-member household
			Highly physically impaired seniors	70+ years, lived alone, more physical restrictions, unsatisfied with their health, motor impairments, used public transport and special transport, leave home less frequently
Haustein et al. (2008) MOBILANZ project	60+ Germany: Augsburg, Bielefeld, Magdeburg	Mobility-specific attitudes; car access, age	*Mobile Car Oriented*	Highest car use, lowest percentage of walking, highest distance travelled per year
			Restricted Mobiles	Highest car use, high percentage of walking, lowest distance travelled per year, lowest leisure time activities per year
			Self-Determined Mobiles	Almost equal percentage of car use and walking, lower use of public transport and cycling, second most longest distance travelled per year
			Pragmatic Public Transport-Oriented	High percentage of walking followed by car (as passengers) and public transport, low activity engagement
			Bike-Oriented	Highest percentage of bike use followed by walking and car, highest leisure time activities, positive ecological norms and perceived mobility necessities
			Eco-Friendly Public transport oriented	Highest percentage of walking and highest percentage of public transport use, highest leisure time activities per year, lowest car use
Haustein (2012)	60+ Germany: North Rhine-Westphalia	Car availability, number of facilities within walking distance, income, social network, public transport control, cycling and walking attitude, weather resistance, perceived mobility necessities	*Affluent Mobiles*	Mostly men, healthy, high education, worked, largest social network, high car availability, perceive low public transport control but evaluate all other modes positively, high perceived mobility necessities, longest distance travelled, active in leisure activities, good use of mobile phone and internet
			Self-Determined Mobiles	Mostly men, healthy, open to use all modes of transport, no pressure to always be mobile, good access to car and public transport, can reach many facilities on foot, positive attitudes towards cycling and walking, personally obliged to use environmental friendly modes, active in leisure activities, satisfied with mobility
			Captive Car Users	Mostly females, older-old, single-household, restricted in mobility, dependant on the car, number of facilities they can reach by foot is below average, low public transport control, do not like walking or cycling, least active in leisure activities, not satisfied with mobility
			Captive Public Transport Users	Mostly females, older-old, single-household, restricted in mobility, low car access but high public transport control, dependant on public transport, did not drive a car, negative attitudes towards cycling and car use, average attitudes towards walking, higher social norms to use public transport, not satisfied with mobility, very low use of technology

Hildebrand (2003)	65+ Portland, Oregon, USA	Socio-demographic variables (age, vehicles owned by household, income, household size, gender, driving license, disability, relationship to household head, employment	*Workers*	Mostly males, employed, youngest average age, licensed to drive a car, mobile
			Affluent Males	Males, second youngest age, second highest income, no incidence of disability, drivers, second highest vehicle ownership, independent, highest trip duration
			Mobile Widows	Mostly females, live alone, household heads, low income, have a driving license, mobile
			Granny Flats	Mostly females, live with their children, largest income, one-third disabled, few employed, few licensed to drive, rely on others for some transport needs, lowest trip duration
			Mobility Impaired	Mostly females, second oldest average age, few vehicles per household, more than one-quarter disabled, no driving license, depend on others for travel needs, rely on walking and transit more than other clusters. Public transport played an important role in a restricted manner (lower income, not licensed, older)
			Disabled Drivers	Mostly females, have a driving license but have a disability which affects outside travel, older than average, not employed, rely on auto for most trips
Mandl et al. (2013) (GOAL)	50+ (20 European countries from SHARE database)	Demographics, physical and mental health, social life, living environment, mobility-related aspects	*Fit as a Fiddle*	Youngest (50-59), healthiest, live in partnership, employed, highest education, good social networks, complex and long trips, high car users, low public transport use, satisfied with neighbourhood and infrastructure, high internet users, little problems with technology use
			Happily Connected	60-75 years, live in partnership, fit, highly socially active with high life satisfaction, driving is the most important transport mode (male as drivers, female as passengers), complex trip chains but drive fewer kilometres than younger drivers, open attitude to technology but usage depends on experience
			Oldie but Goodie	Mostly female, 80-90 years, independent, single-household, overall healthy, not severely limited in activities, high self-efficacy, use mobility aids, participate less in social activities, take part in religious activities more often, walking and public transport are preferred modes of transport, lowest car dependency, shorter trips and in off-peak hours, infrastructure problems limit mobility, avoid unknown trips, refuse use of technology
			Hole in the Heart	50-57 years, retired, sick, lower income, strongly limited in activities due to health problems, limited social activities, cars are preferred since public transport use is difficult, non-drivers depend on lifts, most trips are to medical entities, good infrastructure is important, low rate of technology use but some see it as a possibility to improve mobility
			Care-Full	80-100 years, frail, immobile, severe illnesses, use mobility aids, no participation in social activities, depend on care and assistance from others, do not leave home often, travel as passengers or with special transport services, travel for medical purposes, barrier-free infrastructure is very important, technologies rarely used
Mollenkopf et al. (2004) MOBILATE	55+ Finland, Germany, Hungary, Italy, Netherlands	Mobility behaviour (trips made, transport modes used, variety of outdoor activities, satisfaction with mobility)	*High outdoor mobility/high mobility satisfaction*	Mostly younger-old males, healthy, high education, active car drivers. Frequency of trips above average
			Medium outdoor mobility/high mobility satisfaction	Lower satisfaction with financial situation, lower education but still pair with average, lower use of transport modes and variety of outdoor leisure activities
			Low outdoor mobility/still satisfied with mobility	Satisfaction with mobility still in positive score range, components of mobility lower than first two groups
			Low outdoor mobility/unsatisfied with mobility	Older-old females, live alone, lowest education, highest health impairments, most restricted financial situation, non-drivers, all mobility characteristics lied in negative range of values, lowest means and range of outdoor leisure activities, lowest satisfaction levels with mobility

Siren and Haustein (2013)	62-63, Denmark	Future expectations of baby-boomers on transport modes, general living conditions and dependency	*Independents*	Mostly males, high level of education, good health, lived with partner, expected to use individual modes, best car access, optimistic about not depending on others
			Flexibles	Gender balanced, highest level of education and income, expected to use all transport modes and used the car to a lower extent
			Restricted	Mostly females, lower levels of education and income, most restricted in transport especially in car use, dependent on others, lowest annual mileage
Beaudoux and Deleu (2010) Veolia Mobility Lab	65+	Lifestyle of older people	*Young Active Retirees*	Healthy, several activities away from home, travel similar to workers, car is import to permit freedom, abandoning the car is "social death", public transport seen as restrictive
			Retirees in declining	Lower health status, mobility in decline, collective public transport more than car, comfort and security are important in travel, trouble to use special transport services
			Dependent Retirees	Older-Old, bad health, limited capacity of mobility, collective public transport but afraid to travel alone, difficult to understand traffic signs/travel information
Shergold et al. (2015)	UK	Scenario-planning approach, state provision of car, assistive technologies engagements	*Scenario A: Communal Call-Out*	Low-state provision of care and high assistive technologies engagements
			Scenario B: Home Alone and Wired	High state provision of car and high assistive technologies engagement
			Scenario C: Gimme Shelter	High state provision of care and low assistive technologies engagements
			Scenario D: Home Ties	Low state provision care and low assistive technologies engagements
Ravulaparthy et al. (2012)	U.S. (DUST 2009 Disability and Use of Time) – senior couples average age of 68 years	Subjective well-being or happiness (life, health, memory, financial and marital satisfaction)	*Unhappy*	High percentage (46%) avoided walking to activities due to different difficulties, considerable percentage of non-participation in social and leisure activities
			Moderately Happy	High percentage of walking to activities, considerable percentage of non-participation in social and leisure activities, more likely to have difficulties in walking due to lowest level of health satisfaction but did not avoid it, participate in physical activities when given the opportunity, low health and financial satisfaction but high level of life satisfaction
			Uniformly Happy	High percentage of walking to activities,
			Very happy	Very few avoided walking, high participation in social and leisure activities

Table A.1: Review of studies that clustered older people with the respective description of each cluster (Adapted from Haustein and Siren, 2015)

ID number: Locality: District:

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Appendix B: Questionnaire Survey (English version)

Section A: Objective Factors

1. Socio-Demographic and Economic Characteristics

1. Gender: ☐ Male ☐ Female
2. Age: ______________________
3. Marital Status: ☐ Single ☐ Married ☐ Widowed ☐ Divorced ☐ Separated
4. Education: ☐ No Schooling ☐ Primary ☐ Lower Secondary ☐ Upper Secondary ☐ Post-Secondary Non-Tertiary ☐ Short-Cycle tertiary education ☐ Bachelor ☐ Master ☐ Doctoral
5. Household Type: ☐ Single Household ☐ Multi-Member Household
6. Labour Status: ☐ Employee ☐ Employer ☐ Self-Employed ☐ Unemployed ☐ Retired ☐ Inactive (due to disability/illness) ☐ Other ______________
7. Do you have any person assisting you with your self–care, mobility or other daily activities?
   ☐ Yes (specify who and what kind of assistance) ____________________ ☐ No
8. Do you participate in any type of social or other activities?
   ☐ Yes (specify) _________________________ ☐ No

2. Health Characteristics

9. How do you rate your physical health status in the past 3 months? (1 lower; 5 highest)
   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
10. How do you rate your mental health status in the past few months? (1 lower; 5 highest)
    ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
11. Are you taking any medication? If yes, what type of medicine is it and for what reason?
    ☐ Yes: ☐ Prescribed ☐ Over the counter Main reason(s): _________________
    ☐ No

12. Do you use any assistive device? If yes specify whether it is for indoor and/or outdoor use?

Indoor - Outdoor

- ☐ Yes
  - Hearing Aid
  - Glasses
  - Wheelchair
  - Stick
  - Rollator
  - Other (specify)
- ☐ No ____________________

Indoor	Outdoor

13. Did you suffer from a fall in the last year? If yes was it indoors or outdoors?

☐ Yes: ☐ Indoors ☐ Outdoors

☐ No

14. What are the main health issues that affect your outdoor mobility?[2]

☐ Sensory Functions
☐ Mental Functions
☐ Cardiovascular, Haematological, immunological and/or respiratory systems
☐ Neuromusculoskeletal and movement related functions
☐ Depression symptoms
☐ Other (Please specify): ____________________
☐ None

3. Access to Transport Services and Travel Behaviour

15. For what reasons do you usually travel and with what mode? Why do you choose this mode of transport and do you have a preferred time to travel for these purposes?[3]

		Mode	Reason(s)	Preferred time
Shopping	☐			
Medical Care	☐			
Visit Relatives	☐			
Recreation	☐			
All of the above	☐			
I do not go out	☐			
Others	☐			

16. In the past week, did you travel every day? What was the average daily travel time for those days in which you travelled?

☐ Did not travel ☐ Travelled daily ☐ Did not travel daily

☐ <2 hours ☐ 2-4 hours ☐ 5-7 hours ☐ 7+ hours

[2] Participants should be left free to list the main issues and then these should be numerically ranked accordingly by the interviewer (1 represents the first issue mentioned)

[3] Participants should be left free to list the travel purposes and then these should be numerically ranked by the interviewer accordingly (1 represents the first travel purpose mentioned)

17. Are you a:
- ☐ Driver
- ☐ Pedestrian
- ☐ Public Transport User
- ☐ Car Passenger
- ☐ Car driver and Passenger
- ☐ Driver and Public Transport User
- ☐ Driver and Pedestrian
- ☐ Car passenger and Public Transport User
- ☐ Car passenger and pedestrian
- ☐ Public transport user and Pedestrian
- ☐ Driver, Passenger, Pedestrian and Public Transport User
- ☐ Other ______________________________

18. Do you usually travel just in familiar areas? ☐ Yes ☐ No ☐ Not always

19. Do you usually travel alone or accompanied? ☐ Alone ☐ Accompanied ☐ Depends

20. If you are a driver for how many years have you been driving? ______________________

21. If you are not a car driver:

   a. Were you a car driver? If yes, what were the reasons that you stopped driving?

   ☐ Yes: Reason that led to driving cessation ______________________

   ☐ No

   b. Is a car available? How many cars are available in your household?

   ☐ Yes Number of cars available in household ____________________

   ☐ No

22. Do you have the *tallinja* Card? ☐ Yes ☐ No

23. How often do you use public transport?

☐ Daily ☐ Weekly ☐ Monthly ☐ Infrequently ☐ Never

24. How far from your home is the closest bus stop? ________________ Minutes

Section B: Theory of Interpersonal Behaviour

Please select the scale value that best reflects your answer:

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Perceived Consequences					
My travel behaviour improves my quality of life	1	2	3	4	5
I believe that my travel behaviour is safe both for me and for the others	1	2	3	4	5

Affect					
My travel behaviour makes me feel happy	1	2	3	4	5
I am always anxious when travelling due to fears of falling, fears when crossing the road, fears when parking my car or fears when encountering main intersections*[4]	1	2	3	4	5
Social Factors: Self-Concept					
I feel that I am still fit for my travel behaviour and would feel bad if I do not stick to it	1	2	3	4	5
It is appropriate for me to adopt different compensation techniques (e.g. travel during the day, during nice weather, use familiar areas and routes, use technological devices to help me) in my travel behaviour*	1	2	3	4	5
Social Factors: Norms					
My family/friends agree and with my travel behaviour	1	2	3	4	5
Health Professionals and people in positions of authority agree with my travel behaviour	1	2	3	4	5
Social Factors: Roles					
My travel behaviour is associated with my roles/positions/duties in my family	1	2	3	4	5
My travel behaviour is associated with my roles/positions/duties in other institutions (e.g. work, recreation, social)	1	2	3	4	5
Intention					
I intend to stick to my travel behaviour in the future	1	2	3	4	5
I will stick to my travel behaviour in the future	1	2	3	4	5
Habit					
My travel behaviour is automatic for me. Sometimes I stick to my travel behaviour without actually needing to do it	1	2	3	4	5

[4] *Indicates reversed items

I try to modify my travel behaviour as much as possible and do not feel any weird when I do it*	1	2	3	4	5
Facilitating Conditions					
It is easy for me to travel with the infrastructures and travel information available (e.g. complicated/poorly exposed routes/signs, complex intersections, position of traffic lights/curves/turning points/bus stops, security issues (e.g. poor lighting, bad weather), narrow parking spaces, online travel information)	1	2	3	4	5
The way other people behave in the road environment makes my travel more difficult (e.g. the way they drive, how they behave in public transport, the way they walk)*	1	2	3	4	5
Travel Behaviour					
In general, my travel behaviour was consistent in the past three months	1	2	3	4	5
In general, I always found some obstacles when travelling in the past three months*	1	2	3	4	5

Thank you for your time

Numru tal-Identità:	Lokalità:	Distrett:

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Appendix B: Questionnaire Survey (Maltese Version)

Sezzjoni A: Fatturi Oġġettivi

1. Karatteristiċi soċjodemografiċi u ekonomiċi

1. Sess: ☐ Raġel ☐ Mara
2. Eta': ____________________
3. Stat Matrimonjali: ☐ Waħdi ☐ Miżżewweġ/Miżżewġa ☐ Armel/Armla ☐ Divorzjat/a ☐ Separat/a
4. Edukazzjoni: ☐ Bla Skola ☐ Primarja ☐ L-inqas livell ta' Sekondarja ☐ L-ogħla livell ta' Sekondarja ☐ Post-Sekondarja (mhux Terzjarju) ☐ Ciklu qasir t'edukazzjoni Terzjarja ☐ Baċċelerat ☐ Master ☐ Dottorat
5. Tip ta' familja: ☐ Persuna waħida ☐ Aktar minn persuna waħda
6. Stat t'impjieg: ☐ Impjegat ☐ Nħaddem in-nies ☐ Naħdem għal rasi ☐ Qiegħed/Qiegħda ☐ Irtirat/Irtirata ☐ Inattiv/a (minħabba diżabbilta/mard) ☐ Oħrajn ________
7. Għandek xi persuna li tassistik fil-mod ta' kif tieħu ħsieb tiegħek nnifsek, fil-mobbiltà jew f'attivitajiet oħra ta' kuljum?
   ☐ Iva (speċifika min u x'tip t'assistenza) ____________________ ☐ Le
8. Inti tipparteċipa f'xi tip ta' attivitajiet soċjali jew attivitajiet oħrajn?
   ☐ Iva (speċifika) ____________________ ☐ Le

2. Karatteristiċi ta' Saħħa

9. Kif tikklasifika l-istat ta' saħħa fiżika tiegħek f'dawn l-aħħar 3 xhur? (1 l-inqas; 5 l-iktar)
   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
10. Kif tikklasifika l-istat ta' saħħa mentali tiegħek f'dawn l-aħħar 3 xhur? (1 l-inqas; 5 liktar)
   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
11. Bħalissa qed tieħu xi mediċina? Jekk iva, x'tip ta' mediċina hi din u għal-liem raġuni?
   ☐ Iva: ☐ Preskiritta ☐ Tixtriha mill-farmaċija Raġuni/jiet prinċipali: __________
   ☐ Le

12. Tuża xi apparat assistiv? Jekk iva speċifika jekk tużahx għal ġewwa jew/u għal barra?

Ġewwa- Barra

☐ Iva

- Hearing Aid
- Nuċċali
- Siġġu tar-roti
- Bastun
- Rollator
- Oħrajn (speċifika)

☐ No ____________________

13. Waqgħajt xi darba fis-sena li għaddiet? Jekk iva, ġewwa jew barra?
☐ Iva: ☐ Ġewwa ☐ Barra
☐ Le

14. X'inhuma l-kwistjonijiet ta' saħħa ewlenin li jaffetwawlek il-mobilità tiegħek meta tkun barra?[5]
☐ Funzjonijiet Sensorjali
☐ Funzjonajiet Mentali
☐ Sistemi kardjovaskulari, ematoloġiċi, immunoloġiċi u/jew respiratorji
☐ Funzjonijiet relatati man-nervituri u muskoli
☐ Sintomi ta' Dippresjoni
☐ Oħrajn (Jekk joġgħbok speċifika) ____________________
☐ Xejn

3. Aċċess għas-servizzi ta' Trasport u l-Imġieba fl-Ivjaġġar

15. Għal-liem raġunijiet l-aktar li tivvjaġa u b'liem mezz ta' trasport? Għaliex tagħżel da nil-mezz u għandek xi ħin ippreferut biex tivvjaġġa għal dawn ir-raġunijiet?[6]

		Mezz	Raġuni(jiet)	Ħin preferut
Xiri	☐			
Kura Medika	☐			
Nżur xi qraba	☐			
Rikreazzjoni	☐			
Ir-raġunijiet ta' fuq kollha	☐			
Ma noħroġx	☐			
Oħrajn	☐			

16. F'din l-aħħar ġimgħa, int vjaġġajt kuljum? Ghal kemm –il siegħa normalment vjaġġajt f'dawk il-ġranet li ħriġt?
☐ Ma vjaġġajt xejn ☐ Kuljum ☐ Mhux kuljum

☐ <Sagħtejn ☐ 2-4 siegħat ☐ 5-7 siegħat ☐ 7+ siegħat

[5] Il-parteċipanti għandhom jitħallew liberi biex isemmu l-kwistjonijiet prinċipali imbagħad dawn ikunu ikklasifikati numerikament minn l-intervistatur (1 jirrapreżenta l-ewwel kwistjoni msemmija)
[6] Il-parteċipanti għandhom jitħallew liberi biex isemmu ir-raġunijiet li l-aktar jivvjaġaw għalihom. Imbagħad dawn ikunu ikklasifikati numerikament minn l-intervistatur (1 jirrapreżenta l-ewwel raġuni msemmija)

17. Inti:
- ☐ Sewwieq
- ☐ Persuna li timxi
- ☐ Persuna li tuża t-trasport pubbliku
- ☐ Passiġier/a
- ☐ Sewwieq u passiġier
- ☐ Sewwieq u tuża t-trasport pubbliku
- ☐ Sewwieq u timxi
- ☐ Passigier u tuza t-trasport pubbliku
- ☐ Passigier u nimxi
- ☐ Timxi u tuża t-trasport
- ☐ Sewwieq, timxi u tuża t-trasport pubbliku
- ☐ Oħrajn ______________________________

18. Normalmemt tivvjaġġa f'inħawi li inti familjar magħhom biss? ☐ Iva ☐ Le ☐ Mhux dejjem

19. Normalment tivvjaġa waħdek jew ma' xi ħadd? ☐ Waħdi ☐ Ma' xi ħadd ☐ Jiddependi

20. Jekk inti sewwieq, kemm –il sena ilek ssuq? ______________________

21. Jekk m'intiex sewwieq:

c. Kont sewwieq qabel? Jekk iva, x'kienu r-raġunijiet li wassluk biex tieqaf issuq?

☐ Iva: Raġuni li wasslitek tieqaf issuq ______________________

☐ Le

d. Hemm xi karozza disponibbli? Kemm –il karozza hemm disponnibli fil-familja tiegħek?

☐ Iva Numru ta' karozzi disponibli fil-familja ____________________

☐ Le

22. Għandek *tallinja* Kard? ☐ Iva ☐ Le

23. Kemm il-darba tuża t-trasport pubbliku?

☐ Kuljum ☐ Kull ġimgħa ☐ Kull xahar ☐ Kultant ☐ Qatt

24. Kemm qiegħda l-bogħod mid-dar tiegħek l-eqreb *bus stop*? ________________ Minuti

Sezzjoni B: Teorija t'Imġieba Interpersonali

Jekk jogħġbok agħżel il-valur fuq l-iskala li l-aktar jirrifleti t-tweġieba tiegħek

	Ma naqbilx ħafna	**Ma naqbilx**	**Newtrali**	**Naqbel**	**Naqbel ħafna**
Konsegwenzi Perċepiti					
Il-mod ta' kif nivvjaġġa jtejjibli l-kwalità tal-ħajja	1	2	3	4	5
Jien nemmen li l-mod ta' kif nivvjaġġa hu *safe* kemm għalija u kemm għall-ohrajn	1	2	3	4	5
Emozzjoni					
Il-mod ta' kif nivvjaġġa jagħmilni kuntent/a	1	2	3	4	5
Jien dejjem nkun anzjuż/a meta nivvjaġġa minħabba biżgħat li naqa', biżgħat meta nkun qed naqsam it-triq, biżgħat meta nkun qed nipparkja l-karozza jew meta niġi f'intersezzjonijiet prinċipali *[7]	1	2	3	4	5
Fatturi Soċjali: Awto-stima					
Jien nħossni għadni tajba/ tajjeb għal mod ta' kif nivjaġġa u nħossni ħażin kieku ma nagħmilx dan	1	2	3	4	5
Jien nħoss li għandi nikkumpensa meta nivvjaġġa (e.ż. nivvjaġġa biss matul il-ġurnata, f'temp bnazzi, f'żoni u rotot li jien familjari magħhom, nuża mezzi teknoloġiċi biex jgħinuni)*	1	2	3	4	5
Fatturi Soċjali: Normi					
In-nies ta' madwari (familja/ħbieb) jaqblu mal-mod ta' kif nivvjaġġa jien	1	2	3	4	5
Professjonisti tas-Saħħa (tobba) u nies f'pożizzjonijiet t'awtorità jaqblu mal-mod ta' kif nivvjaġġa jien	1	2	3	4	5
Fatturi Soċjali: Rwoli					
Il-mod ta' kif nivvjaġġa hu assoċjat mal-pożżizjoni(jiet)/sitwazzjoni(jiet)/impenji li għandi fil-familja	1	2	3	4	5
Il-mod ta' kif nivvjaġġa hu assoċjat mal-pożżizjoni(jiet)/sitwazzjoni(jiet)/impenji li għandi f'istituzzjonijiet oħra (e.ż. xogħol, rikreazzjoni, soċjali)	1	2	3	4	5

[7] * Tindika punti bil-kontra

Intenzjoni					
Jien bi ħsiebni nżomm ma' l-istess mod ta' kif nivvjaġġa fil-futur	1	2	3	4	5
Jien ser inżomm ma' l-istess mod ta' kif nivjaġġa fil-futur	1	2	3	4	5
Vizzju					
Il-mod ta' kif nivvjaġġa hu awtomatiku għalija. Kultant inżomm ma' din l-imġieba mingħajr ma attwalment jkolli bżonn li nagħmel dan	1	2	3	4	5
Jien nipprova nbiddel l-modi ta' kif nivvjaġġa kemm jista' jkun possibli u ma nħossnix stramb/a meta nagħmel dan*	1	2	3	4	5
Kundizzjonijiet iffaċilitati					
Huwa faċli għalija li nivvjaġġa bl-infrastrutturi u bl-informazzjoni li hawn disponnibli (e.ż. rotot/sinjali kkumplikati jew ma jidhrux sew, intersezzjonijiet kumplessi, il-pożizzjoni tat-traffic lights/dawriet/bus stops, kwistjoni ta' sigurta (e.z. dawl baxx, temp ikrah), spazji dejqa ta' parkeġġ, informazzjoni fuq l-ivjaġġar fuq l-internet)	1	2	3	4	5
Il-mod ta' kif in-nies l-oħra jġibu ruħhom fit-triq jagħmilli l-mod ta' kif nivvjaġġa jien aktar diffiċli (eż. kif isuqu, kif jaġġixxu f'tal-linja, kif jimxu fuq l-bankini etċ.)*	1	2	3	4	5
<u>Imġieba tal-ivjaġġar</u>					
Ġeneralment, l-imġieba tal-ivjaġġar tiegħi kienet konsistenti f'dawn l-aħħar tliet xhur.	1	2	3	4	5
Ġeneralment jien dejjem sibt xi ostakli meta vjaġġajt f'dawn l-aħħar tliet xhur *	1	2	3	4	5

Grazzi tal-ħin tiegħek.

Appendix C: Number of Older People in Residential Homes

Total	**5,028**										
Birkirkara	141	Ħal Balzan	193	Ħaż-Żebbuġ	4	Mtarfa	114	Santa Venera	90	Victoria	231
Birżebbuġa	10	Ħal Għargħur	5	Iklin	-	Munxar	5	Senglea	38	Vittoriosa	19
Cospicua	153	Ħal Għaxaq	-	Kalkara	5	Nadur	4	Siġġiewi	26	Xagħra	3
Fgura	50	Ħal Kirkop	4	Marsa	22	Naxxar	115	St Julian's	84	Xewkija	-
Floriana	68	Ħal Lija	25	Marsaskala	37	Paola	46	St Paul's Bay	127	Xgħajra	-
Fontana	-	Ħal Luqa	987	Marsaxlokk	4	Pembroke	-	Swieqi	-	Żebbuġ	<3
Għajnsielem	16	Ħal Qormi	32	Mdina	17	Qala	<3	Ta' Kerċem	7	Żejtun	189
Għarb	-	Ħal Safi	4	Mellieħa	153	Qrendi	-	Ta' Sannat	-	Żurrieq	4
Għasri	-	Ħal Tarxien	33	Mġarr	13	Rabat	336	Ta' Xbiex	<3		
Gudja	4	Ħamrun	134	Mosta	413	San Ġwann	21	Tal-Pietà	150		
Gżira	36	Ħ'Attard	390	Mqabba	-	San Lawrenz	-	Tas-Sliema	144		
Ħad-Dingli	<3	Ħaż-Żabbar	16	Msida	233	Santa Luċija	4	Valletta	62		

Table C.1 Distribution of older people residing in institutional households by locality (NSO, 2014b)

Name	Address	Telephone	Email	Residents[8]	Residents[9]
Church Homes					
Apap Institute	St Joseph Institute Road Sta Venera	21489860		38	40
Casa Leone	Sacred Heart Avenue St Julians	21334063	casaleone@onvol.net	75	75
Dar Hanin Samaritan	SDC Museum Triq il-palazz l-Ahmar Sta Venera	2144 4702		25	26
Dar Madre Margerita	29-30 Msain Street Qormi	21441121		18	23
Dar Sagra Familja	43, Marquis Scicluna Street Naxxar	21438025		85	85
Dar San Pietru	9/11 Sir Ugo Mifsud Street Lija	21442545		16	17
Dar Sant'Anna	Cornelio Dingli Street Senglea	21827710		32	32
Dar Saura	Nikolo Sarria Street Rabat Malta	21454595		62	65
Dar Trionfi	Triq Sant'Ursola Victoria Gozo	21556471			5
Dar tal-Kleru	Christo Sacerdos Anglu Grima Str Fleur de Lys B'Kara	21441670		39	51
Pax et Bonum	240 Gerolomo Cassar Street Mosta	21433907		77	92
Proziuncola House	Father Edgar Street Mgarr	21574715		8	7
St Catherine's Home	Triq il-Pitkali Attard	21436461		92	96
St Dominic Home	Triq Enrico Mizzi Victoria Gozo	21557520			25
St Paul's Home	Little Sisters of the Poor Fra Diegu Square Hamrun	21237639		70	80
St Theresa Home	3, Castle Hill Victoria Gozo	21556469			8
Private Homes					
Age Concern	Central Home Independence Avenue Mosta			105	103
Casa Antonia	Pope Alexander VII Junction Balzan	21496277	info@casa-antonia.com.mt		130
Casa Arkati	Constitution Street Mosta	21434342	casaarkati@caremalta.com		109
Casa Francesco	561/2 St Joseph High Road Sta Venera	21250000		75	

[8] Number of Residents as per Parliamentary Secretariat for Rights of Persons with Disability and Active Ageing (http://www.activeageing.gov.mt/en/Pages/Residential-Homes/Residential-Homes.aspx)
[9] Number of Residents as per form Health Minister in 2010 (http://www.independent.com.mt/articles/2010-10-28/news/homes-for-the-elderly-282366/)
For some residential homes the number of residents was not online (and thus cell was left empty)

Casa San Paolo	Triq it-Turisti, Bugibba	23277000		191	
Casa Serena	Sir Luigi Preziosi Street	21577897 21577915	info@casaserenamalta.com		114
Charian Residence	Salini Road Marsascala	21636392	charmaineschembri@yahoo.com		32
Jasmine Nursing Home	Valley Road Msida	21330707	info@jasminenursinghome.commt.mt		
Marina Palace	Msida Seafront Msida	21238712	marinapalacehome@melita.com		93
Medina Home	106, Labour Avenue Rabat Malta				
Roseville	St Anthony Street Attard	22560000	nfo@roseville.com.mt		105
Sa Maison	22 Marina Street Pieta'	27241907	samaison@gmail.com		85
St Mark's	2nd Floor St Mark's Clinic Clarence Street Msida	21239488			19
Villa Messina	St Dominich Square Rabat Malta	21454889	villamessina@caremalta.com		138
Villa Robinich	Triq il-Kulvert Fgura	21666142			60
Villa San Lawrenz	Triq Cangura San Lawrenz Gozo	21564645	villasanlawrenz@go.net.mt		
Prince of Wales	Triq Manwel Dimech, Sliema	21322766	info@princeofwales.com.mt		
Hilltop Gardens Retirement Village	Triq l-Inkwina, Naxxar	21432277			
Seniors helping Seniors	St.Julian	27 383161	care@fiorinilowell.com		
Charella Residential Homes	Sliema	21346719			
Government Homes					
Bormla Home	Pjazza Santa Margerita Bormla	21823234	cospicuahome@caremalta.com	130	130
Floriana Home	Pjazza E.S.Tonna Floriana	21237619		46	45
Jean Antide Ward MCH	Mount Carmel Hospital Attard				
Male Geriatric Ward	Gozo General Hospital Victoria Gozo				
Mellieha Home	Triq il-Wied Mellieha	21523364	mellieha@caremalta.com	180	31
Mosta Home	Triq id-Dawr mosta	21432720			68

Msida Home	Triq l-Imragg Msida	21250611/06 12		64	64
Mtarfa Home	St David Street Mtarfa	21450869		123	123
Residenza Sant'Anna	Gozo General Hospital Victoria Gozo				
San Gorg Preca Ward	Mount Carmel Hospital Attard				
Santa Bernardetta Ward	Mount Carmel Hospital Attard				
St. Vincent de Paule Residence	Ingieret Road, Luqa	21224461		>1100	
Zammit Clapp Residential Home	St Julians	21313004	zch@caremalta.com	129	
Zejtun Home	Triq id Dahla ta San Tumas Zejtun	21805702	zejtunhome@caremalta.com	204	167

Table C.2 List of Residential Homes in Malta

Appendix D: Description of Sample by Age and Gender

			Females	Males	Total
Age group	60-69	Count	175	102	277
		Percentage	63.2%	36.8%	100.0%
	70-79	Count	108	37	145
		Percentage	74.5%	25.5%	100.0%
	80-89	Count	50	18	68
		Percentage	73.5%	26.5%	100.0%
	90+	Count	6	4	10
		Percentage	60.0%	40.0%	100.0%
Total		Count	339	161	500
		Percentage	67.8%	32.2%	100.0%

Table D.1: The sample of the study by age group and gender

		Single	Married	Separated	Widow
60-69	Females	6.90%	83.40%	1.10%	8.60%
	Males	6.90%	88.20%	1.00%	3.90%
70-79	Females	13.90%	64.80%	0.90%	20.40%
	Males	10.80%	75.70%	0.00%	13.50%
80-89	Females	12.00%	44.00%	0.00%	44.00%
	Males	11.10%	61.10%	5.60%	22.20%
90+	Females	16.70%	0.00%	0.00%	83.30%
	Males	0.00%	75.00%	0.00%	25.00%
Total	Females	10.00%	70.20%	0.90%	18.90%
	Males	8.10%	82.00%	1.20%	8.70%

Table D.2: Marital status of the sample of the study by age group and gender

		Education					
		No Schooling	Primary	Secondary	Bachelor	Master	Doctoral
60-69	Females	4.6%	34.9%	56.6%	3.4%	0.6%	0.0%
	Males	3.9%	12.7%	65.7%	13.7%	3.9%	0.0%
70-79	Females	13.9%	50.9%	31.5%	2.8%	0.9%	0.0%
	Males	10.8%	37.8%	43.2%	2.7%	2.7%	2.7%
80-89	Females	28.0%	52.0%	20.0%	0.0%	0.0%	0.0%
	Males	22.2%	55.6%	16.7%	5.6%	0.0%	0.0%
90+	Females	83.3%	16.7%	0.0%	0.0%	0.0%	0.0%
	Males	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%
Total	Females	12.4%	42.2%	42.2%	2.7%	0.6%	0.0%
	Males	8.7%	24.2%	53.4%	9.9%	3.1%	0.6%

Table D.3: Highest education levels by age groupd and gender

		Occupation Status			
		Work	**Housewife/Priest**	**Inactive/Unemployed**	**Retired**
60-69	Females	12.6%	45.7%	7.4%	34.3%
	Males	15.7%	2.0%	4.9%	77.5%
70-79	Females	0.9%	59.3%	0.9%	38.9%
	Males	0.0%	0.0%	0.0%	100.0%
80-89	Females	0.0%	74.0%	0.0%	26.0%
	Males	0.0%	0.0%	0.0%	100.0%
90+	Females	0.0%	83.3%	0.0%	16.7%
	Males	0.0%	0.0%	0.0%	100.0%
Total	Females	6.8%	54.9%	4.1%	34.2%
	Males	9.9%	1.2%	3.1%	85.7%

Table D.4: Occupation status by age and gender

		Personal Assistance	
		Yes	**No**
60-69	Females	13.1%	86.9%
	Males	9.8%	90.2%
70-79	Females	22.2%	77.8%
	Males	27.0%	73.0%
80-89	Females	34.0%	66.0%
	Males	16.7%	83.3%
90+	Females	100%	0.0%
	Males	16.1%	83.9%
Total	Females	20.6%	79.4%
	Males	16.1%	83.9%

Table D.5: Need of Personal Assistance for basic mobility needs by age and gender

	Physical Health Rating				
	1	**2**	**3**	**4**	**5**
60-69	0.7%	4.3%	23.5%	39.4%	32.1%
70-79	3.4%	9.0%	34.5%	33.8%	19.3%
80-89	4.4%	20.6%	20.6%	36.8%	17.6%
90+	10.0%	40.0%	20.0%	30.0%	0.0%
Mental Health Rating					
60-69	0.7%	3.6%	11.6%	33.9%	50.2%
70-79	0.0%	2.8%	3.4%	20.7%	73.1%
80-89	0.0%	2.9%	4.4%	14.7%	77.9%
90+	0.0%	0.0%	0.0%	60.0%	40.0%

Table D.6: Physical and Mental Health ranking (from 1 to 5) by age group

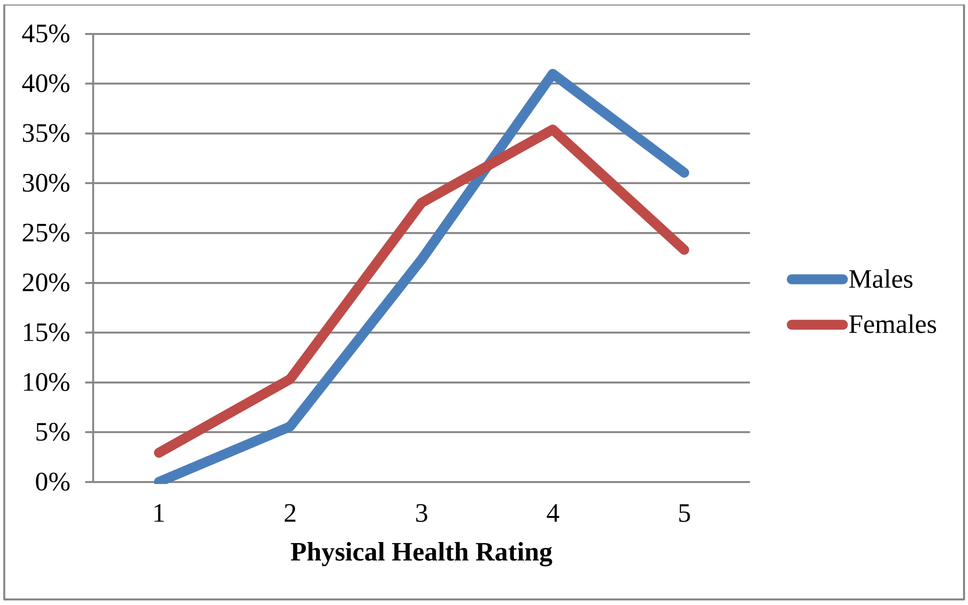

Figure D.1: Physical Health Rating by gender

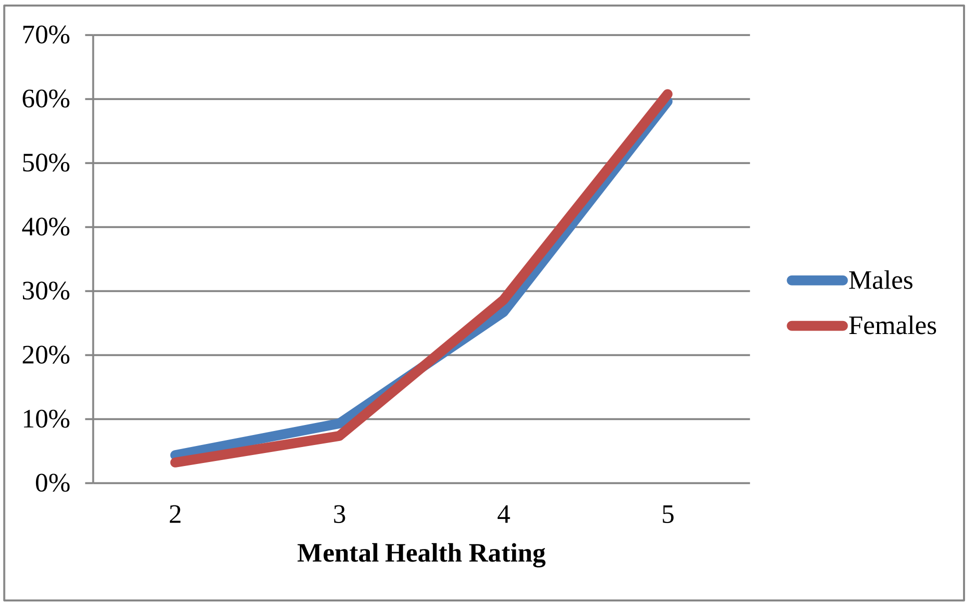

Figure D.2: Mental Health Rating by gender

		Medicine In-take		
		Prescribed	**Over the counter**	**No Medicine**
60-69	Females	62.9%	4.0%	33.1%
	Males	59.8%	2.0%	38.2%
70-79	Females	83.3%	3.7%	13.0%
	Males	81.1%	5.4%	13.5%
80-89	Females	92.0%	2.0%	6.0%
	Males	94.4%	0.0%	5.6%
90+	Females	100.0%	0.0%	0.0%
	Males	100.0%	0.0%	0.0%
Total	Females	74.3%	3.5%	22.1%
	Males	69.6%	2.5%	28.0%

Table D.7: Medicine in-take by age and gender

		Fall in previous year	
		Yes	**No**
60-69	Females	18.3%	81.7%
	Males	2.9%	97.1%
70-79	Females	31.5%	68.5%
	Males	10.8%	89.2%
80-89	Females	20.0%	80.0%
	Males	16.7%	83.3%
90+	Females	50.0%	50.0%
	Males	25.0%	75.0%
Total	Females	23.3%	76.7%
	Males	6.8%	93.2%

Table D.8: Fall in previous year by age and gender

		Assistive Device	
		Yes	**No**
60-69	Females	22.9%	77.1%
	Males	27.5%	72.5%
70-79	Females	18.5%	81.5%
	Males	16.2%	83.8%
80-89	Females	34.0%	66.0%
	Males	11.1%	88.9%
90+	Females	83.3%	16.7%
	Males	50.0%	50.0%
Total	Females	24.2%	75.8%
	Males	23.6%	76.4%

Table D.9: Assistive Device by age and gender

		Participation in Social Activities	
		Yes	**No**
60-69	Females	25.1%	74.9%
	Males	27.5%	72.5%
70-79	Females	35.2%	64.8%
	Males	16.2%	83.8%
80-89	Females	28.0%	72.0%
	Males	27.8%	72.2%
90+	Females	0.0%	100.0%
	Males	0.0%	100.0%
Total	Females	28.3%	71.7%
	Males	24.2%	75.8%

Table D.10: Participation in social activities by age and gender

Appendix E: Descriptive Statistics

Mode choice

	Males	Females
1	Driver, Pedestrian & Infrequent Public Transport User (22.4%)	Pedestrian, Passenger & Infrequent Public Transport User (25.1%)
2	Driver & Pedestrian (17.4%)	Pedestrian & Passenger (16.2%)
3	Driver (13%)	Frequent Public Transport User & Pedestrian (9.4%)
4	Driver & Infrequent Public Transport User (12.4%)	Frequent Public Transport User, Pedestrian & Passenger (9.1%)
5	Driver & Frequent Public Transport User (5.6%)	Passenger (8.3%)

Table E.1: Combination of transport modes (in chronological order) used by gender

	Males	Females
1	Frequent public transport user (20%)	Infrequent public transport user, pedestrian and passenger (29.7%)
2	Frequent public transport user and pedestrian (16.7%)	Pedestrian and Passenger (19.1%)
3	Infrequent public transport user and pedestrian (16.7%)	Frequent Public Transport user and Pedestrian (11.3%)
4	Pedestrian and Passenger (16.7%)	Frequent public transport users, pedestrian and passenger (11.0%)
5	Infrequent public transport user, pedestrian and passenger (13.3%)	Passenger (9.9%)
6	Passenger (13.3%)	Pedestrian and Infrequent Public Transport user (8.1%)

Table E.2: Combination of modes used by gender by the non-drivers in chronological order

Travel purposes

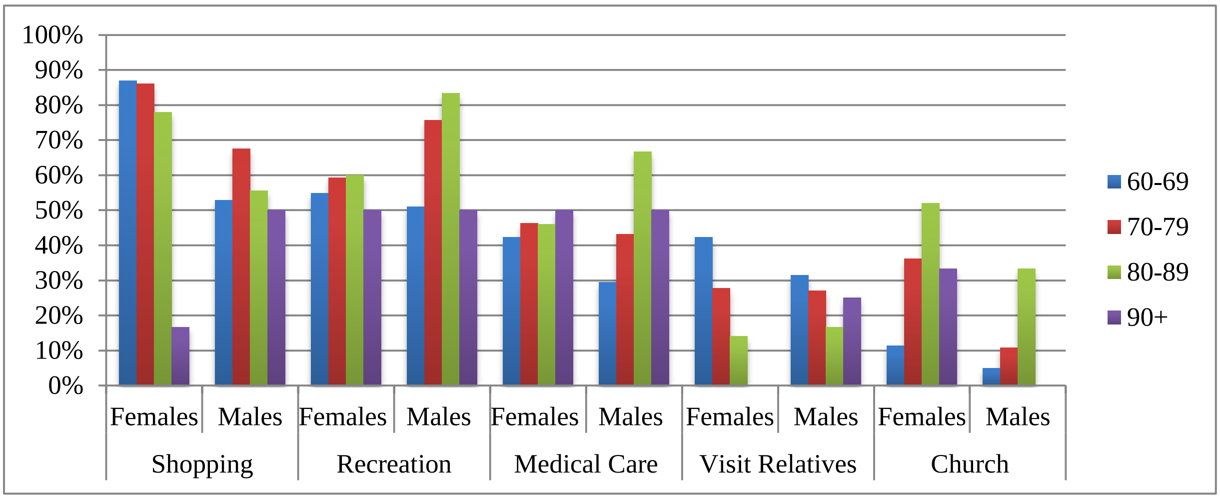

Figure E.1: Travel Purpose by age and gender

Mode choice by travel purpose

Mode of transport	Shopping (%)	Medical Care (%)	Recreation (%)	Visit Relatives (%)	Church (%)
Car (driver)	14.4	16.1	23.49	27.4	3.1
Car driver/passenger	0.26	0.5	0.90	/	
Car passenger	8.7	26.5	30.4	30.6	8.2
Car passenger/public transport	0.51	4.3	1.20	4.5	
Car driver/public transport	0.26	0.5	0.30	1.3	
Car passenger & public transport	0	0.47	0.30	0.6	
On foot	58.9	9.95	16.6	17.2	84.7
On foot/car driver	2.57	0	2.1	0.6	
On foot/car passenger	5.44	0.95	0.90	1.9	2.04
On foot & Car Passenger			0.60	0.6	
On foot/public transport	2.31	0.95	1.20	1.27	
On foot & public transport	0.51	0	0.30		1.0
On foot/car passenger/public transport			0.3		
On foot/private coach			0.30		
Public transport	5.40	36.5	14.8	14	
Ambulance	0	0.47			
Service offered by hospital	/	2.84			
Minivan			4.8		
Minivan/coach			0.30		
Motorcycle	0.26	/	0.6		
On foot, public transport/car driver	0.26				
Taxi	0.26		0.60		

Table E.3 Mode choice by travel purpose

		Car (driver) (%)		Passenger (%)		Passenger/ Public Transport (%)		On foot (%)		On foot/ Passenger (%)		On foot & Passenger (%)		On foot/ car (driver) (%)		Public Transport (%)		Hospital Service (%)	Minivan (%)
		M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**F**	**F**
Shopping	**60-69** **70-79** **80-89** **90+**	56.36 26.92 / /	/		12.1 11.3 / 100			18.18 61.5 100 50	56.7 73.2 78.05	/ / / 50	/ / 12.2			10.9					
Recreation	**60-69** **70-79** **80-89** **90+**	60 51.5 40 50	12	/ / 20 50	6.2 47.6 48.8 100			14.5 24.2 25	15.2 25.4							14.5 12.1	18.1 11.1 19.5		/ / 22
Medical Care	**60-69** **70-79** **80-89** **90+**	56.7 37.5 23.1 50		/ / 23.1	16 35.6 60 33.3	/ / / 50			/ 15.6 13.0							30 43.75 38.5	47.3 35.6 13.0	/ / / 66	
Visit Relatives	**60-69** **70-79** **80-89** **90+**	75 60 /	13.5 11.5	/ / 50	37.8 46.2 62.5	/ / 50		12.5 20	13.5 30.8 25				/ / 12.5			/ 20	20.3		
Church	**60-69** **70-79** **80-89** **90+**	50 / /		/ / 16.7	/ / 20 50			50 100 83.3	90 91.4 76 50										

Table E.4: Travel purpose by gender, age and transport mode used

Type of Travel Purposes

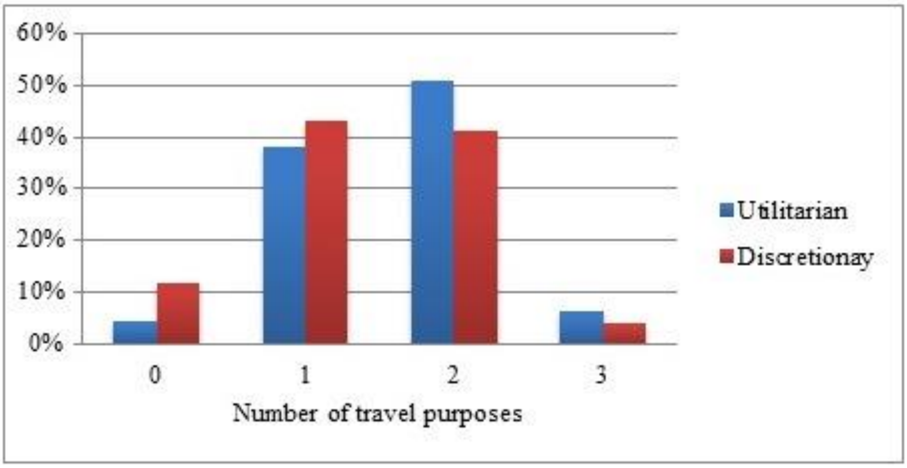

Figure E.2: Percentage of utilitarian and discretionary travel purposes

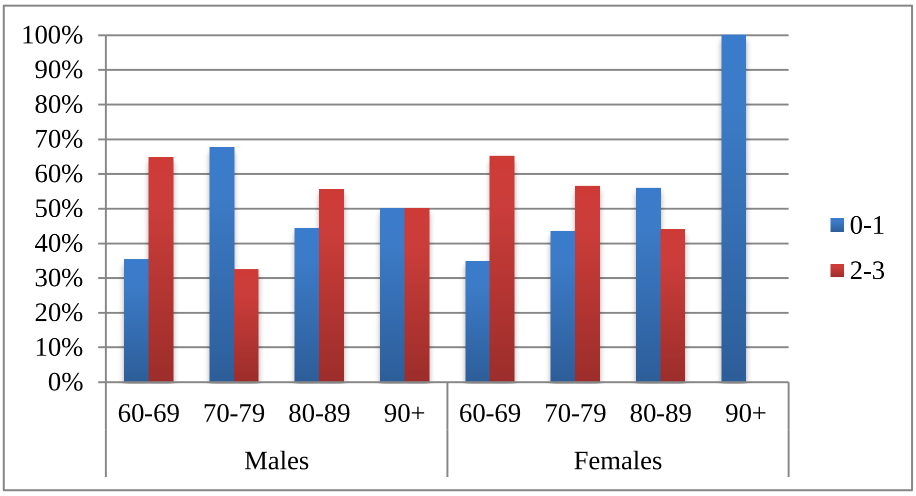

Figure E.3: Utilitarian travel purposes by age and gender

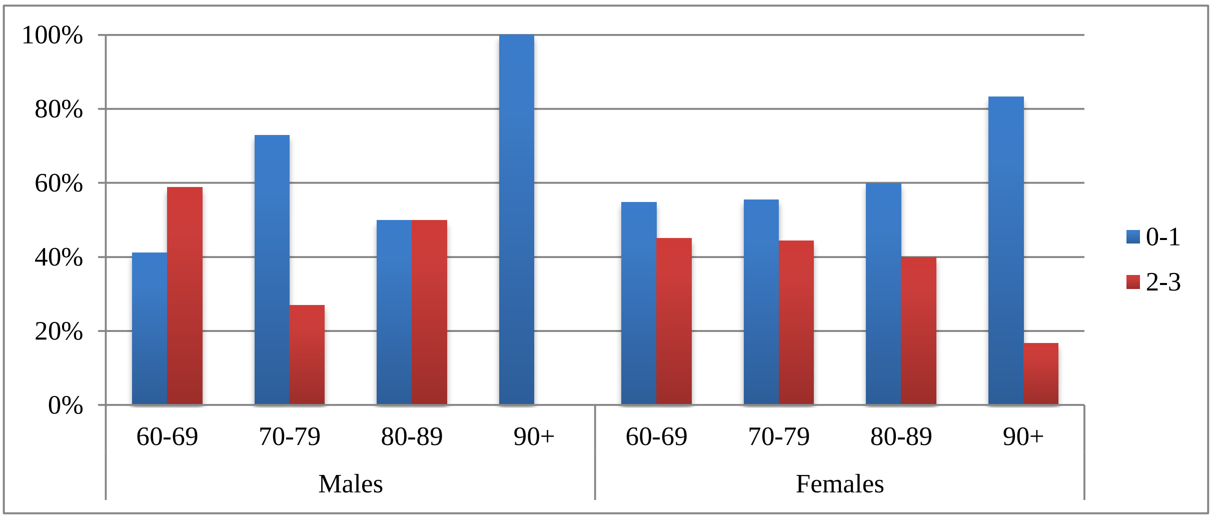

Figure E.4: Discretionary travel purposes by age and gender

Travel Range and Travel Accompaniment

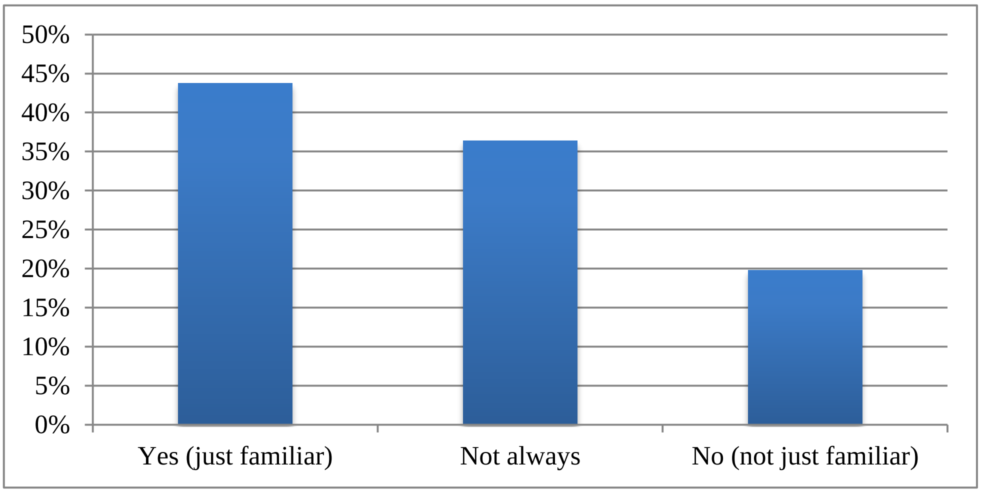

Figure E.5: Travel range of older people

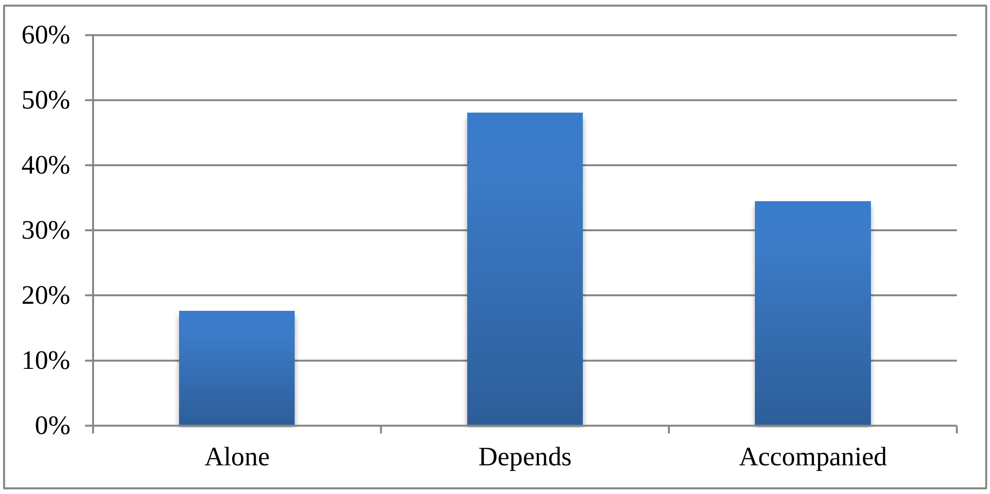

Figure E.6: Travel accompaniment of older people

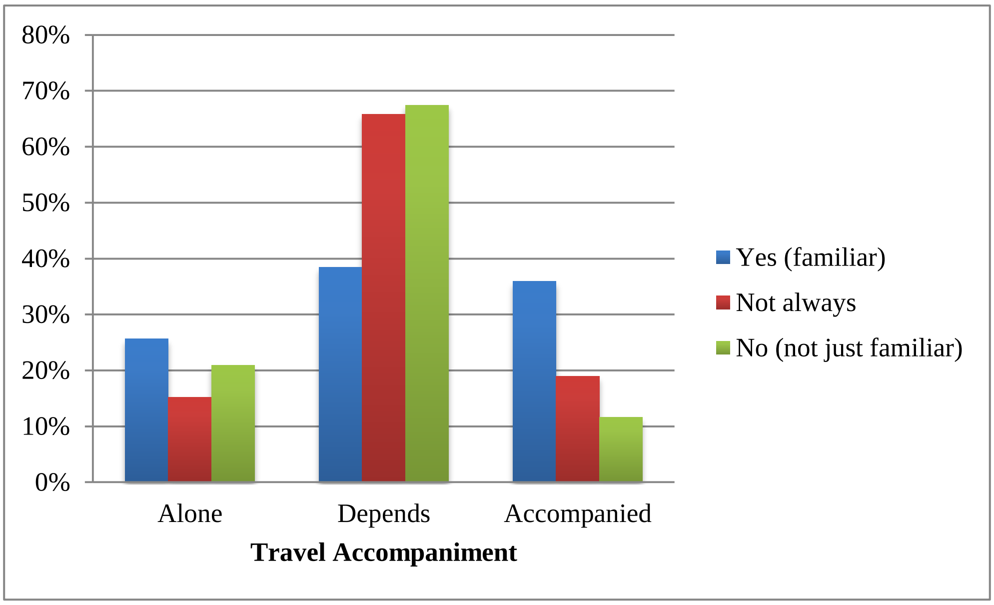

Figure E.7: Travel range vs travel accompaniment for older males

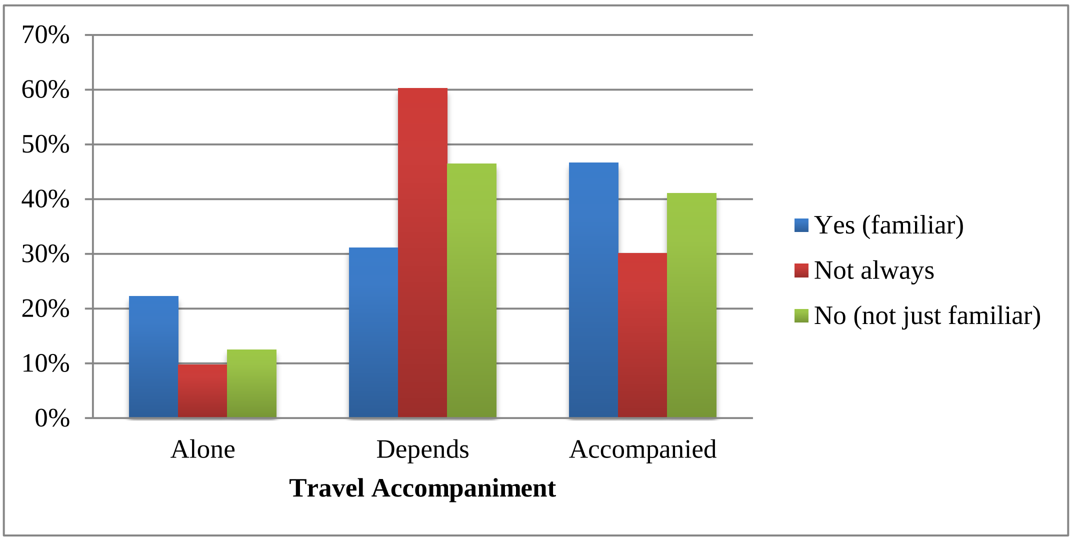

Figure E.8: Travel range vs travel accompaniment for older females

Travel Time and Travel Frequency

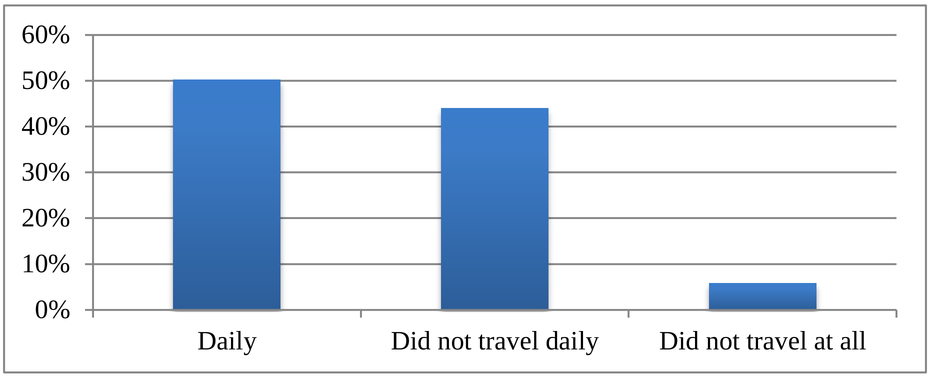

Figure E.9: Travel frequency of older people during survey week

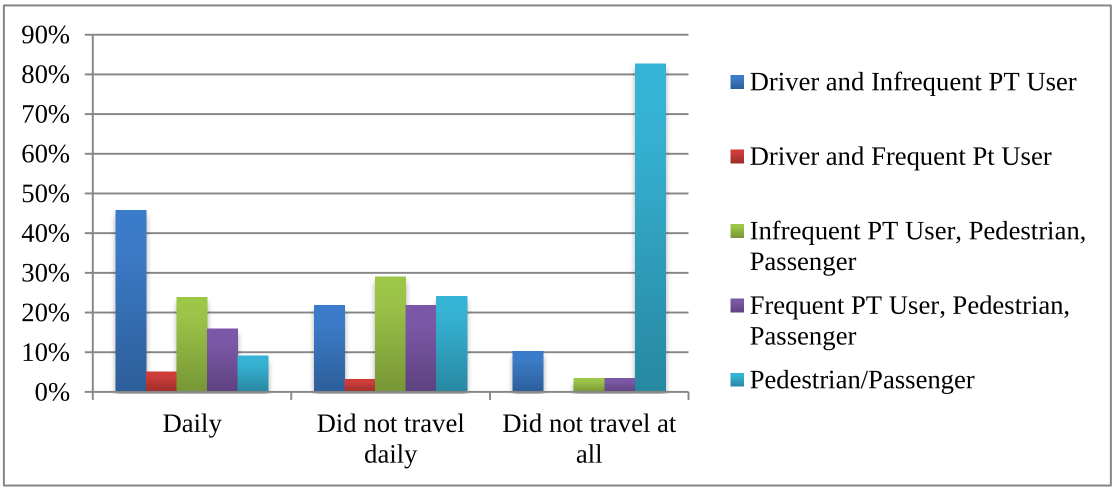

Figure E.10: Travel frequency during survey week by combination of transport modes used

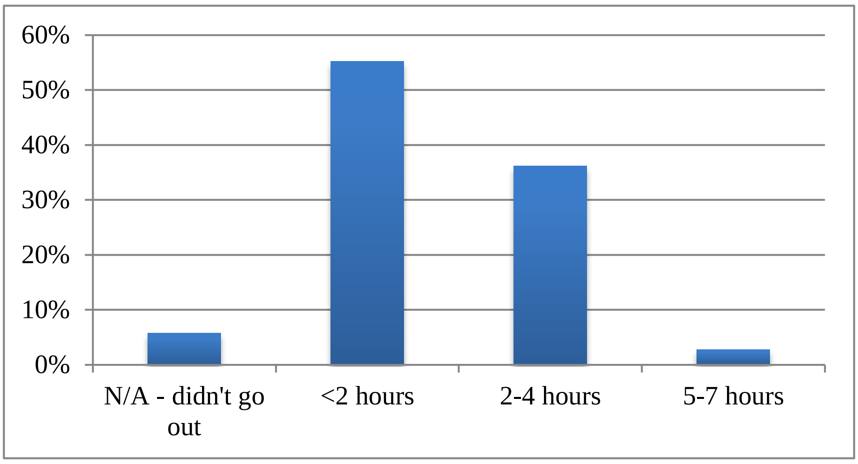

Figure E.11: Average daily travel time for older people during survey week

Females					
		Travel Time			
		N/A - didn't go out	**<2 hours**	**2-4 hours**	**5-7 hours**
60-69	Daily		59.6%	39.3%	1.1%
	Did not travel daily		76.2%	22.6%	1.2%
	Did not travel at all	100.0%			
	Total	1.1%	66.9%	30.9%	1.1%
70-79	Daily		62.5%	35.4%	2.1%
	Did not travel daily		67.9%	30.2%	1.9%
	Did not travel at all	100.0%			
	Total	6.5%	61.1%	30.6%	1.9%
80-89	Daily		60.0%	40.0%	
	Did not travel daily		68.0%	32.0%	
	Did not travel at all	100.0%			
	Total	20.0%	52.0%	28.0%	
90+	Did not travel daily		100.0%		
	Did not travel at all	100.0%			
	Total	66.7%	33.3%		
Total	Daily		60.5%	38.2%	1.3%
	Did not travel daily		72.6%	26.2%	1.2%
	Did not travel at all	100.0%			
	Total	6.8%	62.2%	29.8%	1.2%

Table E.5: Travel time vs travel frequency for older females by age

Males					
		Travel Time			
		N/A - didn't go out	**<2 hours**	**2-4 hours**	**5-7 hours**
60-69	Daily		36.2%	55.1%	8.7%
	Did not travel daily		39.4%	60.6%	
	Total		37.3%	56.9%	5.9%
70-79	Daily		36.4%	54.5%	9.1%
	Did not travel daily		50.0%	41.7%	8.3%
	Did not travel at all	66.7%		33.3%	
	Total	5.4%	37.8%	48.6%	8.1%
80-89	Daily		50.0%	37.5%	12.5%
	Did not travel daily		77.8%	22.2%	
	Did not travel at all	100.0%			
	Total	5.6%	61.1%	27.8%	5.6%
90+	Did not travel daily		100.0%		
	Did not travel at all	100.0%			
	Total	50.0%	50.0%		
Total	Daily		37.4%	53.5%	9.1%
	Did not travel daily		50.0%	48.2%	1.8%
	Did not travel at all	83.3%		16.7%	
	Total	3.1%	40.4%	50.3%	6.2%

Table E.6: Travel time vs travel frequency for older males by age