THE SELF-PERCEIVED MOBILITY OF OLDER ADULTS IN GRONINGEN

A subjective approach towards mobility

Colophon

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Abstract

The mobility of an individual is influenced a wide array of factors. Maintaining a high level of mobility is essential for the well-being of all age groups. However, especially older adults face are more at risk of a decline in mobility. The province of Groningen faces an aging population resulting in an increasingly bigger population of older adults. This provides local policymakers in Groningen with new challenges to ensure older adults have sufficient mobility. Therefore, it is especially important to understand which factors influence the mobility of this population group at risk. Hence, this thesis aims to answer which factors influence the self-perceived mobility of older adults in Groningen. Extensive literature research points out that these factors can be categorized into people-based and place-based factors and operate within the context of Groningen. People-based factors are personal characteristics such as age, gender and health. Place-based factors are characteristics specific to a place such as facilities. This thesis will employ ordered logistic models, using data from Sociaal Planbureau Groningen and Statistics Netherlands to study the relation between these factors and self-assessed perceived mobility of older adults within the context of Groningen. The results generally support the hypothesis that both people-based and place-based factors influence the perceived mobility of older adults in Groningen. However, for some factors, no evidence was found that they impact the perceived mobility of older adults in Groningen. Besides this, the research shows how the local context can influence the perceived mobility of older adults. Policymakers can use these results to identify groups and areas that are at risk of having lower perceived mobility and adjust transport policy to ensure a sufficient level of mobility for older adults.

I: List of Abbreviations

Abbreviation	Meaning	Translation
SPG	Sociaal planbureau Groningen	Social planning agency Groningen
CBS	Centraal bureau statistiek	Statistics Netherlands
PC6	Postcode 6 gebieden	Postal codes with 6 charters
Ref	Reference category	-

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1. Introduction

1.1 Problem Definition

The aging population in countries across the world has become more prevalent in the last few decades. This trend of an aging population will only continue in the upcoming decades. An aging population is also prevalent in the province of Groningen (Centraal Bureau Statistiek, 2021). Projections show that mostly rural municipalities of Groningen will have one of the highest shares of older adults in the Netherlands (CBS Statline, 2019). An aging population provides policymakers with the societal challenge of assuring a high level of well-being and quality of life for this age group that is becoming increasingly bigger. An important factor that influences well-being is the mobility of an individual. There is a clear correlation between well-being and mobility in the literature (Vella-Broderick & Stanley, 2013; Siren & Hakamies-Blomqvist, 2009; Metz, 2000). An individual with a high degree of mobility will find it easier to maintain social contacts, reach green spaces more easily, and have fewer problems reaching essential facilities located further away (Papa et al., 2018). Therefore, this high degree of mobility leads to the higher well-being of this individual. On the contrary, a person with low mobility might have more trouble maintaining social contacts and is less able to reach green spaces or other essential facilities (Delfmann et al., 2021; Papa et al., 2018). Older adults often face the challenge of a decreasing mobility (Papa et al., 2018), making this group vulnerable to social exclusion, depression, and an overall lower level of well-being (Chevallier et al., 2018). Particularly older adults who are not able to drive a car are vulnerable to social exclusion because they are more dependent on friends and family for transportation. (Dumbaugh, 2008; Hjorthol et al., 2010). Thus policymakers need to provide a sustainable and inclusive solution to maintain or increase the mobility of an aging population to ensure the future well-being of older adults. For current aging policies that are in place such as healthy and active aging, a declining mobility provides a challenge for policymakers. (Rocha et al., 2021). Therefore, studying factors that impact the mobility of older adults in the province of Groningen can provide policymakers in the field of healthy aging with new relevant insights.

As mentioned above, the province of Groningen also inevitably faces an aging population, especially in the more rural areas. Föbker & Grotz (2006) point out that older adults are a very heterogeneous group. This group constantly changes over time due to new cohorts entering this age group, while the share of older cohorts in these age groups decreases due to mortality. The studies of Haustein (2010) and Hjorthol et al. (2010) point out that younger cohorts entering the age of 65+ have better health, a better lifestyle, higher income, and a higher share of older adults owning a driver's license compared to older generations. Given that the population of older adults is very heterogenous and constantly changes over time, it is not easy to apply results from previous case studies that study the mobility of older adults to the case of Groningen. In fact, assumptions about the entire population of older adults in Groningen would be tough to make based on research in another spatial context. Considering the heterogeneous study population and the different spatial context of Groningen, studying the mobility of older adults in Groningen can contribute to the existing literature on mobility.

In the literature, mobility is defined as moving from one location to another (Meijering, 2021). The literature on mobility distinguishes two views of mobility, an objective view on mobility and a subjective one. Most literature uses an objective view on mobility. Objective mobility is often defined as amount of trips taken or the daily distance traveled by a person. On the other hand, the subjective concept of perceived mobility is sometimes used instead of the objective concept of mobility (Collantes & Mokhtarian, 2007). Perceived mobility is how an individual assesses their ability to move from one location to another. Using perceived mobility is a more subjective approach toward mobility. So, rather than a researcher assessing an individual's mobility, perceived mobility uses people's subjective perceptions of their mobility. Objective measurements can give useful insights into distance traveled or trips undertaken. However, it does not capture the subjective experience of this trip.

Thus, using a subjective measurement of mobility through the eyes of a respondent might provide valuable insights into the mobility and the well-being of older adults (Collantes & Mokhtarian, 2007). Taking into account the points illustrated above, this thesis will use perceived mobility to measure mobility, which is a more subjective approach to mobility, rather than using an objective approach to get a better insight into how older adults experience their mobility in Groningen. In order to get a better insight of the perceived mobility of older adults, it is important to study which factors influence this perceived mobility.

In the literature a wide array of factors influence the perceived mobility of older adults. Nikou & Economides (2015) categorize them into people-based and place-based characteristics. The people-based characteristics refer to individual characteristics such as age, socioeconomic status, and health. Another vital concept influencing mobility is an area's accessibility or the physical built environment (Nikou & Economides, 2015). These factors are described as place-based characteristics, which refer to a place's hard infrastructure and present facilities. These factors can directly influence the mobility of older adults and often refer to the accessibility of an area. However, place-based characteristics can also refer to the neighborhood's socio-economic context, such as social cohesion and population structure, which can indirectly influence mobility (Fisher et al., 2004). So, mobility is both influenced by people-based characteristics as well as people-based characteristics. Studying how these factors influence the perceived mobility of older adults in Groningen can on one hand, contribute to the current literature on mobility and on the other hand, it can provide policymakers information on which factors they might need to focus to improve mobility of older adults in Groningen.

1.2 Study aim and research question

This thesis will aim to include both place and people-based characteristics and study how these factors influence the perceived mobility of older adults in Groningen. This phenomenon will be studied quantitatively using a self-build dataset consisting of multiple surveys carried out by Sociaal Planbureau Groningen (SPG) with additional data from Statistics Netherlands. The factors that influence perceived mobility of older adults in Groningen will be identified by employing an ordered logit regression. Ultimately, combining people-based and place-based characteristics can lead to a broader understanding of how older adults perceive their mobility and what factors cause perceived mobility to change. The research question formulated below helps to reach the goal stated above:

What factors influence the perceived mobility of older adults in the province of Groningen

1.3 Sub-questions:

As mentioned above, the factors that influence the perceived mobility of older adults are categorized into people-based and place-based factors. Therefore, two sub-questions are created to study both people-based and place-based factors separately. The first sub-question is about the people-based part and thus refers to individual characteristics that influence perceived mobility rather than characteristics of a place that might influence the perceived mobility.(Akhavan & Vecchio, 2018). The following sub-qeuestion is formulated with the aim to study the role of individual characteristics in the perceived mobility of older adults in Groningen.

What are the people-based factors that influence the perceived mobility of older adults in Groningen

The second question focuses on the place-based factors in Groningen. As mentioned above, place-based factors refer to the hard infrastructure or facilities in an area (Akhavan & Vecchio, 2018). Examples are highway ramps, bus stops, and supermarkets. However, place-based characteristics can also refer to the socio-economic context of a neighbourhood (Fisher et al., 2004; Sylvers et al., 2022). Examples are social cohesion and the share of older adults in a neighbourhood. This part will focus on the attributes specific to a particular place or area and study their influence on the perceived mobility of older adults in the province of Groningen. The following sub-question aims to answer the question of which place-based factors influence the perceived mobility of older adults in Groningen.

What are the place-based factors that influence the perceived mobility of older adults in Groningen?

As previously stated, the population of older adults is rather heterogeneous (Fobker & Grotz, 2006). Therefore, generalizations would be very hard to make for the entire population group in Groningen. The first two sub-questions are formulated so that the answer can contribute to the current literature on perceived mobility. However, from a societal point of view, it would be interesting to identify the areas and groups at risk of having lower perceived mobility. The province of Groningen consists of an urban municipality surrounded by some relatively rural municipalities. Some of these areas are characterized as shrinking areas that experience population decline, an aging population, and a decline in facilities. Since this research is about older adults in the province of Groningen it is essential to apply this local context to the research. Providing the local context would be especially interesting for policymakers looking to improve and ensure the mobility of older adults or accessibility in certain areas. The following sub-question aims to answer how the local context influences this research:

Which population groups and areas in Groningen are at risk of lower perceived mobility?

1.4 Approach:

This thesis is structured as follows. Firstly, a literature research will be conducted. In this literature research, different theories about perceived mobility will be discussed in the theoretical framework. Consequently, people-based and place-based factors will be derived from existing literature on mobility. The last part of the literature research discussed the local context and presents the conceptual model that is used as basis for the analysis. After the literature research, the methodology section is presented. This section operationalizes the conceptual model and explains which quantitative technique will be used. The results section displays the results of three ordered logistic models. This section will display how people-based and place-based factors influence the perceived mobility of older adults in Groningen. Following, the results are discussed in-depth in the discussion section. Lastly, an answer to the research question and the sub-questions will be given in the conclusion.

2. Literature research

This section gives the theoretical background of the concept of mobility and perceived mobility and discusses the factors that influence perceived mobility. Firstly, different mobility theories will be discussed to provide a theoretical background of the concept of mobility. The second part of this section will focus on older adults and perceived mobility to see which factors in the literature can influence the mobility of older adults. Then, to fit the research question, the local spatial context of Groningen will be applied to the perceived mobility of older adults. Ultimately, this will lead to a conceptual model based on the literature, which will provide the foundation for the analysis in this thesis.

2.1 Theoretical framework: The concept of mobility

2.1.1 The utilitarian vs. the capability approach

As mentioned in the introduction, there is a strong relationship between mobility and well-being (Siren & Hakamies-Blomqvist, 2009). Well-being itself is a rather broad concept that is used across several scientific disciplines. This results in several approaches that study the well-being of humans; one of these approaches is the study of the relationship between well-being and mobility (Nordbakke & Schwanen, 2014). On the one hand, there is the utility approach firmly rooted in economics. This hedonic approach assumes people will maximize their utility or, in this case, their well-being which can be defined by, for example, happiness. It focuses on the resources a person has available and their consumption (Nordbakke & Schwanen, 2014). The utilitarian approach is an excellent example of a hedonic theory where humans try to maximize their happiness through their resources and consumption (Gasper, 2004). This utilitarian approach can also be applied to the concept of mobility, mainly when measuring objective mobility. Different modes of transport and infrastructure of a person can be seen as the resources, and the usage of these different modes of transport and infrastructure can be defined as consumption. There is some criticism on hedonistic theories, such as that the utilitarian approach favors happiness and well-being in the short term while neglecting happiness and well-being over the longer term (Nordbakke & Schwanen, 2014). For instance, A trip with a car may lead to greater utility and happiness in the short term because it takes less time than a bike. However, taking the trip by bike may lead to health benefits in the long term compared to taking a car, which may lead to more happiness in the long term. Another influential approach is the capability approach developed by Sen (1993). This eudemonic approach differs from hedonistic approaches such as the utilitarian approach (Nordbakke & Schwanen, 2014). Sen (1993) states that the ability to use resources varies across humans depending on personal and social context. Instead of utility constituting the mobility of humans, so-called functions constitute the mobility of a person. Sen (1993) states that people can derive multiple functions from a good. Examples of transport-related functions are access to goods and services, leisure, and social interaction (Beyazit, 2011).

As mentioned, transportation can have multiple functions. For example, a person could take a bike ride with a function to visit the supermarket but also with a function of leisure because this person enjoys cycling in nice weather. Another difference is that the capability approach focuses on the capability of using resources, for example, a car, instead of just the resources (Ryan et al., 2015). Moreover, as previously stated, the capability approach considers a broader social context. Following the capability approach, if persons have equal resources, such as a car, this would not necessarily mean these persons have the same capability to use this car nor derive the same amount of well-being or perceived mobility from using a car (Sen, 1993; Ryan et al., 2015). This is why perceived mobility is grounded in the capability approach (Nikou & Economides, 2015). Two persons with equal resources can still perceive their mobility differently due to differences in their capabilities. The example above shows that the capability of transforming mobility resources by people is dependent on several factors. Meijering et al. (2019) categorizes these different factors that influence the capability of using mobility resources into conversion factors.

Firstly, there are personal conversion factors that include, for instance, health and income. These personal conversion factors translate roughly into people-based factors, to which this thesis often refers. Secondly, there are social conversion factors, which encompasses societal norms or policy. Lastly, there are environmental conversion factors that refer to the built environment or place-based characteristics in this thesis (Meijering et al., 2019). An example of how these difference conversion factors constitute the capability of a person to make use of mobility resources is an older adult who owns a bike. The capability to use this resource is dependent if this older adult is in good health to use this bike (personal conversion factor), if it is acceptable by society for older adults to drive around on a bike (social conversions factor) and if there are enough safe bicycle lanes (environmental factors). Ryan & Pereira (2021) note that due to this difference in capabilities between persons, uniform assumptions about accessibility are hard to make.

2.1.2 The ecological approach and the life course perspective

The ecological approach also applies to the concept of mobility. Traditionally, it has been influential in gerontology research by adding a spatial place-based dimension to this discipline (Nordbakke & Schwanen, 2014). However, it is also applied to transport research due to its geographic dimension, especially for older adults. Lawton & Nahemow (1973) can be seen as influential contributors to the development of this ecological approach. The ecological theory focuses on the continuously changing interaction between humans and the environment and how this shapes social constructions and mobility (Nordbakke & Schwanen, 2014). The ecological approach assumes that a person's mobility is either improved or restricted by the environment (Rantakokko et al., 2015). An example of improvement could be safely walkable areas for older adults. An example of a restriction could be high curbs on sidewalks, restricting older adults' mobility. These environmental factors relate to personal factors such as socioeconomic status and education (Thornton et al., 2017). The ecological approach differs from the capability approach at its core. For example, the ecological approach is a hedonic theory, while the capability approach is a eudemonic theory (Nordbakke & Schwanen, 2014). However, both theories show that mobility is influenced by people-based and place-based factors.

The life course perspective is also an emerging approach within transport research. This approach often studies mobility in a social context (Rau & Sattlegger, 2017). The life course perspective is a longitudinal framework that states that an individual's past experiences and future expectations shape their actions. This framework helps study transitions in individual behaviour (Jones et al., 2014). Thus, it could also be applied to study someone's behaviour regarding mobility. Mobility biography research uses the life course perspective as a basis for mobility research (Scheiner & Holz-Rau, 2013). This field of research assumes that stable routines and habits shape daily mobility. These routines and habits change over the life course by so-called events (Rau & Sattleger, 2017; Scheiner & Holz-Rau, 2013). These events can be continuous or discrete events. An example of a continuous event is the declining cognitive function over the life course, which impacts mobility. An example of a discrete event is obtaining or losing a driver's license. Mobility biography research often uses individual discrete events because they are easier to measure. However, Rau & Sattleger, (2017) underline the importance of measuring mobility within the life course perspective in a household context considering an individual's life course is often entangled with other family members. For instance, an older adult may not be able to drive a car anymore, which declines this individual's mobility. However, their partner might still be able to drive a car which increases this individual's mobility. The mobility biography is intertwined with other biographical processes in life, such as employment biography and residential biography. In the life course approach, determining which biographical process shapes the other is difficult. For instance, a change in residence may trigger a change in mobility. However, a change in mobility might also trigger a change in residence. Despite this, mobility is often treated as an outcome in mobility biography research (Scheiner & Holz-Rau, 2013). Shove et al. (2012) state that routines in the life course shape the mobility of a person.

These routines are shaped by meanings, competences, and materials. Meanings consist of norms and beliefs across the life course in society regarding transport modes. Competences encompass acquiring skills and knowledge to use a particular mode of transport and are sometimes reflected with a certification of competence such as a driver's license.

These competencies can somehow be related to the capabilities in the capability approach (Sen, 1993) since both competencies and capabilities construct how an individual can make use of different modes of transport . Lastly, the material component of these routines consists of the resources and the built environment (Rau & Sattlegger, 2017; Shove et al., 2012). The life course perspective differentiates from other theories and approaches, and the people-based and place-based components are not as distinguishable in this approach as in previous approaches. Nevertheless, it provides an essential perspective of how other events in the life course can impact the daily mobility of individuals and how they can shape the subjective mobility of older adults.

2.1.3 Other transport and mobility literature:

An influential study by Geurs & Van Wee (2004) about the different components that influence accessibility can be useful to study the accessibility and place-based component of this thesis. Geurs & Van Wee (2004) also identify that the individual component influences accessibility. This individual component is similar to people-based factors in this research. Moreover, accessibility consists of a land-use, transport, and temporal component. The land-use component refers to the spatial distribution of facilities such as bus stops and healthcare clinics. The transportation component refers to the infrastructure of an area and its locational characteristics. Lastly, the temporal component refers to time constraints. An example of a temporal component can be the opening hours of facilities, but also seasonal effects. For example, older adults might be less mobile in the winter due to slippery roads and sidewalks (Portegijs et al., 2014). The land-use and transportation components could be applied to define the place-based characteristics. The demand and supply of the land-use and transportation components are also an essential part of this theoretical framework (Geurs & Van Wee, 2004). For example, the supply of jobs might be high in an area, but the demand for jobs among retired older adults is rather low. The example above illustrates why it is crucial to consider the relation between demand and supply of facilities and infrastructure in this research. For instance, some facilities might not be relevant for the population that is being studied.

The paper of Webber et al. (2010) provides a theoretical framework for the concept of mobility. It shows the spatial dimension of the mobility concept, which can be a person's home as well as the whole country. A person's capability to move around in these different spaces depends on financial, psychological, environmental, physical, cognitive, gender, cultural, and biographical influences. These different influences across space, together with the abovementioned approaches, will form the basis for the literature review.

2.2 Literature review: mobility and older adults

2.2.1 Older adults: a group at risk

As mentioned in the introduction, a clear connection exists between the mobility of people and well-being. However, due to several issues, such as deteriorating health, older adults face declining mobility and consequently a decline in well-being. The mobility of an older adult is dependent on several components, as illustrated in the theoretical background. In this thesis, these components are categorized in people-based and place-based components.

2.2.2 People-based factors

Age, gender and household

The process of aging correlates with an increasing prevalence of physical and psychological disabilities that can restrict the mobility of older adults, the age of a person can therefore be a strong predictor of perceived mobility (Rosso et al., 2013; Akhavan & Vecchio, 2018; Rantakokko et al., 2013). It also has to be noted that life expectancy has risen due to better lifestyles and healthcare. This rise in life expectancy results in, on the one hand, a larger share of older adults in older age categories such as 80+ who are more at risk of having disabilities and thus lower mobility. On the other hand, due to these lifestyle and healthcare improvements, older adults in younger age categories such as 65-70 still enjoy an overall high mobility level (Hjorthol, 2013). Therefore, when applying a life course perspective, it can be observed that newer cohorts of older adults have higher mobility than older cohorts in previous decades had (Haustein, 2010). Due to this increase in life expectancy and lifestyle, the literature often divides older adults into two categories. First of all, there is a category of young older adults with relatively high mobility and secondly, a category of old older adults with relatively lower mobility (Scheiner & Holz-Rau, 2013; Hjorthol, 2013; Alsnih & Hensher, 2003).

Besides age, gender can also be a strong predictor of mobility of older adults. Firstly, on average, females live longer than men and are more at risk of having a disability and thus more at risk of having lower mobility (Ahmed et al., 2016). Moreover, there is a gender difference when it comes to possession of a driver's license, and possession of a car. Especially in older cohorts the percentage of males owning a driver's license is higher than the percentage of females owning a driver's license. This results in higher mobility for males (Mitra et al., 2021). The reason for this is traditional gender roles, which are especially prevalent in older cohorts. These gender roles relate to the social conversion factors discussed in the capability approach and to meanings in mobility biography research, which entails social norms and values (Shove et al., 2012; Meijering et al., 2019). However, it is noteworthy that among newer cohorts, the share of females possessing a driver's license has been rising (Siren & Haustein, 2013). Lastly, Haustein & Siren (2015) state that females take, on average fewer daily trips, feel less safe while traveling, and have a higher fear of falling, which leads to lower perceived mobility.

The last factor to take into consideration is the relationship status of an older adult. As stated in the life course perspective, solely looking at mobility on the individual level might not accurately explain the degree of mobility of older adults. For example, not owning a driver's license might restrict a person's mobility, but if someone else in the household owns a driver's license, this might positively impact mobility (Ryan et al., 2015; Rau & Sattleger, 2017). Haustein & Siren (2015) state that older adults in single households experience higher degrees of perceived mobility due to the need to go outdoors for social contact. However, this study was controlled for by crucial factors such as age and gender. Older adults that live alone are often older, widowed, female, and experience more disabilities (Haustein & Siren, 2015). Thus single households often experience lower degrees of mobility.

Income and education

Following the framework of Webber et al. (2010) the financial situation of an individual or household can influence the mobility of older adults. Older adults with high income have more transport options available and are more capable of reaching further distances (Webber et al., 2010). Other papers also mention the importance of income when studying mobility. However, these papers also mention looking at the socioeconomic status rather than just income (Shumway-Cook et al., 2005; Yeom et al., 2008). For example, Shumway-Cook et al. (2005) found that older adults with lower income and high school education were less mobile than older adults with high income and high education. Following the capability approach (Sen, 1993), this can be explained that individuals with low income and low education have fewer resources and capabilities to use different modes of transport. Overall, females experience more financial restrictions impacting their mobility than men, which once more underlines the importance of gender in mobility research (Haustein & Siren, 2015).

Physical health and psychological factors

As stated above, physical and cognitive impairment at older ages can have a profound impact on the mobility of older adults. The framework by Weber et al. (2010) also mentions the importance of physical health, psychological factors, and cognitive health. Firstly, age correlates with a decline in muscle mass, vision impairment, and loss of balance (Seidler et al., 2010; Rosso et al., 2011). This can lead to a decline in mobility and daily activity. A loss of mobility and daily activity can lead to even more decline in muscle mass and bone density impairing mobility even more, putting an individual in a negative spiral that only leads to more loss of mobility. The restriction of daily activities can also lead to social isolation, depression, and other adverse mental effects. Loss of mobility due to frailty and disabilities could ultimately lead to premature mortality (Rosso et al., 2011). Maintaining sufficient physical health and thus mobility is a cornerstone of policies such as healthy aging and aging in place.

Besides physical health, psychological and cognitive health also influence mobility (Weber et al. 2010). The aging process is also associated with a loss of cognitive functions, with dementia as an extreme example. This decline in cognitive functioning can negatively impact mobility. Psychological factors also play an important role when studying mobility. These factors include self-efficacy, fear, feeling of safety, and social relations that can impact mobility (Rantakokko et al., 2013; Rosenberg et al., 2013). Low self-efficacy and fear of falling or driving can lead to lower mobility. Discouragement of close social relations to drive can also negatively impact the mobility of older adults (Weber et al., 2010). The pressure of social relations to surrender driving can be related to capability approach and the life-course perspective that both state that social relations can influence the mobility of an individual (Meijering et al., 2019; Shove et al., 2012). Besides age, gender also plays an important role here. Females often express more fear and feel unsafe than men (Haustein & Siren, 2015). Another psychological factor is how often older adults undertake outdoor trips. A higher frequency of trips allows a person to become more familiar with the environment and thus reducing the psychological barrier of undertaking trips (Ryan & Pereira, 2021). This relates to the life course approach where daily habits, in this case, trips, are shaped by actions and routines in the past (Rau & Sattleger, 2017). Additionally, there is a bidirectional relationship between physical and psychological health (Cohen & Herbert, 1996). For example, too much stress can negatively affect a person's physical health, and, in return, physical health conditions can cause stress (O'Connor et al., 2020).

Reflecting on the theoretical background, psychical and psychological health construct the capabilities of an individual's mobility capabilities. Physical and psychological health can be considered a personal conversion factor within the capability approach (Meijering et al., 2019). However, psychological health can also be a social conversion factor since societal norms can psychologically push older adults to restrict their mobility (Meijering et al., 2019).

Using the framework of Geurs & Van Wee (2004), the temporary component can also play an important role in the relation between mobility and health. Some physical health impairments only temporarily restrict mobility, such as sprained ankle. Moreover, seasonal effects, for example, the winter, can increase the fear of falling due to slippery roads and can lead to more depression, negatively impacting mobility (Weber et al., 2010; Geurs & Van Wee, 2004). The psychological component plays a vital role in measuring perceived mobility instead of mobility since it is based on the self-reflection of older adults on their mobility. Loss of mobility can lead to adverse psychological effects such as social isolation and dementia. Besides the factors above, age and education are often used as proxies to measure both physical and psychological health (Deary et al., 2009).

Social capital

Social capital is both seen as a predictor and outcome of mobility. On the one hand, higher mobility enables older adults to maintain social contact. On the other hand, older adults with a high amount of social capital are more motivated to be mobile (Siren & Hakamies-Blomqvist, 2009). Thus, the relation between social contacts and perceived mobility is again bidirectional. Social contacts can empower adults to be more mobile (Crewdson, 2016) , but on the other side, frequent contact with social contacts can also be the effect of high mobility . Mollenkopf et al. (2004) state that the social context influences the outdoor mobility of individuals.

Modality

The last personal factor this thesis will discuss is the modality of older adults. Different modes of transport all have a different impact on the mobility of older adults. One mode of transport particularly has a significant impact on the mobility of older adults: the car. Access to a car enables older adults to independently participate more in daily activities, positively impacting their well-being (Haustein & Siren, 2015; Siren & Hakamies-Blomqvist, 2009). Mitra et al. (2021) found that there are also differences between males and females regarding car access. Males were overall more mobile than females. This is partly because females give up their driving license earlier than males, and men more often possess a driver's license in the first place. Here, psychological factors can also play a role. Older adults are more likely to reduce their car use due to fear of driving, for example, during rush hour or at night. The fear of driving is especially applicable to females, making car use less opportune for older adults (Bauer et al., 2003). Ryan et al. (2015) state that the type of household also matters. Older adults with a partner are often experiencing higher mobility because they can support each other. For instance, a person could still drive their partner, who has no driver's license, around.

As previously mentioned, older adults are a heterogeneous population (Fobker & Grotz, 2006). The literature indicates that there is likely to be a difference between the current generation and the upcoming baby-boom generation (Haustein, 2010; Akhavan &Vecchio, 2018). Siren & Haustein (2013) state that a larger share of older adults will possess a driver's license and a private car, resulting in higher mobility of older adults. This trend of rising mobility of the elderly has already been visible over the past years (Haustein, 2012), which can be explained through the life course perspective as a cohort effect (Jones et al., 2014). Newer cohorts often possess a driver's license in the first place and thus feel more comfortable driving a car. This increase in car use sketches an optimistic scenario for the future, but Siren & Haustein (2013) point out that some nuance needs to be applied. A car-dependent society can further increase social inequalities among older adults. These inequalities can arise for older adults who do not own a private car, possess a driver's license, or cannot drive anymore (Chevallier et al., 2018). This group of older adults often already has a disadvantaged socioeconomic position in society, and increasing car dependency can increase this inequality even more (Haustein, 2012). Haustein & Siren (2015) point out that mainly old older adults with health impairments have no longer access to a car. This while a car enables young older adults to stay active and healthy. This can increase social inequality considering old older adults already suffer from lower mobility.

Taking the USA as an example of a car-dependent society, one can observe that the distance to facilities is generally larger, and public transport networks are less dense and accessible (Pucher & Lefèvre, 1996). In the case of Groningen, a more car-dependent society could result in the disappearance of even more local facilities on which less mobile older adults are often dependent. Haustein (2012) points out that older adults dependent on their car are less satisfied with their mobility options. This phenomenon can also be explained through the capability approach. Having the freedom to choose between a car and other modes of transport can increase a person's well-being. This freedom in making choices could mean that just the mere presence of public transport can increase the perceived mobility of a person even though this person does not use public transport (Ryan et al., 2015).

This is underlined by Metz (2000), who theorized that the concept of mobility also consists of so-called potential travel, which is the idea that a trip could be made even though this trip is not actually undertaken. This relates to the capability approach, which states that the mere presence of alternatives can increase mobility and well-being (Sen, 1993; Nikou & Economides, 2015). Moreover, older adults often reduce the frequency of their car use due to physical impairment or psychological factors. On top of that, a share of older adults will surrender their driver's license at a point in their life. This cessation of the driver's license can lead to a sudden loss of perceived mobility and stress and depression among older adults. This effect can be eased by providing enough alternative modes of transport (Chau & Jamei, 2021). Moreover, promoting physical activity through mobility can lead to better cognitive and physical health (Sylvers et al., 2022). Lastly, picking the car over other modes of transport is less environmentally friendly (Siren & Haustein, 2013).

Public transport is another important mode of transport, especially for older adults over 75 who have surrendered their cars (Shrestha et al., 2017). However, as Ryan et al. (2015) point out, older adults are less inclined to use public transport than other age groups. A framework by Borges (2012) states that older adults' public transport usage depends on affordability, accessibility, acceptability, and availability. Accessibility and availability to, for example, bus stops is one of the most important factors that allow older adults to use public transport (Shrestha et al., 2017). However, this is a place-based factor that will be discussed in the next section. Affordability is dependent on the income of an older adult, which is a people-based factor. Acceptability reflects the societal and personal norms and values of using public transport. Papa et al. (2018) state that sufficient public transport provision is essential to include the older adult population in society. Haustein & Siren (2015) note that older adults in Europe who use multiple modalities, such as cycling, public transport, and cars, are highly mobile. Older adults who are mainly dependent on one modality such as public transport or dependent on a car have lower mobility.

Lastly, it is noteworthy that walking and cycling are also important modes of transport in the Dutch context. Mollenkopf et al. (2004) underline this by stating that a large share of the trips over short distances is either done by cycling or walking. This highlights an important distinction between trips over long distances, where the car or public transport is used, and trips over short distances where walking and cycling are more common than other modes of transport.

2.2.3 Place-based component

The built environment & Facilities

So far, only people-based factors have been discussed. However, as the literature framework has shown, the environment or place-based factors also influence perceived mobility (Geurs & Wee, 2004) . An age-friendly built environment has been increasingly more important over the past few years (Chau & Jamei, 2021). The reasons are the aging of the population but also due to policy that is in place, such as the policy aging in place that focuses on older adults that independently keep living in their residential place (Tenand et al., 2020). The aging population and current policy require adapting homes and other buildings for older adults and a sufficient built environment that caters to older adults' needs to remain mobile (Chau & Jamei, 2021). When talking about people-based factors, there is a clear difference between the built environment in urban and rural areas, with urban areas often having more transport options and connectivity than rural areas (Peacock & Pemberton, 2019). Furthermore, urban areas often have more facilities than rural areas (Föbker & Grotz, 2006). Moreover, the distance to facilities is also shorter in urban areas. However, the high density of traffic, poorly maintained sidewalks, and unsafe crossing areas in urban areas might also negatively impact mobility for older adults, as Peacock & Pemberton (2019) point out. However, Yeom et al. (2008) point out that older adults in rural areas overall have lower mobility and have a higher risk of losing their mobility than older adults in urban areas. Clarke & Gallagher (2013) also discovered that walkability is an important factor that influences mobility together with access to public transport. Föbker & Grotz (2006) point out that the proximity to basic facilities such as supermarkets makes older adults less dependent on outside help and increases their perceived mobility. Especially public transport stops can be seen as important facilities (Ryan et al., 2015; Papa et al., 2018) since public transport can be used to reach other facilities. Lastly, both the studies by Chau & Jamei (2021) and Yeom et al. (2008) conclude that a mixed-use neighbourhood enhances the outdoor mobility of older adults. Gallagher et al. (2012) also note that safety from crime in neighbourhoods is a contributing factor to the mobility of adults. Following the capability approach, calculating the objective accessibility for older adults in an area has its limitations due to the different sets of capabilities older adults have (Ryan & Pereira, 2021). Calculating the accessibility in the built environment is incredibly complex when including multiple modes of transport and individual travel needs.

The neighbourhood context

A study by Fisher et al. (2004) also found that neighbourhood characteristics such as walkability, parks, and facilities can influence older adults' physical activity and mobility. However, Fisher et al. (2004) also found that other neighbourhood characteristics such as income, social cohesion, and population structure can influence mobility. The findings by Gallagher et. (2012) and Fisher et al. (2004) show that place-based factors can be further split into the physical and the socio-economic context of the neighbourhood. Social cohesion in a neighbourhood can foster social ties for older adults in close proximity to their homes. Consequently, this can lead to more physical activity for older adults and higher perceived mobility (Fisher et al., 2004).

2.3 The context of Groningen

2.3.1 Spatial & Demographic profile

The province of Groningen is located in the north of the Netherlands, as figure 1 shows. The municipalty which contains the capital of the province is also called Groningen and is characterized as an urban area. Figure 1 shows the population density per square kilometer per municipality in the province of Groningen. It is visible that the capital's municipality has significantly more population density and can be characterized as a more urban area, while the surrounding municipalities have a more rural character. Figure 1 also shows the percentage of older adults 65 years or older per municipality. It can be observed that this percentage is relatively low in the municipality of Groningen compared to the surrounding areas. The Dutch national government classified some of these surrounding municipalities as shrinking regions (Rijksoverheid, 2019). These are regions that face population decline, brain drain, and aging. These issues result in facilities moving away from these regions impacting the mobility of the older adults in these areas. These issues provide extra challenges for policymakers to provide a suitable environment for healthy aging. The municipalities in Groningen that are classified as a shrinking region are Het Hogeland, Eemsdelta, Oldambt, Pekela, Stadskanaal, Veendam and Westerwolde (Rijksoverheid, 2019).

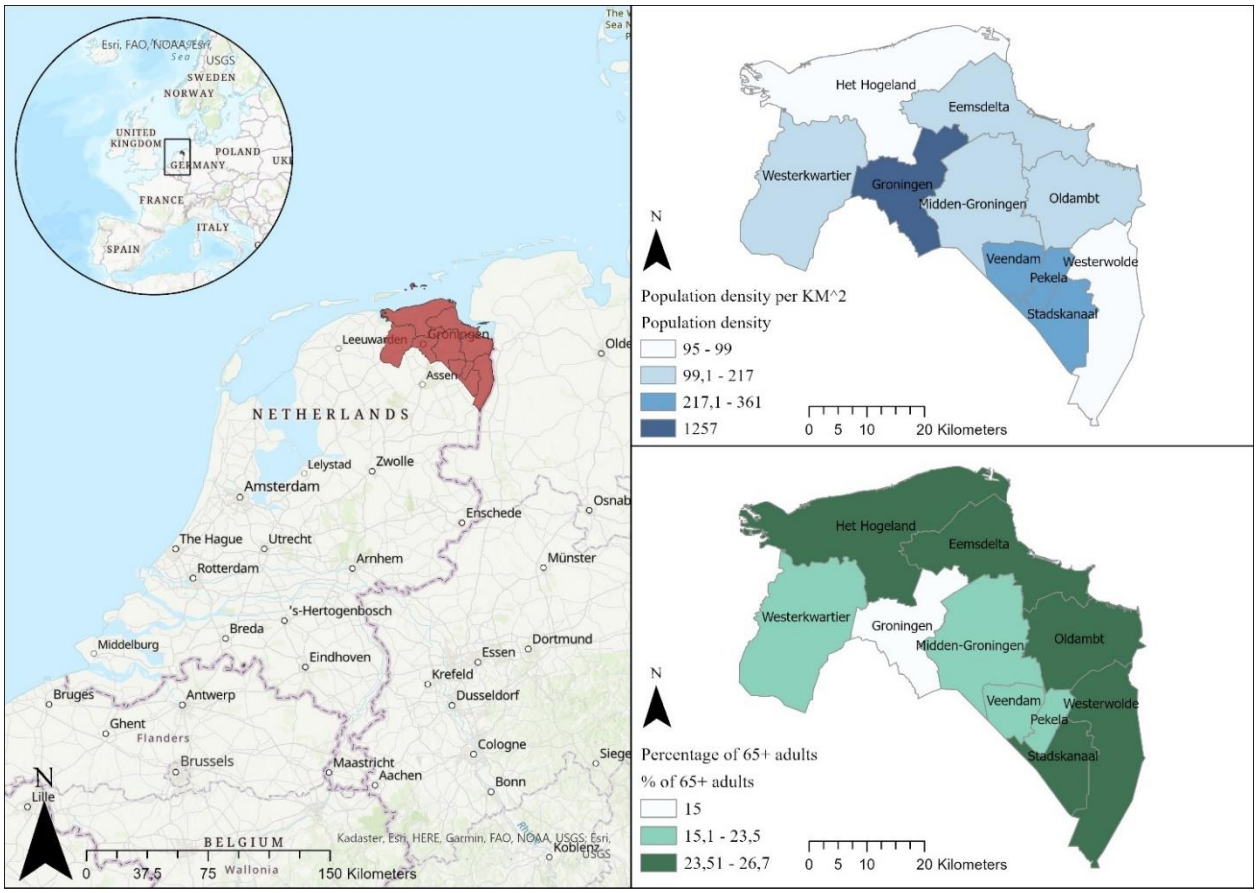

Figure 1: Location of the province and demographic context of the province Groningen

2.3.2 Mobility in Groningen

The literature shows a difference in mobility between urban and rural areas (Peacock & Pemberton, 2019). The accessibility of an urban area, such as the city of Groningen, is often higher than that of rural areas. These rural municipalities, classified as shrinking areas, face problems of population decline and often have to travel further to reach facilities (Tillema et al., 2019). Thus one would expect that these areas overall have a lower degree of mobility (Föbker & Grotz, 2006). However, reports suggest that individuals in these areas do not face a lower degree of mobility (Tillema et al., 2019; Harms et al., 2010). An explanation for this is a change in people-based factors such as an increase in car use and income, allowing people to travel further distances to facilities. However, Tillema et al. (2019) mention that older adults are still more vulnerable in these areas, despite the rise in car use. Harms et al. (2010) mention that public transport in Groningen for older adults is not very relevant, and only a minor share of older adults regularly use public transport. As an alternative to public transport, older adults make use of special regional taxi services, which allows them to travel from door to door, making it a more convenient alternative to public transport (Harms et al., 2010).

In the municipality of Groningen, mobility policy focuses on safety and accessibility for vulnerable groups such as older adults. Due to the increase in electric bikes, older adults have become more mobile. However, these electric bikes also increase the risks of traffic accidents, resulting in more severe injuries due to the higher speed of electric bikes. (Gemeente Groningen, 2021). Policy on the provincial level also focuses on the safety in traffic of older adults on bikes while at the same time promoting biking and walking among older adults (Provincie Groningen, 2021).

2.4 Conceptual model

Figure 2 shows the conceptual model of this research. Both categories of people-based factors and place-based factors are represented in this model. It can be observed that the factors that fall under the category of place-based factors are the built environment, facilities, and socio-economic context of the neighbourhood. On the other side, there are people-based factors which consist of psychological and cognitive factors, socio-economic factors, car use, demographic factors, and physical factors. Note that these terms are also umbrella terms for a wide array of other factors. For example, demographic characteristics consist of age, gender, and household. However, these specific factors that fall under these umbrella concepts are kept out of this conceptual model to keep the model simple. Instead, the methodology section of this thesis will list all these factors in an uncluttered table. Besides people-based and place-based factors, the context of Groningen also influences the self-perceived mobility of older adults in Groningen. The hypothesis is that people-based and place-based factors influence the perceived mobility of older adults. Moreover, it is expected that the local context of Groningen also influences the perceived mobility of older adults in Groningen.

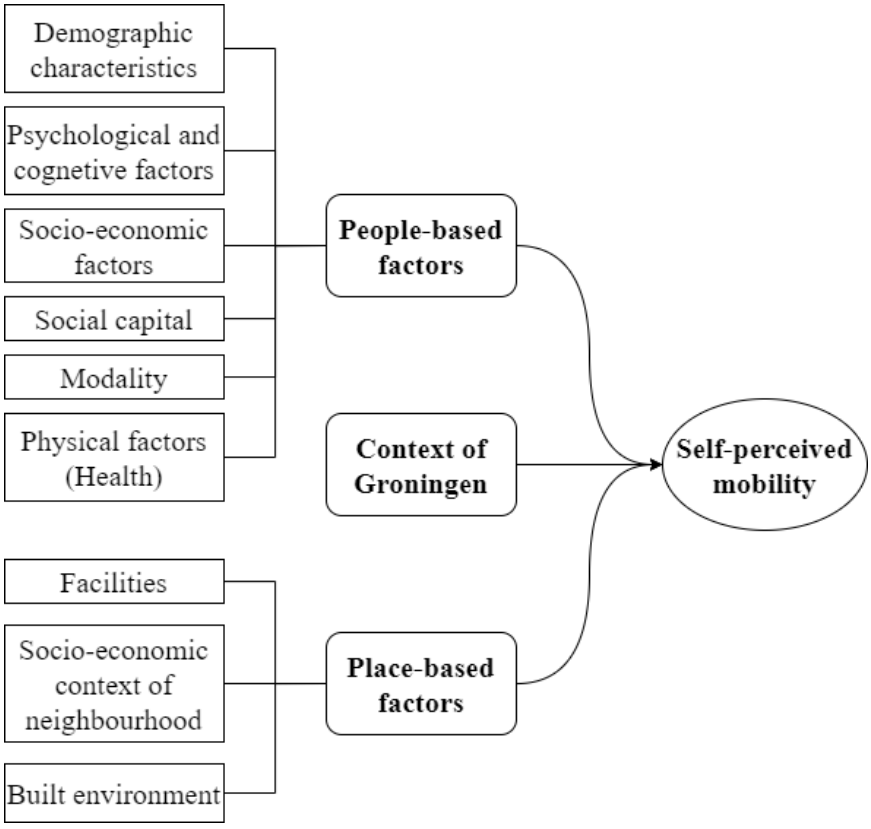

Figure 2: Conceptual model

3. Methodology

Now that the theoretical framework and conceptual model have been defined, this thesis will now discuss the methods that will be used to operationalize the conceptual model. Firstly, the dependent variable and the dataset are being discussed. The following section will discuss how people-based factors are operationalized. Then, the following paragraph discusses how place-based factors are operationalized. Subsequently, the local context of Groningen will be discussed. Consequently, the statistical model this research will use will be discussed, and lastly, the limitations of the data.

3.1 The dataset and the dependent variable

This research will make use of a quantitative approach to measure perceived mobility. This thesis will use several surveys performed by SPG in the province of Groningen. SPG is part of CMO STAMM, which is a research institute in the social domain that has a panel in Groningen with over 7000 members of 18 years and older. This sample size will however decrease by selecting respondents who are 65 or older. This panel provides both longitudinal and cross-sectional data. Some personal data is longitudinal. This longitudinal data includes place of residence, age, income, education, home-ownership, type of household, and position in the household. Some surveys from the panel data are issued multiple times across time. These surveys can also provide longitudinal data. Surveys that are issued only one time can be considered cross-sectional. Although they do have longitudinal background information about the respondent. The base survey used in this research is a survey from 2020 about livability in the province of Groningen. This survey contains the question of how adults assess their mobility on a 1-10 scale. This question will be the dependent variable in this research and will be transformed into an ordinal variable. This question has only been asked in this survey, meaning this research will treat the data as cross-sectional and employ statistical models fit for cross-sectional data. This survey contains over 3000 respondents, of which 1505 are 65 years or older. The different surveys that will be used for descriptive statistics and the statistical model are highlighted in table 1.

Due to a unique identifier code, it is possible to link the answers from respondents from different surveys issued by SPG. On the one hand, this is an advantage considering SPG has issued over 50 surveys since 2015, resulting in much information about the respondent. On the other hand, not every panel member fills in every survey. Therefore, linking multiple surveys will result in missing cases. This data limitation will be further discussed in the data limitations part of this research. The data from SPG also contains postal codes, making it possible to add external data from other sources. This will be done by adding data from the national statistics office of the Netherlands on a municipal or neighborhood level. Table 1 also includes these external data sources.

Table 1: Data sources derived for this research

Name survey (Dutch)	Description (English)	Date of dataset	Source:
Leefbaarheids monitor	Survey about livability in Groningen	October 2020	Panel Sociaal Planburea Groningen
Ketenmobiliteit Provincie Groningen	Survey about chain mobility in the province of Groningen.	2020	Panel Sociaal Planburea Groningen
Zevende meting Gronings perspectief	Longitudal survey on perspective of residents in the province of Groningen on local gas extraction	September 2020	Panel Sociaal Planburea Groningen
Nabijheid voorzieningen; afstand locatie, wijk- en buurtcijfers	Proximity of facilities on neighbourhood or level	2019	CBS Statline (2019)
Kerncijfers wijken en buurten	Data about neighbourhoods in the Netherlands	2022	CBS Statline (2022)
Leefbaarometing 2020	Data about livability per neighbourhood	2020	Ministerie van binnenlandse zaken (2020)

3.2 Quantifying the conceptual model

Data is used from the surveys and databases in table 1 to quantify the conceptual model. Firstly, people-based factors will be discussed. Table 2 will give an overview of all the people-based variables that will be used for the linear regression. Secondly, the place-based factors will be discussed, of which table 3 gives an overview.

3.2.1 People-based factors

Demographic characteristics and socio-economic status

The people-based factors from the conceptual model are operationalized by using survey data from SPG. As previously mentioned, the survey Leefbaarheids monitor in 2020 is the base survey. This survey contains demographic characteristics, such as age, gender, and household type. Due to categories in the household variable having small amounts of cases, the variable will be recategorized to if the respondent lives alone or not. It also contains information about the respondents' socioeconomic status, such as income, education, and to what extent the respondents are making ends meet at the end of the month. The questions about income and education have been categorized into three categories of low, middle and high. Over 200 respondents did not fill in this question for the income variable. These missing cases are not an anomaly considering that people are reluctant to disclose their income in most questionnaires. Nevertheless, a ‘missing’ category will be included in the model for the income variable. The question if the respondent can make ends meet at the end of every month has 4 different categories. These categories are ‘a lot of trouble’, ‘some trouble’, ‘no trouble but have to watch out’, and ‘no trouble at all’.

The first two categories have been merged due to the low amount of cases in the category ‘a lot of trouble’. This survey also contains the dependent variable of perceived mobility, making it the base survey. This survey provides this research with the base model. As mentioned in the literature, demographic and socio-economic characteristics can be strong predictors for mobility and act as a strong proxy for other unobserved factors. They are therefore included in many statistical models that study mobility (Ryan et al., 2015; Rantakokko et al., 2015; Fisher et al., 2004; Papa et al., 2018).

Psychological and cognitive factors

Overall, thes concepts of psychological health and cognitive functioning are more challenging to quantify than, for example, socio-economic status. An older age and low education is associated with lower cognitive functioning. These variables have already been discussed and will be included into the statistical model. Several valuable questions are asked in different surveys that can be used to measure psychological health. For example, there is a question about the perceived safety feeling in the neighbourhood or village on a 1-10 scale. This question about safety will be included in the analysis. Additionally, questions have been asked about how often the respondent feels happy, desperate, lonely calm, angry, powerless, in control, and dejected in the last four weeks. This research will employ a principal component analysis to combine these questions about respondent feelings into one factor that measures psychological well-being. These variables are measured on a 1-6 Likert scale. This ordinal scale is not ideal for a principal component factor analysis which requires a continuous variable. However, the research by (Korhonen & Siljamäki,, 1998) states that a principal component analysis could also be performed with ordinal data. The standardized scores of the principal component analysis will be stored as a separate variable that measures psychological well-being.

Health

The question about how respondents assess their own health has been asked in several surveys from SPG. This question consists of five answer categories which are ‘very bad’, ‘bad’, somewhat okay, ‘good’, and ‘very good’. Due to the low amount of cases, the categories of ‘very bad’ and ‘bad’ have been combined into the category ‘(very) bad’. Several studies use this self-assessed health as a predictor of mobility (Ryan et al., 2015; Fisher et al., 2004). Therefore, this rating can be used to determine the self-assessed health of the respondents. This question will be used to assess the overall health of the respondent.

Social capital

As discussed, the relation between social capital and mobility can go in both directions. However, in this research, social capital is treated as a cause to be more mobile and thus have higher perceived mobility (Mollenkopf et al., 2004). Several questions are asked across different surveys about the social contacts of the respondent. However, using different surveys will significantly reduce the sample size, as discussed in the data limitations section of this chapter. Table 2 shows that there is one question about to which extent the respondent feels connected with the people in the village or neighbourhood on a 1-10 scale. This question will be included into the model and can also apply to the neighbourhood context.

Modality

Within the data of SPG, there are several questions asked about modality. First, there is a valuable question about which modes of transport the respondent owns. This question is valuable because it includes a distinguishment between being the driver of the car or a passenger. It also contains questions about other modes of transport, such as owning a bike or a motorcycle. This research will not use all of these modes but merely the ones about car use (both as driver and passenger) and (electrical) bicycle use, because these two modes of transport are primarily used in the Dutch context (Mollenkopf et al., 2004). A question is also asked about how often the respondent uses public transport. This question consists of 5 categories that measure how often the respondent uses public transport.

This question is transformed into a binary variable of yes and no due to a low amount of cases spread across the different categories. This survey also includes statements about public transport such as: 'there are many places I would like to go but are hard to reach with public transport.' These statements could be answered on a 1-5 likert scale ranging from strongly disagree to strongly agree. Due to the limited amount of cases in some categories, the statements have been transformed to a 1-3 likert scale with the following categories: '(Stronlgy) disagree'. 'neutral', and '(Stronlgy) Agree'. Table 2 gives an overview of these statements together with the other questions relating to modality.

Table 2: People-based variables included in the model

Category	Variable/question	Dataset
Dependent variable	1-10 rating of perceived mobility	Leefbaarheids monitor 2020
Demographic characteristics	Age	Leefbaarheids monitor 2020
	Gender	Leefbaarheids monitor 2020
	Household type/size	Leefbaarheids monitor 2020
Socio-economic characteristics	Income (categories)	Leefbaarheids monitor 2020
	Education (categories)	Leefbaarheids monitor 2020
	Do you have trouble with making ends meet each month?	Leefbaarheids monitor 2020
Psychological factors	Satisfaction rate with safety in the neighbourhood	Leefbaarheids monitor 2020
	Do you feel happy/lonely/desperate/calm in the past 4 weeks?	Groningen perspectief 7e meting
Health	Self-rated health	Groningen perspectief 7e meeting
Social capital	Satisfaction rate with social contacts in neighbourhood	Leefbaarheids monitor 2020
Modality	Modes of transport that individual owns	Ketenmobiliteit
	Statement: there are lots place I would like to go but can't reach with public transport	Ketenmobiliteit
	Statement: I'd like to be more mobile with more availability of modes of transport to reach my destination easier	Ketenmobiliteit
	Statement: Is transport an obstacle in your daily life?	Ketenmobiliteit
	Do you make use of public transport?	Participipatie 2017/ Ketenmobilitiet

3.2.2 Place-based factors

Built environment

A common way of assessing the accessibility of a place is using network analysis techniques using GIS. However, due to the heterogenous group and different modes of transport, measuring the objective accessibility of the built environment in an area is a challenge with severe limitations due to the different set of capabilities of older adults (Ryan & Pereira, 2021). Therefore, developing a large set of maps with different accessibility scores for different population groups with different types of modalities is beyond the scope of this research.

Instead, the concept of accessibility is operationalized using population density as a proxy. A higher population density generally means that there is more connectivity, accessibility, and also more facilities. The people-based factors will account for the heterogeneity of the study population, and together with the distance to several facilities, population density can assess the accessibility of an area. Statistics Netherlands provides population density statistics and distance to facilities in kilometers on the neighbourhood level. These neighboorhood statistics have been linked with the neighboorhood of the respondents from the SPG data. Due to extreme outliers in the population density variable, the natural logarithm is taken to improve the trustworthiness of the model.

Beside the question about population density , there are questions in the survey of SPG that ask respondents to grade the attractiveness of the physical environment on a 1-10 scale and a question to give a grade the satisfaction with their residence on a 1-10 scale. Both these questions have been included in the model. A limitation of this paper is that no questions are asked about perceived barriers in the built environment, such as in the papers of Rantakokko et al. (2013) and Gallagher et al. (2012).

Facilities

The Dutch national statistical office has information on neighbourhood level on the average proximity of different facilities. This average is calculated by calculating the distance via the road network to a facility of every individual in a neighbourhood (Centraal bureau statistiek, 2012). Additionally, the average amount of facilities within a 1-kilometer distance, 3-kilometer distance, 5-kilometer distance, and in some cases, 10-kilometer and 20-kilometer distances are calculated (Centraal bureau statistiek, 2012). Not all proximity statistics will be included, for example, proximity to schools is not that relevant for older adults. The relevant proximity statistics have been shown in table 3. Some of these proximity statistics to facilities are only relevant for selected groups of older adults. For example, distance to a pharmacy is only relevant for older adults who have to visit a pharmacy regularly. Some proximity statistics that might be relevant are not available through Statistics Netherlands. Respondents in the survey from SPG are also asked to give a grade about how satisfied they are with the facilities in the village or neighbourhood on a 1-10 scale. This question will also be included as a variable in the model.

Neighbourhood context

The context of the neighbourhood can be measured by using data from Statistics Netherlands (CBS Statline, 2022). This dataset contains information about the population structure and neighbourhood income. Social cohesion measured in the paper of Fisher et al. (2004) is not measured explicitly on a neighbourhood scale in the Netherlands. However, social cohesion is part of the liveability index, which is available on the neighbourhood level in the Netherlands.

This liveability measurement consists of the following indicators: physical environment, stock of houses, facilities, social cohesion, and safety. Some of these indicators have already been included in the surveys of SPG. The liveability index might cause collinearity between the variables. Hence, a correlation matrix was made between all these variables.

Here the question that asks the respondent to grade the liveability in the neighbourhood on a 1-10 scale correlates with other questions about safety, social cohesion and the quality of the respondent's residence. Thus a choice was made to omit this question to preserve the trustworthiness of the model. The liveability index from the national government does not correlate with these questions and will be included in the model. Other than questions about safety and social cohesion. The percentage of older adults above the age of 65 in a neighbourhood is used to measure the neighbourhood context. This percentage of older adults can be calculated using data from Statistics Netherlands on the neighbourhood level. Due to outliers in this variable, the natural logarithm is taken of this variable to eliminate this issue.

Table 3: Place-based variables included in the model

Category	Variable	Dataset
Dependent variable	1-10 rating of perceived mobility	Leefbaarheids monitor 2020
Built environment	Population density	CBS Statline (2022)
	Distance to highway ramp	CBS Statline (2019)
	Satisfaction rate own residence	Leefbaarheidsmonitor 2020
Facilities	Distance to train station	CBS Statline (2019)
	Distance to daily utilities/groceries	CBS Statline (2019)
	Distance to bus stops/amount of bus stops	CBS Statline (2019
	How satisfied are you with the facilities in your village or neighbourhood?	Leefbaarheids monitor 2020
Neighbourhood context	Liveability % of 65+ older adults Statement: I feel connected with my neighbourhood	Leefbaarometer CBS Statline (2022) Groningen perspectief 7e meeting

3.2.3 the context of Groningen

As the conceptual model shows, the factors stated above operate within the context of the province of Groningen. Within the province of Groningen, the national government defines some areas as shrinking areas. These more rural areas face problems such as population decline, aging, and the disappearance of facilities which could lead to lower mobility (Tillema et al., 2019). The question remains if there is indeed a difference in perceived mobility between older adults in areas defined as shrinking areas and areas that are not defined as shrinking areas. An argument can be made that some place-based factors already measure the local context. However, they do not measure the local context from a policy perspective. Hence, a binary variable that shows if a respondent lives in a shrinking area or not will be added to the model to provide local context.

Consequently, interaction variables between people-based factors can be made to provide more detailed results on the difference in perceived mobility between shrinking areas and other areas. Interaction variables that make sense from a theoretical perspective are gender, car use, living alone or not, spendable income, and public transport usage. The interaction variables that have been included in separate models are listed in table 4. Interaction variables have only been added by performing if the log-likelihood ratio test between the nested model and the model with the interaction variable was significant. Table 4 also shows the interaction variables that were tested but did not improve the model and thus have been excluded from the analysis.

Table 4: variables that apply to the local context of Groningen

Category	Variable	Dataset	Included or not
Dependent variable	1-10 rating of perceived mobility	Leefbaarheids monitor 2020	
Local Context	Is the area defined as shrinking area or not?	Leefbaarheidsmonitor 2020	*Included in model 1, 2 and 3*
	Interaction between shrinking area and car-use	Leefbaarheidsmonitor 2020 andKetenmobiliteit	*Included in model 3*
	Interaction between shrinking area and gender	Leefbaarheidsmonitor 2020	*Included in model 2*
Interaction tested but not included in model	Interaction between shrinking area and household size	Leefbaarheids monitor	*Not improving the model*
	Interaction between shrinking area and spendable income	Leefbaarheids monitor	*Not improving the model*
	Interaction between shrinking area and public transport use	Leefbaarheids monitor 2020 and Ketenmobiliteit	*Not improving the model*

3.3 The Model

The dependent variable is measured on a 1-10 scale. Arguably, this scale could be treated as an interval variable. However, due to the odd distribution of the cases, this research will transform the dependent variable into an ordinal variable. A method to test the relationship between a dependent ordinal variable and several independent variables is an ordered logistic regression. Table 6 in the result section shows the distribution of the 1-10 rating of self-perceived mobility. As can be seen, the distribution is extremely skewed, with a significant amount of older adults rating their mobility a nine or a ten. It can also be observed that very few older adults rate their mobility insufficient, leading to categories that have very few cases. These categories might make the model unstable, leading to coefficients that could be wrongly interpreted (Hall, 1992). Therefore, the categories will be reclassified roughly according to the distribution of the quantile percentages. This transformation of the dependent variable will lead to the category 1-7 rating, the rating 8, the rating 9, and the rating 10.

Before building the entire model, a base model will be made with demographic and socio-economic characteristics. Then, different variables groups will be added step-wise while checking for multicollinearity. This process will lead to a final model, which is presented in the results section of this thesis as model 1. In additional to this, two more models will be created, both with an interaction effect. These models contain all variables from model 1 but with each with one extra interaction variable. Table 5 provides an overview of the three models that are presented in the result section of this thesis.

Table 5: Different ordered logistic models in this research

	Model 1	**Model 2**	**Model 3**
Variables:	All base variables without any interaction (see tables 2,3 and 4)	All variables from model 1 + interaction between gender and shrinking areas	All variables from model 1 + interaction between car-ownership and shrinking areas

3.4 Data limitations and ethical considerations

This research uses a quantitative approach to measure the concept of perceived mobility using surveys from the panel of the organization of SPG. On the one hand, using these datasets has an advantage because it provides the researcher with plenty of respondents who answered many questions. Because of this, the researcher has access to plenty of data. On the other hand, the surveys from SPG have not been specifically designed to fit the research question of this thesis. Designing a survey for this research might be able to answer the research question more specifically. This is one of the major disadvantages of using secondary data sources. The surveys from SPG contain plenty information, but some questions that could be relevant for this research have not been asked in the surveys of SPG. Nevertheless, it would be a time-consuming and costly process for the researcher to collect this substantial amount of information and reach this sample size.

As it has become clear, the SPG surveys use unique identifiers for their respondents, making the surveys linkable with each other. The linking of surveys is very useful. However, there are also some limitations to linking surveys with each other. Not every member of the SPG panel fills in every survey. So, linking other surveys to the primary survey that is used for this research will result in missing answers for a respondents who did fill in the primary survey but not the other surveys. The method this research will use is that the missing cases are assumed to be missing at random and that these missing cases can be accounted for by other predictors such as gender, income or education. To preserve the analysis's sample size, the missing cases will be deleted using listwise deletion. Moreover, cases above the age of 110 have been dropped. After manually inspecting these cases, it could be concluded that the respondents have wrongly reported their age . These respondents likely skipped the question of filling in their birthday by entering 01/01/1900 as their birthday.

Altogether, This data treatment will cause observations to drop from the original 1505 to 979. In the results section, the number of observations may vary. This variation is observations is due to missing cases by linking other surveys.

The last data limitation is that the surveys of SPG have been distributed over several years. The researcher needs to be careful with linking surveys to the primary survey. For example, respondents might be in possession of a car in the year 2014, but at the time of the primary survey that is being used in 2020, they might have already surrendered their car. However, if the survey from 2014 is linked to the primary survey of 2020, the dataset will display that this person still is in possession of a car. Thus some variables in this research face the issue of over-reporting. Together with the issue of missing cases, this could contribute to the untrustworthiness of the model. The larger the time between the surveys, the bigger the change is that some variable might have changed. To limit the issue of untrustworthiness, this will research will only make use of surveys that were distributed in a close time-span the to the survey of the dependent variable.

Some essential ethical considerations need to be considered while using the panel data from SPG. As mentioned above, the panel data contains much information due to the linkability of the surveys. Despite the respondents' names being anonymized. This extensive information, such as PC6 postal codes, could still lead to someone being able to identify a respondent. This is why the researcher will not use this data in any harmful way and to protect the respondent's anonymity. The data is stored in the online environment of SPG and can only be accessed here through a unique ID and password at the office of SPG. The researcher also has access to this online environment outside of the office, but this online environment is extra protected by a two-factor authentication system. A last crucial ethical consideration is that the results of this research should not let to any persons being able to be identified. This is especially important to consider when displaying the results of respondents spatially.

4. Results

This section of this thesis presents the result from the ordered logit regression. All models that will be presented in sections can be found in Appendix A. Before presenting the model, some descriptive statistics are presented to illustrate the context of the province of Groningen. After this, the people-based factors will be presented, and consequently, the place-based factors. In the last part of this section, this thesis will come back to the local context of Groningen by discussing the variables of the model that apply to the local context. The influence of place-based and people-based factors on the self-assessed perceived mobility of older adults in Groningen can be studied using the results from the ordered logit regression. As discussed in the methodology section, three models are created. Model 1 contains all variables; model 2 contains all variables with an interaction between gender and shrinking areas, and model 3 contains all variables with an interaction between car ownership and shrinking areas.

4.1 Descriptive statistics

4.1.1 Perceived mobility

Table 6 shows the distribution of grades older adults give their mobility. As can be seen, older adults in Groningen rate their mobility overall relatively high, with 37% rating their mobility a perfect 10. Just 4.12% give their mobility an insufficient grade. It can also be observed that the distribution of these grades is rather skewed. As previously explained, due to this skewness, the variable is transformed into an ordinal variable.

Table 6: Distribution of grades of self-perceived mobility (with missing cases)

Grade of self-perceived mobility	Freq.	Percent	Cum.
1	4	0.27	0.27
2	9	0.60	0.86
3	7	0.47	1.33
4	20	1.33	2.66
5	22	1.46	4.12
6	55	3.65	7.77
7	118	7.84	15.61
8	339	22.52	38.14
9	374	24.85	62.99
10	557	37.01	100.00
Total	1,505	100.00	
Mean	8.66		
Standard error	0.039		

Figure 3 shows the average grade for each municipality in the province of Groningen. As can be seen, Older adults in the municipality where the city of Groningen is located and the municipality of Pekela have the lowest average mobility, while older adults in the municipalities of Veendam and Stadskanaal score on average the highest. These average scores are an interesting result, considering that objective mobility is generally higher in urban areas due to the proximity of facilities.

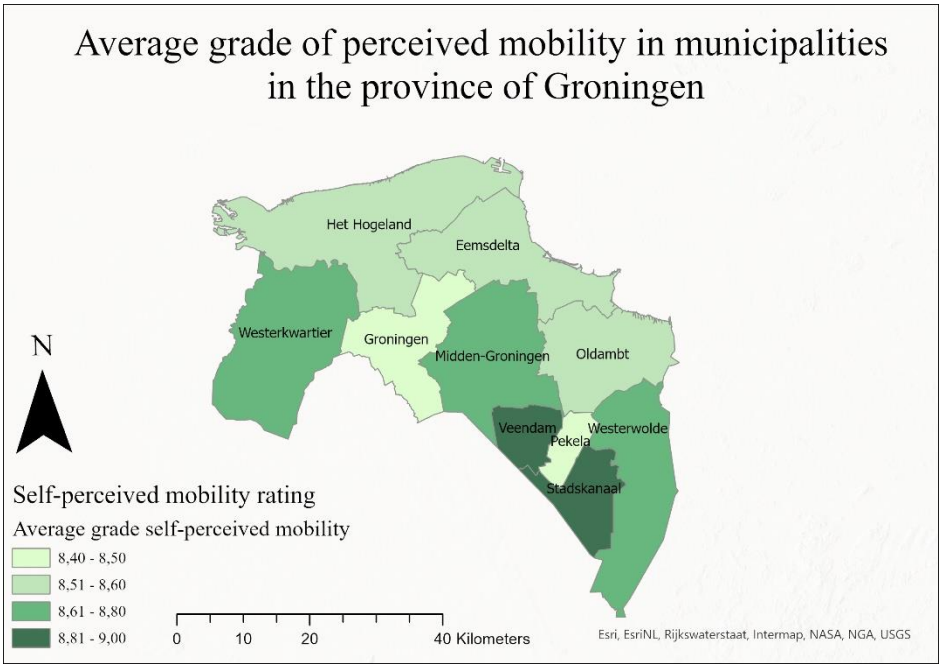

Figure 3: Average grade of perceived mobility for each municipality in Groningen

4.1.2 Car-use and public transport use in the province of Groningen

This paper has paid extensive attention to car use and public transport and their influence on the perceived mobility of older adults. Table 7, table 8, and table 9 provide the context of the usage of these two modes of transport in the province of Groningen. Note that the total amount of observations varies, due to an issue with missing cases caused by linking different surveys as discussed in the methodology. Table 7 provides the percentages of different age groups and genders that have a car at their disposal. Especially males have a high percentage of car ownership with an average of 93%. Compared to males, the percentage for females is lower but still, on average, 80.7%. It can also be observed that the percentage for males does not differ much when comparing age groups. This percentage does differ for females. Table 7 shows that females less often possess a driver's license and possibly surrender their car more often than males due to an array of factors as found in the literature (Mitra et al., 2021; Haustein, 2012). Table 8 shows the mean grade of car ownership tabulated by gender. As observed, older adults who own a car rate their mobility on average higher than older adults who do not own a car. However, there seems to be no difference in gender regarding the average rating of perceived mobility.

Table 7: Car ownership by age groups and gender

Do you have a car at your disposal (answer=yes)	**Male**	**Female**	**Total**
Age 65-75	521 (93.1%)	317 (82.1%)	747 (88,9%)
Age 75+	217 (92.7%)	79 (77.0%)	296 (85.6%)
Total answered yes	738 (93.0%)	396 (80.7%)	1134 (88.3%)
N=1285			

Table 8: Mean grade of perceived mobility by car-ownership and gender

Mean rating of perceived mobility	**Male**	**Female**	**Total**
Has no car at disposal	7.20	7.52	7.40
Has car at disposal	8.78	8,91	8,83
Total N=1285	8.67	8.64	

Table 9 shows if older adults in Groningen make use of public transport. The percentage of older adults using public transport more than three times a month in the province of Groningen is 13.99%. This statistic is further evidence of the paper of Tillema et al. (2015) that state that public transport was not being used often in Groningen by older adults. The mean perceived mobility for older adults who use public transport is lower than that of older adults who do not use public transport.

Table 9: Public transport use in the province of Groningen

Does the respondent make use of public transport (over 3 times a month)	**Freq.**	**Percent**	**Mean perceived mobility**
No	1,119	86.01	8.69
Yes	182	13.99	8.39
Total	1301	100.00	

4.2 Ordered logistic regression

4.2.1 model specifications

This section will present the results from the ordered logistic regression. Table 10 shows the model specifications of this ordered logistic regression. It shows that the number of observations has dropped to 979 due to linking different surveys. Table 11 shows the distribution of perceived mobility of older adults for these 979 observations, and as can be observed, the distribution and mean of grades do not change radically with fewer cases. Table 10 shows that the Chi-squared statistic has a value of 412,81, which corresponds to a P-value lower than 0.0005, meaning that the null hypothesis that none of the independent predictors have a coefficient of 0 can be rejected. The pseudo-R-squared has a value of 15,74%, meaning that 15,74% of the variance between the dependent and independent variables can be explained through this model. All three models can be found in Appendix A. The following parts in this section will split the model into parts to make it more presentable.

Table 10: Model specifications for model 1.

Model Specifications (only model 1)	
Number of observations	979
Chi^2	403.82
Prob>Chi^2	>0.0005
Pseudo R^2	0.1540
Log likelihood	-1109.1254

Table 11: The distribution of the grade of self-perceived mobility without the missing cases

Grade of self-perceived mobility	**Freq.**	**Percent**	**Cum.**
1	2	0.20	0.20
2	4	0.41	0.61
3	3	0.31	0.92
4	8	0.82	1.74
5	10	1.02	2.76
6	39	3.98	6.74
7	71	7.25	13.99
8	241	24.62	38.61
9	258	26.35	64.96
10	343	35.04	100.00
Total	979	100.00	
Mean **Standard error**	8.69 0.045		

4.2.2 People-based factors in the model

Table 12 shows the people-based factors of all three models.

Table 12: the people-based component of model 1,2 &3

Ordinal scale of perceived mobility	Model 1 (β)	Model 2 (β)	Model 3 (β)
Age	-0.110**	-0.117**	-0.113**
Age^2	4.33e-05	0.000104	6.06e-05
Gender (Male=Ref)			
Female	-0.0887	0.171	-0.0864
Household (living together=Ref)			
Lives alone	0.227	0.209	0.262
Income (Low=Ref)			
Middle	-0.0823	-0.111	-0.0696
High	-0.166	-0.179	-0.156
Missing	-0.132	-0.120	-0.136
Education (Low=Ref)			
Middle	-0.253	-0.255	-0.229
High	0.0321	0.0431	0.0544
Do you have trouble making ends meet? (No=Ref)			
No but have to pay attention	-0.294**	-0.295**	-0.294**
Yes some or big trouble	-0.623**	-0.634**	-0.625**
Psychological well-being (PCA)	-0.0112	-0.0165	0.000514
Satisfaction with safety in neighbourhood (1-10 grade)	0.115*	0.114*	0.117**
Self-rated health status (Very good =Ref)			
(Very) bad	-2.555***	-2.572***	-2.588***
Somewhat okay	-1.801***	-1.836***	-1.832***
Good	-0.960***	-0.984***	-0.972***
Satisfaction rate with social contacts in neighbourhood/village (1-10 grade)	0.0984	0.103	0.0947
Are you in possession of (no=Ref):			
A normal bike	0.258*	0.277*	0.243
An electric bike	-0.00523	0.00313	-0.0221
A car (as driver)	0.911***	0.915***	1.257***
A car (as passenger)	-0.0150	-0.0205	-0.00253
Do you make use of public transport (no=Ref)			
Yes	-0.441**	-0.471**	-0.424**
In daily life transport forms an obstacle (strongly disagree=Ref)			
Neutral	-0.414*	-0.399	-0.382
(Strongly) Agree	-1.231***	-1.225***	-1.282***
Lots of places I want to reach are hard to reach with public transport (strongly disagree=Ref)			
Neutral	0.0344	0.0213	0.0124
(Strongly) Agree	0.350*	0.353*	0.342*
I would like more transportation options			
Neutral	-0.349*	-0.349*	-0.344*
(Strongly) agree	-0.332	-0.330	-0.323

***P<0.01, **P<0.05. *P<0.1 Observations: 979

Demographic and socio-economic characteristics

As the model shows, the variable age is significant with a negative coefficient. Thus whenever the age rises the log odds of having lower perceived mobility rise. In other words, a higher age is likely associated with lower self-perceived mobility of older adults. The square of the age variable is not significant, indicating that there is no non-linear effect of the age variable on perceived mobility. The influence of age on perceived mobility in the models confirm the findings in the literature where age is a strong predictor for perceived mobility as well as a proxy for other predictors such as a decline in physical health, car use, psychological well-being, and cognitive functioning (Rosso et al., 2013; Akhavan & Vecchio, 2018; Rantakokko et al., 2013). Besides age, gender was also expected to be of influence on the perceived mobility of older adults . However, this variable is not significant in the models, meaning gender in this model is not likely to influence self-perceived mobility. It could be the case that gender differences have been accounted for by other variables such as car use, health, or possibly age. However, when using the evidence from the different statistical models, there is likely no difference between males and females when it comes to self-perceived mobility. Another explanation is that self-perceived mobility is measured instead of just mobility. So even though in several studies, the mobility of females is lower than males (Ryan et al., 2015; Ahkavan & Vecchio, 2018), females in Groningen might not perceive it like that.

The same conclusion applies to the variables income and education. Despite the apparent relation between income, education, and self-perceived mobility in the literature (Shumway-Cook, 2005), it is not likely that these variables influence self-perceived mobility in the three models of this research. However, when looking at the variable that measures spendable income instead of just income, it turns out that spendable income is likely to influence self-perceived mobility. Older adults in Groningen who have trouble making ends meet are more likely to have a lower perceived mobility than older adults in Groningen who have no trouble at all. The relation between spendable income and perceived mobility is in line with the literature that states that older adults with less income have fewer capabilities to make use of different modes of transportation and are often restricted in their mobility (Webber et al., 2010; Sen, 1993). The variable that measures if a respondent is alone in the household or not is also insignificant. It is, therefore, not likely that older adults who live alone in a household have lower perceived mobility, as the literature suggests (Rau & Sattleger, 2017). However, Haustein & Siren (2015) state that older adults living alone have higher perceived mobility due to their need to go outside more to maintain social contact. These effects may cancel each other out, hence the insignificant coefficient.

Psychological and cognitive factors

The psychological factors are measured as two variables in the three models. As previously discussed, the variable age also acts as a proxy for psychological factors. The scores from the principal component analysis of different questions if the respondent felt happy, angry, calm, desperate, somber, powerless, or nervous are insignificant in the model. This insignificant influence of the principal component analysis means that the standardized principal component scores of these questions likely do not influence the perceived mobility of older adults in Groningen. A possible explanation for this is the question about self-assessed health which is a general question about the respondent's health. This variable can consist of psychological and physical well-being (Cohen & Herbert, 1996). A simple correlation matrix shows a moderate 0.39 correlation between the question about self-assessed health and the variable of psychological well-being. It could be that psychological well-being is already partly represented in the significant variable of self-assessed health. In the model, the perceived safety feeling of a respondent is only significant in the third model. The coefficient is positive, which means that an increase in the grade of perceived safety likely leads to an increase in self-perceived mobility.

This relation is in line with the literature, which states that the feeling of safety in the neighbourhood can positively influence perceived mobility (Weber et al., 2010). The perceived safety feeling in neighbourhood variable in the model applies not only to psychological factors but also partly to the neigbourhood context due to the neighbourhood component in the question.

Health

All categories of the ordinal variable that measures health are significant, and the coefficients are negative. With the category "very good" as a reference category, it can be concluded that it is likely that a decline in self-assessed health is associated with lower self-perceived mobility among older adults in Groningen. As mentioned above, it can be argued that this variable consists of a psychological well-being component and a physical well-being component and that it, therefore, measures both physical health and psychological well-being. Nevertheless, this strong association between health and perceived mobility is in line with the literature where health is also one of the main predictors of mobility (Seidler et al., 2010; Rosso et al., 2011; Mollenkopf et al., 2004).

Social capital

The satisfaction with social contacts in the neighbourhood or village variable is insignificant, meaning that it is not likely that a higher satisfaction with social contacts in the neighbourhood or village leads to higher perceived mobility. This variable also applies to the neighbourhood context category of people-based factors. In the literature, there is a relation between social contacts and mobility.

Modality

The model shows that owning a mechanical or electric bicycle has no significant effect on the perceived mobility of older adults of Groningen. From the theory, this was not expected, considering in the context of Groningen and the Netherlands, biking is an important mode of transport for older adults (Mollenkopf et al., 2004; Provincie Groningen, 2021). Owning a car as a driver is a significant variable, which means that older adults who own a car are more likely to have a higher self-perceived mobility than older adults without a car. This relation between car ownership and perceived mobility is in line with the literature, which also states the important influence of car ownership on mobility (Haustein & Siren, 2015; Siren & Hakamies-Blomqvist, 2009; Jones et al., 2014; Bauer et al., 2003). The models also show that being at the disposal of a car as the passenger has no significant effect on perceived mobility.

The variable if a respondent uses public transport is also significant, but has a negative coefficient, implying that older adults in Groningen who use public transport are likely to have lower perceived mobility. On the one hand, this contradicts the literature, which states that public transport can enhance mobility (Ryan et al., 2015). However, on the other hand, the population groups that use public transport often use it as an alternative because they are not able to make use of other modes of transport such as a car or a bike (Ryan et al., 2015). Thus public transport can be seen as a lesser alternative to other modes of transport, hence the negative coefficient.

The different statements about modality to which respondents could agree or disagree are all insignificant except for respondents who strongly agree or agree with the statement: "In daily life, transportation forms an obstacle." The questionnaire does not elaborate on what causes these transportation obstacles, but it could be both people-based and place-based restrictions. To prevent multicollinearity, a correlation matrix was generated to see if it correlates with other important predictors, such as bad health or no access to a car, but no correlation was found. So although it is not clear what these obstacles precisely are, it is likely that people who experience obstacles in transportation are more likely to have lower perceived mobility. One could state that this person experiencing obstacles has limited capabilities, leading to lower perceived mobility (Sen, 1993). These findings are also in line with the ecological approach that states that restrictions in the environment negatively impact the mobility of a person (Nordbakke & Schwanen, 2014).

4.2.3 Place-based factors in the model

Table 13 shows the place-based component of the entire model. The results will be discussed below.

Table 13: Place-based component of ordered logistic models

Ordinal scale of perceived mobility	Model 1 (β)	Model 2 (β)	Model 3 (β)
Population density (log)	-0.0619	-0.0681	-0.0569
Satisfaction with own residence (1-10 grade)	0.390***	0.392***	0.393***
Satisfaction with physical living environment (1-10 grade)	0.119**	0.125**	0.117**
Satisfaction with facilities in neighbourhood/village (1-10 grade)	-0.0458	-0.0497	-0.0439
Distance to			
Train station	0.0127	0.0119	0.0138
Bus stop	0.0868	0.0882	0.0718
Main road	0.0315	0.0302	0.0293
Daily groceries/utilities	-0.0283	-0.0289	-0.0270
Liveability index	-1.082	-1.064	-1.013
% of 65+ in neighbourhood (log)	0.0282	0.0213	0.00689
I feel connected with the people in my neighbourhood/village (strongly agree=ref)			
(Strongly) Disagree	0.268	0.271	0.270
Neutral	0.0852	0.0743	0.0996

***P<0.01, **P<0.05. *P<0.1 Observations: 979

Built environment

As can be seen, the population density, which is used as a proxy for accessibility, is not significant, indicating that this measurement of accessibility is not likely to influence the perceived mobility of older adults in Groningen. The satisfaction rate with own residence is significant and positive, which means that the higher the satisfaction rate of the residence, the higher the perceived mobility. The attractiveness of the physical living environment is also significant and positive. A more attractive physical living environment is likely to lead to higher perceived mobility. This is in line with the literature where a more attractive living environment, which consists of safety and walkability, can positively influence perceived mobility (Peacock & Pemberton, 2019; Nordbakke & Schwanen, 2014).

Facilities

Despite the evidence from the literature (Föbker & Grotz, 2006; Ryan et al., 2015), the distance to facilities and satisfaction rate of facilities is insignificant in the model. This implies that proximity and satisfaction of facilities does not influence the perceptions of older adults in Groningen about their mobility. An explanation that the distance to a bus stop or a train station is insignificant could be the high share of older adults in Groningen owning a car and the low share of older adults using public transport, as shown in the descriptive statistics of this section. It could be the case that these two facilities are not seen as relevant for older adults and hence do not influence their perceived mobility. Due to a large share of the older adults in Groningen owning a car, essential facilities can easily be reached and thus do not influence the perceived mobility of older adults in the province of Groningen.

Neighbourhood context

The variables that measure neighbourhood context are also insignificant. The liveablity of a neighbourhood and the percentage of older adults in a neighbourhood do not influence the perceived mobility of older adults in Groningen. Nor do people that feel connected to people in their neighbourhood have higher perceived mobility than people who do not. Thus despite the evidence in the literature (Gallagher et al., 2012). No evidence suggests that the neighbourhood context influences the perceived mobility of older adults in the province of Groningen. However, the satisfaction rate of safety in the neighbourhood in table 12 also partly applies to the neighbourhood context and is significant. However, this variable is more about perceived safety by the respondent than objectively measured safety for a neighbourhood.

4.2.4 The context of "shrinking areas" in Groningen

The last component of the model consists of the variable that tests if the respondent lives in a shrinking area or not. Moreover, the interaction between shrinking areas and car ownership and the interaction between shrinking areas and gender are shown in Table 14. The variables gender and car ownership from table 11 have also been added. Note that this component is still part of the entire model in Appendix A and not a separate model.

Table 14: local context componenet of ordered logistic models

Ordinal scale of perceived mobility	**Model 1 (β)**	**Model 2 (β)**	**Model 3 (β)**
Does the respondent live in a shrinking area (No=ref)			
Yes	0.396***	0.589***	1.083***
Gender (Male=Ref)			
Female	-0.0887	0.171	-0.0864
Are you in possession of (no=Ref):			
A car (as driver)	0.911***	0.915***	1.257***
Interaction between shrinking area and car-ownership (as driver)			
Lives in shrinking are##Has a car at disposal	-	-	-0.755*
Interaction between shrinking area and gender			
Lives in shrinking area##Female	-	-0.523**	-

***P<0.01, **P<0.05. *P<0.1 Observations: 979

The model shows that older adults living in rural shrinking areas are more likely to have higher perceived mobility than older adults living in areas not classified as shrinking areas. These results are interesting considering that older adults in rural areas have lower mobility in the literature due to lower accessibility (Yeom et al., 2008; Föbker & Grotz, 2006). Especially these shrinking areas have lower objective mobility than the areas that are not classified as shrinking areas. However, it is essential to keep in mind that the dependent variable is about the self-perceived mobility of older adults and not about actual mobility. Taking this into account, it confirms the findings of Tillema et al. (2019) and Harms et al. (2010) that, even though the distance to facilities keeps getting higher, mobility in shrinking areas is still high.

The interaction variables in model 2 and model 3 also provide interesting results. Whereas the effect of gender is insignificant in the model, it is significant when interacting it with the shrinking area variable. Thus, this model does not provide evidence that there is a difference between males and females regarding perceived mobility, but it does provide evidence that females in shrinking areas have lower perceived mobility than males in shrinking areas. This result could be due to the greater dependency on the car in these shrinking areas, as stated by Tillema et al. (2019). As shown in the descriptive statistics and from the evidence in the literature, females are less often in possession of a car and take fewer trips with cars or other modalities compared to males (Haustein et al. 2012). The interaction of having a car with living in a shrinking area has also been added, as seen in table 14. Model 3 shows no significant interaction effect between car ownership and shrinking areas. However, the coefficients of car ownership and living in shrinking areas do differ from model 1 and model 2.

Coming back to the context of Groningen. Tillema et al. (2019) and Harms et al. (2010) note that older adults in shrinking areas are often more dependent on the car and rarely use public transport. Table 15 and table 16 show the frequency tables of car ownership and use of public transport in and outside shrinking areas. As can be seen, people in shrinking areas make less use of public transport than older adults in non-shrinking areas, possibly since there is less public transport available in these areas but also possibly because a large share of older adults in shrinking areas has a car at their disposal.

Table 15: Cross-tabulation of public transport use and shrinking areas

	Area defined as a non-shrinking area	**Area defined as a shrinking area**	**Total**
Does not use public transport	550 (81.2%)	569 (91.2%)	1119 (86.0%)
Uses public transport	127 (18.8%)	55 (8.8%)	182 (14.0%)
Total **N=1301**	677	624	

Table 16: Cross-tabulation of car ownership and shrinking areas

	Area defined as a non-shrinking area	**Area defined as a shrinking area**	**Total**
Has no car at disposal	93 (14.1%)	58 (9.3%)	151 (12%)
Has car at disposal	569 (85.9%)	565 (90.7%)	1134 (88%)
Total **N=1285**	662	623	

5.0 Discussion

The discussion section will give a more in-depth explanation about the results and the limitations of this research. Table 17 shows an overview of factors that have a positive, negative, or no correlation with perceived mobility.

Table 17: Overview of the relation between independent variables and perceived mobility

Positive relation	**No relation**	**Negative relation**
Spendable income	Gender (model 1 & 3)	Age
Feeling of safety (only model 3)	Living alone	Females in shrinking areas (model 2)
Health	Income	Experiencing obstacles in daily transport
Owning a car	Education	Using public transport
Satisfaction with house	Feeling of safety (model 1 and 2)	
Satisfaction with living environment	Factor analysis of psychological well-being	
Living in a shrinking area	Social contacts in neighbourhood	
	Owning a (electric) bike	
	Owning a car (as passenger)	
	Statement: places are hard to reach with public transport	
	Statement: I would like more transport options	
	Population density	
	Distance to facilities	
	Satisfaction with facilities	
	Neighbourhood context	

Firstly, the results from the people-based component of the model are mainly in line with the literature. Evidence for commonly used predictors in the literature such as age, spendable income, health, the feeling of safety, obstacles in transportation, and car use was found in the three models, confirming the importance of these predictors.

Table 17 shows that psychological and cognitive factors were not significant. However, as discussed, age can be a strong proxy for these factors. Hence, at least partial support for all people-based factors, except for social capital, was found in the results that align with the conceptual model. Gender in this model was insignificant despite being a significant predictor in other literature (Ahmed et al., 2016; Mitra et al., 2021; Siren & Haustein, 2015). The descriptive statistics about older adults in Groningen also show that a lower percentage of females have a car at their disposal, which in the literature is one of the causes of females' lower mobility (Mitra et al., 2021). However, there are gender differences in the rural-shrinking areas where car use is more crucial due to the longer distance to facilities which partly confirms the evidence in the literature (Mitra et al., 2021). It could be the case for non-shrinking areas that traditional gender roles, seen by Mitra et al. (2021) as one of the reasons for lower mobility for females, are less present in non-shrinking areas and more present in shrinking areas. Another explanation is that older adults are a heterogenous group (Föbker & Grotz, 2006). Results from other studies that have been performed in another spatial context might yield other results due to a different set of capabilities, competencies, routines, and habits of the population of older adults (Shove et al., 2012; Sen, 1993).

The results from the place-based component and the local context are not always in line with the literature. The variables for satisfaction rate with residence and physical living environment turn out to be significant and in line with the literature providing evidence that the place-based component built environment indeed influences perceived mobility of older adults. However, none of the variables that measure facilities or the neighborhood context turn out to be significant. A seemingly odd result is that older adults in shrinking areas have higher perceived mobility than older adults who do not live in these shrinking areas. This result would suggest that older adults in areas with lower accessibility and longer distance to facilities have higher perceived mobility. This relation is contradictory to the evidence in the literature (Yeom et al., 2008). A possible explanation could be that older adults feel more unsafe and have less walkability in urban areas (Peacock & Pemberton, 2019). However, some areas that are not classified as shrinking areas are not classified as urban areas thus, this could only partially explain this result. Tillema et al. (2019) & Harms et al. (2010) also concluded that mobility for older adults in shrinking reasons is higher, which the results from this thesis also confirm. It is possible that, due to using cross-sectional data, there is a possible selection effect bias in the model due to a bidirectional relationship. The bidirectional relationship can be explained with the life-course perspective or biographical approach where different biographical processes such as mobility and residential biographies shape each other (Rau & Sattlegger, 2017). It could be the case that due to a particular event that impacts the perceived mobility, for example, due to cessation of the driver's license, older adults in shrinking areas can no longer reach the facilities they need. Hence, these older adults move to urban areas where facilities are easier to reach. However, due to their cessation of their driver's license, they still perceive their mobility as lower than older adults in shrinking areas who still have their driver's license. With the cross-section data it cannot be concluded whether this relationship exists and what the direction of this relationship is. This is also called a selection-effect which could lead to bias in this research. For now, this research only provides evidence that older adults in shrinking areas in Groningen indeed have higher perceived mobility as was found in the literature about shrinking areas (Tillema et al., 2019; Harms et al., 2010).

Other limitations in the results were that no information was available on the frequency of trips with different types of modalities which is often used in other research about mobility (Dumbaugh, 2008; Ryan & Pereira, 2021; Ryan et al., 2015). The focus of this research was mainly on car-use rather than other modalities. Despite the importance of owning a car, looking more in depth at more sustainable and inclusive modes of transport is also important. Lastly, as mentioned in the methodology section, SPG did have more relevant data available that could be used in the model, but this data was from other surveys and would have to be linked, reducing the sample size. Overall, the models turned out to be robust, with no extreme changes between the coefficients between the different models.

6.0 Conclusion

This thesis aimed to study which factors influence the perceived mobility of older adults in Groningen. The introduction and literature review show that self-assessed perceived mobility differs from objective mobility. By using self-assessed perceived mobility, the experience of older adults in terms of mobility is more accurately captured. To answer the research question, a distinction has been made between people-based and place-based factors. These factors were derived from the existing literature on mobility. Using data from Sociaal Planbureau Groningen and data from Statistics Netherlands, these people- and place-based factors were operationalized. In addition to descriptive statistics about the perceived mobility of older adults, an ordered logistic regression technique was employed. The three different models in this research test which factors influence the perceived mobility of older adults. The literature review and results section can together answer the research question of this research. Firstly, evidence in this thesis suggests that both people-based and place-based factors influence older adults' perceived mobility. The results in this thesis provide support for the hypothesis and conceptual model that both people-based factors and place-based factors influence the perceived mobility of older adults in the province of Groningen. However, not all factors derived from the literature turned out to be significant in this research. No evidence was found that the people-based factor of social capital and the place base factors, proximity of facilities, and the neighbourhood context, influence the perceived mobility of older adults in Groningen. Nevertheless, evidence from the literature and results indicate that the people-based factors, demographic characteristics, psychological and cognitive factors, socio-economic factors, health, modality, and the place-based factor of built environment impact the perceived mobility of older adults in Groningen. From this evidence it becomes clear that mainly different people-based characteristics influence the perceived mobility of older adults.

Besides studying the influence of people-based factors and place-based factors, the context of Groningen was also applied to identify groups or areas that might be at risk of having low perceived mobility. A few things can be concluded about the perceived mobility of older adults in the context of Groningen. First, older adults in Groningen rate their perceived mobility rather high. Secondly, older adults in rural shrinking areas perceive their mobility as higher than older adults in more urban areas, despite the objective mobility generally being higher in urban areas and lower in rural areas. This is likely due to differences within groups in both these areas rather than a difference between place-based factors. These results show the importance of including people-based characteristics and that policymakers should not only look at areas with low objective mobility or accessibility but also should take into account the subjective mobility of certain groups. Lastly, females perceive their mobility lower in shrinking areas compared to males, making females in shrinking areas more at risk of having lower perceived mobility. These conclusions show that policymakers should incorporate both people-based and place-based factors to be able to more accurately identify groups and areas that are at risk of having lower perceived mobility.

Nonetheless, this research also has limitations. First of all, the major limitation is the issue of the selection effect together with the bidirectional relationships between perceived mobility and other variables in this research caused by the cross-sectional structure of the dataset. Other data limitations are using secondary data, the skewness of the dependent variable, and the limitation of linking different surveys. These limitations have already been thoroughly discussed in the methodology section. The last limitation is that this research only makes use of quantitative methods. Qualitative methods could provide more in-depth insights into the influence of people-based and place-based factors on the perceived mobility of older adults. Future research could focus on incorporating a qualitative component when studying the perceived mobility of older adults. The results of this research can from a basis in order to help identify target groups at risk for this future qualitative component.

Furthermore, future quantitative research on the perceived mobility of older adults in Groningen could include time-series data instead of cross-sectional data to partly eliminate the issue of bidirectional relationships between the dependent and independent variables.

All in all, this thesis has shown by using an extensive literature review that incorporates several approaches to mobility and by employing quantitative data analyses how different factors can influence the perceived mobility of older adults in the context of the province of Groningen. It contributes on the one hand to the existing literature on mobility by showing the relevance of using perceived mobility and providing local spatial context to a heterogenous population group. On the other hand, this research provides information of important factors that influence the self-perceived mobility that can be used as a basis for policymakers to target certain groups or areas that are at risk.

References

Ahmed, T., Vafaei, A., Auais, M., Guralnik, J., & Zunzunegui, M. V. (2016). Gender roles and physical function in older adults: Cross-sectional analysis of the International Mobility in Aging Study (IMIAS). *PLoS One*, *11*(6), e0156828.

Akhavan, M., & Vecchio, G. (2018). Mobility and Accessibility of the Ageing Society. Defining Profiles of the Elderly Population and Neighbourhood. *TeMA-Journal of Land Use, Mobility and Environment*, 9-22.

Alsnih, R., & Hensher, D. A. (2003). The mobility and accessibility expectations of seniors in an aging population. *Transportation research part a: policy and practice*, *37*(10), 903-916.

Bauer, M. J., Adler, G., Kuskowski, M. A., & Rottunda, S. (2003). The influence of age and gender on the driving patterns of older adults. *Journal of Women & Aging*, *15*(4), 3-16.

Beyazit, E. (2011). Evaluating social justice in transport: lessons to be learned from the capability approach. *Transport reviews*, *31*(1), 117-134.

Borges, I. (2012). The added value of accessible public transport for all in the context of demographic ageing. AGE Presentation at XXIII World Road Congress, Paris, France.

CBS Statline. (2015). *Nabijheid voorzieningen; afstand locatie, regionale cijfers.* Consulted on 10 may, 2022 via https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80305ned/table?fromstatweb.

CBS Statline. (2019). *Nabijheid voorzieningen; afstand locatie, wijk- en buurtcijfers 2019.* Consulted on 10 may, 2022 via https://www.cbs.nl/nl-nl/cijfers/detail/84718NED?dl=348F7.

CBS Statline. (2020). *Regionale prognose 2020-2050; bevolking, intervallen, regio-indeling 2018.* Consulted on 4 april, 2022 via https://opendata.cbs.nl/#/CBS/nl/dataset/84527NED/table?ts=1649075718360.

CBS Statline. (2022). *Kerncijfers wijken en buurten 2021*. Consulted on 13 may, 2022 via https://opendata.cbs.nl/#/CBS/nl/dataset/85039NED/table?ts=1652446961084.

Centraal Bureau Statistiek. (2012). *Nabijheid voorzieningen; afstand tot locatie, buurtcijfers*. Consluted on 12 may, 2022 via https://www.cbs.nl/-/media/_pdf/2016/17/nabijheid-toelichting-2012-12-17.pdf.

Centraal Bureau Statistiek. (2021). *Regionale prognose 2023-2050; bevolking, intervallen, regio-indeling 2021*. Consluted on 4 march, 2022 via https://www.cbs.nl/nl-nl/cijfers/detail/85173NED .

Centraal Bureau Statistiek. (2022). *Wijk- en buurtstatistieken.* Consulted on 11 april, 2022 via https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/wijk-en-buurtstatistieken.

Chau, H. W., & Jamei, E. (2021). Age-Friendly Built Environment. *Encyclopedia*, *1*(3), 781-791.

Chevallier, L. B., Motte-Baumvol, B., Fol, S., & Jouffe, Y. (2018). Coping with the costs of car dependency: A system of expedients used by low-income households on the outskirts of Dijon and Paris. *Transport Policy*, *65*, 79-88.

Clarke, P., & Gallagher, N. A. (2013). Optimizing mobility in later life: The role of the urban built environment for older adults aging in place. *Journal of Urban Health*, *90*(6), 997-1009.

Cohen, S., & Herbert, T. B. (1996). Health psychology: Psychological factors and physical disease from the perspective of human psychoneuroimmunology. *Annual review of psychology*, *47*.

Collantes, G. O., & Mokhtarian, P. L. (2007). Subjective assessments of personal mobility: What makes the difference between a little and a lot?. *Transport Policy*, *14*(3), 181-192.

Crewdson, J. A. (2016). The effect of loneliness in the elderly population: A review. *Healthy Aging & Clinical Care in the Elderly*, *8*, 1.

Deary, I. J., Corley, J., Gow, A. J., Harris, S. E., Houlihan, L. M., Marioni, R. E., ... & Starr, J. M. (2009). Age-associated cognitive decline. *British medical bulletin*, *92*(1), 135-152.

Delfmann, H. de Haan, F. & Janssen, M. (2021). *Gronings welzijn*. Sociaal Planbureau Groningen.

Dumbaugh, E. (2008). Designing communities to enhance the safety and mobility of older adults: A universal approach. *Journal of Planning Literature*, *23*(1), 17-36.

Fisher, K. J., Li, F., Michael, Y., & Cleveland, M. (2004). Neighborhood-level influences on physical activity among older adults: a multilevel analysis. *Journal of Aging & Physical Activity*, *12*(1).

Föbker, S., & Grotz, R. (2006). Everyday mobility of elderly people in different urban settings: The example of the city of Bonn, Germany. *Urban studies*, *43*(1), 99-118.

Gallagher, N. A., Clarke, P. J., Ronis, D. L., Cherry, C. L., Nyquist, L., & Gretebeck, K. A. (2012). Influences on neighborhood walking in older adults. *Research in gerontological nursing*, *5*(4), 238-250.

Gasper, D. (2007). Human well-being: concepts and conceptualizations. In *Human well-being* (pp. 23-64). Palgrave Macmillan, London.

Gemeente Groningen. (2021). *Mobiliteitsvisie*. Groningen.

Geurs, K. T., & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport geography*, *12*(2), 127-140.

Hall, P. (1992). On the removal of skewness by transformation. *Journal of the Royal Statistical Society: Series B (Methodological)*, *54*(1), 221-228.

Harms, L. Kalter, M.J.O. & Jorritsma, P. (2010) *Krimp en mobiliteit, gevolgen van demografiesche veranderingen voor mobiliteit.* Ministerie van Verkeer en Waterstaat.

Haustein, S. (2012). Mobility behavior of the elderly: an attitude-based segmentation approach for a heterogeneous target group. *Transportation*, *39*(6), 1079-1103.

Haustein, S., & Siren, A. (2015). Older people's mobility: Segments, factors, trends. *Transport Reviews*, *35*(4), 466-487.

Hjorthol, R. (2013). Transport resources, mobility and unmet transport needs in old age. *Ageing & Society*, *33*(7), 1190-1211.

Hjorthol, R. J., Levin, L., & Sirén, A. (2010). Mobility in different generations of older persons: The development of daily travel in different cohorts in Denmark, Norway and Sweden. *Journal of Transport Geography*, *18*(5), 624-633.

Jones, H., Chatterjee, K., & Gray, S. (2014). A biographical approach to studying individual change and continuity in walking and cycling over the life course. *Journal of transport & health*, *1*(3), 182-189.

Korhonen, P., & Siljamäki, A. (1998). Ordinal principal component analysis theory and an application. *Computational Statistics & Data Analysis*, *26*(4), 411-424.

Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process.

Meijering, L. (2021). Towards meaningful mobility: A research agenda for movement within and between places in later life. *Ageing & Society*, *41*(4), 711-723.

Meijering, L., van Hoven, B., & Yousefzadeh, S. (2019). “I think I'm better at it myself”: the Capability Approach and Being Independent in Later Life. *Research on Ageing and Social Policy*, *7*(1), 229-259.

Metz, D. H. (2000). Mobility of older people and their quality of life. *Transport policy*, *7*(2), 149-152.

Ministerie van Binnenlandse zaken. (2020). Leefbaarometer meting 2020. Consulted on 3 June, 2022 via https://data.overheid.nl/dataset/leefbaarometer-meting-20201.

Mitra, S., Yao, M., & Ritchie, S. G. (2021). Gender differences in elderly mobility in the United States. *Transportation research part A: policy and practice*, *154*, 203-226.

Mollenkopf, H., Marcellini, F., Ruoppila, I., Széman, Z., Tacken, M., & Wahl, H. W. (2004). Social and behavioural science perspectives on out-of-home mobility in later life: findings from the European project MOBILATE. *European Journal of Ageing*, *1*(1), 45-53.

Nikou, S. A., & Economides, A. A. (2015). The effects of Perceived Mobility and Satisfaction on the adoption of Mobile-based Assessment. In *2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL)* (pp. 167-171). IEEE.

Nordbakke, S., & Schwanen, T. (2014). Well-being and mobility: A theoretical framework and literature review focusing on older people. *Mobilities*, *9*(1), 104-129.

O'Connor, D. B., Thayer, J. F., & Vedhara, K. (2020). Stress and health: A review of psychobiological processes. *Annual review of psychology*, *72*(1).

Papa, E., Carpentieri, G., & Guida, C. (2018). Measuring walking accessibility to public transport for the elderly: the case of Naples. *Journal of Land Use, Mobility and Environment*, 105-116.

Peacock, A., & Pemberton, S. (2019). The paradox of mobility for older people in the rural-urban fringe. *Journal of rural studies*, *70*, 9-18.

Portegijs, E., Iwarsson, S., Rantakokko, M., Viljanen, A., & Rantanen, T. (2014). Life-space mobility assessment in older people in Finland; measurement properties in winter and spring. *BMC Research Notes*, *7*(1), 1-9.

Provincie Groningen. (2021). *Wat Groningers Beweegt.*

Pucher, J., & Lefèvre, C. (1996). The United States: the car-dependent society. In *The urban transport crisis in Europe and North America* (pp. 175-200). Palgrave Macmillan, London.

Rantakokko, M., Iwarsson, S., Portegijs, E., Viljanen, A., & Rantanen, T. (2015). Associations between environmental characteristics and life-space mobility in community-dwelling older people. *Journal of aging and health*, *27*(4), 606-621.

Rantakokko, M., Mänty, M., & Rantanen, T. (2013). Mobility decline in old age. *Exercise and sport sciences reviews*, *41*(1), 19-25.

Rau, H., & Sattlegger, L. (2018). Shared journeys, linked lives: A relational-biographical approach to mobility practices. *Mobilities*, *13*(1), 45-63.

Rijksoverheid. (2019). *Krimpgebieden en anticipeergebieden.* Consulted on 18 may, 2022 via https://www.rijksoverheid.nl/onderwerpen/bevolkingsdaling/krimpgebieden-en-anticipeergebieden

Rocha, N. P., Bastardo, R., Pavão, J., Santinha, G., Rodrigues, M., Rodrigues, C., ... & Dias, A. (2021). Smart cities’ applications to facilitate the mobility of older adults: a systematic review of the literature. *Applied Sciences*, *11*(14), 6395.

Rosenberg, D. E., Huang, D. L., Simonovich, S. D., & Belza, B. (2013). Outdoor built environment barriers and facilitators to activity among midlife and older adults with mobility disabilities. *The Gerontologist*, *53*(2), 268-279.

Rosso, A. L., Auchincloss, A. H., & Michael, Y. L. (2011). The urban built environment and mobility in older adults: a comprehensive review. *Journal of aging research*, *2011*.

Rosso, A. L., Taylor, J. A., Tabb, L. P., & Michael, Y. L. (2013). Mobility, disability, and social engagement in older adults. *Journal of aging and health*, *25*(4), 617-637.

Ryan, J., & Pereira, R. H. (2021). What are we missing when we measure accessibility? Comparing calculated and self-reported accounts among older people. *Journal of transport geography*, *93*, 103086.

Ryan, J., Wretstrand, A., & Schmidt, S. M. (2015). Exploring public transport as an element of older persons' mobility: A Capability Approach perspective. *Journal of transport geography*, *48*, 105-114.

Scheiner, J., & Holz-Rau, C. (2013). A comprehensive study of life course, cohort, and period effects on changes in travel mode use. *Transportation Research Part A: Policy and Practice*, *47*, 167-181.

Seidler, R. D., Bernard, J. A., Burutolu, T. B., Fling, B. W., Gordon, M. T., Gwin, J. T., ... & Lipps, D. B. (2010). Motor control and aging: links to age-related brain structural, functional, and biochemical effects. *Neuroscience & Biobehavioral Reviews*, *34*(5), 721-733.

Sen, A. (1993). Capability and well-being73. *The quality of life*, *30*, 1-445.

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes*. Sage.

Shrestha, B. P., Millonig, A., Hounsell, N. B., & McDonald, M. (2017). Review of public transport needs of older people in European context. *Journal of population ageing*, *10*(4), 343-361.

Shumway-Cook, A., Ciol, M. A., Yorkston, K. M., Hoffman, J. M., & Chan, L. (2005). Mobility limitations in the Medicare population: prevalence and sociodemographic and clinical correlates. *Journal of the American Geriatrics Society*, *53*(7), 1217-1221.

Siren, A., & Hakamies-Blomqvist, L. (2009). Mobility and well-being in old age. *Topics in Geriatric Rehabilitation*, *25*(1), 3-11.

Siren, A., & Haustein, S. (2013). Baby boomers' mobility patterns and preferences: What are the implications for future transport?. *Transport Policy*, *29*, 136-144.

Sylvers, D. L., Hicken, M., Esposito, M., Manly, J., Judd, S., & Clarke, P. (2022). Walkable neighborhoods and cognition: implications for the design of health promoting communities. *Journal of aging and health*.

Tenand, M., Hussem, A., & Bakx, P. (2020). Promoting aging in place through flexible care options: recent developments from the Netherlands.

Thornton, C. M., Kerr, J., Conway, T. L., Saelens, B. E., Sallis, J. F., Ahn, D. K., ... & King, A. C. (2017). Physical activity in older adults: an ecological approach. *Annals of Behavioral Medicine*, *51*(2), 159-169.

Tillema, T., Jorritsma, P., & Harms, L. W. J. (2019). *Bevolkingsdaling en de effecten op de bereikbaarheid en de mobiliteit in Nederland*. Ministerie van Infrastructuur en Waterstaat.

Vella-Brodrick, D. A., & Stanley, J. (2013). The significance of transport mobility in predicting well-being. *Transport Policy*, *29*, 236-242.

Webber, S. C., Porter, M. M., & Menec, V. H. (2010). Mobility in older adults: a comprehensive framework. *The gerontologist*, *50*(4), 443-450.

Yeom, H. A., Fleury, J., & Keller, C. (2008). Risk factors for mobility limitation in community-dwelling older adults: a social ecological perspective. *Geriatric nursing*, *29*(2), 133-140.

Appendix A: Statistical Models

Model 1 Specifications	
Number of observations	979
Chi^2	403.82
Prob>Chi^2	>0.0005
Pseudo R^2	0.1540
Log likelihood	-1109.1254

Ordinal scale of perceived mobility	Model 1 (β)
Age	-0.110**
Age^2	4.33e-05
Gender (Male=Ref)	
Female	-0.0887
Household (living together=Ref)	
Lives alone	0.227
Income (Low=Ref)	
Middle	-0.0823
High	-0.166
Missing	-0.132
Education (Low=Ref)	
Middle	-0.253
High	0.0321
Do you have trouble making ends meet? (No=Ref)	
No but have to pay attention	
Yes some or big trouble	-0.294**
	-0.623**
Psychological well-being (PCA)	-0.0112
Satisfaction with safety in neighbourhood (1-10 grade)	0.115*
Self-rated health status (Very good =Ref)	
(Very) bad	-2.555***
Somewhat okay	-1.801***
Good	-0.960***
Satisfaction rate with social contacts in neighbourhood/village (1-10 grade)	0.0984
Are you in possession of (no=Ref):	
A normal bike	0.258*
An electric bike	-0.00523
A car (as driver)	0.911***
A car (as passenger)	-0.0150

Do you make use of public transport (no=Ref)	
Yes	-0.441**
In daily life transport forms an obstacle (strongly disagree=Ref)	
Neutral	-0.414*
(Strongly) Agree	-1.231***
Lots of places I want to reach are hard to reach with public transport (strongly disagree=Ref)	
Neutral	0.0344
(Strongly) Agree	0.350*
I would like more transportation options	
Neutral	-0.349*
(Strongly) agree	-0.332
Population density (log)	-0.0619
Satisfaction with own residence (1-10 grade)	0.390***
Satisfaction with physical living environment (1-10 grade)	0.119**
Satisfaction with facilities in neighbourhood/village (1-10 grade)	-0.0458
Distance to	
Train station	0.0127
Bus stop	0.0868
Main road	0.0315
Daily groceries/utilities	-0.0283
Liveability index	-1.082
% of 65+ in neighbourhood (log)	0.0282
I feel connected with the people in my neighbourhood/village (strongly agree=ref)	
(Strongly) Disagree	0.268
Neutral	0.0852
Does the respondent live in a shrinking area (No=ref)	
Yes	0.396***

Model 2 Specifications	
Number of observations	979
Chi^2	407.92
Prob>Chi^2	>0.0005
Pseudo R^2	0,1556
Log likelihood	-1107.0784

Ordinal scale of perceived mobility	**Model 2 (β)**
Age	-0.117**
Age^2	0.000104
Gender (Male=Ref)	
Female	0.171
Household (living together=Ref)	
Lives alone	0.209
Income (Low=Ref)	
Middle	-0.111
High	-0.179
Missing	-0.120
Education (Low=Ref)	
Middle	-0.255
High	0.0431
Do you have trouble making ends meet? (No=Ref)	
No but have to pay attention	
Yes some or big trouble	-0.295**
	-0.634**
Psychological well-being (PCA)	-0.0165
Satisfaction with safety in neighbourhood (1-10 grade)	0.114*
Self-rated health status (Very good =Ref)	
(Very) bad	-2.572***
Somewhat okay	-1.836***
Good	-0.984***
Satisfaction rate with social contacts in neighbourhood/village (1-10 grade)	0.103
Are you in possession of (no=Ref):	
A normal bike	0.277*
An electric bike	0.00313
A car (as driver)	0.915***
A car (as passenger)	-0.0205
Do you make use of public transport (no=Ref)	
Yes	-0.471**
In daily life transport forms an obstacle (strongly disagree=Ref)	
Neutral	-0.399
(Strongly) Agree	-1.225***

Lots of places I want to reach are hard to reach with public transport (strongly disagree=Ref)	
Neutral	0.0213
(Strongly) Agree	0.353*
I would like more transportation options	
Neutral	-0.349*
(Strongly) agree	-0.330
Population density (log)	-0.0681
Satisfaction with own residence (1-10 grade)	0.392***
Satisfaction with physical living environment (1-10 grade)	0.125**
Satisfaction with facilities in neighbourhood/village (1-10 grade)	-0.0497
Distance to	
Train station	0.0119
Bus stop	0.0882
Main road	0.0302
Daily groceries/utilities	-0.0289
Liveability index	-1.064
% of 65+ in neighbourhood (log)	0.0213
I feel connected with the people in my neighbourhood/village (strongly agree=ref)	
(Strongly) Disagree	0.271
Neutral	0.0743
Does the respondent live in a shrinking area (No=ref)	
Yes	
	0.589***
Interaction between gender and shrinking area	
Female##living in shrinking area	-0.523**

Model 3 Specifications	
Number of observations	979
Chi^2	407.38
Prob>Chi^2	>0.0005
Pseudo R^2	0.1554
Log likelihood	-1107.3467

Ordinal scale of perceived mobility	**Model 3 (β)**
Age	-0.113**
Age^2	6.06e-05
Gender (Male=Ref)	
Female	-0.0864
Household (living together=Ref)	
Lives alone	0.262
Income (Low=Ref)	
Middle	-0.0696
High	-0.156
Missing	-0.136
Education (Low=Ref)	
Middle	-0.229
High	0.0544
Do you have trouble making ends meet? (No=Ref)	
No but have to pay attention	-0.294**
Yes some or big trouble	-0.625**
Psychological well-being (PCA)	0.000514
Satisfaction with safety in neighbourhood (1-10 grade)	0.117**
Self-rated health status (Very good =Ref)	
(Very) bad	-2.588***
Somewhat okay	-1.832***
Good	-0.972***
Satisfaction rate with social contacts in neighbourhood/village (1-10 grade)	0.0947
Are you in possession of (no=Ref):	
A normal bike	0.243
An electric bike	-0.0221
A car (as driver)	1.257***
A car (as passenger)	-0.00253
Do you make use of public transport (no=Ref)	
Yes	-0.424**
In daily life transport forms an obstacle (strongly disagree=Ref)	
Neutral	-0.382
(Strongly) Agree	-1.282***

Lots of places I want to reach are hard to reach with public transport (strongly disagree=Ref)	
Neutral	0.0124
(Strongly) Agree	0.342*
I would like more transportation options	
Neutral	-0.344*
(Strongly) agree	-0.323
Population density (log)	-0.0569
Satisfaction with own residence (1-10 grade)	0.393***
Satisfaction with physical living environment (1-10 grade)	0.117**
Satisfaction with facilities in neighbourhood/village (1-10 grade)	-0.0439
Distance to	
Train station	0.0138
Bus stop	0.0718
Main road	0.0293
Daily groceries/utilities	-0.0270
Liveability index	-1.013
% of 65+ in neighbourhood (log)	0.00689
I feel connected with the people in my neighbourhood/village (strongly agree=ref)	
(Strongly) Disagree	0.270
Neutral	0.0996
Does the respondent live in a shrinking area (No=ref)	
Yes	1.083***
Interaction between car-use and shrinking area	
Has car##living in shrinking area	-0.755*