

# **How to combat mobility injustices for older people?**

## **Understanding needs and perceptions through a mixed-methods approach in Munich, Germany.**

Master's Thesis  
at the TUM School of Engineering and Design  
at the Technical University of Munich

Supervisors: Prof. Dr. -Ing. Gebhard Wulfhorst  
Dr. - Ing. David Duran, Dr. María Teresa Baquero Larriva  
Technical University of Munich  
Chair of Urban Structure and Transport Planning  
Arcisstraße 21  
80333 München

Submitted by: Helena Gartmeier

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# Exposé

## **Background and state of research:**

The ongoing, global process of urbanization has led to more than half of the worldwide population living in cities by 2023 (Statistisches Bundesamt [Destatis], 2023a). Additionally, western countries, including Germany, are facing demographic changes, leading to an increased share of older people in the citizenry (Zmud et al., 2017). This development affects also the city of Munich, which will experience an increase of persons aged 65 or above of 24.3 % by 2041 (Bayerisches Landesamt für Statistik, 2023a). These megatrends find expression in urban and mobility planning, as cities are required to provide access to everyday basic services for their residents. However, the potential to participate in public life by being mobile, meaning by moving outside of the dwelling place, varies amongst social groups. The resulting concept of mobility justice factors is primarily dimensions service accessibility, transportation availability and exposure to traffic-related externalities. (Duran-Rodas, Haxhija, & Baquero Larriva, 2023; Rammler & Schwedes, 2018) When characterizing older people and their mobility behaviour, it can be stated that they tend to undertake shorter and fewer trips overall, compared to the average adult. Furthermore, the rate of non-mobile people increases with age. It can also be seen that the daily needs of aged persons differ from those of general adulthood, hence resulting in other purposes of mobility. (Belz et al., 2020; Nobis & Kuhnimhof, 2018; Zmud et al., 2017) Social inclusion and participation are essential reasons for older people to move outside of their houses, and the ability to carry out out-of-home activities contributes to personal well-being. Apart from this, both individual and circumstantial premises, such as health and economic status, influence mobile behaviour. Nonetheless, present-days' persons of advanced age are overall more mobile, compared to those of previous generations. (Belz et al., 2020; Land Baden-Württemberg, 2015; Nobis & Kuhnimhof, 2018; Nordbakke & Schwanen, 2015)

Research has begun to consider in which ways and to what extent older persons are affected in their mobility needs, especially by ageing phenomena and resulting physical or mental impairments. (Nobis & Kuhnimhof, 2018) Apart from this, a special focus has been put on older people's safety as potentially vulnerable traffic participants. (Land Baden-Württemberg, 2015) Furthermore, existing research focuses on particular elements of mobility injustices towards persons of advanced age. These include, among others, the walkability of a neighbourhood, as well as health and wellbeing in everyday life. (Alves et al., 2020; Bayar & Yılmaz, 2023; Cinderby et al., 2018; Zaidi et al., 2017) However, perceptions and needs of individuals, their ways to cope with mobility disadvantages, and methods to allocate applicable strategies, remain to be addressed in depth, and thus lay the foundation of this work.

**Goals, methods and expected results:**

This thesis aims to provide an approach to frame mobility injustices in cities, incorporating a methodology to consider requirements of members of disadvantaged social groups, specifically older people.

By employing a literature review at its beginning, this thesis compiles available research on aspects of mobility injustice and its effects on older people. It furthermore outlines existing strategies to adapt urban and mobility planning to this target group, as well as pointing out the deficiencies in considering individual viewpoints on age-friendliness. The field work of this thesis, in particular a mixed-methods approach directed at both residents and experts, is conducted in Munich, Germany. Corresponding investigations are built upon data for the city, retrieved from socio-geographic analyses and areas of injustice for Munich's neighbourhoods. When approaching residents of these at-risk areas, particular attention is paid to the perception of inequalities as well as the specific needs of older people. Apart from this, their methods to deal with injustices are to be examined. In the following, this thesis develops a ranking scheme which illustrates needs and requests for this disadvantaged group, and contrasts the findings to the reviewed literature. Furthermore, specific actions are being proposed to combat the identified mobility injustices. The results are compared to local framework conditions, whereupon further interviews, directed at politicians and other stakeholders, outline the feasibility of strategies to combat existing injustices. The identified fields of action are allocated to potential measures, and evaluated regarding their suitability and their impact. Afterwards, the findings are discussed and final proceedings are proposed.

**Supervision:**

The candidate will present to her supervisors Dr.-Ing. David Duran and Dr. María Teresa Baquero Larriva a draft of the structure for her master's thesis and a work plan two weeks after this approval. Other supervision meetings will be planned with the candidate when necessary. The Chair of Urban Structure and Transport Planning supports the candidate with the contact to relevant actors and or experts if needed. After two weeks of the submission of her thesis, the candidate must defend it by means of a presentation (20 minutes) and the following discussion. The results are responsibility of the author. The Chair does not take responsibility for those results.

# Abstract

Alongside the global trends of urbanization and climate change, western countries, including Germany, are facing demographic changes. The thus increasing share of older people in the citizenry is accompanied by shifting requirements towards urban and transport planning. At the same time, research states that older people are undertaking fewer and shorter trips, with an increased share of immobile persons. Due to individual limitations and premises from the built environment, older adults are seen as an at-risk social group to experience mobility injustice in their daily routines. This thesis seeks to understand their needs, and the interactions between perceived (in-) justice, the local urban and transport infrastructure and personal abilities and preferences.

For this purpose, neighbourhood Waldtrudering in the southeastern outskirts of Munich is chosen as a case study area. It provides a low score in accessibility, availability and use of sustainable transport modes, and exposure, and simultaneously a high share of seniors in the population. First, spatial analyses regarding accessibility, availability and exposure are applied to understand the local framework conditions and identify potential challenges for senior mobility. Second, qualitative, semi-structured interviews with older residents are chosen as a method of empiric social research, allowing for flexible adjustment of the question sequence, and response-based follow-up questions. This field work was carried out in the shape of one-to-one conversations, both in public spaces and senior-specific community centres, during the months of October and November 2023. By involving experts of the Mobility Department of Munich and the respective District Council through guideline-based interviews, actions desired by residents are compared to the local planning framework.

The 33 residents' interviews show that mobility injustices are perceived if seniors are required to readjust their routines. This can also result from a perceived lack of awareness towards the needs of older people by other traffic participants or by transportation planners. Moreover, interviewees who are impaired in their health are more likely to report deficits in justice. This includes access to desired points of interest, but also to public transportation. Walkability and the design of public spaces are relevant to seniors' mobility routines and their comfort and feeling of safety. Despite an overall satisfaction with the public transport network in the study area, private cars are used by the interviewees especially for spontaneous travels, and trips within Munich's surroundings.

The interviewed seniors reported key strategies to cope with mobility disadvantages. These range from adjustments in routing and times of travel to reliance on other persons, but can ultimately also result in the inability to take a trip. Furthermore, it was found that being able to move in the city is associated with additional benefits for seniors. They deliberately choose

active forms of mobility in order to maintain personal health and fitness. Keeping up personal routines and forming a daily structure is relevant to the participants, as well as the possibility for social interactions. Additionally, the interviewees value freedom of choice and independence regarding transportation.

Finally, the planning perspective shows overlaps with the fields of action described by the residents with regard to the importance of a barrier-free environment, including pedestrian infrastructure and public transportation. The latter is furthermore to be supplied spatially and temporarily dense. While understanding seniors as an in itself heterogeneous social group, experts primarily target seniors with personal limitations in their actions.

This thesis demonstrates how methods of empiric social research can support the understanding of the needs of a disadvantaged social group and exceed the insights of spatial analyses. It opens up potential for further research regarding measures for mobility justice and their effects in various spatial contexts.



# Kurzfassung

Neben den globalen Megatrends von Urbanisierung und Klimawandel sind westliche Industrieländer, darunter auch Deutschland, von demographischen Veränderungen betroffen. Der dadurch steigende Anteil älterer Menschen in der Bevölkerung erzeugt Veränderungen in den Anforderungen an Stadt- und Verkehrsplanung. Bestehende Forschung hat gezeigt, dass ältere Menschen insgesamt kürzere und weniger Wege zurücklegen, während der Anteil der nicht-mobilen Personen steigt. Das Konzept der *Mobilitätsungerechtigkeit* berücksichtigt die Dimensionen der Erreichbarkeit von Einrichtungen des täglichen Bedarfs, der Verfügbarkeit von Verkehrsangeboten und der Belastung durch verkehrsverursachte Externalitäten. Aufgrund von individuellen Einschränkungen sowie baulich geprägten Rahmenbedingungen werden ältere Menschen als Risikogruppe wahrgenommen. Die vorliegende Arbeit zielt auf das Verstehen ihrer Bedürfnisse und die Interaktionen zwischen wahrgenommener (Un-) Gerechtigkeit, der örtlichen Stadt- und Verkehrsplanung und persönlichen Fähigkeiten und Vorlieben ab.

Zu diesem Zweck wurde der Stadtteilbezirk Waldtrudering in der südöstlichen Randlage von München als Untersuchungsgebiet gewählt, aufgrund des niedrigen Scores in den Dimensionen der Mobilitätsungerechtigkeit und gleichzeitig eines hohen Anteils an älteren Personen in der dortigen Bevölkerung. Zunächst wurden räumliche Analysen zu Erreichbarkeit, Verfügbarkeit und Belastung durchgeführt, um die örtlichen Gegebenheiten nachzuvollziehen und potentielle Herausforderungen für Ältere zu identifizieren. Anschließend wurden qualitative, semi-strukturierte Interviews als eine Methode der empirischen Sozialforschung mit älteren Anwohner\*innen gewählt, um eine flexible Interviewstruktur und Nachfragen basierend auf vorherigen Antworten zu ermöglichen. Die Studie wurde anhand von persönlichen Einzelgesprächen im öffentlichen Raum und seniorenspezifischen Begegnungsstätten, zwischen Oktober und November 2023, durchgeführt. Durch das abschließende Einbinden von Expert\*innen des Mobilitätsreferats der Stadt München und des örtlichen Bezirksausschuss anhand von Leitfadenterviews können die von Anwohner\*innen genannten Maßnahmen mit lokalen Planungsvorhaben verglichen werden.

Die 33 Anwohner\*inneninterviews zeigen, dass Mobilitätsungerechtigkeiten entstehen kann, wenn es für ältere Menschen notwendig ist, ihr Mobilitätsverhalten zu ändern. Eine fehlende Berücksichtigung der Bedürfnisse vonseiten anderer Verkehrsteilnehmer\*innen und Verkehrsplaner\*innen tragen ebenfalls zu dieser Wahrnehmung bei. Weiterhin erleben ältere Menschen mit Gesundheitseinschränkungen eher Gerechtigkeitsdefizite. Dies beinhaltet die verminderte Erreichbarkeit von Zielen oder dem öffentlichen Nahverkehr. Fußgängerfreundlichkeit und die Gestaltung des öffentlichen Raumes beeinflussen das Mobilitätsverhalten von Senior\*innen und ihr Wohlbefinden und das Gefühl von Sicherheit. Trotz einer insgesamten Zufriedenheit

mit dem Nahverkehrsnetz im Untersuchungsgebiet werden private Pkw von den Interviewpartner\*innen insbesondere für spontane Fahrten und Fahrten in das Münchner Umland genutzt.

Die befragten Personen beschreiben Verhaltensweisen, um mit mobilitätsbezogenen Nachteilen umzugehen. Diese reichen von Veränderungen der Routenwahl und Reisezeiten zur Angewiesenheit auf andere Personen, können letztlich aber auch dazu führen, dass ein Weg nicht angetreten werden kann. Weiterhin konnte festgestellt werden, dass Mobilität für ältere Menschen mit zusätzlichen Vorteilen verbunden ist. Aktive Mobilitätsformen werden bewusst gewählt, um Gesundheit und Fitness zu erhalten. Persönliche Routinen und tägliche Strukturen beizubehalten ist für die Interviewteilnehmer\*innen ebenso relevant wie die Möglichkeit für soziale Interaktionen. Darüber hinaus schätzen die Befragten Wahlfreiheit und Unabhängigkeit in ihrer Mobilität.

Schließlich zeigt die Planungsperspektive Überschneidungen mit den von älteren Anwohner\*innen genannten Handlungsfeldern hinsichtlich der Bedeutung von barrierefreier Infrastruktur, Fußgängerfreundlichkeit, und der zeitlich und räumlich dichten Erschließung mit öffentlichen Verkehrsmitteln. Senior\*innen werden als in sich heterogene soziale Gruppe verstanden, wobei Maßnahmen insbesondere Menschen mit körperlichen Einschränkungen betreffen.

Diese Arbeit zeigt, wie Methoden der empirischen Sozialforschung das Verständnis von Bedürfnissen einer benachteiligten Bevölkerungsgruppe vertiefen und räumliche Analysen ergänzen kann. Sie eröffnet weiterhin Forschungsperspektiven bezüglich der Umsetzung von Maßnahmen für Mobilitätsgerechtigkeit und damit verbunden Effekten unter verschiedenen räumlichen Voraussetzungen.

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# Abbreviations

AM	Active mobility
GHGs	Greenhouse gases
MiD	Mobilität in Deutschland
MVV	Münchner Verkehrs- und Tarifverbund GmbH
pax.-km	Passenger-kilometres
PM	Particulate matter
POI	Point of Interest
PT	Public Transport

# 1 Introduction

## 1.1 Background: A brief history of cities

*Increased concern for the human dimension of city planning reflects a distinct and strong demand for better urban quality.* Gehl (2010)

Uruk – The presumably first metropolis in history is dated 3500 BC. Located in the region of Mesopotamia, present-day Iraq, the city accommodates up to 80,000 highly skilled residents, craftsmen and engineers. Not only early writing systems and literature are developed in Uruk, it is also considered the first city with administrative processes. (Rautenberg, 2022)

In the 5,500 years since, cities have repeatedly played pivotal roles in regional, national and international contexts. They form centres in politics and economics and (host) an ethnically and culturally diverse population. The antique cities of Athens in Greece and Rome in Italy are examples on engineering solutions developed for water management and canalisation. At the same time, public urban places playing a role for everyday processes, such as trade, but also for living politics and public speech. During medieval times and especially after the beginning of industrialization in Europe in the second half of the 19<sup>th</sup> century, cities are experiencing a rapid growth in their population. Throughout their history, cities have been required to provide an abundance of essential services to their inhabitants.

With time, awareness has increased to create modern cities not only in a functional, but rather in a liveable way. When creating and transforming modern-day cities to living environments that consider the “human dimension”, their population composition, and the needs and preferences of social groups must be understood. This approach does not only require cities to provide daily services for their inhabitants. Rather the built-up housing and infrastructure is to be developed or adapted in a people-centric way, striving for a positive quality of life. At the same time, it should address the goal to add value to regional development in times of environmental, economic and social challenges.

## 1.2 Motivation

Urban planning in the 21<sup>st</sup> century is underlying a wide range of developments and global transformations. Aside from urbanization and climate change, western countries, including

Germany, are facing demographic changes. In consequence, the share of older people in the citizenry is increasing, altering the demands to urban and transport planning. This does not only affect the types of daily services that cities are required to provide for their residents. Moreover, the concept of planning “cities for people” has become more popular, striving for a positive quality of life and actively considering personal needs and limitations. In the context of demographic change, the interactions of an ageing society with its built-up environment must be understood. Overall, older people undertake shorter and fewer trips than an average adult. Furthermore, aged persons differ from general adulthood in terms of their needs and objectives to move outside of home, resulting in other trip purposes. It can also be seen that the rate of non-mobile persons increases for the social group of seniors. Nonetheless, senescence and improved healthcare lead to seniors playing “more significant roles in societies and economies” (United Nations, 2020). (Belz et al., 2020; Duran-Rodas, Haxhija, & Baquero Larriva, 2023; Nobis & Kuhnimhof, 2018; Rammler & Schwedes, 2018; Zmud et al., 2017)

As this thesis applies field work in Munich, its outcomes provide an action plan for the study area. Thus, this thesis determines measures to increase justice in at-risk neighbourhoods, apart from an in-depth understanding of mobility patterns and perceptions of the heterogenic social group of seniors in a general context. Moreover, it facilitates considering needs of disadvantaged persons, in particular of older people, in planning processes. By describing present challenges as well as strategies to compensate mobility injustices, the results of this work can serve as an orientation guide in urban planning processes. Additionally, synergies of actions are explored, and feasibilities or possible limitations are outlined. This thesis can contribute to increased awareness regarding disadvantages in urban and transport planning amongst stakeholders. Due to demographic changes, this issue will become increasingly important over time, which is why this work’s outcomes help to transform cities in a future-oriented way. Finally, the approach aims to be replicable in order to serve as a guideline for decision-makers and to create age-friendly, just and liveable cities.

### 1.3 Research questions

This thesis aims to understand the matter of mobility (in-) justice and its perceptions amongst the elder population. In order to approach the (overall) research question of *How to combat mobility injustices towards older people?*, three sub-questions are formulated.



**Research question:** How to combat mobility injustices towards older people?

Sub-question 1: How do older people perceive injustices in their mobility routines?

Research has investigated upon the mobility behaviour of older people, and provided a theorized concept of mobility justice. SQ 1 explores the interactions between personal abilities and needs, the local transportation infrastructure and the perceptions of seniors.

Sub-question 2: How does the examined social group cope with the associated disadvantages?

Adding on to the understanding of mobility injustice, SQ2 seeks to understand if, and how, older people might feel the need to adjust their mobility behaviour if they experience disadvantages.

Sub-question 3: Which potential actions can be allocated to the identified mobility deficits?

Lastly, SQ3 summarizes fields of action and proposed improvements for mobility justice and compares the perspectives of residents to planning strategies of experts.



## 2 Methodology

Literature has described mobility (in-) justice with the dimensions of “accessibility” of daily services, the “availability” of sustainable modes of transportation and the “exposure” to externalities of transport. These are thus applied in this thesis. Furthermore, it outlines the background to existing research classifying older people as at-risk group towards mobility injustice. Moreover, the interactions between urban and mobility planning and an ageing citizenry are laid out. The field work of this thesis, which is directed at both residents and experts, is conducted in Munich.

### Step 1: Literature review

By employing a literature review at its beginning, this thesis compiles available research on aspects of mobility injustice and its effects on older people. For this work, English- and German-speaking sources are considered. The search terms “mobility justice”, “mobility injustice”, “transport disadvantage”, “transport equality”, “transport equity” and “social exclusion” are applied. In further search these expressions are combined with the key words “older people” and “seniors”. In the same manner, German-speaking literature is accessed by the translations of the aforementioned terms. In addition, backward literature search is conducted. Literature is searched via the university library of the Technical University Munich and the online platforms ScienceDirect and Scopus. Finally, with the field work of this thesis being carried out in Munich, Germany, documents published by the City of Munich and associated departments are applied.

### Step 2: Case study selection and spatial analysis

Corresponding investigations are built upon data for the city, retrieved from socio-geographic analyses and areas of injustice for Munich’s neighbourhoods. Waldtrudering, part of the administrative district Trudering-Riem, is chosen firstly based on its high proportion of older people in its population. Secondly, it displays a low score in the aforementioned dimensions of mobility injustice. In order to analyse the study area, spatial investigations are carried out to gain an understanding of potential risk factors for the mobility behaviour of seniors.

### Step 3: Data collection and analysis

When addressing residents of this at-risk area in the second step, particular attention is paid to the perception of inequalities as well as the specific needs of older people. Apart from this, their methods to deal with injustices are to be examined. As these objectives require in-depth investigations, qualitative interviews are chosen as a research method. Their design is semi-structured, allowing for flexibility and adaptation of the questions, depending on the interviewee's reply. The research is conducted between October 18th and November 23rd, 2023, using personal conversations. A total of 33 residents is approached in public places and in two community centres of Waldtrudering, based on their ability to move outside of their homes. between 9:00 and 17:00, both on weekdays and weekends or Sundays. The interviews take, on average, 26 minutes per person, ranging between 8 and 49 minutes.

To evaluate the residents' interviews, a persona-based approach is chosen, allocating experiences to socio-demographic factors, and differentiating three types of residents. In addition, a coding scheme is developed, to allocate the interview contents to eleven main categories, which describe the "Infrastructure" and the "Individual" perspective.

To embed the results to local planning and development, a second interview cycle is directed towards three experts. They provide experience in urban and transport planning in Munich, specifically with the study area, and regarding older people. Consequently, two experts of Munich's Mobility Department are involved, with expertise on the region Trudering-Riem and on social fairness of mobility. Furthermore, a local politician, member of the Local Council Trudering-Riem, working on Building and Mobility, is interviewed. For the expert interviews, a guideline-based design is chosen. The fields of action identified in the residents' interviews are allocated to potential measures, and discussed regarding their suitability and their impact.

Afterwards, the findings of this thesis are reflected, with a special concern on the congruence between residents' deficiencies and experts' suggestions on the one hand, and the interactions between the spatial analysis and the residents' perceptions on the other hand. Finally, limitations and open questions of this work are highlighted and further proceedings are proposed.

This thesis employs both spatial analyses and qualitative research. This combination should provide deeper and more individual insights to how the spatial context shapes the satisfaction of its residents.

The expression "older people" and "seniors" are used as synonyms within this work. Since the retirement age varies amongst countries and over time, the status of retirement is crucial for the suitability of interviewed residents. Finally, because of its focus on passenger transportation, the impact of freight traffic is excluded from the research scope.

# 3 Literature Review

In order to investigate upon the implementation of justice in urban and transportation planning, current megatrends and their effects on cities have to be understood. For this purpose, chapter 3.1 provides essential knowledge on these developments, but also expounds typical mobility patterns of the research group. Chapter 3.2 describes the interactions between the built environment and the behaviour of older persons, and deduces influencing factors for mobility justice towards older persons.

## 3.1 Fundamental knowledge

### 3.1.1 Trends in urban planning

#### 3.1.1.1 Population growth and urbanization

Since the end of the year 2022, the worldwide population has been made up of more than 8 billion people (Deuster et al., 2023). Deuster et al. (2023) expect the global population to peak in the course of the 21<sup>st</sup> century and show potential scenarios on a decline at its end of the 21<sup>st</sup> century- Furthermore, it can be stated that the population developments are expected to differ amongst developing and industrialized countries on the one hand, and between urban and rural areas on the other hand.

In addition to natural population changes within a geographic area, resulting from birth and death rates, migration processes to and from the respective area are to be considered. Regarding the relationship between urban and rural areas, it can be stated that both domestic and international migration are aimed at urban areas in an over-proportional manner, leading to inhabitants' gains. This ongoing process of "Urbanization" is expected to increase the share of persons living in cities globally up to 80 % by 2050, but also the absolute number of citizens, as well as the population density in cities are increasing (Rammler et al., 2019). Causes for urbanization can be found in the attractiveness of township areas in comparison to rural areas. Especially in terms of employment and education, medical supply and cultural institutions, cities provide services of higher diversity and quality. At the same time, countryish regions exhibit deficits which can impact the quality of life there. These include a lack of daily-life services, but also social restraints or a vulnerability towards natural hazards, to which the section "Climate Change" will come back to.

Consequently, cities are entangled with their geographic surroundings by complex interactions. On the one hand, megacities with more than 10 million inhabitants are being formed. In the year 2023, 34 of these highly populated areas can be found worldwide, especially in Asian countries. On the other hand, population gains lead to additional land-use in the periphery of urban cores. Thus, urban sprawl has become a phenomenon of spatial spreading of particularly residential housing areas and cities taking up land first and foremost in their outskirts. In further consequence, suburbanization and “counter-urbanization” are taking place in, amongst others, German cities. Especially families tend to move from urban to sub-urban, but also well-developed and well-connected rural areas, and this trend has been intensified during the Covid-19 pandemic. (European Commission, 2023; Germerott, 2023; OECD, 2018; Rafferty, 2023; Rosenbaum-Feldbrügge & Sander, 2020; Destatis, 2023a)

At the same time, the local population composition shapes the facilities and institutions required. A key requirement towards cities is to provide supplies to all social groups of citizens, including access to local supplies for the needs of daily lives, but also the aforementioned healthcare and recreational opportunities. (Deutscher Städtetag) These services are required to meet the demands of the citizenry and hence depend on the population composition. Consequently, urban planning processes must consider demographic trends, which will be elaborated upon in the following section.

### **3.1.1.2 Demographic changes**

The demography of a country can be described by its birth and mortality rates, immigration to and emigration from a country. Whilst a fertility rate of 2.1 children per woman is required in order to maintain a stable population, this number is lower in the majority of western countries, and also within European populations. At the same time, the life expectancy is rising, for the example in Germany, from approximately 79.0 years for women and 72.5 years for men in the early 1990s to 83.2 years for women and 78.4 years through 2017, not yet including the influence of the Covid-19 pandemic on mortality. Again, similar tendencies can be observed in the European context. (European Commission; Eurostat, 2023; Nowossadeck et al., 2019; OECD, 2023; Smoak, 2023; Destatis, 2023b)

Combined, these developments cause an increase in both the share of older citizens, commonly referred to as aged 60 years or older, and the average age of the total population, whereas the proportion of youths is decreasing. These transformations are referred to as “Demographic change”, meaning “change of the demographic composition” (Vallée et al., 2021). Apart from European societies, especially those in Eastern Asian countries are ageing. These

developments are expected to continue within the upcoming decades, leading to 30 % of the European population being older than 65 years by 2050. Moreover, “demographic change” includes changes in household compositions. Within Europe, more people live in smaller housing units, with a notable increase of single-households. This impacts cities to a larger extent than rural regions and results in an overall larger number of households. Finally, individualization tendencies result in a reduced household size, which, in the context of transport planning, emphasizes private modes of transportation. (European Commission; European Commission, 2023; Rammler et al., 2019; Schwanen & Páez, 2010; Vallée et al., 2021)

With the field work of this thesis being carried out in Munich, Germany, the German demographic trends must be understood. Figure 3.1 below illustrates the predicted population pyramid for the year 2060, compared to baseline scenario of 2013.

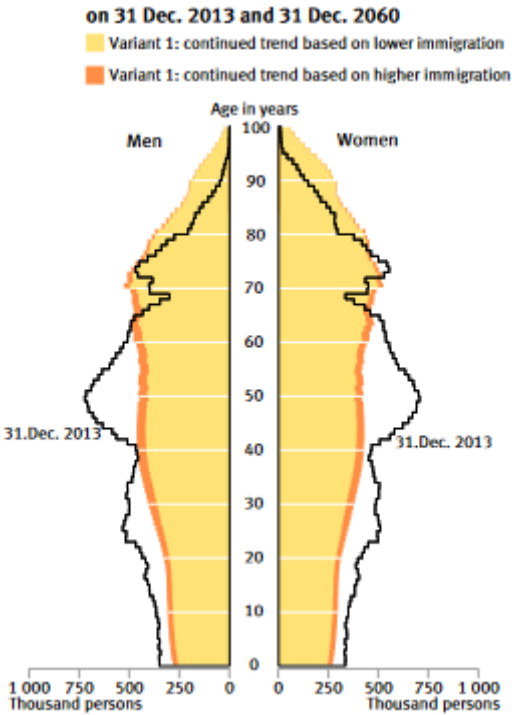


Figure 3.1: Projection of the population in Germany for 2060, with baseline scenario in 2013. Pötzsch and Rößger (2015).

At the same time, domestic migration is to be considered, intensifying discrepancies for instance between urban and rural areas, as outlined above in the section “Urbanization” (Vallée et al., 2021). Alongside with an ageing population and associated effects on required daily services and infrastructure, but also urban housing and labour markets and land consumption, ageing populations have become subject of public and political interest.

### 3.1.1.3 Climate change and global warming

Climate change and global warming (significantly impact) urban planning processes. Caused by anthropogenic emissions of the climate-active so-called greenhouse gases (GHGs), the average global temperature on earth has increased by 1.1 °C since the second half of the 19<sup>th</sup> century (Lee et al., 2023). Even though various gases emitted by human action are climate-active, carbon dioxide (CO<sub>2</sub>) is most commonly referred to, as it accounts for the largest share of anthropogenic GHG emissions. Further climate-active gases include methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs) and sulphur hexafluoride (SF<sub>6</sub>). They can also be expressed in CO<sub>2</sub>-equivalents (CO<sub>2</sub>-eq.), based on their global warming potential (GWP) in comparison to CO<sub>2</sub>, and their lifetime in the atmosphere (United States Environmental Protection Agency, 2023).

In present days, cities have a two-fold relation to climate change, being contributors to global warming on the one hand, and vulnerable regions to climate-change-related phenomena on the other. Cities play a decisive role in order to mitigate global warming effects. This is not only due to their number of inhabitants, but especially to their contribution to their nations' economy and gross domestic product (GDP). Deuster et al. (2023) emphasize that wealth and economic strength are to rather be seen as reasons for locally concentrated GHG emissions than population size per se. Overall, around 70 % of global greenhouse gases (GHGs) are emitted in cities. (Deuster et al., 2023; United Nations, 2020) The main sectors contributing to urban GHG emissions are generation of electricity and heat, agriculture, industry, transportation and buildings. (Langenheld et al., 2020; Lee et al., 2023)

In addition, strategies to transform cities in view of climate change address the resilience towards environmental hazards as well as the adaptability to altering living conditions. Depending on the geographic circumstances, cities can be vulnerable towards flooding, local heavy rainfalls and storms, but also droughts. Kumar (2021) points out that, because of global warming, the local climate can be more variable and associated weather phenomena more intense. Generally, on the grounds of cities being highly populated, as the section "Population growth and urbanization" had shown, strategies to adapt to climate change are critical for cities and their inhabitants. (Kamal-Chaoui & Robert, 2009; Kumar, 2021; Rammler et al., 2019)

Additionally, cities are affected by global warming and climate-change phenomena in another way than the countryside, and display other local climate characteristics. The "Urban heat island effect" describes the issue of urban cores recording temperatures that are up to 10 K warmer than the periphery. This effect can be explained by the higher building densities, the applied building materials and their heat storage capacities, and sealed surfaces. Reduced air chilling from evapotranspiration, air temperatures in cities are higher, and nocturnal cooling



effects are reduced. In addition, wind speeds are overall slower in urban cores, and fresh air ventilation corridors between centres and outskirts can be impaired by the built environment. This also leads to an increase in “heat days”, meaning days with their air temperature maximum at 30 °C or higher. Older citizens are considered as vulnerable to heating stress. As outlined above, the share of seniors in urban communities is to grow, and thus the number of persons potentially vulnerable to climate change-related living conditions. (Deutscher Wetterdienst, n. y.; Leistner et al., 2022)

Finally, it must be born in mind that not only climate-active GHGs occur in urban areas. More than that, air pollutants, with either direct or indirect climatic relevance, or consequences on human health, are emitted. The latter include, amongst others, particulate matter (PM), sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>2</sub>) and volatile organic compounds (VOC). Possible health-related impacts can range from cardiovascular to respiratory diseases to cancer. (Kumar, 2021)

#### **3.1.1.4 Technological developments**

A continuous progress in technological innovation has shaped the past decades. Especially with regard to the interactions between cities and climate change, technology is supposed to support emission reduction. Digitalization allows for a more efficient energy use and, coupled with automatization, a more direct transfer between demand and supply. Finally, the inevitable energy demand is to be covered by renewable sources. Electrifying processes in the sectors of mobility, heating, energy generation and relying on renewable sources for this purpose is seen as crucial for reduced GHG emissions in the aforementioned sectors. (Deuster et al., 2023; Rammler et al., 2019)

The megatrends of urbanization, demographic transitions, climate change and technological innovations find expression in urban and mobility planning. First, cities are required to provide access to everyday basic services for their residents. At the same time, trends in the fields of motorization and technological developments impact citizens' behaviour of travelling in order to meet their needs and to reach desired destinations. Meanwhile, the strive for resource-efficiency in urban planning shapes reflections on mode choice and car dependency, as well as interactions of transportation and land-use structures. (Geurs & van Wee, 2004; Litman, 2023; Napoletano et al., 2018; Rammler et al., 2019; Rammler & Schwedes, 2018) In order to acknowledge all and any of the trends outlaid above, the mobility behaviour of the focus group must be understood.

### 3.1.2 Mobility behaviour of older citizens

When striving for fulfilling their daily needs, humans in general, but also older people in particular are moving outside of their homes. In order to provide age-friendly transportation concepts and to adjust urban planning to the needs of older citizens, the mobility patterns of this social group must be understood. This chapter outlines characteristics of mobile behaviour of older persons, followed by an analysis of mode choice.

The German-wide mobility survey “Mobilität in Deutschland” (translates to “Mobility in Germany”, abbreviated MiD) is conducted countrywide in intervals between five and ten years. With its last elicitation of data being carried out in 2017, it can be stated that a person in Germany moves 80 minutes per day outside of home, covering 39 kilometres by 3.1 trips. For this, the mostly used mode of transportation is car ridership, accounting for more than half of all trips and three out of four passenger kilometres. Variations in these findings can be caused by geographic circumstances. Public transport, active mobility and carsharing services register a higher relevance in urban areas than in countryish regions. In contrast, inhabitants of rural areas undertake longer trips per day and rely on car ownership to a larger extent. Additionally, socio-demographic framework conditions impact mobility patterns of various social groups. (Nobis & Kuhnimhof, 2018)

The latter applies in particular to elder persons, who firstly tend to travel shorter distances per person and day. At the same time, the distance covered by one trip is reduced with older age. In comparison to the average German adult, older people undertake fewer trips per person and day, with an increasing rate of immobile persons and thus a declining rate of mobility in this age group. Follmer and Gruschwitz (2019) and Nobis and Kuhnimhof (2018) show this pattern with 2.8 trips per person and day in the cohort of 65- to 74-year old, and a rate of mobility of rate of 82 %, decreasing to 1.9 daily trips and 67 % of mobile persons in the age group of 80 years and older. Notably, the share of seniors ending car ownership for health-related reasons is increasing significantly for persons aged 70 years and older. At the same time, health problems cause seniors to cover more trips as a car passenger than their average age group, while the total distance travelled is decreasing. (Nobis & Kuhnimhof, 2018)

Secondly, elder citizens are found to travel for other reasons than the population at large. In particular, retirement can have a crucial impact on their daily patterns. In 2023, the average age to enter retirement in Germany has been 64.4 years (Nützel, 2023). The MiD-survey outlines that work-related trips experience a significant decline in the cohort of 60- to 69-year-old. Consequently, a larger share of daily trips is allotted to the purposes of shopping, other errands, and leisure. In comparison to employed adults, seniors scatter their trips more evenly between weekdays and weekends. On a daily basis, older people tend to travel slightly more

in the morning than in the afternoon, and return to their dwellings over noon. Overall, the research group is likely to travel outside of peak hours. (Nobis & Kuhnimhof, 2018; Schwanen & Páez, 2010)

Additionally, shifts in mainly used modes of transportation can be observed with increasing age. In the cohort of persons aged 60 and above, the share of seniors with health-related mobility restrictions, as well as the share ceasing car-ownership for health reasons. Besides, a shift in preferred modes of transportation can be perceived. When reflecting on the proportions of transport modes respecting trips, more movements are being covered by walking in age, as displayed in Figure 3.2 below. In contrast to car rides, which decrease as explained before, the share of trips as car passengers is rising for seniors. Both bicycling and public transportation (PT) do however not account for remarkable differences over age. (Nobis & Kuhnimhof, 2018)

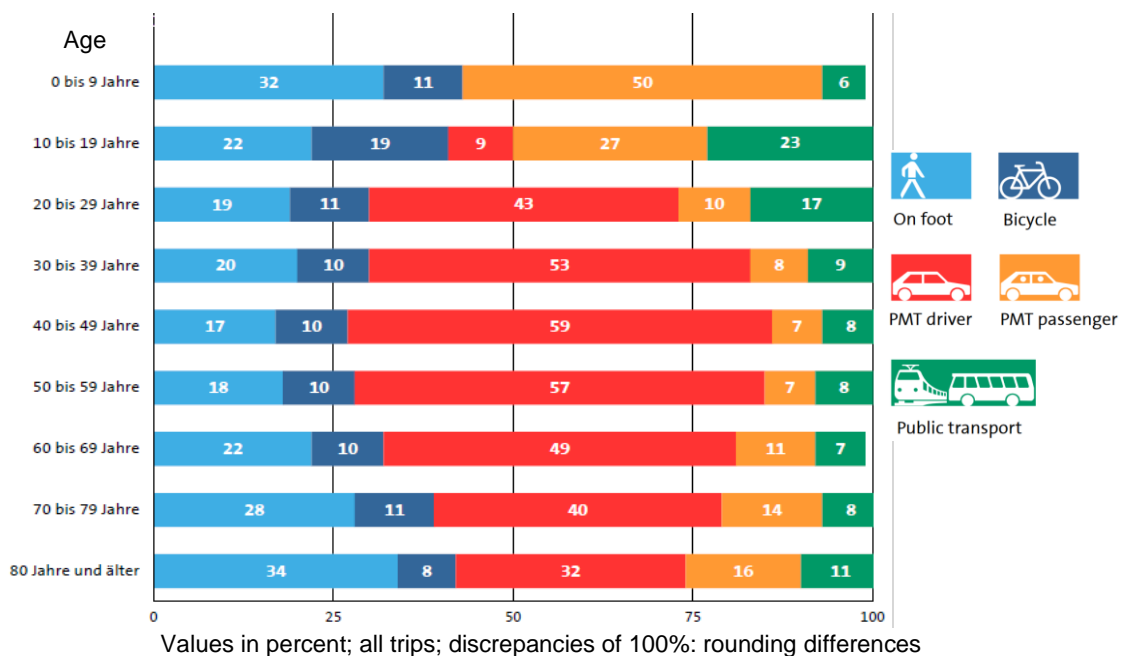


Figure 3.2: Shares of trips itemised by transportation modes, depending on age. Nobis and Kuhnimhof (2018).

When considering the chosen modes of transport with regard to the covered passenger-kilometres (pax. -km) instead of trip numbers, the changing mobility characteristics, as explained in the paragraphs above, come to the fore. Seniors cover fewer trips that are shorter in time, while relying less on motorized forms of transportation, as Figure 3.2 had shown. Combined, these patterns impact the daily travelled distances per person, as one can see in Figure 3.3 below. (Nobis & Kuhnimhof, 2018) Consequences thereof regarding “range and reachability of desired destinations” (Shrestha et al., 2017) are addressed in chapter 3.2.

In spite of these tendencies, Zmud et al. (2017) point out that the focus group of older persons is heterogeneous in itself. As expounded at the beginning of this chapter, mobility patterns of

seniors are affected by the geographic location of their residence. Thus, urban residents cover shorter distances per day in comparison to their rural counterparts (Nobis & Kuhnimhof, 2018; Zmud et al., 2017). Finally, a gender-related mismatch can be observed. Figure 3.3 below illustrates how operating ranges differ between men and women. Even though gender-related differences in the covered distance per day decrease with age, compared to persons in the working age, male seniors travel further per day, with the largest difference to women in trips as car driver. (Follmer & Gruschwitz, 2019; Nobis & Kuhnimhof, 2018; Zmud et al., 2017)

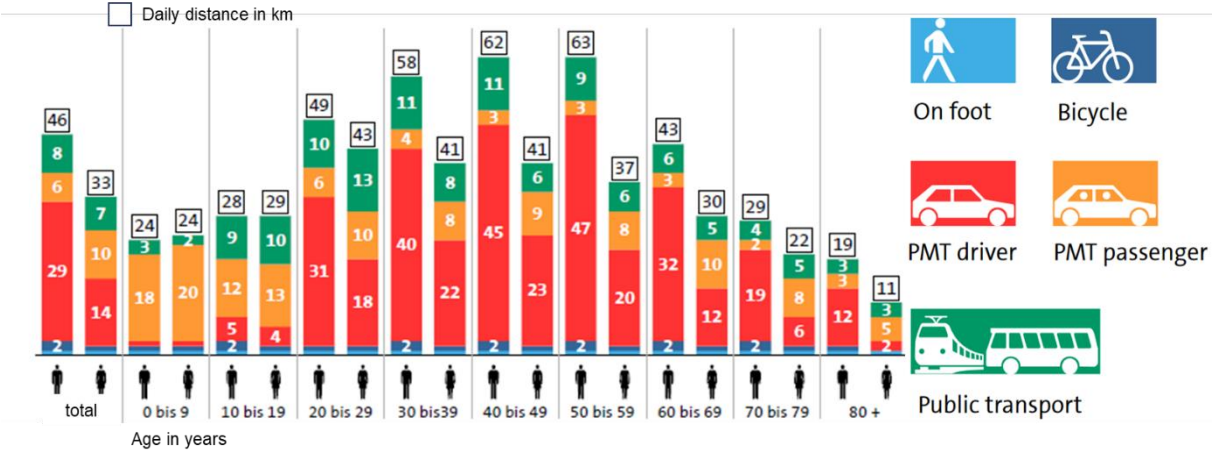


Figure 3.3: Daily travelled distances per mode, itemised by age and gender. Nobis and Kuhnimhof (2018).

This also includes the possession of a car driving license, which, as shown in Figure 3.4 below, displays the largest difference between men and women from an age of 65 years and older. (Follmer & Gruschwitz, 2019; Nobis & Kuhnimhof, 2018; Zmud et al., 2017)

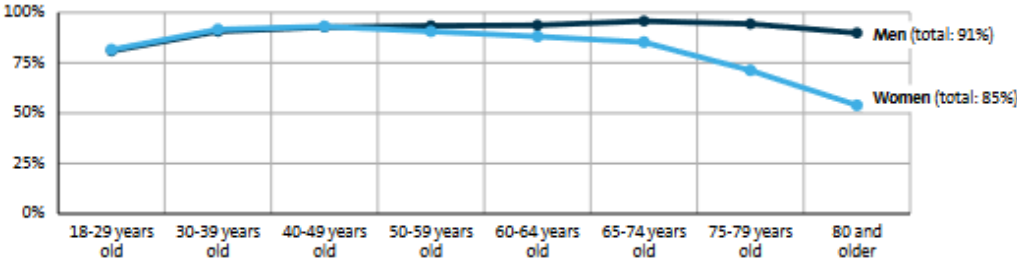


Figure 3.4: Ownership of car driving licences according to gender and age. Follmer and Gruschwitz (2019).

Nonetheless, seniors in present-days are overall more mobile than those of previous generations. Apart from this, the number of persons in the age-group of 65 and older holding driver's licenses has increased continuously since 1982. This trend is particularly brought forth by senior women being in possession of a driver's license, distinguishing present senior generations

from former. This development is likely to continue in the near future. (Shrestha et al., 2017; Zmud et al., 2017).

Lastly, Schwanen and Páez (2010) point out that preferences and everyday patterns of elder persons must be seen in context with decisions in earlier stages of their lives. Thus, experiences during these phases are seen as an essential contribution to seniors' mobility. This comes to the fore when ageing phenomena require adaption or giving up on previous behaviours. (Schwanen & Páez, 2010)

### 3.1.3 Urban and transport planning approaches

#### 3.1.3.1 Traditional planning and resulting challenges

When examining present-day transportation systems against the background of the megatrends presented in chapter 3.1, deficiencies in these planning approaches come to the fore.

Regarding German GHG emissions, the transport sector is the only one in which emissions have not been reduced compared to the 1990s level. Even though technological progress aim to a reduction in emissions per vehicle-kilometre, the absolute amount of emissions has not decreased. This can be explained with increases in the rate of mobile persons and the overall traffic volume as well as an expansion of private vehicle ownership. Thus, taking action in this sector is crucial for Germany to comply with its climate objectives. (Deutschlandfunk, 2023; Langenheld et al., 2020; Rammler et al., 2019)

Furthermore, awareness has increased regarding the interactions of land-use and transportation. As increased automobile travels allow to cover further distances within the same amount of time, services in a city (became more and more spatially spread). Likewise, it relocates residential areas to the urban fringe and fortifies urban sprawl. Car-centric planning neglects further transportation options, thus posing challenges to persons who cannot use this mode. In addition, this traditional form of transport planning requires the most space in comparison to active and public modes, intensifying the competition for the resource "space" in cities. (Litman, 2022) Below, Figure 3.5 depicts the cycle of automobile dependency according to Litman (2022).

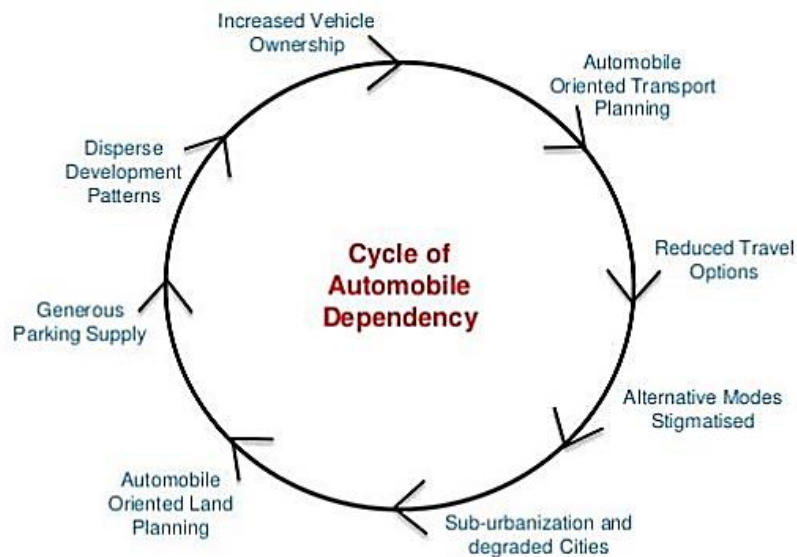


Figure 3.5: Circle of automobile dependency in traditional transport planning. Litman (2022).

### 3.1.3.2 Accessibility as a planning principle

In the traditional, car-centric planning approach, interventions frequently address the challenge of guaranteeing a congestion-free travel flow (Martens, 2020). However, in order to cope with the aforementioned challenges, mobility research has begun to consider additional aspects. Hence, the indicator of ‘accessibility’ has gained attention, particularly when evaluating interactions between spatial and mobility planning. Geurs and van Wee (2004) define accessibility as “the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)”. Martens (2020) adds on to that by emphasizing the value of an accessibility-based planning, since “what counts for people [...] is not mobility per se, but access to valued destinations”.

Differentiating four components of accessibility can facilitate their implementation in planning processes. The “land-use component” reflects the spatial distribution of services as well as the supply and demand for them, in the living areas of individuals, whereas the “transportation component” explains the transportation system and its utility for individuals to fulfil their mobility needs. Additionally, a “temporal component” represents the availability of modes of transport and services time-dependently and duration of a day spent travelling. Finally, personal needs, circumstances and abilities are part of the “individual component”, as well as skillsets. (Geurs & van Wee, 2004; Jehle, 2020)

Pereira et al. (2016) indicate that planning for accessibility can be linked to the concept of “justice”, as individuals vary regarding their “ease with which [they] can reach places and opportunities from a given location” (Pereira et al., 2016). The following chapter explains how the principle of “justice” can be included not only in accessibility- but in overall mobility planning.

### 3.1.3.3 Equity, equality and justice

As shown in chapter 3.1.2 above, the potential to participate in public life by being mobile, meaning by moving outside of the dwelling place, varies amongst social groups. Intensified by the trends and developments outlined in section 3.1.1, research has begun to consider the issue of justice in transportation planning. While striving for “justice” in these fields, the further concepts of “equity” and “equality” have also been theorized. They are briefly differentiated below and visualized in Figure 3.6, focusing on the implementation of these principles in the context of accessibility planning.



Figure 3.6: Visualization of equality, equity and justice in urban and transportation planning. Adaptation of Büttner et al. (2022).

## **Equality**

According to Büttner et al. (2022), equality is achieved by a “distribution of resources and opportunities regardless [of the] needs and abilities [of individuals]”. In this context, support is not only granted to persons perceiving barriers in their mobility behaviour in order to enable them to overcome limitations. It is however assumed that aids for persons in need are also beneficial for people without restrictions. (Büttner et al., 2022; Duran-Rodas, 2021)

## **Equity**

“Transport equity” continues with the principles of accessibility. Thus, all social groups are to be provided with a basic level of access to their desired destinations, and at the same time a special emphasis is put on supporting less-benefitted social groups. Overall, according to Verlinghieri and Schwanen (2020), measures in the field of transport equity are to increase the “minimum level of accessibility”, but also the ease of moving. A transport system based on equity will support persons experiencing barriers in overcoming these, with assistance that is tailored to individual’s needs and abilities. (Büttner et al., 2022; Duran-Rodas, 2021)

Moreover, transport equity also encourages the consideration of transport advantages “across populations and places”. (Karner et al., 2020; Verlinghieri & Schwanen, 2020)

## **Justice**

Finally, the concept of “justice” aims for the removal of barriers and further “cause[s] of injustice” (Büttner et al., 2022) in urban and transport planning. In consequence, residents are able to participate in public life independently, regardless of personal premises. (Büttner et al., 2022) While planning for justice is not equivalent to “everybody must enjoy exactly the same transport conditions” (Pereira et al., 2016), the overall comfort and ease being mobile is enhanced.

Duran-Rodas, Haxhija, and Baquero Larriva (2023) understand mobility justice as a multi-dimensional concept. When focusing on spatial analysis of the urban and transport planning framework, the dimensions of “accessibility” and “availability” are inevitable. This approach builds up on the demand of Pereira et al. (2016) to see distributive justice as a way to allow for accessibility based on human capabilities. With their focus on accessibility planning, Pereira et al. also enhance that justice in planning can set “minimum standards” on the one hand, but take special consideration for disadvantaged social groups on the other hand. They apply these requirements to services of everyday demand, including groceries, healthcare and edu-



cation. Furthermore, Lucas et al. (2016) point out that “transport poverty” can lead to shortcomings not only in accessibility, but also in the availability of modes. Duran-Rodas, Haxhija, and Baquero Larriva (2023) take into account mode availability as well, as stated previously, considering sustainable modes of transport, i.e. public transport and active mobility. Finally, Lucas et al. (2016), Pereira et al. (2016) and Duran-Rodas, Haxhija, and Baquero Larriva (2023) see the “exposure” to traffic-related externalities as a third dimension of mobility injustice. Citizens can be exposed to the risk of accidents and casualties, to air pollution by particulate matter (PM) and noise. Justice in the field of exposure can consequently also be referred to as environmental justice. Finally, the dimension of “procedural” justice is suggested by Duran-Rodas, Haxhija, and Baquero Larriva (2023), meaning the potential to participate in decision-making processes. This requires furthermore the representation and consideration of all social groups. (Karner et al., 2020; Rammler et al., 2019; Verlinghieri & Schwanen, 2020)

In comparison to the “equity” explained above, the idea of “justice” takes a wider range of actors into account. This amounts to participation processes, which allows not only stakeholders and planning personnel, but also local residents and communities. Furthermore, research points out that insufficient justice in transportation systems can result in social exclusion. This issue however can originate from diverse reasons and manifest in different ways. Lucas et al. (2016) refers to deficiencies in the aforementioned dimensions of justice, thus the accessibility, availability and exposure, as well as in the affordability of transport options, as “transport poverty”. Furthermore, Lucas et al. (2016) points out that, especially in industrialized countries, transport poverty due to unaffordability can directly result in social exclusion. When combatting mobility injustices, Sheller (2018) and Martens et al. (2012) point out that actions should focus on providing a minimum level of mobility to all persons striving to fulfilling their mobility needs, and especially address those parts of the population which are least privileged in the status quo situation. They thus add on to Pereira et al. (2016) who have the same understanding for measures for justice specifically in the field of accessibility planning. While systems should avoid excluding population parts, infrastructural developments are not to enable mobility for one social group at the expense of another. (Sheller, 2018)

These dimensions of mobility injustice and associated indicators have found their way into research, and are being linked to further investigations, such as land-use aspects or participation processes (Sheller, 2018). Injustices can appear for example as a reduced share of mobile persons within these groups, in fewer options regarding transportation mode choice or services, or in above-average expenses (Duran-Rodas, Haxhija, & Baquero Larriva, 2023; Rammler et al., 2019).

Figure 3.7 summarizes the dimensions of mobility justice according to the theorized concepts laid out above.

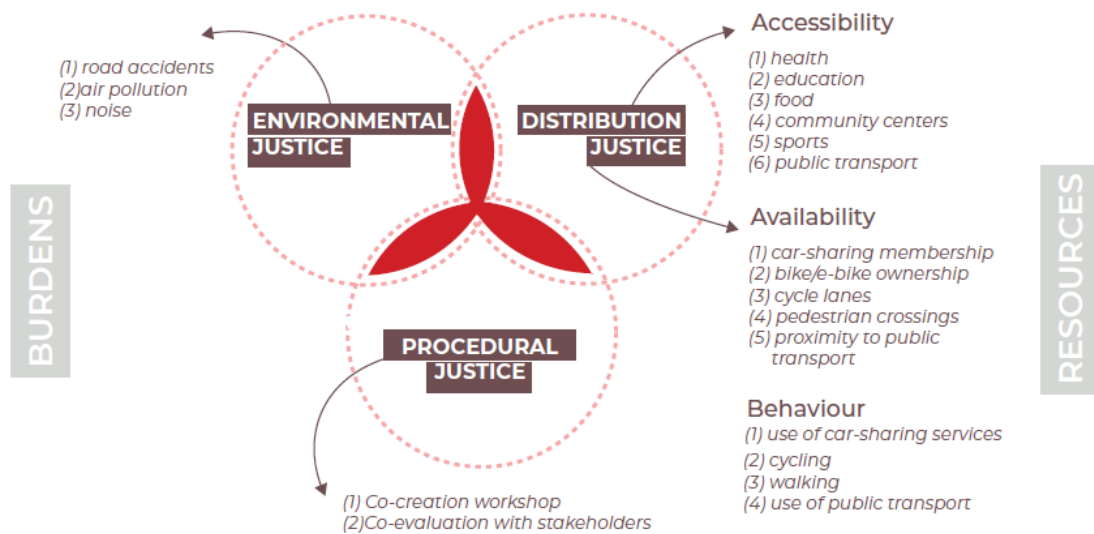


Figure 3.7: Dimensions of mobility justice. Adaptation of Duran-Rodas, Haxhija, and Baquero Larriva (2023).

Thus, Duran-Rodas, Haxhija, and Baquero Larriva (2023) perceive mobility justice as the entity of justice in the environmental dimension, regarding exposure, distributive justice, including accessibility and availability, and procedural justice. In addition, they classify the availability of transport options and the accessibility of services as “resources” towards mobility. These are used in the respective behavioural patterns. Compared to that, exposure is seen as a “burden” towards justice. They furthermore lay out indicators that can be used to describe mobility justice in a spatial context.

## 3.2 State of research

As this thesis aims to facilitate mobility justice for this social group, their attitude towards elements of urban planning must be understood. After the fundamental planning concepts and megatrends had been introduced and explained in chapter 3.1, this section describes their consequences for urban planning. A special focus is put on the interactions between an ageing society and requirements to a well-designed city. Moreover, the state of research regarding the dimensions of mobility justice, and towards seniors in particular, is outlined in chapter 3.2.2.

### 3.2.1 Interactions between an ageing population and urban planning

Due to the demographic processes explained above, the mobility-related needs, capabilities and challenges of aged citizens will come to the fore. Chapter 3.1.2 has already presented the central characteristics of seniors' mobility behaviour. It has thereby been shown that older adults take fewer and shorter trips per day and cover fewer trips as a car driver. (Nobis & Kuhnimhof, 2018) Hence, with regard to the catchment areas of individuals, Noon and Ayalon (2018) argue that "as people age, their living space shrinks". In consequence, older citizens must be able to meet their daily needs within a more localized spatial environment. In addition, even though this social group is likely to experience age-related physical or mental limitations. At the same time, walking trips within the neighbourhood remain important to them, as the share of trips by foot increases in comparison to other modes. (Follmer & Belz, 2018; Nobis & Kuhnimhof, 2018) In the context of shaping urban areas for seniors' walkability, indicators as a slower walking speeds as well as the surface structure and inclines, particularly stairs, are to be considered (Alves et al., 2020).

It follows that daily services with primary relevance for older people are suggested to be located within a radius of 400 metres, equal to five minutes of their walking time. Further points of interest are in consequence to be placed within an accordingly larger catchment area. In addition, the option to rest or socialize in public places and the associated quality of stay become increasingly important with age. (Alves et al., 2020; Noon & Ayalon, 2018)

Special needs that seniors can have towards their environment do not only affect the transportation system. With a more sensitive health state, older adults are more vulnerable to urban heating. Not only is this effect likely to become more serious because of climate change, but it also impacts active mobility and the sojourn of the focus group in public places, emphasizing the need for green infrastructure and cooling elements. (Deutscher Wetterdienst, n. y.)

Apart from the spatial distribution, the range of required services are to be aligned to an other, older composition of communities. An increasing demand for health- and social care is projected together with changes in the housing market. With the additional changes of the labour market, this can become a challenge to a nation's economy. (European Commission, 2023; OECD, 2015) It must also be noted that older people can be vulnerable to rising costs of living. This can impact their mobility behaviour, especially the trip frequency and purpose as well as the mode choice, and consequently their ability to participate in public life. (Schlag & Beckmann, 2013; Shrestha et al., 2017)

On the contrary, demographic changes have the potential open up opportunities for technological innovations and community engagement on the one hand. On the other hand, technological progress and developments requires seniors to adjust to the new, available services. (OECD, 2015; Schlag & Beckmann, 2013)

### 3.2.2 Literature: Mobility (in-) justice towards older people

The group of “older people” is focussed on in this thesis not only because of its increasing share in western countries. Since the impact that senescence can have on mobility behaviour has been studied, as explained in chapter 3.2.1 above, this social group is additionally perceived as particularly at risk of mobility injustices. This chapter describes the interactions between mobility (in-) justice and older people, based on existing research.

Investigating upon the justice of urban and transportation systems with a focus on seniors, their mobility behaviour, as explained in chapter 3.1.2, needs to be understood. It could be shown that the overall number of trips as well as trip distance and duration decrease with age, while the number of non-mobile persons is growing. At the same time, the share of trips covered by foot is increasing. (Nobis & Kuhnimhof, 2018) In consequence, the design of a senior-friendly pedestrian infrastructure is crucial, considering the existence and surface structure of sidewalks as well as slopes, stairs and potential obstacles (Alves et al., 2020).

Moreover Ryan et al. (2015) address socio-demographic and external factors that impact the decision of seniors to include public transport in their mobility routines. Harada et al. (2023) explain that older people can perceive the urge to travel with PT during rush hours, despite their temporal flexibility. In addition, perceived safety and comfort on a PT vehicle as well as the affordability of this mode can be seen as influencing factors for the respective trips. Shrestha et al. (2017) emphasize the need for a holistic perspective on the trips covered by elder citizens. Thus, for instance, the mode choice of public transportation includes the trip to and from the station.

Lucas et al. (2016) evaluate how transport poverties, which, as shown in chapter 3.2.1, cover the dimensions of accessibility, availability, exposure and affordability, can specifically be addressed and which consequences can arise thereof. Deficiencies in mobility justice, which lead to transport poverties, can thus be created if the existing transport options are not well-suited to the individual needs and capabilities, or everyday services cannot be accessed with the local network. Furthermore, burdens including costs, required travel times, and perceived unsafety are to be considered in this context. In addition, consequences can be expected regarding the overall number of trips, their duration and the covered distance. Despite this research

not being conducted with a focus on seniors, the age-related changes in daily mobility, seniors alter their behaviour because of age-related phenomena. The urge to depart from their routines might thus be even more severe if experiencing mobility injustices. Furthermore, injustices towards older people are seen as likely to lead to social exclusion. This is due to “the decreasing ability of older people to overcome different barriers” (Shrestha et al., 2017). Aguiar and Macário (2017) explain that being mobile in age is underlying various, external and personal, factors, including the own health conditions, the living situation and personal abilities. Changes in these factors can alter the mobility behaviour, ultimately also leading to immobility.

The costs for transportation are furthermore found to be of higher relevance for the mobility behaviour of seniors in comparison to travel durations (Shrestha et al., 2017). As Lucas et al. (2016) point out, the unaffordability of transportation can lead to social exclusion. Challenges in this field emerge especially in countries with high rates of old-age poverty.

Moreover, Mollenkopf and Engeln (2008) summarize objectives and indicators that older persons reflect upon for their mobility decisions. Aside from considering the effectivity and efficiency of a mode of transport, personal well-being, security and comfort as well as social factors play a role for the mobility choices of this focus group. Research regarding injustices towards older people has addressed the effects of a lack of justice on this group. Being able to participate in public life and carry out out-of-home-activities is found to be essential for their personal well-being and satisfaction (Aguiar & Macário, 2017; Nordbakke & Schwanen, 2015). In addition, Noon and Ayalon (2018) have found that seniors use public spaces in a variety of ways, not only to travel through, but also to rest and engage in social interactions. Consequently, justice towards older people does not only have to reflect on public places being used by active modes of mobility, but also focus on urban design and the quality of stay. This is also emphasized by Buffel et al. (2012) who state that an increased level of access to daily services and public places (enhances) the participation in public life amongst seniors.

Apart from that, modern technologies and digital services shape the way that travellers receive information while being mobile, and open up possibilities for new mobility solutions. Even though knowledge on digital services and their abilities to carry out associated activities that are relevant to them, is increasing amongst older people (Martinez et al., 2022), Nobis and Kuhnimhof (2018) point out that modern mobility solutions, specifically car-sharing, are used to a small extent by this social group. Iancu and Iancu (2020) have investigated how digital technologies can be designed in a senior-friendly way, in order to provide relevant information to them, and how to incorporate cognitive and visual impairments. In addition, Martinez et al. (2022) have addressed how smart and multi-modal mobility hubs can be designed to meet the needs of older people, concluding that information has to be provided in a “simple and self-explanatory way” (Martinez et al., 2022).

## 3.3 Summary and research gap

### 3.3.1 Literature summary

Chapter 3.1.3.3 has introduced the theorized concepts of “equality”, “equity” and, particularly, “justice” in urban and mobility planning. Research on this field has been presented together with the respective planning dimensions to be considered, and the consequences resulting from a lack of justice. In order to include the concept of mobility in spatial analyses and urban planning, it is subdivided to the dimensions of “accessibility” to services, the “availability” of transportation options and the “exposure” to transportation-related externalities. Furthermore, the aspect of representation and involvement is seen as a part of just mobility planning.

It had subsequently been shown in chapter 3.2 in which ways cities are required to adapt to a changing environment, including demographic changes and an ageing population. The interactions between senescence and urban and planning are shaped by changing needs and abilities of older citizens. As however cities have followed planning strategies that emphasize motorized private transport and a travel of further distances, with consequences on urban sprawl and car dependency, as explained in chapter 3.1.3.1, seniors are seen as likely to experience injustices in their daily mobility routines.

Various researchers have examined individual aspects of the aforementioned dimensions of mobility (in-) justice with regards to older people, as explained in chapter 3.2.2 above. Their research areas summarized in Table 1 on page 26. The ability to use certain modes of transport is linked to age-related limitations and conclusions for elderly-centred policies and mobility planning are drawn. At the same time, there is consensus that mobility contributes to individual well-being and participation in public life as seen in Table 1.

It can also be seen that modern technologies impact the field of urban and mobility planning, and thus must be designed in a senior-friendly way. Especially when addressing this focus group as potentially vulnerable traffic participants, the aspect of safety while being mobile has gained attention.

Nonetheless, a connection between the identified dimensions and corresponding fields of mobility (in-) justice remains to be addressed as a whole, and with an in-depth focus on how they impact older people and their mobility behaviour, as the following chapter 3.2.2 will show.

### 3.3.2 Research gap

Even though research agrees on the peculiarities of older people's mobility behaviour and them being an at-risk group to experience mobility injustice, the question of *How to combat mobility injustices for older people* remains to be addressed.

The theorized concept of mobility injustice consists of multiple factors in the aforementioned dimensions, as Table 1 summarizes. Nonetheless, a wholistic view of mobility (in-) justice for older people lacks an in-depth understanding of if and how the established aspects shape the mobility behaviour of older people. In addition, research has not yet looked at whether injustices experienced in the identified dimensions impact the satisfaction and overall behaviour of older persons in the same way. Furthermore, modes of transportation, and their specifications when being used by seniors, have been in the focus of research. However, the perception of intermodal trips and the embedment of transport options in the neighbourhood is to be addressed with regards to justice.

As the focus group of "older people" is heterogeneous in itself, it must also be understood which spatial conditions and personal factors impact the perception of mobility in age (Shrestha et al., 2017). In this context, it remains to be addressed whether members of this social group perceive injustices differently.

Spatial analyses can enable the identification of at-risk areas, comparing the local urban and transport framework to the respective population groups. This step has been carried out by Duran-Rodas, Haxhija, and Baquero Larriva (2023), designing an (In-)Justice Atlas for the city of Munich. An understanding of how the local urban and transport infrastructure and personal abilities shape the perception of (in-) justice is achieved and on whether the perceptions of residents are in accord with the spatial circumstances suggesting injustices.

Researchers, including Nordbakke and Schwanen (2015) have shown that mobility is a contributor to personal well-being for aged persons, whereas im-mobility can lead to dissatisfaction and social exclusion. Further objectives of mobility for the focus group, and their interactions with perceived (in-) justice, remain to be explored. Even though research has found that mobility injustice towards older people can lead to social exclusion, it must still be studied which coping strategies the focus group applies to avoid this effect.

Lastly, not only the viewpoints of the focus group of seniors are to be investigated. Moreover, the approaches of local intuitions and stakeholders to integrate "mobility justice" in their planings are to be researched.

Table 1: Literature summary: Dimensions of mobility injustice for older people. Own summary.

	Accessibility	Availability				Exposure			Other				
		PT	Walking	Cycling	Car	Safety	Health	Costs	Urban design	Comfort / Quality of stay	Information	Technology	Participation
Aguiar, Macário (2017)	✓	✓	✓	✓	✓	✓			✓	✓			
Alves et al. (2020)	✓		✓			✓	✓		✓				✓
Buffel et al. (2012)							✓	✓		(✓)			✓
Harada et al. (2023)		✓				✓	✓		✓				
Iancu, Iancu (2020)											✓		
Martinez et al. (2022)		✓	(✓)	✓		✓					✓		(✓)
Noon, Ayalon (2018)			✓						✓				
Nordbakke, Schwanen (2015)	✓	✓	✓				✓	✓		✓			✓
Ryan et al. (2015)	✓	✓	✓						(✓)				
Shrestha et al. (2017)	✓	✓	✓			✓		✓	✓	✓			✓



## 4 Study area

This chapter is depicting the spatial and socio-geographic circumstances for the field work of this thesis. First, chapter 4.1 presents related developments and approaches for mobility planning in Munich on a city-wide level. Subsequently, chapter 4.2 outlines the background for selecting Waldtrudering as a study area and key indicators to understand the local urban and transport planning. Finally, spatial analyses of the study area regarding service accessibility, transport availability and the exposure to transport externalities are conducted.

### 4.1 Munich

#### 4.1.1 Demographic developments

In order to investigate the effects of urban and transportation planning on Munich's citizens, the local framework conditions must be understood.

Munich is the capital city of the federal state of Bavaria, located in southern Germany. According to a scheme of regional statistics by the German institute BBSR ("Bundesinstitut für Bau-, Stadt- und Raumforschung", translates to "Federal Institute for Research on Building, Urban Affairs and Spatial Development"), Munich can be classified as a 'Metropolitan urban area'. Being the third most populous city in Germany, Munich is subject to the respective trends explained in chapter 3.1. Moreover, with the city covering an area of 310.7 km<sup>2</sup> and thus a population density of 4,788 inhabitants per km<sup>2</sup>, Munich is the most densely populated German municipality. (Follmer & Gruschwitz, 2019)

From 1,439,474 persons living in the city of Munich in 2012, the number of inhabitants has increased to 1,588,330 by 2022. This tendency is being amplified by an annual migration surplus of 21,760 persons in 2022. (Bayerisches Landesamt für Statistik, 2023a; Statistisches Amt der Landeshauptstadt München, 2022a, 2022b) As with the overall German population, the citizenry of Munich is experiencing ageing processes. The Statistical Office of the City of Munich ('Statistisches Amt der Landeshauptstadt München') forecasts different scenarios for the population development by 2040. According to these, the number of seniors in the age-group between 65 and 74 years is likely to increase by up to 30 %, compared to the population of the year 2022. Smaller growth rates are projected in the cohort of seniors aged 75 years and older. (Referat für Stadtplanung und Bauordnung, 2023a, 2023b) Overall, the citizenry of

Munich is expected to increase in the coming decades (Referat für Stadtplanung und Bauordnung, 2023b).

Figure 4.1 below illustrates the population pyramids in Munich in the years 2022 and forecasted 2040.

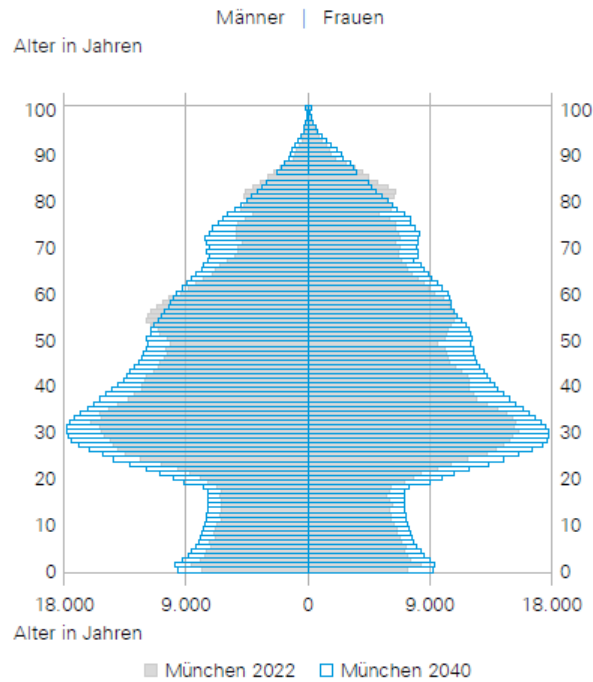


Figure 4.1: Population pyramids Munich in the years 2022 and projected 2040. Referat für Stadtplanung und Bauordnung (2023a).

More than half of the private households in Munich are one-person-households, amounting to 53,8 % in the year 2021. Ageing phenomena lead to an increase in this household type, (and) 24,5 % of people living alone in Munich are aged 65 years or older. (Statistisches Amt der Landeshauptstadt München, 2023)

Furthermore, poverty among seniors continues to increase, intensified by the Covid-19 pandemic. As this trend is projected to persist in the upcoming decade, it must be kept in mind that their financial condition can impact the abilities of seniors to participate in public life. (Landeshauptstadt München, 2022)

## 4.1.2 Mobility planning framework

The housing market in Munich is defined by the aforementioned high population density and migration surplus, in comparison to the annual increase in residential property. Furthermore, Munich is the German city with the highest commuter flows from surrounding municipalities, but also within the city boundaries. (Bayerisches Landesamt für Statistik, 2023b)

With a focus on the social group of seniors, chapter 3.1.2 has expounded the background for an altering mobility behaviour of older adults and described key indicators of their travels. Belz et al. (2020) show that Munich's elderly citizens display inherently similar mobility patterns compared to the nationwide levels.

Seniors in Munich travel 81 minutes per day and cover 26 kilometres with 2.6 trips. Members of the target group have a mobility rate of 81 %. Furthermore, increased car-ridership, especially amongst senior women, can be observed in Munich as well. The share of trips travelled by foot is increasing with age, whereas public transit is slightly less used by elder persons, compared to the adult-at-large. (Belz et al., 2020)

The municipal council of Munich has summarized its aims for city-wide mobility transformations in the strategic paper "Mobilitätsstrategie 2035" (translates to "Mobility Strategy 2035"). Under the overarching goal of a climate-neutral mobility system by 2035, the city aims for a "socially just, barrier-free" (Landeshauptstadt München) mobility. With regards to older citizens, the strategic paper emphasizes the transformation towards a barrier-free public transport, especially regarding stations and vehicles, and specific support for persons with visual or hearing impairments. Apart from this, the Mobility Strategy set the goal of increased safety on trips and eliminating traffic fatalities. (Landeshauptstadt München)

Since May 2023, the "Deutschlandticket" (translates to "Germany ticket") has been introduced as a nation-wide ticket for public transport. Due to its monthly costs of 49 euros, it is also commonly referred to as "49 €-ticket". It allows for the use of regional trains and local public transport in German cities, and is succeeding the temporarily limited "9-euro-ticket", which had offered the same scope for a monthly fee of 9 euros from June to August 2022. The regular PT tickets of Munich's transport company MVV ("Münchner Verkehrsverbund", translates to "Transport Association of Munich") are available besides the Deutschlandticket. Finally, the fare structure of MVV has been adapted in December 2023 due to an expansion of the network area. However, as the field work of this thesis has been carried out prior to that, PT ticketing structures referred to in this thesis are those up to and including November 2023.

## 4.2 Study area: Waldtrudering

### 4.2.1 Selection of the study area

In order to approach the research questions of this thesis, field work is carried out. For this purpose, the focus is narrowed down from a city-wide scale to the neighbourhood-level. Munich consists of 25 administrative districts and 108 neighbourhoods (Statistisches Amt der Landeshauptstadt München, 2023). By investigating needs and perceptions with regards to a district sub-section, detailed links to the local network of urban and transport planning can be drawn, while considering the limited scope of this thesis. Accordingly, the following sections present both the criteria for selecting the study area, Waldtrudering, and the indicators necessary for the further research.

Duran-Rodas, Haxhija, and Baquero Larriva (2023) have investigated the spatial distribution of disadvantaged areas in Munich on a neighbourhood level, as chapter 3.3.2 described. Additionally, they link deficits in the dimensions of mobility justice to the demographic groups living in the respective neighbourhoods. Mobility injustices are analysed for children and teenagers, people with low income, people with a migration background, single parents and older people. (Duran-Rodas, Haxhija, & Baquero Larriva, 2023)

With seniors being the focus of this thesis, the performances of (in-) justice indicators are considered specifically for this social group in the following. Building up on the local circumstances outlined above, the “Mobility score” of a neighbourhood can be defined inverse to “Mobility injustice”. A high mobility score classifies neighbourhoods in Munich with high levels of accessibility, availability and usage of sustainable modes of transport and low exposure to externalities. Calculating these with regard to the living environments of older persons results in Figure 4.2 on the following page. Consequently, neighbourhoods marked in dark blue are inhabited by seniors in an above-average amount, while providing a low mobility score. This suggests that older residents of these neighbourhoods are more likely to experience mobility injustices in their travels than in other parts of the city.

It can be stated that Waldtrudering provides low access to daily services and to PT stops for its over-average proportion of seniors (Duran-Rodas, Haxhija, & Baquero Larriva, 2023, p. 48). At the same time, few sustainable modes of transportation are available for them, such as PT, bicycles and e-bikes or car sharing. Furthermore, the infrastructure in Waldtrudering can be characterized by few available cycling lanes, as well as low walkability. (Duran-Rodas, Haxhija, & Baquero Larriva, 2023, p. 77) In consequence, older people in this neighbourhood live in an area where residents use walking, cycling and PT for fewer trips (Duran-Rodas, Haxhija, & Baquero Larriva, 2023, p. 103). In this context, it must be noted that the average population or

other social groups in Waldtrudering are not necessarily experiencing the same disadvantages.

The location of the study area Waldtrudering is marked in green in Figure 4.2 below.

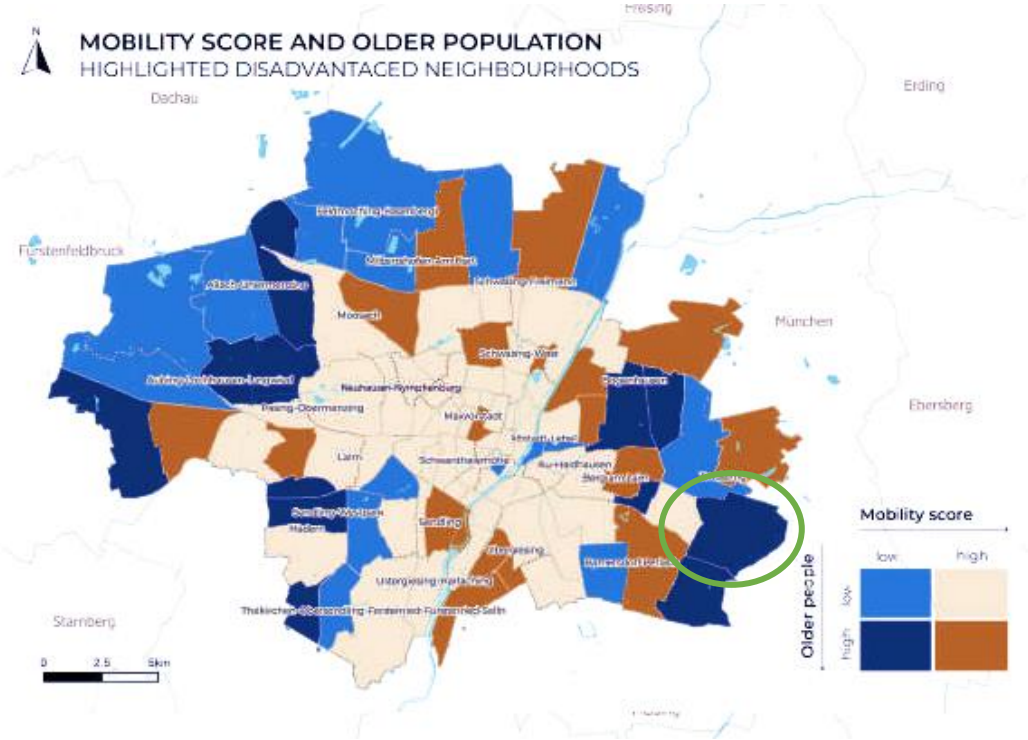


Figure 4.2: Mobility score and disadvantaged areas for older people in Munich, with Waldtrudering marked in green. Duran-Rodas, Haxhija, & Baquero Larriva, 2023

## 4.2.2 Regional and historic context

Waldtrudering is located in the southeastern outskirts of Munich, as depicted in Figure 4.3.

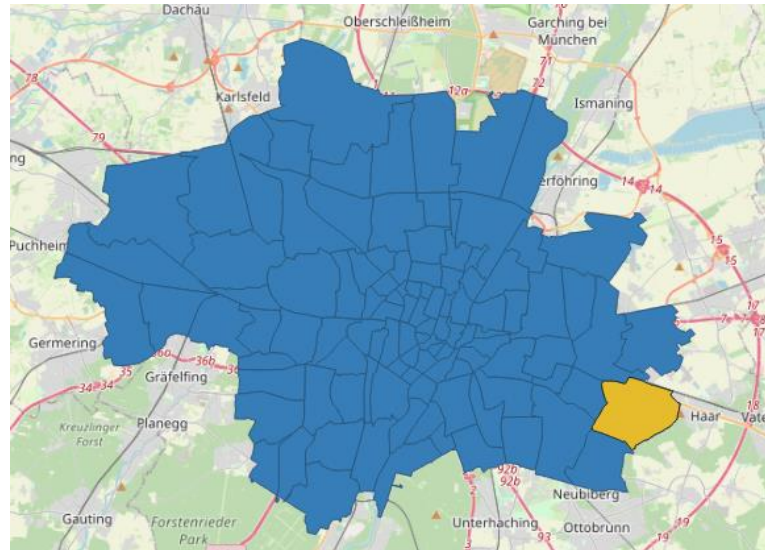


Figure 4.3: Location of Waldtrudering in Munich. Own depiction, using OpenStreetMap (Open Street Map Community, 2023).

Waldtrudering has received its name from the forested surroundings of the area, with the main street design originating in former paths of woodworkers. Formed as a suburb in a Garden city style, the neighbourhood was loosely populated in the beginning of the 20<sup>th</sup> century, and was condensed in the 1960s and 1970s. Land-use patterns in Waldtrudering mainly serve residential purposes, built up especially with single-family and semi-detached houses. The street network is shaped by two main roads. The federal road B304, or “Wasserburger Landstraße”, runs in east-western direction, connecting the city centre of Munich with the eastern periphery. The “Friedenspromenade” is a north-southern connection marking the western edge of the neighbourhood, as shown in Figure 4.4. (Landeshauptstadt München; Pajares et al., 2023)

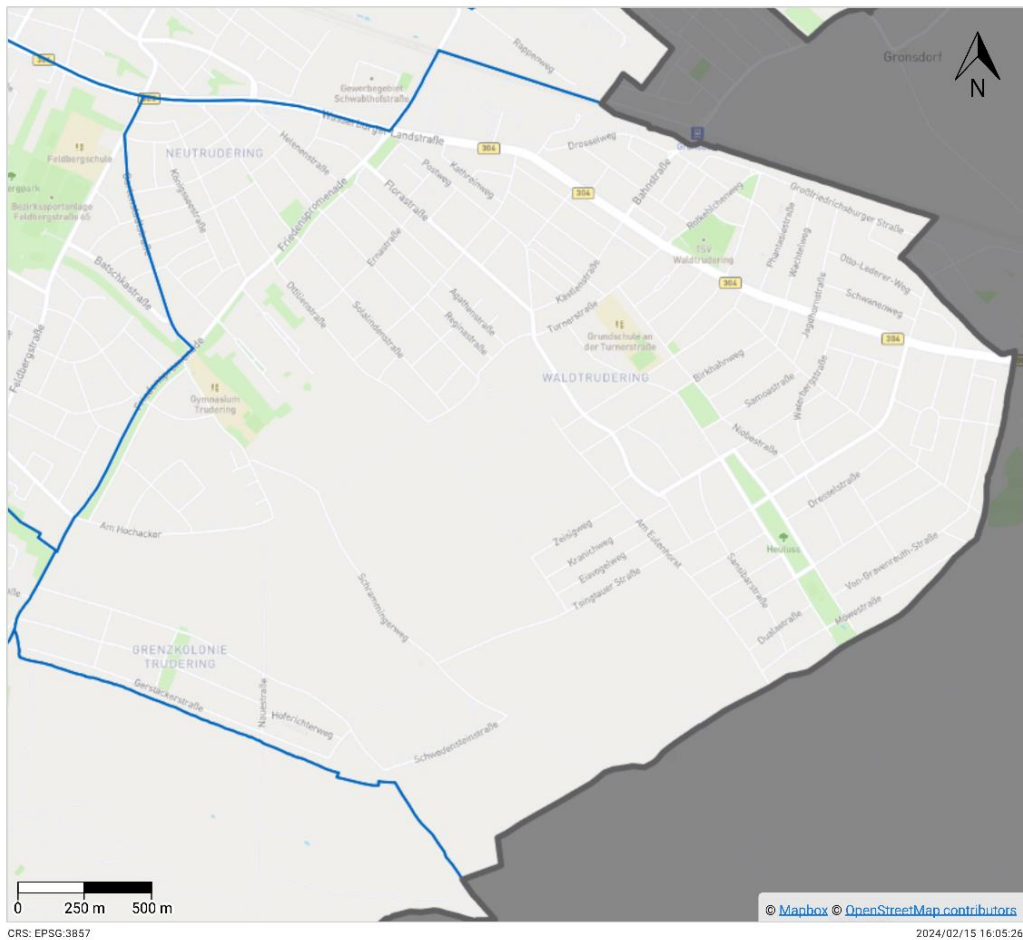


Figure 4.4: Street network in Waldtrudering. Own depiction, using GOAT (Pajares et al., 2023).

The neighbourhood, being a part of the district Trudering-Riem, has experienced the spatial proximity of the former airport Munich-Riem, which has been moved to its present-day location in the northeastern periphery in 1992. (Hutter, 2017)

Table 2 summarizes key indicators for the neighbourhood Waldtrudering, comparing them to the district- and city-levels. The presented data is retrieved from the “Indikatorenatlas” (translates to “Indicators atlas”) by the Statistisches Amt der Landeshauptstadt München (2023) (translates to “Statistical office of the City of Munich”), and refers to the year 2022.

Table 2: Key indicators and corresponding values for neighbourhood characterization.

	<b>Waldtrudering</b>	<b>Trudering-Riem</b>	<b>Munich</b>	<b>Unit</b>
Spatial level	Neighbourhood	District	City	
Inhabitants	28,289	76,002	1,588,330	-
Share of housing area	49.7	31.6	29.3	% of total area
Population density	3,956	3,385	5,112	Inh. per km <sup>2</sup>
Share of seniors (aged ≥ 65)	19.9	15.6	16.9	% of population
Share of seniors in single households	31.0	26.4	24.4	% of single households
Car ownership (private)	495.0	410.8	336.6	Cars per 1000 inh.

Furthermore, the City of Munich has found the district Trudering-Riem to rank in the upper half of Munich's districts regarding unemployment. Table 2 points out that Waldtrudering accounts for a higher share of senior citizens aged 65 years and older in their population compared to the district- and the city-level. Likewise, the area designated to residential purposes is above Munich-average. At the same time, the population density of Waldtrudering is significantly lower compared to the overall city, a phenomenon to be observed in sub-urban neighbourhoods due to urban sprawl. Seniors living alone also account for a higher share of single households in Waldtrudering than in Trudering-Riem or Munich.

In analogy with chapter 4.2.1, Table 2 emphasises that Waldtrudering displays high rates not only in senior population, but also regarding car ownership rates. As mobility data is not gathered on a neighbourhood level, a comparison is drawn between the respective district Trudering-Riem and the city of Munich (Belz et al., 2020). Not only are car ownership rates in the outskirt areas higher compared to the average in Munich. There are both more trips and more passenger kilometres travelled by car. It furthermore becomes clear that even though active mobility is used for more than two fifths, respectively a third, of all trips in Trudering and Munich, less than a tenth of passenger kilometres are covered with these modes. This underlines that the range of a mobile person increases significantly when including motorized transportation. Figure 4.5 and Figure 4.6 illustrate the respective mode shares for the overall population, comparing Munich to the district Trudering-Riem.



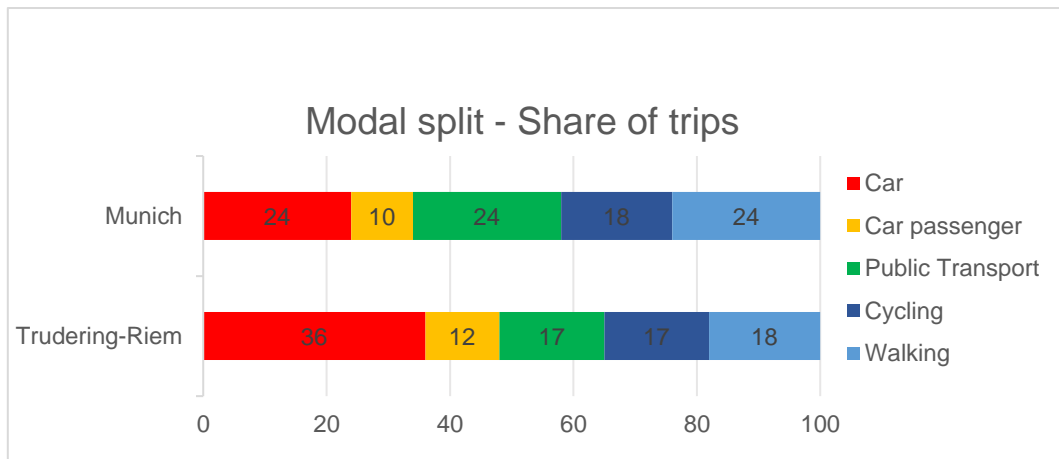


Figure 4.5: Modal split per trip, comparing Trudering-Riem to Munich. Own depiction, based on Belz et al. (2020).

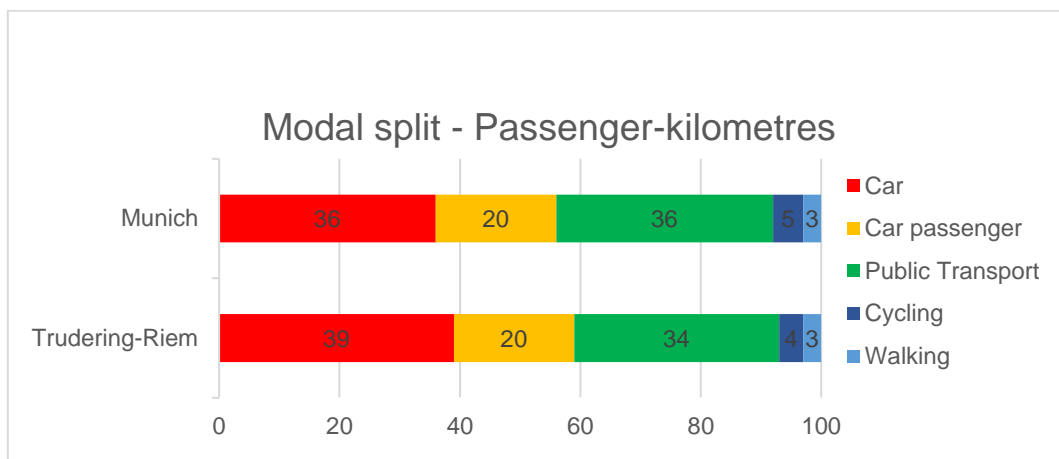


Figure 4.6: Modal split per passenger-kilometre, comparing Trudering-Riem to Munich. Own depiction, based on Belz et al. (2020).

In order to contextualise the mobility behaviour of residents in Waldtrudering, the following chapter presents a status quo analysis of the transportation network and service distribution in the study area.

### 4.2.3 Spatial analysis – status quo

A necessary part of understanding the circumstances for older people’s mobility patterns and developing the interview questions addressing the residents is to study the local urban and transport planning framework. Consistent with the research of Duran-Rodas, Haxhija, and Baquero Larriva (2023), the dimensions of accessibility, availability and exposure are considered

for this. At this point, it must be highlighted that further influencing factors on mobility (in-) justice, as displayed in Table 1 on page 26, such as “technology and information”, cannot be analysed spatially. Alves et al. (2020) summarizes studies on the walking speeds of seniors, out of which an average walking speed of 4 kilometres per hour is assumed for persons aged 60 years and above, and is underlying all of the following analyses that calculate isochrones and catchment areas.

**4.2.3.1 Availability**

In accordance with the methodology of Duran-Rodas, Haxhija, and Baquero Larriva (2023), a focus is put on the availability of sustainable modes of transportation. This chapter presents the infrastructural framework for PT, active mobility and shared services in the study area.

**Public transportation network**

The study area Waldtrudering, being a part of the administrative district Trudering-Riem, is linked to the public transportation network of the city of Munich. Figure 4.7 shows the routes and stops of PT services in the study area.

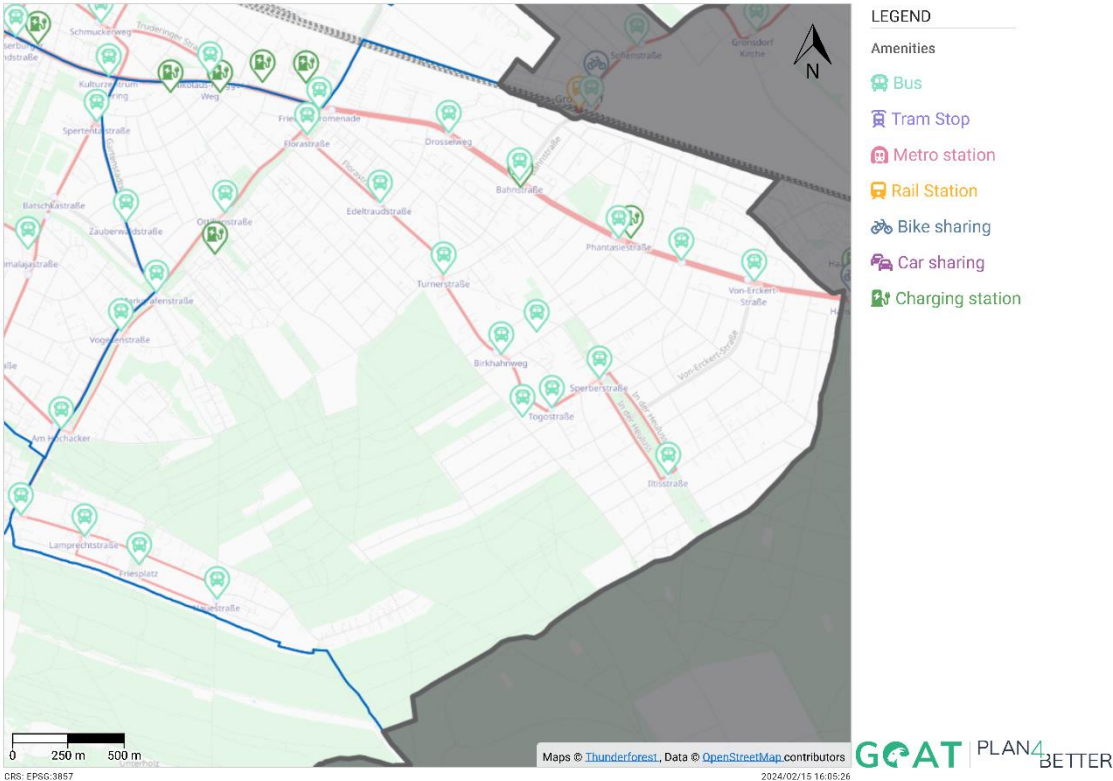


Figure 4.7: Lines and stops of PT services in Waldtrudering. Own depiction, using GOAT (Pajares et al., 2023).

The neighbourhood area is covered by four bus lines, operating on a daily basis and in headways of 10 minutes on weekdays for the line 193. The bus lines 185, 192 and 195 are serviced in a 20-minute-headway on weekdays and weekends. Even though Waldtrudering is not linked to an underground or subway line, those modes of transportation are available in adjacent neighbourhoods, at the stations Trudering and Gronsdorf. U-Bahn services are available every 5 minutes on workdays, and 10 minutes on weekends. In contrast, S-Bahn inbound traffic operates on a 10-minute headway, whereas outbound traffic has a 20-minute-headway. (Münchner Verkehrsverbund, 2022) Below, Table 3 summarizes the available modes of public transportation in Waldtrudering.

Table 3: Public transportation network in Waldtrudering. Münchner Verkehrsverbund (2022)

Type of PT	PT line	Stops in adjacent neighbourhoods
Bus	185, 192, 193, 195	
Underground	U2	Trudering
Subway	S4 and S6	Trudering, Gronsdorf

Fig 15 to Fig 20 in Appendix 1 illustrate the PT quality of stations, based on the frequency in which the station is operated, and the accessibility to and from the station by trips by foot. The analyses compare the respective PT qualities on a weekday to Sundays, during morning, afternoon and night.

**Cycling lanes and shared services**

Cycling lanes in Waldtrudering can be found alongside the main roads. Next to Wasserburger Landstraße, there are one-way cycling paths in both directions, whereas a shared-use path for pedestrians and cyclists can be found alongside Friedenspromenade.

Compared to that, the speed limit in residential areas is 30 kilometres per hour, allowing cyclists to use the roads, lacking infrastructure dedicated for cycling. In Figure 4.8 below, cycling paths are marked in yellow, with the tempo-30-zones in light blue.

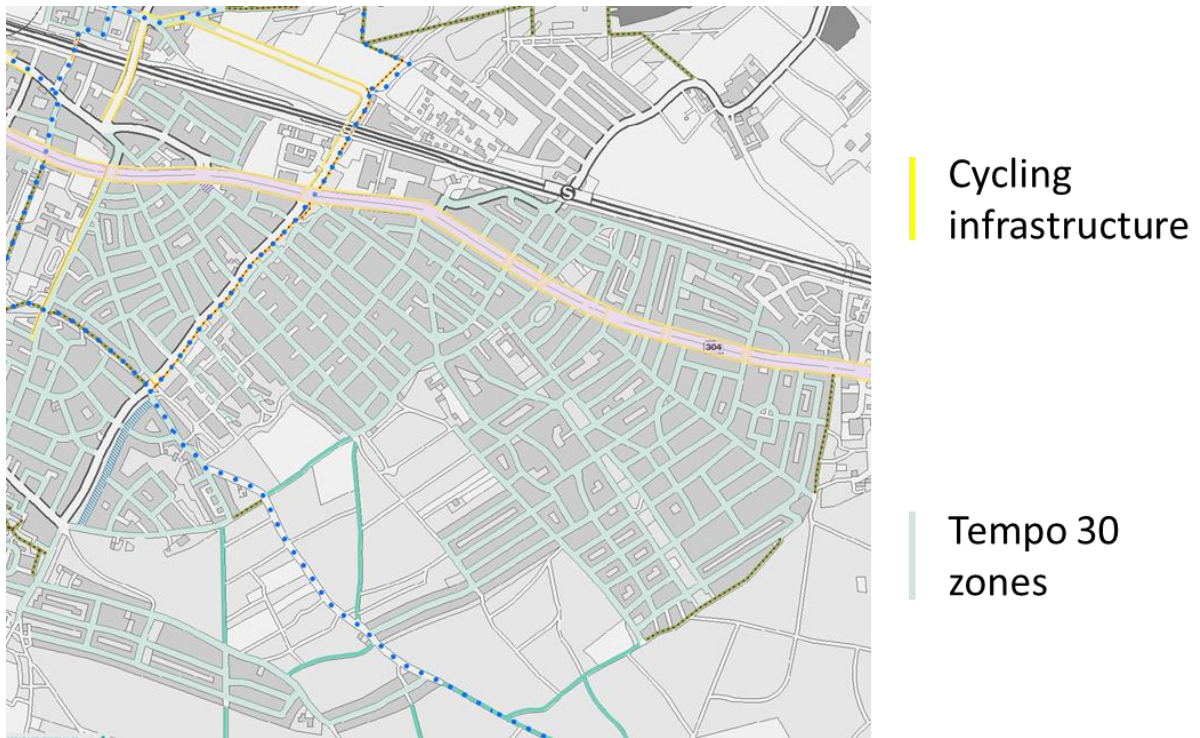


Figure 4.8: Cycling lanes in Waldtrudering. Own depiction, based on Geodatenservice München (2023).

There are neither bike- nor car-sharing-stations operated by Munich’s transportation company in Waldtrudering. In the adjacent neighbourhoods, shared bicycles provided by MVG Rad (translates to “MVG bike”) are available, as shown below in Figure 4.9. However, the sharing system in the urban outskirts of Munich is station-based, preventing a free-floating rental and return.

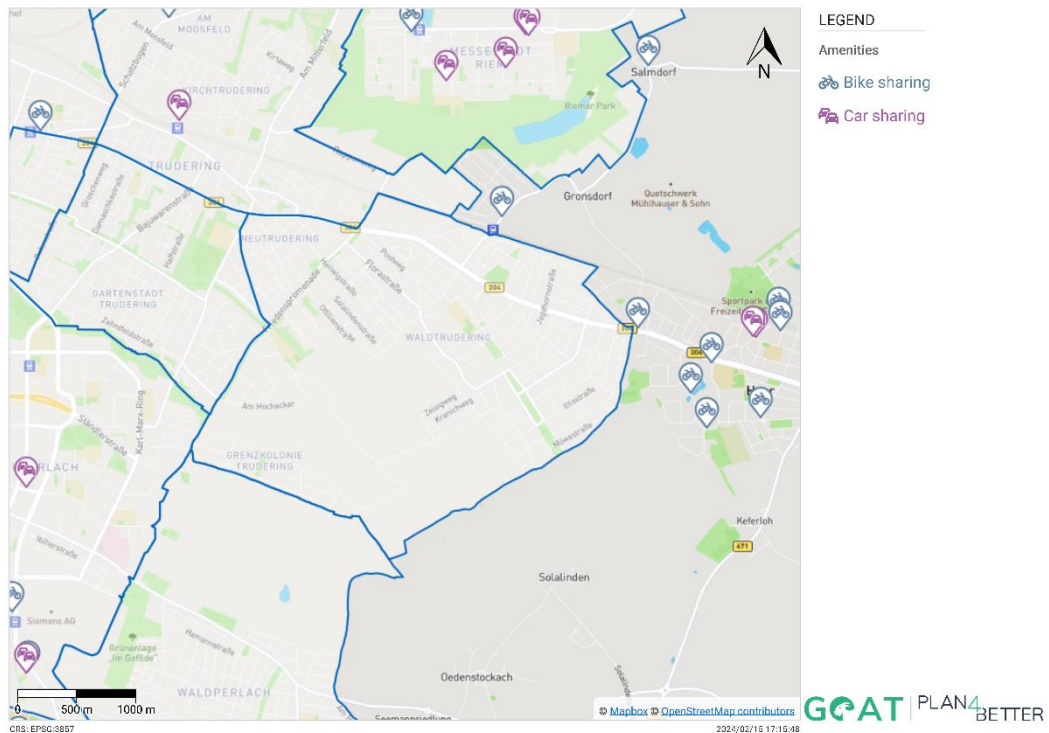


Figure 4.9: Location of stations for shared mobility in the surroundings of Waldtrudering. Own depiction, based on Pajares et al. (2023).

#### 4.2.3.2 Accessibility

For the analyses of the accessibility dimension of mobility (in-) justice, the point of interest (POI) categories of Duran-Rodas, Haxhija, Baquero Larriva, and Ochoa-Ortiz (2023) are applied. These involve supermarkets and grocery stores, services, healthcare and cafés and restaurants. As educational institutions are no destinations for daily senior trips, they are omitted for the subsequent analysis. The following Figure 4.10 depicts POIs in the study area and indicates a spatial concentration of POIs alongside Wasserburger Landstraße and Friedenspromenade.



Figure 4.10: Spatial distribution of POIs in Waldtrudering. Own depiction, based on Pajares et al. (2023)

Accessibility can be enhanced by the proximity of desired destinations. Thus, the buffer zones visualize parts of Waldtrudering within a given distance, as seen from the POIs displayed in Figure 4.10 above. Likewise, the buffer zones illustrate the neighbourhood parts that are able to access these POIs within the respective distance. Below, Figure 4.11 shows the buffer zones of 400 metres and 700 metres. It can be deduced that residents of the southern neighbourhood parts need to cover the furthest distances to access relevant destinations, whereas residents in proximity to the main roads are able to access services within 400 metres or less.



Figure 4.11: Buffer zone of 400 m (left image) and 700 m (right image) for POIs. Own depiction, based on Pajares et al. (2023).

To understand the local accessibility in greater depth, the analyses Fig 9 to Fig 13 in Appendix 1 contain the catchment areas for a distance equal to a 10-minute-walk at a senior-specific speed of 4 kilometres per hour. Other than the buffer zones, catchment areas take the local street network into account. Thus, the parts of the neighbourhood from which POIs can be accessed within 10 minutes or less are displayed. The analyses indicate that residents of Waldtrudering have to walk for more than 10 minutes if they live in the southeastern parts of the neighbourhood. In Addition, Figure 4.12 shows the available destinations within 5 minutes of cycling at a speed of 15 kilometres per hour.

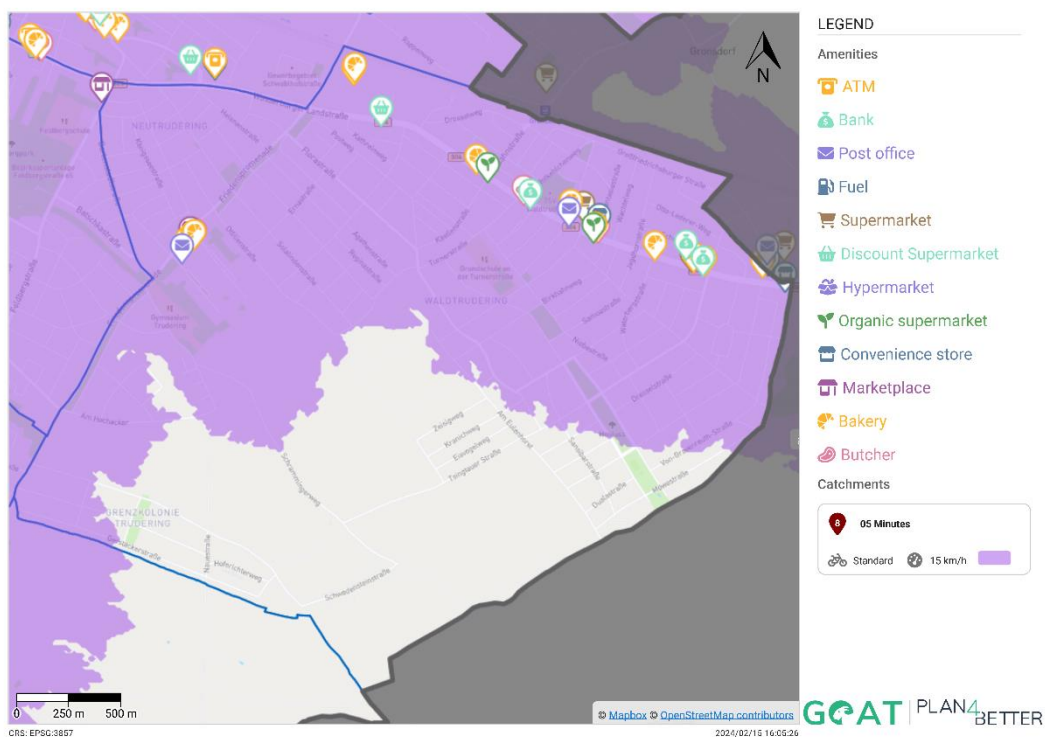


Figure 4.12: Catchment area for Groceries and services within 5 min of cycling. Own depiction, based on Pajares et al. (2023).

Apart from this, the accessibility of services can furthermore be determined in comparison to the local population density. This viewpoint shows whether or not an area is sufficiently equipped with daily services, and the spatial overlaps of supply and demand. The figures Fig 1, Fig 3, Fig 5 and Fig 7 in Appendix 1 thus show a surplus of the population density in comparison to accessibility in the residential parts of the study area, whereas the service concentration alongside Wasserburger Landstraße leads to balanced conditions.

### 4.2.3.3 Exposure

Finally, mobility injustice can be caused by exposure to negative externalities, as chapter 3.1.3.3 had explained. Figure 4.13 below shows that the main roads are the neighbourhood parts being impacted by street traffic noise during day-hours. This can not only influence the residents of these areas, but also the sojourn quality there.



Figure 4.13: Street traffic noise at main roads during daytime. Own depiction, based on Pajares et al. (2023).

In addition to the strain of traffic noise, being exposed to the risk of accidents can affect the experience of seniors. Figure 4.14 on the following page 43 illustrates road accidents alongside Wasserburger Landstraße and Friedenspromenade. Consequently, the risk of negative, transport-related externalities is highest at the two largest traffic axes. In addition, first and foremost accidents involving cyclists occur within the residential parts of the study area.



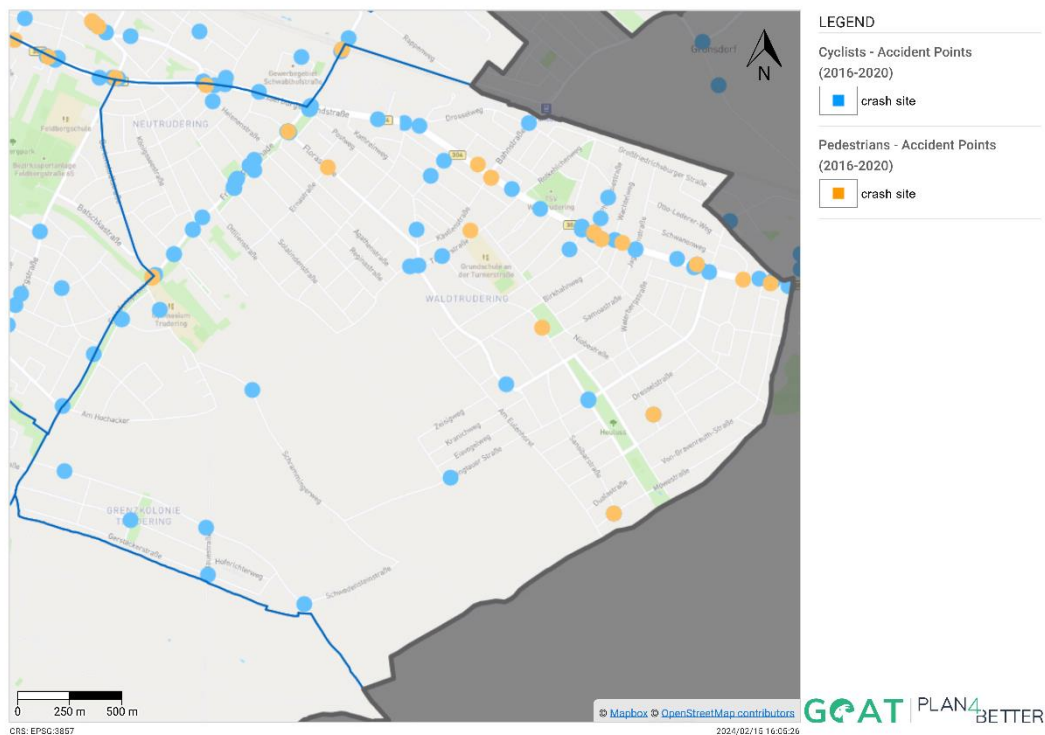


Figure 4.14: Locations of accidents involving pedestrians or cyclists. Own depiction, based on Pajares et al. (2023).

#### 4.2.3.4 Summary: Spatial injustices on a neighbourhood scale

The previous analyses of transport availability, service accessibility and exposure to transport externalities shows the spatial distribution on the neighbourhood scale.

Overall, it can be stated that service accessibility increases with proximity to the main roads, Friedenspromenade and Wasserburger Landstraße. The spatial analyses demonstrate that, depending on the place of residence within the study area, older people take longer than 10 minutes at a senior-specific walking speed to access relevant POIs. In comparison to that, the study area can be covered by bike within a shorter time. However, trips by bicycle have to be carried out on streets in the residential parts of the neighbourhood, as the cycling lanes are concentrated to the main axes Wasserburger Landstraße and Friedenspromenade. Furthermore, buses are the only PT service available, providing a different supply quality between weekdays and weekends, and requiring changes between bus lines, but also for trips involving the U-Bahn or S-Bahn. The exposure to noise from road traffic is highest alongside those roads, especially affecting quality of stay and travels in these neighbourhood parts.

The spatial analyses suggest that older people in Waldtrudering can experience injustices on the one hand as a lack of access to services and insufficient available transport options. On the other hand, as they are required to travel to the two main roads to meet their needs, the

exposure to negative externalities, particularly noise and a risk of accidents, is increasing. Lastly, as more cyclists than pedestrians have been involved in road accidents in the residential parts, the lack of cycling lanes there might increase safety concerns of seniors.

# 5 Data collection

## 5.1 Residents interview

### 5.1.1 Interview design

Chapter 3.3 has summarized the state of research on mobility injustice towards older people. While chapter 3.3.1 shows that elements of mobility justice have been addressed regarding their effect on this social group, it remains to be investigated how seniors perceive mobility (in-) justices on their daily trips, as chapter 3.3.2 has pointed out. Thus, the research question addressed in this thesis, on *How to combat mobility injustices towards older people*, is approached within three sub-questions. Out of these, the method of interviewing residents has been selected to investigate upon sub-question 1, *How do older people perceive injustices in their mobility routines*, as well as sub-question 2, *How does the examined social group cope with the associated disadvantages*. In addition, the results gained from residents' interviews will contribute to sub-question 3, *Which potential actions can be allocated to the identified mobility deficits?*

As this work has the intention of gaining in-depth understanding of individuals' perceptions, highlighting coherencies and backgrounds, qualitative interviews are chosen for the data collection process. Scholars agree that personally conducted interviews are particularly suited for research addressing older people (Kelle & Niggemann, 2002; Lamnek & Krell, 2016). By meeting their "desire for extended narration" (Lamnek & Krell, 2016), this method is seen as fruitful in the given context. In the next step, a semi-structured format has been selected. This variety of qualitative research allows for a flexible adjustment of the questions' order. Furthermore, as it is possible to selectively choose, but also to exclude, follow-up questions based on earlier replies, the semi-structured approach has been considered as particularly suitable for this work's research purpose. (Kallio et al., 2016) The following Figure 5.1 shows the resulting interview structure.

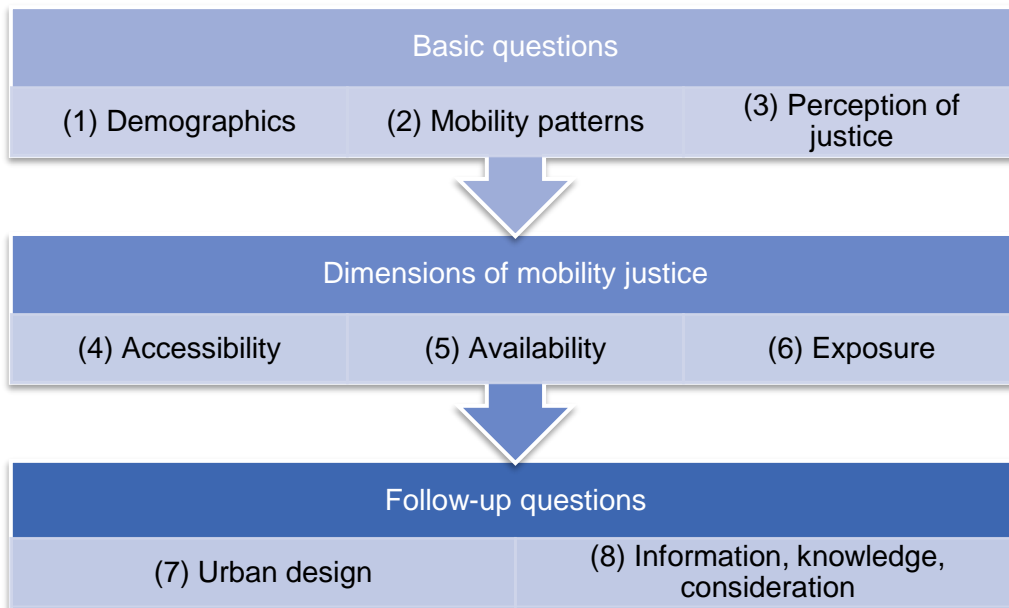


Figure 5.1: Structure for interviews with residents. Own depiction.

The questionnaire for interviewing residents can be found in Appendix 2 on page XL, where the interview structure and sub-categories follow the scheme presented in Figure 5.1 above. Due to the qualitative approach, the set of questions is designed for in-depth narration on motivations and backgrounds and is composed of open questions. The flexibility regarding the structure and formulation of questions allows for cross-references to earlier replies of the interviewees. In order to gain insights in the mobility routines of the participants and to allow for an open narration environment, the first block of questions addresses typical behaviour and potential challenges that the interviewee encounters. To capture the interviewee's understanding for (in-) justice, they are also asked to give examples on respective situations in their mobility behaviour. In addition, suggested improvements and objectives of being mobile are enquired. If not brought up on the part of by the interview partners themselves, the subsequent questions of the blocks 4 to 6 add the dimensions of mobility (in-) justice. The availability-based questions address both the predominantly used modes of transport and the required infrastructure. Accessibility is explored together with types of relevant POIs, and exposure involves environmental (in-) justice on the one hand, but also perceived safety and costs of mobility on the other hand. Finally, the blocks 6 and 7 include further aspects that have been investigated towards senior-friendliness as outlined in chapter 3.3.1.

## 5.1.2 Interview conduction

The ability of older persons to move outside of their homes is a crucial prerequisite to considering them suitable for the data collection. Thus, residents are approached in Waldtrudering in public places and senior-specific social centres. The access to the field in the latter was enabled by the employees of such institutions, in this context specifically the “Familienzentrum” (literal translation “Family centre”) and the “Promenadentreff” (literal translation “Promenade meetup”), who act as disseminators (Lamnek & Krell, 2016). Moreover, older persons who are walking, cycling or resting in public places in the study area are approached, informed about the research purpose, and asked to participate.

Overall, the interviews were conducted between October 18<sup>th</sup> and November 23<sup>rd</sup>, 2023. The oral conversations are recorded by a mobile device for the subsequent transcription and evaluation process. The interviews are carried out in German. Table 9 in Appendix 3 contains detailed information on the time and place of the conducted interviews. Below, Figure 5.2 marks the location of the Promenadentreff at the major road Friedenspromenade in blue, and the Familienzentrum, in the northern residential neighbourhood parts, in orange.



Figure 5.2: Location of Promenadentreff and Familienzentrum. Own depiction, using OpenStreetMap (Open Street Map Community, 2023)

When conducting qualitative research with the focus group of older persons, their willingness and ability to participate in the data collection process can vary individually. On request of the

participants, four interviews are conducted in small groups, as marked in Table 9. In these compositions, the course of discussion includes extensive narration in which the researcher is not involved, but which contribute to the gain of knowledge regarding the research questions. All members of these group interviews are thus part of the sample. Apart from this, during the interviews with the participants 5 and 12, one or more members of the social environment of the interviewee are present. However, unlike in the aforementioned group conversations, they are not included in the research sample.

As one group interview has been conducted with the residents 27 to 33, but found not suitable for the scope of this research in the subsequent analysis, it is omitted from the evaluation process.

### 5.1.3 Evaluation strategies

#### 5.1.3.1 Demographics

In order to classify the composition of the research sample, demographic indicators are considered. These include first of all the gender and age of interviewees, as well as the household (HH) size. Finally, information on personal, health-related restrictions is gathered and factored into the evaluation. These cover permanent physical limitations, requiring for example the use of a wheelchair, as well as temporary limitations at the time of the interview, resulting for example from an injury. Due to research anonymity, personal data is collected and stored separately from the residents' interviews.

Below, Figure 5.3 summarizes the relative numbers of demographic characteristics of the interview sample.

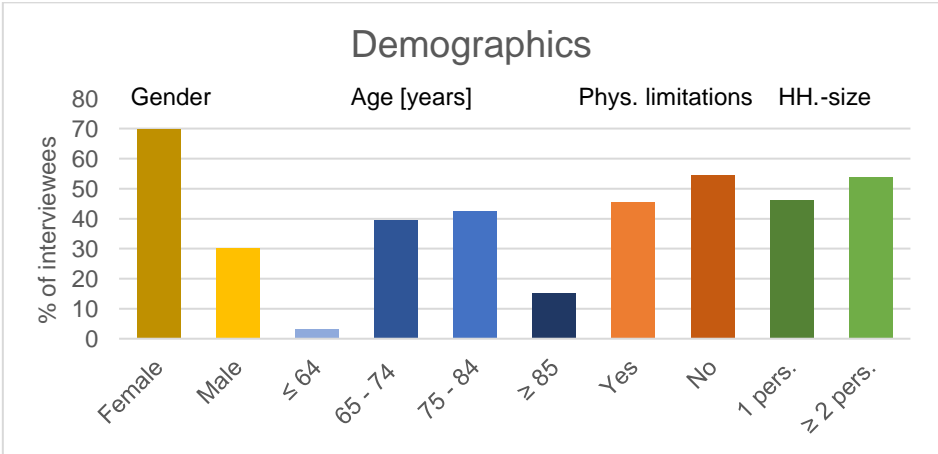


Figure 5.3: Demographic characteristics of the interviewed residents, relative numbers. Own depiction

Apart from the demographic characteristics, the ownership of bicycles and cars in the household is assessed. For the latter, both the possession of a valid driver’s license and the presence of a roadworthy vehicle in the household are presumed. As Figure 5.4 illustrates, 24 of interview partners have access to a car, which they either own themselves or share with a spouse. Compared to that, 18 of the interviewed seniors own a bicycle. In this context, it must be highlighted that 6 of the participants possess neither a car nor a bike in their household.

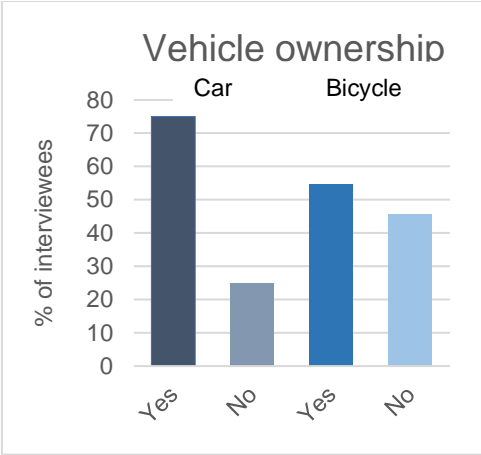


Figure 5.4: Vehicle ownership amongst the interviewed residents, relative numbers. Own depiction.

In addition to the demographic characteristics, the place of dwelling is enquired. Figure 5.5 illustrates the corresponding neighbourhoods, based on the ZIP-code, in light blue. As shown furthermore in Table 4 below, the interviewees reside in Waldtrudering as well as in adjacent areas. However, as they are approached within Waldtrudering and regularly travel there, inhabitants of the adjacent ZIP-code areas qualify for the sample of this work as well.

Table 4: Number of interviewed residents based on ZIP-code areas. Own summary.

ZIP-code area	Number of interviewed residents
Waldtrudering	19
Kirchtrudering	8
Trudering-Riem	1
Ramersdorf-Perlach	1
Daglfing-Johanneskirchen	3
Haar	1

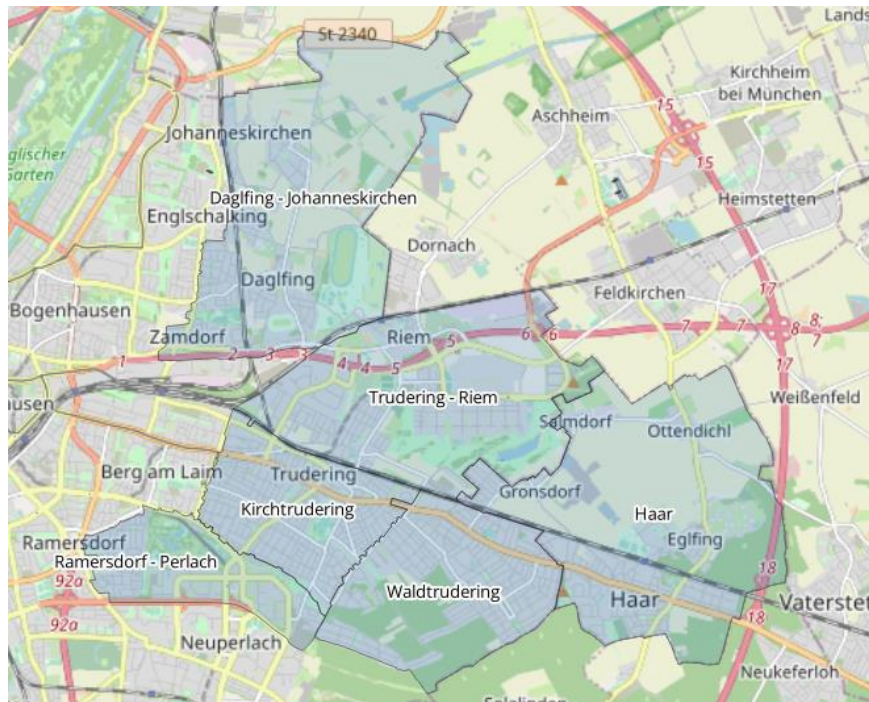


Figure 5.5: Places of residence of the interviewed residents, ZIP-code level. Own depiction.

### 5.1.3.2 Personas

Building up on the key findings regarding interviewee demographics, as outlined in the section above, personas are developed. This methodology allows for an understanding of an examined population, or parts thereof. Personas can be described as “fictional characters representing a homogenous class of users” (Vallet et al., 2022) and hence epitomize the abilities, preferences and needs of the respective demographic group. Within scientific research and project planning, personas are used to identify fields of action and adjust measures. At the same time, this methodology can be used to incorporate individual traits and to simplify the communication between stakeholders. (Sato et al., 2022; Vallet et al., 2022; Vallet et al., 2020)

As the development of personas in this thesis is following the interview phase, the results are referred to as “actual personas” (Sato et al., 2022). By means of the interviewees’ demographics shown in section 5.1.3.1, and considering the statistical data available for the neighbourhood, as presented in Table 2 on page 34, three personas are delineated. These are defined by the characteristics of the sample, hence representing the socio-demographic range of interviewees while avoiding redundancies. This is furthermore in line with the findings of Schlag and Beckmann (2013, p. 46), who observe three phases of activity and changes in mobility behaviour in the senescence of older people.



Distinguishing between three types of seniors in Waldtrudering, their characteristic abilities, preferences, behaviour and encountered challenges are used for the evaluation process. Figure 5.6 summarizes the resulting characteristics of the three personas “Anne”, “Bill” and “Caroline”.

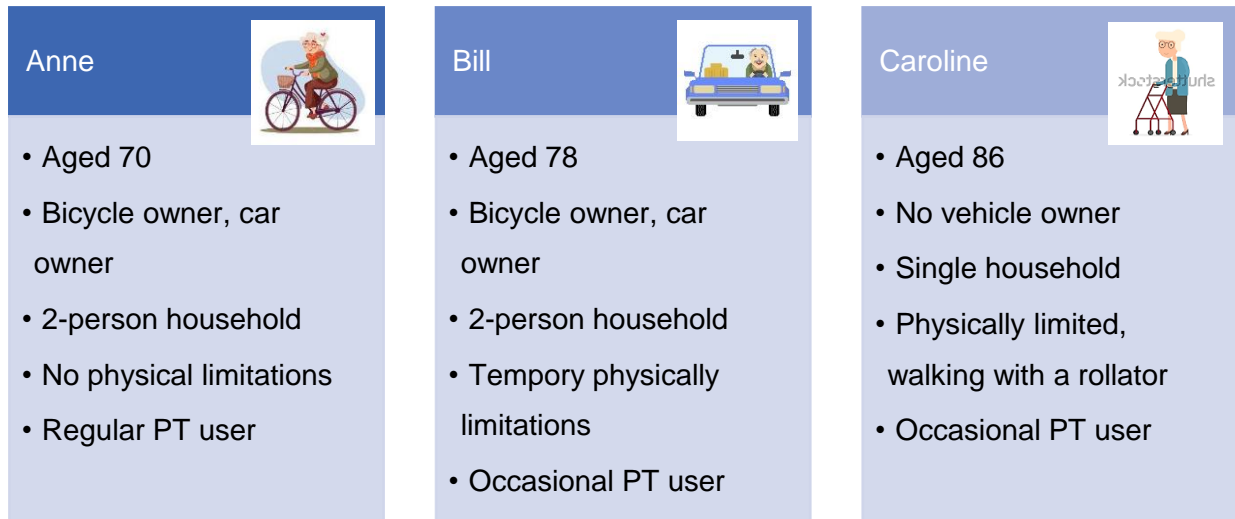


Figure 5.6: Personas. Own depiction.

In this context, it must be emphasized that these personas portray representative, but fictional residents of Waldtrudering. For this study, they are aids for describing situations and challenges that the interview participants encounter, and preferences that they display. The persona-based approach supports a concise evaluation, as it facilitates narrowing down the sample size for the process. It also helps to link the situations described by the interviewees to actual, socio-demographic framework conditions.

### 5.1.3.3 Coding

#### Methodology

In order to assign evaluation codes to the transcribed interviews, a catalogue of key words has been developed in the forefront. These inductive codes differ from the deductive codes as the latter have been established during the evaluation process.

For this, eleven main coding categories have been selected inductively. Table 10 in Appendix 4 presents them together with the associated sub-codes and differentiates inductive and deductive codes. This evaluation part is conducted manually, using MAXQDA.

The expressions applied for deductive coding have been selected during the evaluation process. As Table 10 shows, the deductive sub-codes amplify and extend the scope of the inductively chosen coding phrases.

For the coding process, the following principles are followed.

- i. One code can exceed a singular sentence and thus be assigned to one or more paragraphs.
- ii. One sentence or paragraph can be assigned multiple codes. This is especially relevant for highlighting interactions between the coding categories.
- iii. A code can also appear multiple separate times or not at all within one interview.
- iv. Sentences can remain uncoded. These sections of the interviews are hence not considered in the concluding evaluation.

Furthermore, it must be noted that only the sub-codes, presented in Appendix 4, are utilized in the evaluation process, but not the primary categories. The coding consequently allows for multiple sub-codes of one main category to be assigned to one sentence or paragraph. As codes of multiple categories can describe one sentence or paragraph, the interactions and dependencies between sub- and main categories can be addressed in the subsequent evaluation process.

With the codes presented in Appendix 4, the main coding categories can be differentiated between the fields of “Individual” and “Infrastructure”. The former describe personal “Routines”, “Satisfaction”, the issue of seniors being “Personally affected”, and “Suggested improvements”. The latter includes descriptions of the “Neighbourhood”, “Accessibility and POIs”, the local “Infrastructure” for urban and transport planning and the “Modes of transport” used by seniors. Finally, “Limitations” in the experiences of older people can arise from both infrastructural and individual conditions.

## 5.2 Expert interviews

### 5.2.1 Interview design

The experts’ interview design builds up on the insights gained from the residents’ interviews. Moreover, it aims towards an understanding of whether and how the concept of mobility justice is implemented in processes on various planning scales. Involving local experts of urban and transport planning addresses first and foremost the research question SQ3, ‘Which potential actions can be allocated to the identified mobility deficits?’.

The expert interview design therefore continues the information on transport disadvantage and mobility injustice gained from the residents interviews, as described in chapter 6.1.3, and the desired actions to reduce disadvantages and enhance justice that are presented in chapter 6.1.4.

The opening question invites experts to elaborate on their experiences with (in-) justice in their work and special features to consider when planning for justice for seniors. Together with information on the planning framework, corresponding measures for the topics “Walkability”, “Cyclability”, “Public transport” and “Diverse residential areas” are addressed. These subjects have been found in the focus of the majority of improvements seniors in Waldtrudering desire. Associated measures are furthermore considered regarding additional constraints and benefits for older people. In addition, previous actions taken in the study area and their effects on seniors are discussed. Likewise existing strategies for senior-friendly mobility in other areas of Munich are considered, which can serve as role models for Waldtrudering.

Up to and including 2023, the city centre in Trudering has been rebuilt. The main objectives for this construction work were reduced traffic volume, including transit traffic, and increased quality of stay by re-structuring the street design. During the opening event of the rebuilt city centre in Trudering in May 2023, the Local Council (Bezirksausschuss) has conducted a survey amongst neighbours. It indicates that, despite the reconstructed street design, citizens first and foremost criticise a lack of cycling lanes and the reduced number of trees, and desire additional speed monitoring. (Hohenester et al., 2012; Ziegler, 2023) As residents name the same deficits regarding the re-design, experts are enquired about whether improvement works regarding cycling infrastructure and clarity of traffic situations are intended.

Finally, the expert interviews provide perspectives on common constraints in senior-friendly urban and mobility planning in general, and in particular regarding the study area.

The complete set of interview questions directed to the experts can be found in Appendix 5. For this research purpose, a guided interview structure is chosen, in which the entirety of questions is asked in the, but allows for deepening individual aspects.

## 5.2.2 Interview conduction

The experts approached for interviews can be characterized by their position in urban or mobility planning institutions, as this thesis thematizes mobility in the context of land-use and spatial structures. Furthermore, experts E1 and E3 have work experience in the planning region Trudering, whereas expert E2 concentrates on the planning region Munich-East. Thus,

questions do not only address the generalized planning context, but also the neighbourhood development. Finally, they demonstrate experiences in planning strategies for older people and further disadvantaged social groups.

As the experts E1 and E2 are members of the same department, they are approached within one interview, whereas the interview with expert E3 is conducted separately. The conversations are carried out on the 6<sup>th</sup> and 7<sup>th</sup> of February 2024, as summarized below in Table 5, together with the work experience of the interview partners. All of the conversations are carried out digitally, whereby the audio is recorded.

Table 5: Participants in the expert interviews. Own summary.

Nr.	Level	Board	Responsibility	Date
E1	City of Munich	Mobility Department	Contact person Trudering	07.02.2024
E2	City of Munich	Mobility Department	Expert on pedestrian traffic Munich-East	07.02.2024
E3	Trudering City of Munich	District Council Committee for Disabled	Local politician with focus on mobility and transport Expert on mobility for Impaired	06.02.2024

### 5.2.3 Evaluation strategies

In like manner as for the residents, the expert interviews are evaluated by means of MAXQDA. The basic principles of coding, as presented in chapter 5.1.3.3 concerning the residents’ interviews, are applied to evaluate the expert interviews as well. As the findings gained from the expert interviews add on to the information of the residents’ interviews, the identical coding scheme is applied. To take the planning perspective and interview question on related barriers into account, the code “Barriers and challenges” is added. Thus, present-day constraints in planning for mobility justice for older people can be understood. Compared to that, the coding categories “Personally affected” and “Satisfaction” are omitted.

# 6 Findings

## 6.1 Residents

As explained above in chapter 5.1.3.3, the evaluation categories can be divided into “Infrastructure” and “Individual”. The applied coding structure supports the allocation of interview segments to the overarching topics as shown below in Table 6. In addition, the codes of “Routines”, interviewees being “personally affected”, and their “satisfaction” support the classification of information into the listed topics and the allocation of personas.

Table 6: Overview of topics in residents’ interviews and corresponding codes. Own summary.

Chapter	Codes	Topic
<b>6.1.1</b>	<b>Infrastructure</b>	
<b>6.1.1.1</b>	Modes of transport	Mode choice
<b>6.1.1.2</b>	Types of POIs, Trip purposes	Points of interest and trip purposes
<b>6.1.1.3</b>	Car Public transport Parking spots PT stops Street design Noise, air pollution	Perception of motorized transportation
<b>6.1.1.4</b>	Active Mobility Urban design, walkability, cyclability Street design	Perception of active mobility and public places
<b>6.1.1.5</b>	Are daily services accessible? Diversity, Proximity Types of POIs, Trip purposes	Accessibility of POIs
<b>6.1.1.6</b>	Neighbourhood	Neighbourhood developments
<b>6.1.2</b>	<b>Individual</b>	
<b>6.1.2.1</b>	Feelings Health Costs Weather Traffic situation (Walking) distances Digitalisation and information	Influencing factors on mobility behaviour
<b>6.1.2.2</b>	Feelings	Feelings about mobility situations
<b>6.1.2.3</b>	Mobility benefits	Additional benefits of mobility

After the typical mobility routines of older persons have been described, together with their preferences, potential challenges they encounter, and their perspectives in these matters, chapter 6.1.3 thematizes the field of “mobility injustice” as perceived by the residents. Whereas the findings presented in the following chapters 6.1.1 to 6.1.3 can already contain information on fields of action in the study area for which improvements are desired, chapter 6.1.4 summarizes the improvements that interviewees desire for their neighbourhood. With the personas developed in chapter 5.1.3.2, the findings are linked to personal abilities and socio-demographic frameworks.

## 6.1.1 Infrastructure

### 6.1.1.1 Mode choice

Older people, as the overall population, choose their main modes of transportation according to their trip purposes. As chapter 4.2.3 has shown, Waldtrudering can be covered by foot and bicycle as well as by car and public transport. Overall, the sample uses the whole range of available modes of transport. The mode choice first and foremost depends on vehicle ownership. As Figure 5.4 in chapter 5.1.3.1 has laid out, 24 of the interview partners have a private car in their household and 18 persons possess a bicycle. Furthermore, interviewees choose modes that enable them to fulfil their daily needs and grant them access to the POIs and destinations, according to their trip purposes. It must be stated that a large share of older persons uses more than one singular mode of transport for their daily needs. Multi- and inter-modal travel is a part of mobility routines for 30 of the 33 interviewees. Trips as a car passenger, including trips by taxi or other passenger transport services, are also relevant for the sample.

- Anne: *Okay, every trip I can take walking, I walk. Every trip I can do by bicycle, I cycle. Every trip I can do by public transport, I use public transport for, and for some trips I use the car. (34)*

Modes are not only chosen based on the trip purpose, but reflect personal preferences and abilities. Especially older citizens that are not limited by their health choose active forms of mobility, first and foremost for short-distance trips within the neighbourhood.

- Anne: *I use the car seldomly, because I rarely need it, only to do larger grocery shopping trips, or to visit friends, where it is otherwise difficult to get there. (37)*  
*[...] for the more basic groceries. All of that is accessible by foot here, so within a radius of 400, 500 metres one can get basically everything. For trips to the hardware store I*

*need the bicycle, the hardware store is further away, approximately one kilometre or two kilometres. (9)*

If more than one mode of transport is available to them and suitable to fulfil the trip purpose, seniors include additional, potentially limiting, factors in their mode choice, which will be elaborated in greater depth in chapter 6.1.2.1. In addition, a mode of transport can be chosen deliberately in favour of supplementary benefits, to which chapter 6.1.2.3 will come back to.

Finally, older residents of Waldtrudering appreciate PT for trips to Munich’s city centre and other, centrally located, destinations.

- Bill: *But it is convenient, and I can reach the Marienplatz [Munich city centre] within twelve minutes, when I enter [PT] here. So it could not be better at all, so I don’t take the car for this. (12)*

Mobility behaviour for older citizens does not only factor in their mode choice, but also the times of travel. As for their temporal flexibility over the course of a day, they travel anticyclical to avoid rush hour traffic, and tend to travel less in the evening and night hours.

- Anne: *Whenever possible, I travel anticyclical, as one calls that. (11)*

These adjustments regarding mode choice and times to travel furthermore follow the objective to avoid uncomfortable or overwhelming situations. The chapter 6.1.2.2 will elaborate upon this effect on mobility behaviour in depth.

### 6.1.1.2 Points of interest and trip purposes

Chapter 4.2.3.2 has presented the spatial distribution of existing POIs in Waldtrudering. The destinations relevant for senior citizens are summarized and categorized in Table 7 below.

*Table 7: Categories of POIs that are relevant for regular trips of seniors. Own summary.*

<b>Groceries</b>	<b>Healthcare</b>	<b>Leisure</b>	<b>Social interactions</b>
Supermarkets, grocery stores	Doctors	Cultural institutions	Family, friends
Weekly markets	Pharmacies	Sports	Senior community centres
Specified stores	Hospitals	Recreation, greenery	Churches
Facilities, services			Cafés, restaurants

## Groceries and weekly markets

Purchasing groceries is a trip purpose for all senior citizens, causing regular out-of-home activity. For this, they mainly rely on supermarkets, with branches of Edeka, REWE and Penny to be found in Waldtrudering. Furthermore, supermarkets of Lidl, Aldi or Netto are located in adjacent neighbourhoods and municipalities. Waldtrudering does offer a range of specified food stores in addition, including organic supermarkets, bakeries and butchers, which are of relevance for the local senior community.

- Anne: *At the Friedenspromenade, there is a REWE. And the bakery and so on, and when I go to the bakery, I often go to the REWE as well, or to the REWE in Haar. That is on my way home, I just have to turn right to find a large beverage store, and there is a post office as well. And this way I can access everything wonderfully. So, I am very satisfied with my street and my flat, so it couldn't be better for me! (14)*  
*That is even an over-supply, I would say, an over-supply for groceries, with an Edeka, an Aldi, a REWE and such. (34)*
- Caroline: *The weekly market, yes, I love it, I enjoy going there. Sometimes I buy something, I indulge in something, it is very expensive. (5)*

## Specified stores, facilities and services

Apart from grocery shopping, seniors require further stores for more specific needs. These also include services such as banks or post offices. The analysis of the neighbourhood supply in chapter 4.2.3.2 and Appendix 1 shows that such POIs are scarce in Waldtrudering. The interviewees confirm that they travel to adjacent neighbourhoods or the city centre of Munich for specified needs. As distinct from grocery and food shopping, these trips do not occur on a daily basis. As Caroline is limited in her health and in the modes she can use, she does not take regular trips for this purpose, unlike Anne and Bill.

- Anne: *Here, in the neighbourhood, it's mainly just groceries, since, yes, when I need clothes for example, I drive to the city centre, I have more options there, which are not so far apart. (37)*
- Bill: *One should not take that many car trips anyway, but for certain trips one has to take the car, because it would be too far by foot. And it is not a problem to drive to PEP or the Riem-Arcaden [the shopping centres in adjacent neighbourhoods] I always have a possibility to park there, or at Lutz or Segmüller. (1)*



## Healthcare and pharmacies

Similar to purchases of food and groceries, the majority of senior citizens are satisfied with the healthcare options in the study area. Even though medical specialists practise in Waldtrudering in addition to general practitioners, older people are also willing to cover further distances for healthcare, if they have had positive experiences with doctors in other parts of the city. However, the perception of pharmacies is ambivalent in the study area. Because of the concentration of pharmacies in the eastern parts of Wasserburger Landstraße, residents in the southern and western neighbourhood lack local options. This is especially desired by residents with health limitations and a regular need for medication, and will be expanded on again in chapter 6.1.4.

- Anne: *The medical care is good, I think, there are a lot of doctors here. Many dentists, orthopaedists as well, several general practitioners too, yes, my general practitioner is nearby here. (23)*
- Bill: *There are countless doctors here in the area, I have to say, but I visit some doctors in the city centre as well, and for this I use PT, as one does not get a (car) parking spot in the city centre. (37)*
- Caroline: *And if I have appointments that are further away – last week, I had a medical appointment in the hospital “Rechts der Isar” – my son comes around. He can manage all those issues and gives me a ride and picks me up again afterwards. (4)*

## Leisure, sports, and recreation

For their leisure, seniors access local destinations as well as such that are further away, like entertainment and cultural institutions. Even though older people travel beyond the neighbourhood boundaries on such occasions, they also enjoy local cultural events. In comparison to grocery purchases and daily errands, these trips occur less often. Likewise, sports facilities in Waldtrudering are limited to one sports club and the groups of the Familienzentrum. On the other hand, citizens value the local possibilities for recreation and public places with high quality of stay. Greenery and green infrastructure, coming along with Waldtrudering’s outskirts-location, are of relevance, especially for active mobility, as chapter 6.1.1.4 will elaborate on in greater depth. Finally, leisure trips are directed to the surroundings of Munich.

- Anne: *[But] I have discovered that there is a range of cultural events in the outskirts as well, very interesting [things], by now. One does not necessarily have to travel to the city centre [...]. By taking part in cultural events in Haar or in the cultural centre here [in Trudering], one can decide on that a quarter-hour beforehand, take the bicycle, drive here, and you’re in! (38)*

- Bill: *For shopping, there are the... Riem-Arcaden over there, but for something special like... theatre, a real opera, I have to get to the city centre. (10)*

### **Senior community centres, cafés and restaurants**

Guests of the Familienzentrum and the Promenadentreff participated in this thesis, as chapter 5.1.2 has explained, thus those institutions are relevant for the interviewees' social lives. The variety of possibilities to get together at those centres, or by engaging in activities organized by the church, is highly esteemed by older people. Furthermore, older citizens get involved in social initiatives themselves, for example voluntary work in the aforementioned community centres, or as school crossing patrol. Similarly, cafés and restaurants are social meeting points for older residents. Social interactions are not limited to these POIs, but also take place in public areas, which will be picked up again in chapter 6.1.1.4.

- Anne: *Well, then I check [the programme] at the family centre or see if there's anything I'd like to attend. And concerning the knitting club, I thought of it as a way of exchanging thoughts, or to simply help one another. (13)*
- Bill: *We have the center there now, so we have a REWE there, we have [Vinzenz] Murr there, and we even have three bakeries! Yes, and then to eat out, as I said, there's a new place in the district, in the new building district there's a Chinese restaurant that's quite good and historic... the Lindengarten, these are historic inns. (8)*
- Caroline: *On Monday, we will start again with "Dancing while sitting" [...]. And I go there, even though I cannot dance any more, not even when sitting, but I enjoy the cosy atmosphere, the music is nice [...], and so there's always something going on! Like I said, a week later, we have our senior-meeting again. That takes two hours in the afternoon [...], with a nice presentation. There is always someone coming by to give a presentation on something. Most of the times, that is really interesting for us older people. (4)*

#### **6.1.1.3 Perception of motorized transportation**

##### **PT stops, changing, inter-/ multimodality**

Chapter 4.2.3.1 has presented the framework conditions of PT in Waldtrudering. As the area is developed mainly by bus lines, citizens who live close by the main roads can find a bus stop close to their residence. However, the access to PT decreases for people living on the edges of the neighbourhood. In addition, the ability to walk to the nearest PT stop is influenced by

personal health. This concern is especially severe for seniors like Caroline, who relies on PT trips as a motorized form of transport.

- Caroline: *So, I mostly travel by PT, but the next stop is 300 metres away, and if you are in pain, or older, 300 metres are a lot already. (10)*

Secondly, the perception of local buses can be influenced by their headway and operating times as well as by related waiting times. As shown in chapter 4.2.3.1, the only bus line in Waldtrudering which is operating in a 10-minute-headway is line 193, whereas the other services are running every 20 minutes. This shows particularly in the case of delays or service disturbances, which cause extended waiting times. Consequently, the supply density on these lines is perceived as low by seniors who rely on them, like Caroline. In comparison, Anne describes such malfunctions as making a trip less enjoyable, but instead of waiting, she would walk.

- Caroline: *That'd be a matter to me, that the buses run every ten minutes. That way, it would be less severe if one was cancelled, but if one [bus] is cancelled now, one has to wait for 40 minutes. (7)*
- Researcher: *And if trips are cancelled, has that happened to you? [...]*
  - Anne: *Yes, like I said – then I go by foot. (13)*

Overall, residents of Waldtrudering include PT in intermodal trips. In this context, buses are frequently used as a mode to access the U-Bahn or S-Bahn in Trudering. Changing from a mode operated on street level to the subway or underground can pose challenges to seniors with a need for an elevator or an escalator to access the tracks of these services. This shows especially as the singular, direction-changing escalator there can lead to waiting times when accessing the station. Besides, defective elevators can impair older travellers in accessing the tracks. Elevators are also used by seniors who intend to transport their bicycle in the U-Bahn or S-Bahn, a possibility which first and foremost applies to leisure purposes and jaunts. Chapter 6.1.4.3 will come back to the improvements desired in this context.

In addition, the aforementioned waiting times specifically for bus trips play a role when changing from the U-Bahn or S-Bahn in Trudering to the local buses. Due to the different headways, waiting times for the connecting buses can be perceived as long, and the coordination between the PT services as insufficient.

To cover the first and last mile to and from the U-Bahn- or S-Bahn-station, Bill uses his car, as he does not live in proximity to a bus stop. Anne prefers to cycle to the station. This does not only allow them to avoid waiting times for the bus and reduces the overall travel times, but also increases the feeling of flexibility and independence towards the times to travel, and the selected PT station. Overall, the lack of tangential PT connections for trips in the outskirts and

surroundings of Munich is criticised, which leads to longer travel times and the need for frequent changes.

- Bill: *Now, first I have to walk to the bus, then I wait for the bus, I enter and ride to the S-Bahn, then I have to wait again – just with regards to the travel time that is a great effort. (37)*

*And yes, if the cars are available, one drives the two or four kilometres to the next U-Bahn station. (38) And if I drive to the city centre [of Munich], I usually take the car [one underground stop further into town] to Kreillerstraße. (38)*

Finally, especially regarding bus trips in the neighbourhood, the interviewees feel acknowledged by other traffic participants and bus drivers. Caroline values support to board the vehicle with her rollator, if no low-floor buses are employed.

- Caroline: *And especially, what I notice when I go by bus: there is always someone to help me out. (4)*

### **Cars, parking spots**

Amongst the interviewees, their private cars are used for specific purposes. Due to the aforementioned waiting times for bus services, car trips are seen as advantageous for spontaneous travels. In this context, the flexibility of motorized individual transport in comparison to PT trips is valued. Car owners furthermore prefer this mode for trips in the periphery of Munich and enable seniors to access destinations with an inconvenient or insufficient PT connection. To transport goods, car travels are perceived as better suited, in accordance with the personal health conditions. For trips to the city centre of Munich however, the interviewees prefer PT, because of challenges with finding a parking spot, and discomfort with the inner-city traffic volume.

The interactions between car ridership and personal health conditions are described as ambivalent. On the one hand, citizens who are limited in their mobility options, especially in their ability to carry out daily trips by active mobility, rely on their private car. On the other hand, senior citizens give up or are asked to give up car ridership as a consequence of health conditions. Older residents who do not own a car or are not able to drive themselves, like Caroline, rely on others for necessary trips to destinations that are not accessible by other modes. This can be by family members, but also require trips by taxi or shuttle services

Available parking spots close to their destination are a central aspect of car travels. Larger supermarkets and stores like a hardware store provide customer parking, whereas the options

alongside Wasserburger Landstraße are scarce. The availability of parking spots can impact the choice of destinations, if alternative POIs are reachable.

- Bill: *As far as parking spots are concerned, that is a problem, one can see that it is pure chance to find a free parking spot. And for the survival of bakeries or stores, parking spots are very important. (1)*

Researcher: *Which [POIs] are less accessible [by car]?*

- Bill: *Yes, those located at Wasserburger Landstraße. Mostly, when I go to the bakery, I am lucky [to get a parking spot], otherwise I go to the bakery at Friedenspromenade. (14)*

On the other hand, the high car ownership rates in the neighbourhood impact the streetscape in the residential areas. Consequently, parking spaces are scarcer in these parts of Waldtrudering, leading to additional traffic searching for parking spots, and resulting in potentially longer walking distances from their parked car to the final destination. This is not only the case at their very dwelling place, but also for guests at the Familienzentrum, which, as Figure 5.2 on page 47 had shown, is located in the residential areas, too. The large number of parked vehicles impacts the traffic flow in residential areas.

- Anne: *However, for instance I sometimes take the car here [to the Familienzentrum], when for example I have to continue on afterwards, the car is loaded with different things. For this reason, I take the car and in this residential area here, it happens frequently, if you don't find something on the parking lot itself which has only three parking spots, if you don't find something there, it becomes difficult to find something around here. Then you have to drive around the block a couple of times until you can park your car here. (9)*
- Bill: *What is for us ... so a problem which I see, is, gradually, the traffic situation, also in residential areas, because everything is parked full with cars, you almost can't get through anymore. (38)*

## **Noise, air pollution**

As Waldtrudering is a mainly residential neighbourhood, speeds for traffic in the housing areas are limited to 30 km/h. Those streets are, to a large degree, no through-streets, which is why local residents perceive their surroundings as quiet.

- Bill: *So, back there at our place, it is very quiet. I live all the way back, so nearly at the edge of the forest, therefore noise is not a concern for me at all. (38)*

- Anne: *Traffic noise? Doesn't bother me. We live relatively close to the main road. (34)*

At the main roads however, street traffic noise is impacting the seniors' experiences. This leads to a decreased quality of stay, especially regarding the fact that most services are concentrated around this area. The level of noise there has furthermore an impact on the route choice of pedestrians and cyclists, like Anne, when making their way to a destination at the main road or passing through.

- Anne: *Yes, so near the busiest roads like the ones right ahead, the Wasserburger Landstraße or the Truderinger Straße [in the city centre of Trudering], those are the two major roads, it is indeed loud, I think. But I don't actually stay there, I drive through and then I'm gone! (37)*

*And I mean, if you know what apart from abrasion from tires and the dust that collects on roads and all of that gets blown up into the air every time – yes, of course. For me it is... that is why I don't like travelling along the main roads. I do it at times, if necessary, but I don't like it as I'm aware of all these issues, and that lessens the enjoyment then. (16)*

#### 6.1.1.4 Perception of active mobility and public places

##### **Walkability, connectivity, road crossings**

As 28 out of the 33 interviewed residents walk regularly, in line with their abilities, the necessary infrastructure for this must be considered. Trips by foot are either taken in order to access POIs, thus the proximity of services can influence the walkability, or for leisure purposes and recreation. The walkability of a neighbourhood involves the availability of infrastructure for pedestrians on the one hand, and its quality on the other hand. For the interviewees, sidewalk quality goes with its width, surface structure and evenness, and the height of kerbstones. Especially in the residential areas of Waldtrudering, street design is shaped by parked cars, which has an impact on the pedestrians' experiences. In addition, insufficient pedestrian infrastructure poses challenges for seniors with physical limitations or walking aids, as Caroline explains.

- Caroline: *First of all, they [the sidewalks] are full of parked cars, and, unfortunately, they are so sloped, and due to the slope, I have to hold the walker [meaning: the rollator] really tight, and that is hard for my shoulders. (4)*

Residents as Anne can have a similar experience, for example when walking with a shopping trolley or a stroller, and consequently show consideration for neighbours like Caroline.

- Anne: *What bothers me are the sidewalks, and the sidewalks because they all are so lowered [and thus uneven]. So, for older people, with a rollator you have no chance, you are so busy holding the rollator in order to not fall over, and it is similar with a stroller. (13)*

As Figure 4.4 in chapter 4.2.2 has shown, road types in Waldtrudering vary between residential areas and the two main roads. Being a federal road, the Wasserburger Landstraße has two lanes for motorized traffic in both directions, divided by a greened lengthways island in the centre, which is however not designed for road crossings. To change sides at Friedenspromenade and Wasserburger Landstraße, pedestrians tend to rely on traffic lights. Especially for crossing the Wasserburger Landstraße, seniors criticise the low number of traffic-signalled crossing opportunities, but also short green phases on traffic lights. Overall, the infrastructure for pedestrians is seen as fundamental to enhance their perceived safety and comfort on these trips.

- Anne: *I experience deficits with the traffic lights. Sometimes, one has to wait for a really long time for the green light, and if it turns green, the green phase is really short, so short that even I can barely manage to cross the street, and I am a good walker. [...] For example to cross the Wasserburger Landstraße, one uses the traffic lights almost always, because it is a very busy road. The times for crossing are extremely short. And if one has severe walking problems, one can reach the middle of the road and has to wait for another five minutes, for the next green phase. (23)*

Finally, chapter 4.2.3.2 has shown in which neighbourhood parts residents are required to cover further distances to access POIs. As the ability to walk these distances can be diminished by health issues, benches and possibilities to rest are required, especially for seniors like Caroline. This helps her to maintain their ability to go by foot while enhancing perceived safety and comfort.

- Caroline: *And then we go to REWE, which is right there, and there I sit down on a bench. As I got sick now [...], and my gait is unsteady. (5)*

### **Cyclability and cycling infrastructure**

Similarly to trips by foot, interviewees report cycling trips both for access to POIs and leisure trips. As chapter 4.2.3.2 has explained, cycling also allows residents to cover distances in the neighbourhood within shorter travel times compared to walking. Figure 4.8 in chapter 4.2.3.1 has shown that bicycle paths in the study area are localized to the main roads Wasserburger Landstraße and Friedenspromenade. For the 18 cycling interviewees, the available cycling

paths contributes to their satisfaction with this mode. Criticism includes their uneven surface structure and the lane width, making overtaking manoeuvres more difficult. Cyclists have to use the streets in the residential areas in the tempo-30-zones. However, the lack of cycling lanes in this spatial context is not necessarily considered an issue by itself, due to the low traffic volume of motorized transport. In these parts of the neighbourhood, the speed limit of 30 km/h enhances the perceived safety. In addition, parking cars can cause unclear traffic situations. This is why cycling residents are ambivalent about whether or not the residential areas require additional bicycle paths. In order to improve the experiences of older cyclists, not only the available infrastructure, but also the behaviour of other road users influences the perceived safety and comfort. Parking cars on the bicycle paths at the main roads and an overall lack of consideration are perceived as challenges. Furthermore, bicycle parking is described as improvable. Additional, rain-protected and well-lit parking possibilities at the main PT stations Trudering and Gronsdorf can hence facilitate intermodal trips. Anne is the resident who, due to her regular bike trips, expresses the largest concerns on cyclability.

- Anne: *That could be better in my opinion. So, you always hear that, if you cycle on the road, that cars have to keep a distance of 1,5 m. But the bicycle paths are only about this wide and there are supposed to fit two cyclists side by side – so someone can overtake – and you just don't look at the spacing anymore. So, I find the bicycle paths too narrow, and they also often aren't in a good condition because of tree roots making their way. (22)*

*The Wasserburger Landstraße is fully parked with cars, that's where the bicycle path is, where you can cycle. But on the left side you have parked cars, parked together really closely. Often, when you want to cross a street, those cars actually stop right on the bicycle path and if you rant, they rant right back. (23)*

- Bill: *No, there are no bicycle paths. Correct, yes. Well, it is like that and I think that the cars should drive a little slower. Some just race through there, but ... no, it think it is okay, you don't need to have a bicycle path everywhere. (13)*

### **Green infrastructure, quality of stay**

Public greenery serves multiple functions for seniors' behaviours. First of all, they value green infrastructure for active mobility. Such pathways are chosen deliberately by older cyclists, but also pedestrians, for an increased feeling of comfort and safety. Apart from this, older people use the local green infrastructure, particularly the proximity to the eponymous forests around Waldtrudering, for walks. Smaller parks are perceived as additional opportunities for recreation and places with high quality of stay. Furthermore, considering the urban heat island effect,



citizens appreciate the cooling effects of greenery. Resulting from Waldtrudering's historic origins, as described in chapter 4.2.2, residential properties in the area oftentimes include a private garden. For seniors, this firstly contributes to a pleasant image of the neighbourhood, and secondly allows the interviewees to rest in private outdoor areas. Spending time in the private garden can thus add on to, but also replace, leisure-motivated trips. For the purposes laid out above, older residents claim that the preservation of urban greenery should be considered in future neighbourhood developments and land-use plans. In addition to greenery, urban furniture enhances quality of stay, especially benches to rest on.

- Anne: *Yes, the forest of Trudering here is shaping the area, one can say, with a lot of trees still standing there, where one can spend time nicely, and a pretty park. That [park] is the Graf-Spee-Platz, which is also really, really lively. (9)*
- Bill: *And as I live close to the forest in Waldtrudering, I do of course have the possibility to take a long stroll every evening, whenever I feel like it. (34)*
- Caroline: *I own a beautiful garden. And due to my problems with walking, I rather walk around 20 times in my front yard [...] I am close-by at least, so I can sit or lay down if I need to. (15)*

#### 6.1.1.5 Accessibility of POIs

As shown in chapter 3.1.3.2, the concept of accessibility requires the consideration of the spatial distribution of services as well as the ability of individuals to overcome the respective distance with a, for them, reasonable effort. Spatial analyses have shown that the concentration of POIs is highest alongside Wasserburger Landstraße, leading to a balanced proportion of population- and service density. In this part of their neighbourhood, residents perceive Waldtrudering as densely supplied. The proximity of trip destinations can influence their accessibility to seniors. This is especially the case for trips covered by active mobility. As a consequence of the spatial distribution of POIs, the distance between the place of residence and the main roads is to be considered in this context.

Anne, who can use the whole range of available transport options, benefits from the proximity to POIs in her neighbourhood as she can use active mobility for short-distance trips. Furthermore, Anne takes trips to the city centre of Munich and outside of the city for specific, service- and leisure-based activities. As she can select the mode of transport that is suited best to access a desired destination, she is satisfied with the accessibility in Waldtrudering.

- Anne: *That is practical for us. We can walk over there with a shopping cart. Within ten minutes, maximum, we can access REWE. And for other stores this is similar. They*

*are all accessible by foot. Whether that is the pharmacy or a doctor around the corner, that is all well-structured here, so we don't have any problems. (12)*

*Yes, everything is close here, but a lot of destinations are still in the city centre, to see certain doctors, or our family, or stores. But for daily needs, let's say for groceries and something like that, we are incredibly well equipped here. So, we live in the direction of Haar [...], and there, one can, or has to, actually think about which supermarket to go to – basically, there are way too many. Yes, Haar overall is offering a lot in addition, thus I am often travelling in this direction. Or to Baldham. There is my hairdresser, for example. Whenever possible, I cycle there. (16)*

*So, at the moment everything is really well accessible, but perhaps it'll be different in ten years' time. (23)*

Bill owns a car and a bicycle. As he lives further away from the densely supplied main roads, he considers active mobility as less suitable to access required destinations. He prefers car trips over PT, except for trips to the city centre of Munich. However, he does not have a PT stop within close reach. Active modes of mobility are used by Bill regularly, but, due to minor health problems, he does not employ them for further distances. He can still access daily services due to private vehicle ownership, but he expresses the concern of whether the accessibility of POIs for him was diminished otherwise.

- *Bill: I live so far from the nearest stores that it is not reasonable to walk there. [...] Yes, if one is still very mobile, so one has the possibility to either take the bike or the car, then it's alright. [...] Otherwise, my place of residence would be a little difficult for older people who don't have a car any more or who are no longer able to bike. (38)*

Caroline does not own vehicles in her household. She walks to destinations that she requires regularly, but, due to her health impairments, she requires a high density and proximity of POIs. Occasionally, she combines trips by foot with bus trips within the neighbourhood. To cover further distances to essential POIs, she relies on others to give her a ride, but also explains that she omits trips to destinations if they are not accessible to her.

- *Caroline: That is all here. The way across the street and then in that direction to REWE, there is also the bakery Traublinger, and the other [bakery] is also there, the [...] Pfistererei. They are all there, and like I said, that's the direction. Because Trudering is the [other] way, and that is often too far for me. (4)*

### 6.1.1.6 Neighbourhood developments

Particularly seniors who have been living in Waldtrudering for a longer period of time have described their perceptions of previous neighbourhood developments. These include the relocation of the former airport Munich-Riem in 1992, which is widely associated with an increased quality of life.

- Bill: *So, Trudering has experienced an enormous upvaluation, the biggest upvaluation of the century has been the relocation of the airport Riem to Freising, Erding. [...] Before that, it has been hellishly noisy here. (40)*

Apart from this, densification and creation of new housing are perceived as positive if contributing to high-quality neighbourhood development. The growth in the absolute population number and thus in the population density can also increase the range and number of services. For instance, an extension of PT supply is described, specifically in bus lines. Older residents furthermore value actions that had been taken to increase the quality of sidewalks and cycling paths and the expansion of greenery.

- Caroline: *But, how do I put this, I enjoy walking through the settlement, because it has been beautifully greened. (8)*
- Bill: *And public transport has become more and more, meaning additional bus lines. (40)*

Immigration to the area goes hand in hand with the overall immigration to the city of Munich, as described in chapter 4.1.1, but is also part of sub-urbanization processes. Older residents are critical towards side-effects of a rising number of inhabitants. Long-time residents observe a decline in local supplies. Despite the large number of stores alongside the main roads, and their overall accessibility for senior citizens, as chapter 6.1.1.5 has shown, the options for shopping in the neighbourhood's edges have been reduced. At the same time, the number of private vehicles is increasing, shaping the image of residential areas with a rise of parking traffic in public spaces.

Finally, the interviewees characterize the district Trudering-Riem as wealthy. As this can result in rising rents and overall costs of living, especially seniors with a small pension can be challenged by that. What is more, wealth facilitates private vehicle ownership, thus reducing the demand in the neighbourhood for public services, including PT.

- Bill: *With all of these multi-family houses, it has led to one parking spot being planned for one flat, so with a parking garage underneath, and the other cars stand outside [in the streets] and they actually park everywhere. (9)*

*The prices have gone up massively. As the client base is here. Other, long-term residents, I'd say, who (live here) as well, they can't keep up with that, as I am for example [financially] limited to my pension. (15)*

- *Caroline: Here, in the outskirts, one can no longer buy everything, unfortunately. I moved here [...] 40 years ago, when there were a lot more retail businesses in Wasserburger Landstraße – really good stores – so that one did not have to drive to the city centre [of Munich]. Out here, one could basically get everything, and the number of stores dwindled with time. (15)*

*I also feel bad when the buses, there are only one or two passengers on the bus. That is a great pity for the supply service. (21)*

Besides from the local developments of Waldtrudering, the reconstruction works of the city centre in Trudering is addressed by 12 interviewees. The redesigning, up until 2023, aimed for increased quality of stay, a strengthening of local economies and traffic calming measures. Seniors in Waldtrudering move in this newly designed area regularly, including trips to local stores and services, to and from the U-Bahn and S-Bahn station in Trudering, or to pass through. The additional urban furniture and increased sidewalk width are praised by Caroline. However, a large share of older residents is dissatisfied with the reconstruction works. Especially bicycle users criticise the lack of cycling infrastructure, and the resulting need to share the road with motorized vehicles raises safety concerns. Moreover, the parking situation is described as unclear.

- *Caroline: And Trudering, in the centre of Trudering, they have created a pedestrian zone this year [in 2023], with a lot of benches, you can sit down anywhere. They designed a fountain [...], a large ice cream parlour with seats outside, and they planted trees. They did it quite nicely. There are also many lovely shops. This turned out really beautifully! (7)*
- *Bill: One has to say now, so let's say, the whole thing actually went wrong a little. And when you talk to people now, I go to the hairdresser there, buy myself an ice cream or something, I go shopping. If you talk to the local business owners there, the neighbours of the 'Truderinger Meile' ['Mall of Trudering'] or how it's called, they are all complaining. Built with a huge effort, long construction times, and now there are far fewer parking spaces. It is really narrow, wide sidewalks, almost no path for cyclists, the buses have to get through. So, it's so cramped now that practically everything that it was supposed to do [...] wasn't accomplished. (25)*

## 6.1.2 Individual

The previous chapter 6.1.1 has laid out how older people interact with the infrastructure for urban planning and transportation in the study area. At the same time, additional factors must be considered which impact mobility behaviour on an individual level.

### 6.1.2.1 Influencing factors on mobility behaviour

#### Health and personal limitations

First and foremost, health and physical limitations can be found to impair seniors in their mobility routines. On the one hand, this factor is highlighted by individuals who are personally affected on the one hand. Such limitations can range from the need for a wheelchair, a rollator, or crutches to illnesses concerning their bodily functions for movement, the circulatory system, or balance. This means that affected seniors adjust their mobility behaviour, firstly their mode choice. If adjustments cannot be made, health limitations can impact the enjoyment or even cause a feeling of insecurity on a trip. Finally, the accessibility of destinations can be decreased due to physical constraints. Similar experiences affect seniors that are temporarily limited, for example due to injuries. On the other hand, residents without health-related mobility restrictions show consideration by reporting scenarios that they perceive as challenging for limited persons. It thus shows that the local infrastructure, especially for pedestrians, is perceived differently depending on personal abilities.

- Caroline: *The next [bus] stop is 300 metres away, and if you are in pain, or older, 300 metres are a lot already. (10)*  
*So, if you can't walk, that is a major barrier, I have to say. (19)*
- Anne: *Oh dear, now I cannot think of anything. Oh, actually, yes! So, I think that people with a rollator or a wheelchair, they are likely to have struggles, as there are recurrently sidewalks [with high curbstones], or the elevators at stations for U- and S-Bahn are not working. And lately, I realized that these scooters are standing everywhere, those [...] e-scooters. And it seems that people do not think of such people [with rollators or in wheelchairs], who need a proper crossing to change sides of a street. This is often exactly where these e-scooters are parked. Or I think that this is really bad for blind people. (22)*
- Bill: *I think so, yes, it was just for me back then when I was walking with crutches for a long time. I was dealing with this for a very long time after the accident. Now, when I*

*walked across the intersection when it is green, I never made it, it was very stressful back then, I never made it across while it was green. (21)*

### **Weather, seasonal circumstances**

Correlating with the topic of health outlined in the paragraph above, weather and seasonal factors are considered by seniors. This comes to the fore for active modes of transportation. Especially during wintertime, older people voice their concerns about active mobility. Insufficient maintenance of such infrastructure, specifically regarding snow clearing and salt spreading on sidewalks and on streets and lanes designated for cycling, can raise older people's anxiety about safety. As a consequence, bicycles are less used during wintertime.

- *Anne: Then, the roads here are neither gritted nor salted, so that is too dangerous, which is why I do not do that anymore. Generally, I do not care about the weather too much, but when the roads are slippery, that is dangerous [...]. Often, the bicycle lanes are not cleared of snow, and the streets are neither gritted nor salted, except for the main roads, so it is possible to cycle along the main roads. (9)*
- *Bill: No, it's too risky. [...] It's often just the areas on the side or something like that that are smooth, they're more slippery than the road, and then you just fly, well. I had two or three crashes and then I said, well, the bike will be forgotten during that time. So, in older age, one should take a little care of one's bones, yes it's like that! (24)*

In addition, cold or rainy weather can provoke these people to a mode shift from active mobility towards motorized forms of transportation. Moreover, reliability of PT increases in subjective relevance in those weather conditions because waiting times at PT stations are perceived as less comfortable. During the summer period however, seniors are occasionally reducing their activities, such as walking and cycling, to avoid heat.

- *Caroline: Unfortunately, it's like this, if the bus just left, one has to stand around for 20 minutes, and that is not too enjoyable, especially during wintertime. (11)*
- *Anne: There is a bus close to my place of residence, and in heavy rainy weather, or I do not feel like [walking or cycling], I take the bus as well. (16)*

Nonetheless, older people who are experienced pedestrians and cyclists strive to employing these modes in disregard of adverse weather conditions.

## Costs

With regards to the matter of old-age poverty, examined in chapter 4.1.1, costs for mobility are a factor to be considered for the sample. These include the overall costs of living on the one hand and mobility-related expenses on the other hand. The latter are associated among older people with costs for individual motorized transport, and the purchase of PT tickets.

Seniors who are using public transport regularly have reported to rely on the “Deutschland-ticket”, or “49-euro-ticket”, since 2023. Aside from saving expenses, the interviewees value the 49-euro-ticket for increased convenience. This way, they do not face the need to deal with ticket types and diverse fare systems of PT. Overall, 11 of the interviewees claim to use the 49-euro-ticket.

- *Anne: Yes, I use the 49 € card because I sometimes ride my bike outside, and the 49-euro-ticket is useful because I no longer have to worry about the fare zones, yes. It works everywhere. That is pretty good. (39)*

Similar benefits have been associated with the limited time offer of the “9-euro-ticket”. In addition, five interviewees who are not obtaining the 49-euro-ticket have used the 9-euro-ticket for one or more months. As they use PT occasionally, like Bill, the monthly costs of 9 euros are perceived as rather acceptable than 49 euros.

- *Bill: So, I don't take frequent trips [by PT], I have to say. This is why, when there still was the 9-euro-ticket, I purchased it at an instant, but for 49 [euros], I am still thinking about it. I don't have it on my mind now, but I have to take so many trips for it to be worth it, and I don't do that, and then I rather don't buy it. (37)*

Munich's public transport companies offer further passes for seniors that can be purchased on a monthly or yearly basis. These tickets are used by regular PT passengers, whereas vice versa the ownership of a season ticket can, just like the 49-euro-ticket, motivate additional trips by PT. Caroline uses a senior-specific PT pass for disabled persons, which is perceived as a low-cost option for mobility.

Further PT tickets purchased by seniors include single trip-, 10-trip-, or one-day-tickets for occasional usage. Especially the former two options are however perceived as costly for sporadic PT users. Due to the fare structure of Munich's PT system, this is particularly the case for trips directed out of the city and in the surroundings. Even though car trips appear to be less expensive for infrequent PT users, car travel, first and foremost car ownership per se, can be a matter of costs.

- Bill: *I still have [a car], but the one I drive at the moment will probably not pass the next MOT, and I can't (afford another car at an instant). [...] So, I don't know yet what to do afterwards. (15)*

Costs for fulfilling mobility needs can rise for older people with physical limitations. Alternatives to self-executed trips, such as delivery services or taxis, are seen as costly.

- Anne: *Yes, because we are very mobile! If you are restricted, you have to spend a lot of money. If you cannot do that, it's difficult. (26)*
- Researcher: *And you said that taking a taxi is also a matter of costs for...?*
  - Caroline: *That is a matter of costs, yes, it simply is that way. (10)*

It can be concluded that subscriptions to monthly or yearly PT tickets can lower the barriers to mobility, increase the number of trips per se, and create convenience and simplification. These objectives are also associated with the 49-euro-ticket, aside from benefitting seniors who, in addition, travel outside of the area of Munich's transport association. Amongst the research sample, the 9-euro-ticket has invited infrequent PT users to use this mode more, whereas the 49-ticket is advantageous for seniors who travel by PT regularly. Finally, information on ticket options and subscription conditions for older persons can support them in identifying an appropriate offer for them.

### **Digitalisation and information**

As described in chapter 3.1.1, seniors face technological development and digitalization in their daily lives. Seniors who are experienced with digital technologies use them in their daily lives. These services are used to receive information about, and during, travels, especially by PT. Information is appreciated for trips which occur outside of Waldtrudering and also beyond the city of Munich, and in the case of delays, detours, or construction work.

Besides, carrying out daily services digitally can have a two-fold effect on older people. They firstly familiarize themselves with services that they consider useful or necessary in their daily routines. For example, online banking has become common amongst older citizens. Consequently, their need to undertake related trips is reduced. This can also help them avoiding further travel distances, as for instance the number of bank branches in the study area is decreasing.

- Bill: *And of course, you struggle without online banking. I mean, we can still use it, and if you can comprehend it, even in old age, then it is great. But for others of the same*



*age, who can't do that or for example don't have a laptop, then that is actually difficult.*  
(35)

At the same time, digitalisation is described as potentially exclusionary. This affects seniors who are unexperienced with such technologies, are unwilling to use them due to privacy concerns or cannot afford a mobile device. Great emphasis is consequently put by interview participants on introducing digital technologies in a senior-inclusive way, while maintaining a possibility for analogous alternatives. For the purchase of tickets for PT, alternatives like ticket-machines are desired. In this context, senior-specific support regarding the use of digital technologies is desired. This suggestion, which can for example involve assisting persons, is picked up again in chapter 6.1.4.

- *Anne: Yes, I don't think it's okay, because you simply have no choice left. To be able to simply say, I can, either I have to leave it and cut myself off completely and don't do anything, nothing more, so no more cell phone, no more laptop. (11)*

*And with the 49 € ticket, people, and especially the older people again, had to buy it online. [sarcastically] Great! And I just was in the centre there, Marienplatz or even Ostbahnhof. Do you know how long the queues were? I've nether seen anything like this.*

- *Researcher: You mean [the queues] to be able to buy the 49-euro-ticket in person?*
- *Anne: Exactly! As not everyone can do that online. (35)*

Finally, services for shared mobility are not used amongst the interviewed residents.

### **6.1.2.2 Feelings about mobility situations**

#### **Unsafe and overwhelmed**

First of all, the network of public places in Waldtrudering is overall perceived as safe. This is also the case for being on a public transport vehicle.

On their out-of-home movements, insecurity is perceived by seniors in context with an increased risk of injuries, which can cause long-term physical consequences for members of the researched group. This is why the desire to feel safe has an impact on various aspects of older peoples' mobility behaviour.

The first strategy of seniors to cope with safety concerns is to pay increased attention to their surroundings and other traffic participants. In comparison to that, trips feel more effortless to older people if they feel acknowledged by others. This aspect will be elaborated on in the following section “Considered or overseen”. Situations that raise safety anxiety involve the crossing of and moving alongside busy roads, specifically Wasserburger Landstraße and the centre of Trudering.

- *Caroline: And there I have to, I always pay attention to make eye contact or make [the other traffic participants] notice me, so they know ‘Yes, I want to cross now’ [...], because as a pedestrian I don’t want to risk an accident with a car. There you definitely come out on the short end. (40).*

The goal of avoiding a sense of being overwhelmed can impact older people’s mobility behaviour. This is due to them requiring for example more time to adjust to busy or unfamiliar situations. Overwhelming situations can raise concerns about an increased risk of injuries and are thus to be avoided. Busy traffic situations are a prominent example to be perceived as overwhelming, especially rush hour traffic both on streets and in PT vehicles. Furthermore, with Waldtrudering being a residential area, trips in the centres of Trudering and Munich are perceived as more stressful due to the higher traffic volume.

- *Bill: So I do travel to Munich’s centre, but by PT only, because doing that by car requires steady nerves. (35)*

Specific concerns are furthermore highlighted by interviewees who have already been involved in a traffic accident in their old age.

- *Anne: And for older people who are no longer able to walk well, getting on and off the bus is a risky and difficult situation. Because someone almost always has to help, because they can’t fall down anymore, if they do, then something major is broken. (24)*

*Researcher: And what about the S-Bahn and U-Bahn in Trudering?*

*Caroline : No, I do not dare to travel with those anymore, and I don’t need to travel such far distances any longer. (4)*

### **Considered or overseen**

First of all, a lack of consideration can be perceived regarding the needs of seniors. This can be the case in urban and in transportation planning matters and give older residents the feeling that their specific needs not being acknowledged to a sufficient degree in the planning process.

Apart from that, seniors talk about a lack of consideration and thoughtfulness by traffic participants. Inconsiderate behaviour of other traffic participants can cause behavioural changes of seniors, but also make them perceive a trip as less positive. Interactions can therefore be found between a perceived lack of consideration and feelings such as overburdening or insecurity. Depending on personal abilities and experiences, this can impact their mobility behaviour, as explained in the section “Unsafe and overwhelmed” above.

- Anne: *Well, I find car drivers extremely impatient here to be honest, that doesn't just apply to Trudering, but in general. Insanely cursing, impatient, fast! (23)*

*[The consideration that is shown is] overall very different. There are some who are considerate, just as there are those who are not considerate. (22)*

In contrast to this, older people value considerate behaviour that other traffic participants show, for example when being offered a seat when using PT. In this context, it must be underlined that, while they deserve and value the justified support shown to them, for example with preferential seating in busses, seniors do not necessarily insist on it. Instead, they appreciate support, but still strive for personal independence.

- Bill: *Well, it happens to me more and more often that people on the bus, tram or S-Bahn stand up for me. Yes, and I had an experience and... the subway was packed [...], I just squeezed in and a young pregnant woman wanted to stand up for me. Well, I was shocked, I mean I didn't accept the spot. (8)*

Furthermore, an essential part of “feeling considered” to older people is to receive relevant information in a, to them, suitable way. This includes information on a trip as well as senior-specific support. The former is especially relevant when changes have to be made to mobility routines, for example due to construction works, but also in unfamiliar situations. A special need for this arises for seniors with impairments or difficulties with orientation. As explained before under the topic of Digitalisation and Information, the focus group values the opportunity for analogous sources of information in addition to digital offerings. In addition, digital services that are used regularly by seniors are to be adapted to that user group.

In a similar way, challenging situations within the study area are not only described by seniors who are immediately affected. Instead, consideration to these obstacles can come from other members of the researched group who are unaffected themselves. This consideration arises from direct observations of challenges or similar experiences of persons in the own social network.

### 6.1.2.3 Additional benefits of mobility

Additional benefits regarding their mobility motivate seniors to move outside of their homes and make trips more enjoyable. They can impact the decision-making process with regards to a specific mode or aiming for a specific purpose for out-of-home activity. These are factors that, when focusing on the mobility of aged persons, consequently need to be taken into account, apart from enabling them to get from A to B. They enhance the value that being mobile has for the researched group. As these benefits come in addition to the sheer fulfilment of mobility needs, they should not be connected to additional challenges or disadvantages.

#### Health and fitness

Especially for older people, being mobile includes more objectives than fulfilling the trip purposes described in chapter 3.1.2. Choosing cycling and walking as modes of transportation is frequently due to fitness and health benefits of active mobility. These trips by active mobility are both for undirected leisure purposes, such as taking a walk, but also to fulfil daily needs. Remarkably, this applies for residents despite various personal physical limitations. All portrayed personas enjoy physical activities in conformity with their abilities. Even though Caroline is limited in her ability to cover further distances as a pedestrian, walking aids and regular rests support her on walking trips. Seniors like Anne, who are not physically limited, include trips both by foot and by bicycle in their routines, and use the latter also for further distances that exceed the neighbourhood. Finally, Bill perceives the bicycle as a joint-friendly activity to be mobile.

- Anne: *And the bicycle is for the closer surroundings, shopping et cetera nearby, or specifically as a fitness programme from time to time.*  
*If I go to the bakery, that is less than half a kilometre, roundabout 500 metres. I often take this trip by foot. I decide to walk deliberately, when I think I have to exercise more or should exercise a little more. As cycling is not so intense, and when I cycle short distances, I do not have the feeling of being very active, so I walk sometimes, because I have enough time to do so. (9)*
- Bill: *I say, as long as my muscles do their job, I do not need an electric motor for my bicycle. This means I use my bicycle also to stay in motion, to activate my joints and so on, and because I enjoy it.*
- Caroline: *I walk outside in every weather! [...] I need that, and as long as I walk, my leg is also doing better. (4)*

## Social interactions and participation

Being mobile is a central requirement to enable older adults to participate in public life, which is why this aspect is relevant to all personas. Possibilities for social interactions are seen first and foremost in the community centres of the neighbourhood and in senior-specific events and courses. The activities that they engage in have to be suited to their personal abilities and preferences. Thus, Anne enjoys the sports group at Familienzentrum, whereas Caroline attends the handicraft meetings there. Additionally, the enhancement of active mobility and public places with a high quality of stay, for example parks and greened areas with benches, allow for spontaneous encounters and support the desire for social interactions of this group. Furthermore, especially long-time inhabitants of Waldtrudering value the residential, sub-urban character of the area, as it facilitates being in touch with their neighbours. This benefit of social interactions is especially relevant for the residents who live in single households.

- Anne: *Here, for example, our table tennis group. That is always really nice, we play, we chat, that is good for me. Or having a group of friends, yes, that is very important. (23)*
- Bill: *I go to the Promenadentreff a lot, to be in contact [with others], for lunch or board game afternoons to seeing a movie and so on. (7)*  
*That is also good for us, because, the neighbours, I grew up here, and the younger people living around me now are all very helpful. (38)*
- Caroline: *No, sometimes it's really nice to open up to someone, especially when you're living alone, and this is why I am really glad that I can come to the knitting club here every 14 days. (14)*  
*Or you meet someone or see someone [you know] from time to time. Then you join in. (1)*

## Independence, flexibility

As seniors do not have to include commutes in their daily mobility routines, the times of day for their trips are more flexible. Furthermore, they value private modes, specifically trips by bicycle and car, as they are available to the owners flexibly in time and space, in comparison to public transport. Anne enjoys regular cycling as a way of being independent in her mobility behaviour. At the same time, if temporary limitations, for example due to an injury, cause Anne to rely on others, she ends up less satisfied. In addition, Bill values car ownership for the door-to-door experience and spontaneous trips, which is why he perceives shared mobility as less suitable for him. Furthermore, older persons value freedom of choice in their mobility behaviour. This includes the aforementioned mode choice, but also the opportunity to choose the

times and days for their travels freely. For the sample, maintaining independence, in line with their abilities and required support, contributes to personal well-being.

- Anne: *I prefer to cycle, that way I am independent and can get everywhere, and also cover further distances. (37)*
- Bill: *The car is really convenient, it's there, I know it's in front of the door and I sit in it and I'll probably get ahead well with that. And then I don't have to think for long about when the bus leaves or rather when it runs or if the S-Bahn runs at all. (9)*
- Caroline: *Yes, what do I think... I hope to stay healthy for a long time, nobody should have difficulties with me. That is my desire, as long as I live, I do not want to be a burden for anyone. (2)*

In addition, spontaneity is valued regarding the costs of mobility. Particularly the 9-euro-ticket during the summer 2022 has been perceived as advantageous due to its monthly purchase option. In comparison to that, as laid out in the section "Costs", the 49-euro-ticket is seen as a rather long-time investment. However, once purchased, the 49-euro-ticket enables its holders to travel flexibly within and around Munich.

In addition, senior-specific services can support them in their independence, and their abilities to carry out desired activities. This can be by the help of an accompanying person on trips, especially for older persons who feel insecure. Their family or members of their social network can take up this role, but also voluntary workers from senior centres. Besides, courses from the respective social institutions can provide knowledge that older travellers lack on their trips, including digital support.

### 6.1.3 Perception of mobility (in-) justice

As a part of the question collection posed at the interviewees, they are directly asked about their perception of mobility (in-) justice. The description of unjust experiences can thus be compared to personal circumstances and challenges that senior citizens encounter, enabling an understanding of the interactions between transport disadvantage and mobility injustice.

#### 6.1.3.1 Perception of injustice

First of all, residents who claim that they are not perceiving injustices in their mobility patterns are expressing an ability to carry out their desired trips, based on a sufficient accessibility,

proximity and availability of options. Furthermore, seniors who are making changes in their routines assess them in line with their senescence and thus not as unjust if they are still able to meet their mobility needs.

Subsequently, older adults who claim that they are not experiencing injustices themselves explain that by their good health conditions.

- Anne: *No. Probably that's because we are still too fit. I have to be honest on this. (13)*

Interviewees with physical limitations describe injustices, which occur because of walking distances that are not comfortable or feasible to them, in order to access relevant destinations, such as POIs and PT stops.

- Bill: *Well, if you live where I live and get older and you are no longer mobile and need to go shopping. And there is no way to drive there now. (38)*

Apart from the distance itself, the urban design of such footpaths can be cause to injustices, specifically a lack of benches or possibilities to rest while walking. Mobility injustice has also been perceived by older adults with regards to the short green phase at the pedestrian traffic light signalling to cross Wasserburger Landstraße.

With regards to PT, the connection with buses at the station in Trudering, after arriving by S-Bahn or U-Bahn, is seen as a deficit.

Injustices are furthermore described as a lack of senior-specific offers, particularly insufficient support, and economic tenseness, and a consequently reduced ability to participate in public life. In the context with the latter, the lack of a cost-reduced 49-euro-ticket for older persons is assessed as an injustice. Besides, being required to use digital technologies despite a perceived lack of knowledge is seen as a contributing factor for injustice.

- Bill: *I think that the fact that working people can travel for practically free, partially, the commuters, is unfair! (39)*

Injustices are also described by interviewees who claim to be not affected personally about situations that can be unjust to other seniors. This includes challenges that physically impaired persons, specifically when using a rollator or a wheelchair, encounter. Injustices are assumed to result from barriers in the pedestrian infrastructure, with a limited sidewalk width and uneven surfaces. Overall, the high number of parking cars in residential areas is seen to contribute to decreased walkability, with obstacles on sidewalks, such as parked electric scooters, having the same effect. Consideration to impaired seniors is also expressed by suggesting additional benches in the residential parts of the neighbourhood, which support them in further walking

distances. Finally, the access to buses is rated as unjust for seniors with a walking aid. Similarly, a lack or the defectiveness of elevators at stations to U-Bahn and S-Bahn is assessed as a cause of injustices.

### 6.1.3.2 Summary

It can be stated that, in the description of senior citizens, mobility injustices result in dissatisfaction and cause disadvantages. However, actions to address encountered disadvantages, as the following chapter 6.1.4 will expound in depth, can be addressed in order to prevent injustices. It must be highlighted that, even if encountering challenging situations, older persons report to be satisfied with their mobility, provided that they are able to meet their daily needs. From the scope of this thesis, mobility injustices can be characterized as highly individual. What is more, injustices can be reported by seniors who claim not to be affected by them themselves. It is however possible that they experience disadvantages that are related to these injustices, specifically with regards to the urban design for pedestrians and PT but are able to cope with such disadvantages.

Older persons emphasize the value of routines for their mobility behaviour, it must thus be considered whether or not seniors choose their patterns deliberately. Being able to continue behaviour of earlier stages of life or intentionally make changes in age is thus a way to avoid injustices. In comparison to that, the perception of being forced to give up routines or a desired behaviour can be identified as a form of mobility injustice. Such impulses can be externally imposed to seniors, for instance because of health impairments, rising expenses for mobility, or a change of vehicle ownership. When required to alter routines, experiences in earlier stages of life can furthermore impact the risk of arising injustices.

- *Caroline: And now, I try to do everything by foot or by PT. Then you are limited of course, if you have been used to drive a car for your whole life. (5)*

In such cases, the availability of suitable and well-designed alternatives is essential. In addition, a lack of consideration towards the specific needs of seniors can cause or enforce a perception of injustice. This feeling can be caused by the design of the local urban structure and transportation system. If the infrastructure, for example the proximity of bus stops, is perceived as insufficient, it can either cause older persons to use that very mode of transport less, or it can prevent them from perceiving travels by PT as an alternative for their routines. In addition, a lack of consideration by other traffic participants can enforce the dissatisfaction in a situation. The impression of not being considered can also arise in the context of insufficient investments of finances and personnel to a senior-specific services.



## 6.1.4 Desired actions and suggested improvements

In addition to understanding the mobility behaviour of seniors in Waldtrudering as well as their perceptions of the local infrastructure, actions are to be derived. Those have their background firstly in directly communicated, desired improvements. Building upon own experiences in Waldtrudering, the residents address injustices they experience. Furthermore, they may combat consequences of limitations or improve challenging situations. Desired actions can also lead to more enjoyable transport experiences, or display consideration towards other seniors even if the interviewee themselves is not affected. This can be fortified if they have gained prior insights in the mobility behaviour of older people, for example in their private sphere, from voluntary work with this social group, or as member of political bodies. Secondly, proposed actions are motivated from positive examples in other neighbourhoods or cities. The suggested actions either aimed to improve the existing framework or are based on additional services to be implemented.

### 6.1.4.1 Walkability and urban design

Related to the deficiencies experienced with active forms of mobility, seniors express desired improvements for the respective infrastructure. Accordingly amended walking infrastructure for seniors necessitates adaptations in street intersections. In order to cross Wasserburger Landstraße, green phases of pedestrian traffic lights are requested to be extended. This benefits physically impaired seniors especially, but makes the street crossings more convenient for other adults of advanced age as well.

- *Anne: What, when I, where I have a deficiency is at the traffic lights. So when you, sometimes, you have to wait forever for it to turn green, and when it turns green, it's green for such a short time, really short, that even I, and I'm a good walker, can just get across there if I'm lucky. (23)*

Additional benches can improve the walking experience in Waldtrudering. However, one interviewee remarks that such seatings should not only be located alongside the main roads. Instead, when establishing benches in the residential areas, they can support older persons with physical impairments and enable them to rest while covering the walking distance between the main roads and their place of residence.

- Researcher: *Would it help you when walking if there were more benches available?*
  - Caroline: *Yes, yes, that is helpful for me. (14)*

#### 6.1.4.2 Cyclability

As chapter 4.2.3 has shown, cycling lanes in Waldtrudering are limited to the main roads. Especially alongside Wasserburger Landstraße, the lanes are criticised for being too narrow.

- Anne: *Well, I think the bike paths are too narrow, and in many cases they're just not in a good condition because the tree roots then make their way. (22)*

Moreover, two-track cycling infrastructure is desired in this part of the neighbourhood, allowing users to follow the main road in both directions, without the need for road crossings. Furthermore, the local cycling infrastructure has been addressed for added services. Older residents require a plus of bicycle parking facilities. Implementing these at the S-Bahn-stations enhances intermodality, with additional potential for increased comfort by providing rain-protected, well-lit parking. As seniors use various types of bicycles, this parking can also be perceived as more convenient if usable for multiple tyre widths.

#### 6.1.4.3 Public transport – Services and stations

Furthermore, PT services are mentioned (in?) suggestions for neighbourhood development. As buses can be used to access S-Bahn- or U-Bahn-stations, an improved intercommunication between those modes is desired. This is related to the objective of reducing waiting times and increasing reliability and comfort. Aside from improving the PT experiences by facilitating inter- and multimodality. Furthermore, additional services are desired. By increasing the frequency of buses from a 20-minute- to a ten-minute-headway, waiting times can be reduced and temporal flexibility enhanced. Moreover, in case of service cancellation, waiting times for the next bus are reduced. To bridge the waiting times at bus stops more comfortably, weather-protecting is required.

- Anne: *Um, yes, I already got upset about it once and wrote a letter. I arrived with the S-Bahn and at exactly that moment the bus left. So the intercommunication between the bus and the S-Bahn or subway could actually work better. (34)*  
*We now also have two buses, one goes to Neuperlach Süd, the other to Illtisstraße and so on. One thing is that they actually drive one behind the other. If there was a little difference of about five minutes in the waiting time. One bus arrives, maybe it's late, I don't know, and then the other one comes along on the other side, and it might be a*

*little better if they were scheduled differently. One [every] ten minutes, the other five minutes after that. (13)*

- *Caroline: That'd be a matter to me, that the buses run every ten minutes. That way, it would be less severe if one was cancelled, but if one [bus] is cancelled now, one has to wait for 40 minutes. (7)*

Even though escalators and elevators are available at the PT stations in Trudering and Gronsdorf, they require improvements in accordance to the needs and requests of older people. Elevators are criticised for unreliability, which particularly affects physically limited persons, but also travellers transporting luggage, or bicycles on intermodal trips. Because of the escalators being small-sized, additional waiting times can be required for their usage. As there is a single escalator, operating in alternating directions, leading to the U-Bahn and S-Bahn in Trudering, seniors put forward the request of a second such device. They see this measure as relevant as, especially during rush hours, a large number of oncoming passengers can block the escalator and cause waiting times.

- *Caroline: The thing with the elevators needs to be improved a bit, because some elevators already exist and are closed then. (10)*
- *Anne: If I can now get back to the elevators in the U-Bahn and S-Bahn: do they always have to be so small? Because I mean, you can only fit two strollers in there or... and the others persons who want to go with you, let's say older people who can't walk so well? (35)*

*[..] In Trudering, there is only one escalator when you go down or up, it doesn't matter. And there's [...] [a local politician] who's trying to get this done now as well to have a second escalator so that it goes both directions at once, yes, because there's always a change. (36)*

In order to facilitate the usage of public forms of transport, seniors desire additional services for the first or last mile to and from their place of residence. For this, an on-demand shuttle service is proposed, which can complement or replace trips with the existing bus network. This is perceived as advantageous for physically limited seniors who thus can reduce walking distances or avoid walking if needed. Furthermore, autonomous buses are suggested, with a similar intended purpose.

- *Caroline: So, I mostly travel by PT, but the next stop is 300 metres away, and if you are in pain, or older, 300 metres are a lot already. [...] If there was a shuttle service, that'd be even easier for me. (10)*  
*But an autonomous bus, that'd be great, I think that's really great. If we got picked up by it and taken to the next bus stop or the station in Trudering. That'd be a great service indeed. (5)*

#### 6.1.4.4 Accessibility and POIs

Apart from suggestions regarding the transportation options in the neighbourhood, the POIs in the neighbourhood are addressed in the context of desired actions. Specifically addressing POIs and services instead of an improved transport connection to the existing destinations is, firstly, based on the fact that certain POIs are currently not available in Waldtrudering. Even though types of seniors are satisfied with the supply of POIs, as they can meet their daily needs within the neighbourhood, more specified stores are requested. These include stores for clothing and shoes and a hairdresser as well as a haberdashery store for handiwork items. Such shops are not required by older people on a daily basis, but shorter distances to these are seen as helpful, and support wellbeing and leisure activities.

Apart from these, grocery stores offering a wide, high-quality selection of goods are suggested, especially in the western parts of the neighbourhood.

- Researcher: *Is there a type of store for example that'd be important for you in the area, which you don't have at the moment?*
  - Bill: *Yes, I think, more grocery stores. Unfortunately, if one store closes it turns into cleaners or a car dealer. (23)*

In this context, POIs are desired if they are considered to increase quality of life and contribute to a high-quality neighbourhood development. Apart from grocery stores, a café with increased quality of stay is desired for the same reason. Additionally, older people perceive these POIs as beneficial if they were implemented close-by their place of residence, hence not requiring longer-distance trips.

- Bill: *Maybe a nice café would be pleasant.*
  - Researcher: *Ah, so to sit down during summertime, or in general?*
  - Bill: *Yes, I mean there [at Friedenspromenade] is the bakery Traublinger, they run some kind of café. But I always feel a little disturbed there because of the shopping. (8)*

Finally, a reason to desire additional POIs is due to the low accessibility of current services. This is the case especially for seniors who require that type of POI on a regular basis. A pharmacy in the surroundings of Friedenspromenade is thus desired by Caroline, who, because of her physical limitations, has struggles accessing pharmacies in the other parts of Waldtrudering.

- Caroline: *A pharmacy would be reasonable, so I feel (bad) about that. I always have to take the bus to the centre in order to access a pharmacy.*

- Researcher: *So there are pharmacies at Wasserburger Landstraße, but...?*
- Caroline: *There are pharmacies, in Truderinger Straße as well, but I can only take the bus there, as I don't have a car. So it's not too easy for me to get there, so if I had someone close-by [operating a pharmacy], it'd be much better. So I feel really bad about us not having a pharmacy here. (7)*

#### 6.1.4.5 Further suggestions

Finally, in the context with mobility costs, reduced fares for PT tickets, specifically for seniors, are brought forward. As explained before, seniors value the 49-euro-ticket for convenience and the possibility to take multiple PT trips irrespective of the associated costs. However, it is suggested to introduce a similar ticket at a reduced fare, benefitting especially seniors in an economically tense situation.

- Bill: *[It'd require] perhaps a „small Bayernticket“ or so, which would then cost roundabout 15 euros. [...] For older people, who have little, so they can jaunt to Lake Starnberg for example. If they have little money, [...] [the 49-euro-ticket] is too expensive, and that 9-euro-ticket particularly was great for this. So there should be more regional offers, especially the older citizens, they rather stay in the area instead of taking far trips. (24) Yes, but, for example, if, [like] the 9-euro-ticket, if they offered that for cheaper. It doesn't have to be 9 euros, could also be 18 or 29, but for the month. (35)*

Finally, it is suggested to establish senior-specific support regarding digital technologies. This is explained by an interviewee as an opportunity to have a direct contact person when encountering challenges.

- Anne: *I'd simply need a personal advisor. Yes, it's really frustrating for me, if I don't get ahead on my own, then I am upset about myself. (11)*

## 6.2 Experts

### 6.2.1 Strategies for senior-friendliness and mobility justice

“Mobility justice for older people” is not a widely-used key principle in local planning. Nonetheless, the concept of “justice” has found entrance in Munich’s planning. This is displayed in gender-sensitive mobility planning on the one hand, and infrastructure that is inclusive and barrier-free, especially towards pedestrians on the other hand.

Furthermore, local expert E3 classifies mobility innovations depending on whether or not they contribute to justice in older people’s mobility patterns. Electric scooters are hence seen as not just towards seniors. This form of micro-mobility is not widely used amongst this social group and does hence not contribute to a higher mobility rate, further or more trips for seniors. What is more, electric scooters can also impair older pedestrians if parked on sidewalks based on a free-floating scheme. In comparison to this, electric wheelchair rentals, which are offered currently in Munich’s city centre, can support seniors, especially with walking impairments. (Landeshauptstadt München, 2024a)

Other examples on interventions in favour of older persons include the Munich-wide accompanying service for PT. Upon demand prior notice, mobility-impaired people can receive an accompanying person for their trips on weekdays. (Katholischer Männerfürsorgeverein München e.V., 2022)

### 6.2.2 Local planning in Waldtrudering

Aside from senior-specific mobility incentives, experts are asked to provide insights to local planning. Expert E2 highlights that the history of urban planning in Waldtrudering and its location have given it its present-day single-family housing character, “*optimized for the motorized private transport*” (E2). Consequently, transformative measures in such neighbourhoods are perceived as more difficult as designing a newly built area. This is especially relevant for the residential areas of Waldtrudering. Whilst the total population is increasing and car ownership rates in the study area are above Munich’s average, E1 points out that building regulations do not require owners to provide a private parking spot for all motorized vehicles. Consequently, the parking pressure is high on residential streets, limiting the available public space for other purposes. Moreover, the traffic situation in these areas is described as ambivalent by expert E1. Even though the side streets are designed first and foremost for residential traffic, they are

characterized by through-traffic to and from the Friedenspromenade and Wasserburger Landstraße.

Besides, typical constraints in urban and mobility planning in Waldtrudering are discussed with the experts. Due to buses being the only PT mode covering the neighbourhood, as explained in chapter 4.2.3.1, a lack of resources on the part of the operating company, especially regarding personnel, can restrict the possibilities for additional PT services. Furthermore, land-use types and thus the building structure and population density, and a shortcoming of public places limit the local potential to take transformative actions.

As laid out in chapter 6.1.1.6, residents are critical of aspects of the re-designed city centre in Trudering. Their perceptions regarding this are in line with a survey conducted by the District Council Trudering-Riem during the re-opening event in 2023 (Ziegler, 2023). In contrast to that, experts positively highlight the improved sidewalk quality. The objective of a reduced traffic volume is also considered achieved. This is why no improvement works are intended, while the experts both on the city- and district-level are aware of the criticism.

- E1: *It's always funny when you've finally designed something nice and new, and then the first criticisms and requests for renovations come.*

Within the framework of mobility hubs planned in Munich, a station for shared mobility is to be established in Friedenspromenade, including shared cars and cargo bicycles (Landeshauptstadt München, 2024b). Other long-term measures for the neighbourhood include an extended tram link between Haar, a city adjacent to the eastern border of Waldtrudering, and Berg am Laim. (E3) While there are specific timelines for the implementation of mobility hubs within two or three years from 2024, and current planning addresses the precise location of these hubs, according to E1, the tramway extension is not a project to be realized in the near future.

### 6.2.3 Comparison to desired actions

Chapter 6.1.4 has presented the desired actions and suggested improvements (voiced) by residents. With regards to further objectives of seniors' mobility, it can be stated that experts especially target the matters of safety and independence. In this context, the issue of barrier-free infrastructure is of high relevance for planning projects.

Despite the concept of "mobility justice for older people" not yet being widely used, experts express awareness that within a disadvantaged social group, various needs might arise. This means that *"one cannot only say, okay, let's design something gender-sensitive, and suddenly*

*one realizes, okay, there are different needs amongst one disadvantaged social group” (E1).* The framework within which actions are to be taken thus emphasizes walkability as the most inclusive mode of transport.

In comparison to this, expert E3 claims that precise actions and timelines for planning on a city-wide level. Thus, the District Council identifies potentials for development in the neighbourhood and suggests measures, their realization however is conducted by the City of Munich or the municipal utilities.

### **6.2.3.1 Walkability**

As trips by foot are central to the daily mobility routines of older people, the local pedestrian infrastructure contributes significantly to their experiences.

From the perspective of the District Council, the addressed challenges and associated actions include the residents’ replies. This affects first and foremost the sidewalk quality, including their width and surface structure. In this context, it must not be overseen that an inclusive, barrier-free infrastructure does not only consider physically impaired persons, but, for instance persons with visual impairments, as pointed out by the Mobility Department.

Expert E3 agrees on public benches facilitating trips by foot for physically impaired persons, which is why (these) have been installed alongside Wasserburger Landstraße. Chapter 6.1.4.1 has however shown that older people also desire additional benches in the residential areas.

In order to enhance walkability in Waldtrudering, possibilities to cross Wasserburger Landstraße are desired. As chapter 6.1.1.4 has explained, the lengthways central island is not designed as a traffic island for pedestrians or cyclists. Expert E3 thus suggests that, together with adjustments of its infrastructure, for example with lowering the kerbstones, this island can be opened up as a crossing aid without traffic lights. However, according to E3, the concern of safely shaping this measure is raised from the city-level, which is why its implementation (is not planned in short term).

Lastly, it has already been explained in chapter 6.2.1 that obstacles on the sidewalks can impair pedestrians, especially seniors who are health limited. This matter can be solved by restrictions on the one hand, or enhanced consideration amongst other road users on the other hand.



### **6.2.3.2 Public transportation**

Because of buses being the public mode of transport, their headway impacts the temporal availability of this mode and the accessibility of destinations. Expert E3 agrees with the residents of Waldtrudering on a 10-minute-headway of bus services leading to an improved experience. Together with an improved coordination between buses and other PT modes, these actions are supposed to reduce waiting and thus the overall travel times, and motivate a shift from car trips to PT. Similarly, E3 proposes a direct bus linkage between the eastern parts of central Munich and Waldtrudering.

Furthermore, the design of PT stations is to be adjusted in a senior-friendly way. As the station Trudering is of high relevance for trips involving S- and U-Bahn, E3 and the District Council have picked up the issue of limited accessibility because of the single-track escalator. The additional supplies of the station, including escalators and bathrooms, are to be repaired within shorter maintenance times. With regards to the bus stops in the study area, E1 refers to the aforementioned objective of the City of Munich to re-design them in a barrier-free way. The same applies to the PT vehicles.

Finally, rental services of electric wheelchairs are seen as a first- or last-mile solution in Waldtrudering, allowing residents with walking impairments to cover the distance to and from a PT stop.

### **6.2.3.3 Further strategies**

In line with the heterogeneous experiences of seniors with new technologies, experts agree that maintaining analogous beyond in addition to digital services involves social groups with less digital expertise. For the purpose of providing information on PT travels, real-time screens are to be added to bus stops in Waldtrudering. Overall, the provision of information in a suitable way for older adults is a subject amongst experts. Interview partner E3 proposes to provide information for seniors on the digital monitors in PT vehicles.

With regards to bicycle trips, neither the Mobility Department nor the District Council express senior-specific actions that are planned. Cyclists however are also supposed to benefit from additional possibilities to cross Wasserburger Landstraße by means of re-building the central traffic island, as explained above in chapter 6.2.3.1.

This is also the case in terms of mobility-related costs. Expert E3 points out the possibilities to receive affordable PT tickets for senior citizens with disabilities or in economically tense situations. These do however not enable older adults in general to travel at reduced costs.

Both the re-densification of the neighbourhood and the simultaneous decrease in stores in the residential areas are thematized by experts. It can be stated that the spatial concentration of POIs alongside the main roads can require longer trips. While experts are aware of this potential challenge for older residents, they suggest methods to facilitate overcoming these distances. Specifically for seniors with health impairments, a system of shared, rental electric wheelchairs is suggested in the neighbourhood, as explained in chapter 6.2.1 above.

As chapter 6.1.2.3 had thematized, older people value objectives of mobility that exceed the transportation process itself. Regarding these, expert E2 emphasizes the relevance of creating safe mobility options for the researched group: *“Actually everything is based on security. So, if someone feels safe, they also use a certain mode of transport.”* (E2) This is why the work of the Mobility Department aims for safety for pedestrians through barrier-free infrastructure.

Table 8: Comparison of actions desired by residents and suggested by experts. Own summary.

Desired by residents	Suggested or implemented by experts
<b>Walkability</b>	
Benches in residential areas	Benches alongside Wasserburger Landstraße
Crossings of Wasserburger Landstraße	Barrier-free sidewalks
Extension of green phases at pedestrian traffic lights	Crossings of Wasserburger Landstraße Traffic-calming measures
<b>Cyclability</b>	
Wider cycling lanes	Crossings of Wasserburger Landstraße
Two-track cycling lanes	
Crossings of Wasserburger Landstraße	
Additional bicycle parking, including rain protection	
<b>Public transport - services</b>	
Coordination of buses and other PT lines	10-minute-headway on all bus lines
Denser headway	Rental service for electric wheelchairs
Additional PT offers: Autonomous vehicles, On-Demand services	
<b>Public transport - stations</b>	
Larger, functional elevators	Shorter maintenance periods for facilities at PT stations: elevators, bathrooms
Additional escalators	Additional escalator
Additional bus shelter	Barrier-free bus stops Digital, real-time displays at bus stops
<b>POIs</b>	
Additional stores: clothing, haberdashery, pharmacy	
High-quality services: groceries, café	
<b>Costs</b>	
Reduced PT ticket costs	

In general, both participation of the focus group during planning processes and the publication of information in a senior-friendly are crucial for the success of the work of experts.

It must furthermore be stated that, with respect to their strive for independence and social acknowledgement, impaired senior citizens might hesitate to openly ask for support. An example was declared by an interviewed resident as following.

*I do have a [disability] certificate, but I do not want to show that [on buses], because I am embarrassed about that. (19)*

Expert E3 appeals to older people to show their limitations with more self-confidence. At the same time, information on the available senior-specific support must be provided to the focus group.

Overall, it can be deduced that the actions requested by older residents overlap to a greater extent with the work of the District Council. This can be explained by a different focus of actions in comparison to the actions of the pedestrian experts of the Mobility Department. In addition, the scope of the District Council is spatially more limited to the study area, whereas actions of the Mobility Department involve a larger spatial scale, including traffic flows to and from Munich, and focus on other social groups as well.

# 7 Analysis and synthesis

## 7.1 Analysis of findings

The findings gained by conducting qualitative, semi-structured interviews with residents, as shown in chapter 6.1, are used to approach the sub-questions 1 to 3. In addition to that, guided interviews with experts deepen the understanding of sub-question 3. These sub-questions are elaborated upon in the respective chapters 7.1.1 to 7.1.3. Together with the spatial analyses of the study area, the findings of the empiric social research address the overarching research question of *How to combat mobility injustices for older people* in chapter 7.2.

### 7.1.1 SQ 1: How do older people perceive mobility injustices in their routines?

The concept of mobility (in-) justice has been theorized regarding the dimensions of accessibility, availability and exposure. For the qualitative research of this thesis, these dimensions have been applied and expanded by urban design, information and participation. Previous spatial analyses support classifying perceived injustice with the local urban and transport network in the study area Waldtrudering in Munich.

First of all, it can be stated that older people link the aforementioned dimensions to their experiences with mobility. Apart from the spatial framework conditions, the individual perspectives on their travels are equally impactful. Three personas, “Anne”, “Bill” and “Caroline” have consequently been developed to account for the heterogenic socio-demographic backgrounds, and personal abilities and preferences of older people.

While interviewees are satisfied with the density and diversity of local points of interest for daily needs, destinations beyond the boundaries of their neighbourhood are less accessible for seniors with physical limitations. This affects specific stores and leisure-motivated destinations and can lead to the inaccessibility of a destination.

Seniors include trips by foot in their mobility routines, to access points of interest, for the first and last mile to and from PT stations, and on undirected trips for leisure purposes. Older people with health impairments also walk regularly in accordance with their physical conditions. It must however be noted that walking trips amongst residents with lower accessibility to POIs by foot contribute less to fulfilling specific trip purposes and instead are undertaken as undirected

walking trips for leisure and recreational purposes. This indicates that proximity is an essential contributor to accessibility by active mobility.

The temporal availability of public transport options is perceived depending on how frequent that very mode is used and whether the interviewee relies on it. Seniors agree with the spatial analysis as they desire a denser headway for buses in the study area. This request is however not arising from the spatially identified different service qualities between weekdays and weekends. Instead, frequently operating buses reduce waiting times, and increase comfort when changes are required. Within the sample, the availability of automobile transportation has not been perceived as a prerequisite for mobility and mobility justice.

Both spatial analyses and qualitative research identify the exposure to traffic noise and air pollution as an injustice that predominantly affects the main roads. Even though seniors are widely not impaired at their place of residence, these externalities affect the quality of stay in public spaces. For active mobility, the route choice can be influenced by the exposure to noise and air pollution, but also due to safety concerns. Likewise, these predominantly occur in neighbourhood parts with a high volume of motorized traffic.

In addition to the possibility to meet their mobility needs, older citizens strive for health benefits of active mobility and associate “being mobile” with personal independency. Finally, out-of-home activities allow for social interactions and participation. The additionally considered dimensions of urban design and information enhance justice if they are shaped in an inclusive and barrier-free way. This entails that seniors can be supported in carrying out their trips. In contrast to that, both urban and digital infrastructure can pose challenges and lead to exclusion if they do not consider the needs of the researched group.

It must be pointed out that mobility justice for older people is not only shaped by the experience of service accessibility, transport availability and exposure to externalities on a trip. Moreover, the possibility to carry out that trip in a, for them, suitable and comfortable way contributes to perceived justice. In this context, routines in mobility behaviour are highly relevant. Seniors are less likely to perceive their daily mobility as unjust if they can deliberately choose their patterns. When required to alter their usual or desired mobility behaviour, suitable alternatives are crucial. Their design must also be in an age-friendly way, so that the purpose of the trip can be maintained, while not perceiving the alternative as a deficit. However, both externally imposed and individual factors can limit the capacities of older persons to respond to changes. The more an older person is thus confronted with limiting factors, the more likely they are to be forced into a situation in which they experience injustices.

The questions for the qualitative interviews addressing residents are aimed at an understanding of typical patterns and perceptions. Thus, they do not test hypothetical scenarios for the

developed personas. However, the findings of this thesis suggest that “Anne”, “Bill” and “Caroline” are likely to be pushed towards mobility injustices by different risk factors.

In general, the individual health has been found to impact mobility behaviour and the perception of the local infrastructure. “Anne” represents the sub-group of seniors who are not impaired by health limitations or mobility costs. However, the benefits she associates with regular trips by foot or bike can be diminished in case of an accident or age-related limitations. In addition, Anne is not comfortable with digital technologies and thus might feel excluded by transport options like on-demand offers based on a mobile device.

“Bill” possesses a private car, which he uses regularly, as required distances to POIs exceed his comfortable distance for walking or cycling. Thus, factors that limit his ability for car trips, such as rising costs, can lead to overall lower accessibility and, due to the low availability of PT options close-by, increase the risk for injustice.

“Caroline” is limited in her walking due to health problems. To her, the design of the local infrastructure can influence her ability to take a trip and access a chosen destination.

These observations open up the potential for formulating and testing hypotheses on scenarios for mobility injustices to different groups of seniors, and thus will be picked up again by chapter 8.3.

### 7.1.2 SQ 2: How does the examined social group cope with resulting disadvantages?

Perceived mobility injustices, as described in chapter 7.1.1 above, can disadvantage older people in their mobility. Accordingly, the interviewees have established strategies to cope with resulting disadvantages. In this context, it must be highlighted that the effect of disadvantageous mobility situations does not necessarily equal the perception of “mobility injustice”. The coping strategies laid out in this chapter are applied if older adults are confronted with a, for them, disadvantageous situation.

Firstly, seniors take trips despite negative associations. Certain situations are thus described as less enjoyable, or as challenging. As described in chapter 6.1.2.2 the feelings of being overlooked, overwhelmed or insecure during a trip can motivate them to alter their behaviour.

Considering the circumstances and the availability of alternatives, older people deliberately choose detours or other connections to enhance safety and comfort. Within the sample, this strategy is applied for trips by active mobility, causing them to avoid travel routes on which

they perceive the aforementioned negative feelings. On trips including public transport, the selection of stations to begin or end the trip at can be influenced by the same reason. In addition to the routing, the times to travel are adjusted to avoid challenging situations. In particular, travels during rush hours, evenings or nights are shifted to feel more secure and avoid overwhelming traffic situations. Moreover, seniors choose between travel modes with the same intent. The desire to feel safe on the trip stems from fear of injury, which, especially for older adults, can cause long-term limitations. Thus, they are rather willing to accept smaller, deliberately chosen changes, for example avoiding bicycle trips during wintertime, provided that alternatives are available to fulfil their needs.

The desire to overcome disadvantages can necessitate additional efforts. This can be in order to alter the personal behaviour, as explained in the paragraph above, but also to overcome barriers. Coping strategies in this context can include additional financial expenses, longer durations of travels or compromises in flexibility and independence. These efforts can create the need or desire for additional support. This can come from the respective social environment, including the spouse, family members, friends and neighbours. Apart from that, support can be provided by senior-specific institutions. Overall, it must be born in mind that a modified behaviour can involve sacrifices of mobility-based benefits. Receiving support or relying on accompanying persons can be perceived as a decrease of independence, a mode shift from active mobility to motorized transport reduces the health benefit of walking or cycling, and avoiding of certain travel times reduces spontaneity.

Finally, experienced disadvantages can impact the choice of destinations. This can mean that, if more POIs of the same type are suited to fulfil their needs, older people deliberately choose the one that is easier accessible to them. Ultimately, a trip can be omitted as a consequence of disadvantages.

In sum, disadvantages can lead to injustices if the affected seniors lack suitable alternatives which maintain comfort and the trip purpose, or if they are not capable to adjust their behaviour. The ability to depart from routines or the preferred habits is based on personal characteristics, including health and living conditions, vehicle ownership and experiences during earlier stages of life.



### 7.1.3 SQ 3: Which potential strategies can be allocated to the identified fields of action?

In addition to the actions that are desired by older people, experts working in the Mobility Department of the City of Munich and the District Council Trudering-Riem are involved in this thesis. To them, “mobility” is a matter of general public provisions. They thus follow the overarching objective of creating barrier-free infrastructure to enable mobility for everyone.

The main fields of action, both from the residents’ and from the experts’ perspective, are the walkability of the neighbourhood and the PT supply. It must be added that a disagreement exists with regards to the implementation of suitable measures, though both parties agree on challenges for seniors in the study area.

With respect to walkability, the sidewalk design, including its width and surface structure is seen as crucial contributor to mobility justice. In addition, benches are to be provided, allowing for rests and supporting further walking distances. Measures on road crossings for pedestrians enhance the connectivity in the neighbourhood and thus the access to POIs, while increasing safety. Finally, sidewalks need to be free of obstacles, such as parking vehicles or electric scooters.

Beyond measures aimed at pedestrians, but also the PT infrastructure needs to be transformed in a barrier-free way. This includes both the access to stations, which also requires functional elevators and escalators, and the vehicle design itself. In addition, a spatially and temporally dense PT supply the access to and availability of this mode, thus increasing its attractiveness. In this context, the first and last mile to and from a station can impact the suitability of PT for trips by seniors. Modern, individualized solutions, such as on-demand transport or electric wheelchair rental services, are being brought forward to bridge this gap.

The suggested measures are to enable seniors with physical limitations to maintain their mobility behaviour while supporting their ability for independent trips. What is more, the experts’ base their interventions on safety for traffic participants and especially the seniors. Not only the availability of transport options, but also the quality of the local urban and transport network influences seniors, as the example of sidewalk design shows. This aspect has to be promoted further in planning for mobility justice, especially with regards to the quality of stay in the public.

While the aforementioned fields of action proposed by residents have also been covered by experts, measures on cyclability and costs of mobility are currently not prioritized in senior-specific planning. Nonetheless, addressing these can prevent seniors from experiencing dis-

advantages and ultimately mobility injustices. With regards to bicycling, it must be emphasized that this mode is frequently used for access to a larger catchment area, independence and spontaneous trips, while allowing for health benefits and joint-friendly exercise.

Overall, “justice“ for seniors from the experts’ perspective requires the specific consideration of this social group with its needs and abilities in planning processes. In this process, it must be emphasized that the social group of seniors is heterogeneous. Lastly, the design of just urban and transportation networks for older persons requires action in a larger spatial and disciplinary context. As the experts involved in this thesis point out, the perceived problems associated with, for instance, high car ownership rates, have to be addressed in larger-scale approaches. Measures for mobility justice must be embedded in local development strategies. Potential for this arise for example from the trans-municipal and interdisciplinary “Handlungsraumstrategie” of the City of Munich.

## 7.2 Synthesis: How to combat mobility injustices for older people?

The inability to alter mobility routines while continuing to fulfil mobility needs is increasing the risk to experience mobility injustices. This is due to a feeling of security and satisfaction when moving within routines on the one hand. On the other hand, in line with the findings of Shrestha et al. (2017) addressing “the decreasing ability of older people to overcome different barriers”, this social group has fewer options to alter their routines. These limitations can come both from individual as well as external factors. The risk to be affected by mobility injustices is thus increased for seniors as consequences of limitations per se, but also arises from a dependence on that routine. Being forced by external changes to alter their behaviour instead of it being a deliberate choice can thus not only lead to mobility injustices, but, if alternatives are unavailable, ultimately to immobility.

Actions for mobility justice from the perspective of experts and local planners can be seen as building up on the approach of Martens et al. (2012). Consequently, the minimum level of mobility has to be raised to enhance the overall justice in urban and mobility planning. In the context of Munich, this is on one hand to be achieved by particularly aiding physically impaired seniors to overcome barriers, like long walking distances. On the other hand, the Mobility Department of the city is striving for an inclusive infrastructure with the goal of an overall barrier-free cityscape. Mobility is thus ensured for seniors who are limited due to those barriers, while creating a more comfortable experience for citizens who are not impaired at present.

Within this thesis, it was furthermore outlined which additional objectives older people value regarding their mobility. These can be influential factors on the choice of modes and routes as well as on trip generation. The perspective of planning proposals aiming for mobility justice for older people should hence exceed the trip itself, and factor in independence, social interactions and maintaining health. Likewise, the design of public places and opportunities to rest has an impact on outside-of-home movements of the researched group and should be reflected upon in the field of mobility planning.

In order to maintain routines, the preferences of the sub-sets of older adults who are not yet experiencing mobility injustices must be addressed as well. Supporting them in their desired travel behaviour acknowledges their desire for independence and enables them to maintain their preferences and routines. At the same time, assistance can be provided to instruct older persons about additional mobility options, reducing their apprehension when considering those modes and creating positive associations, thus easing potential transitions in later life. In this context, the provision of information is essential, regarding alternatives and senior-specific support if temporary or long-term changes are made. In addition, mobility routines and behaviour of older persons must be understood if they should be successfully considered in future planning.

Strategies for mobility justice, especially when requiring transformative strategies in existing neighbourhoods, involve a wide range of stakeholders. This is the case both for their fields of work fields and the regions within their responsibility. By raising awareness amongst stakeholders, mobility justice can be included in planning as an interdisciplinary principle. Likewise, consideration by other traffic participants reduces the confrontation with mobility injustices and facilitates receiving support.



## 8 Discussion and limitations

### 8.1 Discussion: Results of this thesis

With regards to mobility characteristics of older persons, the field work of this thesis confirms existing literature in the point that members of the focus group move within a smaller daily range. What is more, the sample tends to avoid peak travel hours, and values their mobility for additional benefits, for personal physical and mental well-being and social interactions.

The insights gained by means of qualitative residents' interviews show both congruities with the spatial analyses conducted in chapter 4.2.3, but also differences. While spatial analyses classify the access to daily services and POIs as low due to the local concentration of services alongside the main roads, the satisfaction with accessibility is higher in the neighbourhood. Likewise, the service density is perceived as positive. Nonetheless, the qualitative research confirms that older residents living in the southern parts of the neighbourhood have to exceed their comfortable walking distances for trips to daily services. In this context however, it must be highlighted that, within the sample, older people in Waldtrudering value bicycle trips in order to access POIs, which reduce the travel times. In addition, trips with the private car are conducted to meet spontaneous needs, but also to transport goods and for trips in the periphery. With regards to the availability of sustainable modes of transport, a consensus between spatial and qualitative analysis can be deduced, regarding the spatial availability of sustainable transport solutions.

Finally, within the dimension of exposure, the overlap between spatial description and results from the residents' interviews can be assessed as ambivalent. The perception of noise does not negatively impact older people in the residential areas, which are first and foremost characterized by access traffic. In comparison to this, street traffic noise alongside the main roads influences the quality of stay nearby and causes detours. Furthermore, the exposure to situations that raise safety concerns leads to an altered mobility behaviour.

Adding on to the theorized dimensions of mobility (in-) justice, senior citizens acknowledge the influence of their conception of the built environment and the quality of public places on their mobility behaviour. For instance, the design of the pedestrian infrastructure and the routing of walkways in a neighbourhood can have an impact on the overall accessibility. This senior-specific effect can require a broader view on mobility (in-) justice, investigating the satisfaction and comfort of a trip in addition to its spatial requirements. Moreover, considering the specific needs of older adults can be seen as an extension of procedural justice. The interviewees of

this thesis highlight that justice to them includes the consideration of their concerns and abilities both by traffic participants and planners as well as the design of infrastructure and digital technologies.

Qualitative approaches are chosen in a context when in-depth research is required, addressing backgrounds for individuals' behaviour, preferences and perceptions. For the research questions of this thesis, this methodology has proven suitable. Against this background, the residents' interviews, as evaluated in chapter 6.1, have already shown that different types of seniors display different understandings of "mobility injustice" and disadvantages in their mobility routines.

Mobility planning experts agree on this matter, illustrating that there are varying needs amongst one disadvantaged group. While strategies primarily address physically impaired persons, emphasis should also be put on the needs and potential vulnerabilities of seniors without health limitations. Chapter 8.3 will come back to how a deeper understanding of mobility justice amongst stakeholders can shape planning processes. At the same time, the provision of information of information in a senior-friendly way, both regarding the existing transport network as well as on future initiatives, contributes essentially to a just interaction with this social group.

Finally, this thesis indicates specifications that affect urban and mobility planning in urban outskirts districts. These areas interact with the city centre and the urban surroundings, but also with the periphery. Consequently, transportation options must consider tangential and peripheral travels of residents. Additionally, neighbourhoods at the urban fringe can be especially affected by transit traffic and associated externalities. Overall, a holistic planning, aiming at mobility justice, requires local governance and benefits from trans-municipal partnerships.

## 8.2 Limitations

The data collection of this thesis addressing residents is carried out in a qualitative format. The flexible, semi-structured format in the residents' interviews facilitates follow-up questions. In consequence, the results aim for an in-depth understanding of individual backgrounds and perceptions. However, findings gained in qualitative approaches are not generalizable to a larger scale. This is especially due to the semi-structured format allowing for various focuses in every interview, depending on the interviewee's reply. (Kelle & Tempel, 2020)

Bias in qualitative research has to be considered to classify the results. As the data has been collected in face-to-face-interviews, social desirability can cause interviewees to slant their replies. This can, on the one hand, be explained by fewer contact points with the idea of "mobility

(in-) justice”, compared to “mobility behaviour” and “encountered challenges”. On the other hand, older people potentially downplay the challenges they encounter due to a desire to be perceived as a full, independent member of society. Further distorting factors involve respondent bias, specifically due to social desirability, and agreement bias. With regards to the interviewed experts, selection bias can shape the replies. It must also be noted that potential bias by the researcher can impact the conduction and evaluation of qualitative research, in particular the data collection, coding analysis and deduced information. (Kelle & Tempel, 2020) Furthermore, the spatial and temporal scope of the field work is limited, which is why the results describe a snapshot and do not highlight long-term developments.

As the interviewees have been contacted in senior-specific institutions, community centres and public places, the sample has a desire for social interactions. Moreover, as shown in chapter 5.1.3.1, the majority of interviewees is female. Aside from a higher share of women in the senior population due to a higher life expectancy, they can also be found to be more likely to get engaged in public life and in activities of the social centres where interviewees are approached (Colley et al., 2016), and to participate in social research (Becker, 2017). It must also be stated that interviewees approached at the Familienzentrum partly attend local sports groups. Amongst them, the share of residents using active modes of transport and striving for health benefits is increased, compared to the sample. Overall, the sample composition does not display the composition of older inhabitants of the study area, which is why specific perceptions and behaviours might be over- or underrepresented.

The older people approached in this work can be classified by their ability to be mobile, as they were approached for the sample collection in public places. This is why this work does not cover the perceptions of non-mobile seniors nor their prerequisites for renewed mobility, or their perception of mobility (in-) justice. Likewise, seniors with mental limitations, including cognitive impairments, and residents of retirement homes have not been approached within the research scope.

It furthermore can be worthwhile to reflect on how the perception of mobility (in-) justice is shaped in neighbourhoods with other socio-geographic framework conditions. The field work of this thesis has been carried out in an outskirts neighbourhood with a high share of older people in the population, a high car ownership rate and a low mobility rate. Consequently, it remains to be addressed how senior-specific services and age-friendly infrastructure in regions with a smaller share of older people are designed. The perception of travels by active modes or PT might thus differ for instance between outskirts and city-centre neighbourhoods.

This research has its focus on mobility (in-) justices that occur on everyday trips due to the interactions of urban and mobility planning. Neither holiday trips nor aspects as the interior design of PT vehicles are considered.

Lastly, the experts involved in this thesis can be characterized by their knowledge in urban and mobility planning, with a focus on active mobility and public transportation. Due to the limited scope of this research and, at the same time, a research focus on residents, experts from transport companies and mobility start-ups, gerontology and the Department of Urban Planning and Building of Munich have not been approached. Their viewpoints however can be beneficial when striving for a holistic strategy for mobility justice.

These limitations underline the potential for follow-up research, which is why the following chapter will elaborate upon open questions in the field of mobility justice for older people.

### 8.3 Potential for follow-up research

The results of this thesis indicate additional fields of study to be considered when striving for mobility justice. Firstly, as explained in chapter 8.1, the research of this thesis does not include non-mobile seniors. Understanding their barriers to recouping their ability to move outside of their homes can add crucial comprehension of mobility (in-) justice. Similarly, mentally impaired older citizens remain to be subjects of research.

Secondly, additional research can investigate the identified fields of action in the study area in greater depth, continuing the work of this thesis, and demonstrate the perceptions of seniors towards mobility (in-) justice. Their desired actions, needs and priorities are to be embedded and considered in local planning. A spatial allocation of mobility interventions, such as sharing stations or pedestrian crossings, is worthwhile to be addressed in this context. At the same time, the effect of measures of mobility policies and in the urban and transport network can be assessed. This enables the verification of the personas applied in this thesis, especially regarding their vulnerability to certain developments, and their responses to changing framework conditions, as suggested in chapter 7.1.1.

Moreover, the question arises of whether, and in what way, other demographic and potentially disadvantaged groups as well as to the overall citizenry can be impacted by measures enhances mobility justice for seniors, for example by a barrier-free pedestrian infrastructure. On the other hand, their implementation can cause potential challenges, hence wider investigations on consequences can help to prioritize measures. To that end, further local planning authorities as well as stakeholders both from academia and industry can be considered. Building up on the understanding of mobility justice provided in this thesis, a strategic approach can be developed, which supports the allocation and assessment of measures to increase mobility justice.



A neighbourhood of Munich with a high share of seniors in its population and a low performance in the dimensions of mobility justice has been chosen as a study area. Further research can elaborate perception of and measures for mobility justice in another spatial context. This can include effects that a higher population density or a less car-centric mobility planning can have on the experiences of seniors. At the same time, the satisfaction with local senior-specific services and options, such as community centres, can be addressed in areas where this social group accounts for a smaller share in the population. The research focus of this thesis has been on the metropolitan area of Munich. Further research can address the impacts on mobility (in-) justice resulting from disparities in mobility behaviour and transport infrastructure between urban and rural communities. An over-ageing of rural regions in Germany, but also in other nations, emphasizes the urgency of this field. In this context, different climatic and cultural environments can be taken into account. Following this, urban and transport planning processes can be shaped differently with simultaneous consideration of mobility justice towards seniors. This includes the design of newly developed neighbourhoods and urban environments, being based on a just mobility system from the ground up.

The social group of “older people” is heterogeneous in abilities, preferences and needs. The field work of this thesis could furthermore show the value of routines for seniors’ mobility behaviour. This raises the question of how older people can be supported in maintaining their habits on the one hand. On the other hand, there is potential in investigating on how experiences and education in earlier stages of life can help to avoid injustices. Shrestha et al. (2017) find the mobility behaviour at advanced age, for example the willingness to use certain modes of transport, depending on the experiences with the respective mode during earlier stages of life. In this context, it must be considered that different senior generations display different mobility patterns. Enabling mobility justice in the long term requires understanding the behaviour of present-day adult generations.

Lastly, this work opens up the question on how mobility (in-) justice interacts with further urban planning strategies. With focus on the social group of seniors, alternative housing forms like multi-generational housing can gain relevance in urban planning and possibly impact mobility behaviour. Besides, the impact of modern mobility solutions, including on-demand transport, autonomous vehicles or smart mobility hubs is to be studied with a focus on different social groups.



## 9 Conclusion and outlook

This thesis has continued the literature-based understanding of mobility injustice with a specific focus on older people. By the means of a case study in Munich, it investigates how this social group perceives their mobility routines, encounters injustices, and how they cope with associated disadvantages. To conclude, it could be shown that perceived injustices result from a non-inclusive transport infrastructure, a lack of senior-specific services and insufficient consideration to their needs. In this context, mobility injustices affect seniors if they are required to give up routines, and this perception can be enforced by a limited ability to adjust to disadvantages or changes. Mobility planning experts in Munich design their measures first and foremost to enable a minimum level of mobility to all citizens, understanding mobility as an element of public provision of services. Finally, the relevance of cross-boundary planning is highlighted when aiming for mobility justice.

Urban and mobility planning has begun to develop people-centric approaches during the late 20th and early 21st century. This thesis has laid its focus on the increasingly relevant social group of seniors. Supporting them to meet their needs according to their abilities and creating comfort in both new and familiar environments presents challenges to cities. Nonetheless, ageing societies also bear potential if institutions “continue investment in skill across all generations” (European Commission, 2023).

The concept of mobility justice, as expanded upon in this thesis, can serve as orientation for social and inclusive transformations in cities. At the same time, it must be linked to further urban developments and global megatrends, first and foremost global warming. This emphasizes the need for reduced emissions of GHGs actions for climate neutrality. The “15 minute city”-concept can be used as an example of how the consideration of interactions between spatial and mobility planning allows for shorter trips, sustainable transportation, inclusive infrastructure and liveable public spaces. By investigating how “mobility justice” can create synergies with “15 minute cities”, urban planning can strive for both social and environmental sustainability.



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Appendix 1: Additional figures. Spatial analysis – Study area Waldtrudering

The analyses of Appendix 1 are generated using GOAT (Pajares et al., 2023). Catchment area analyses consider a 10-minute-walking-radius at a walking speed of 4 kilometres per hour.

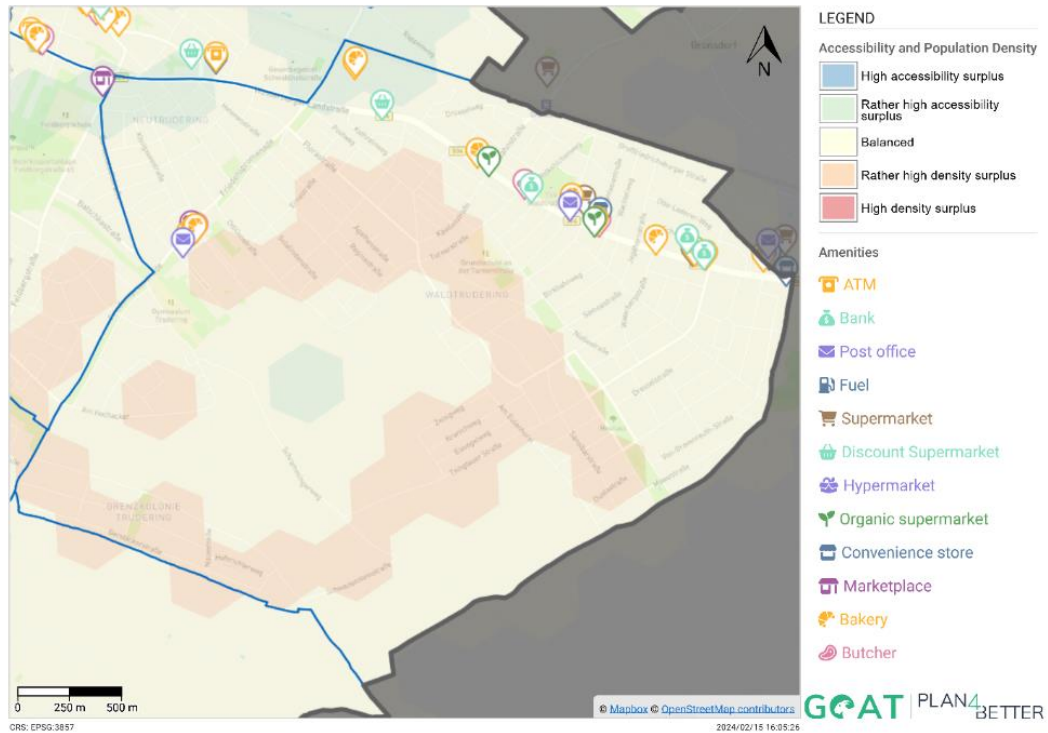


Fig 1: Accessibility and population density – Groceries and services.

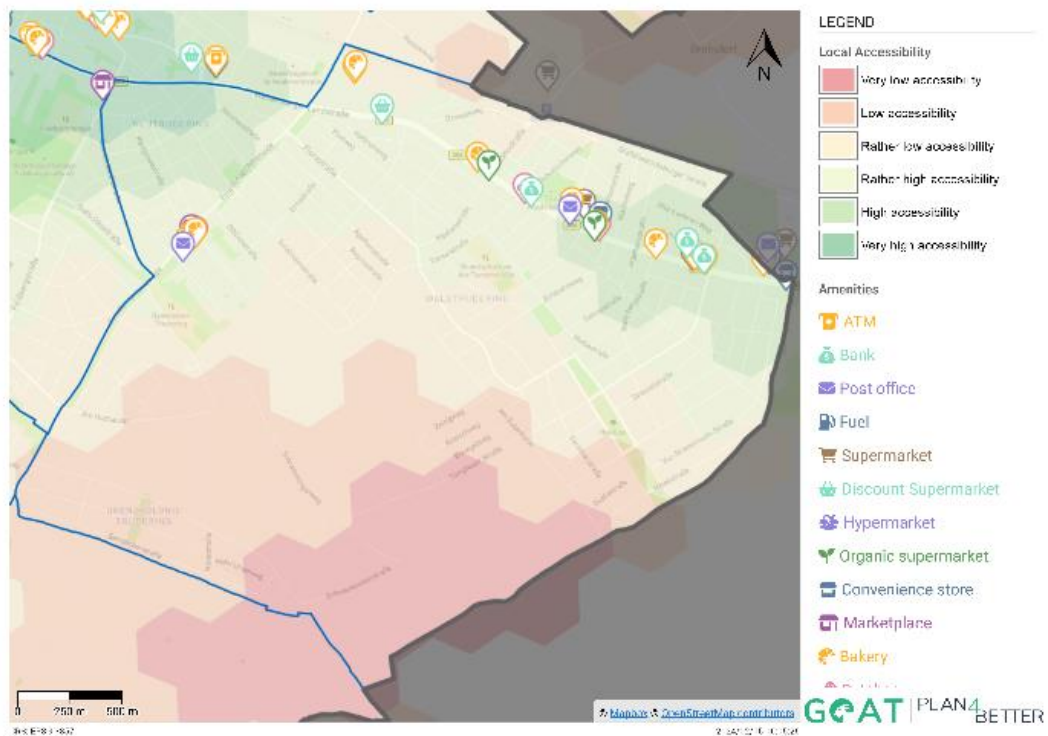


Fig 2: Accessibility - Groceries and services.



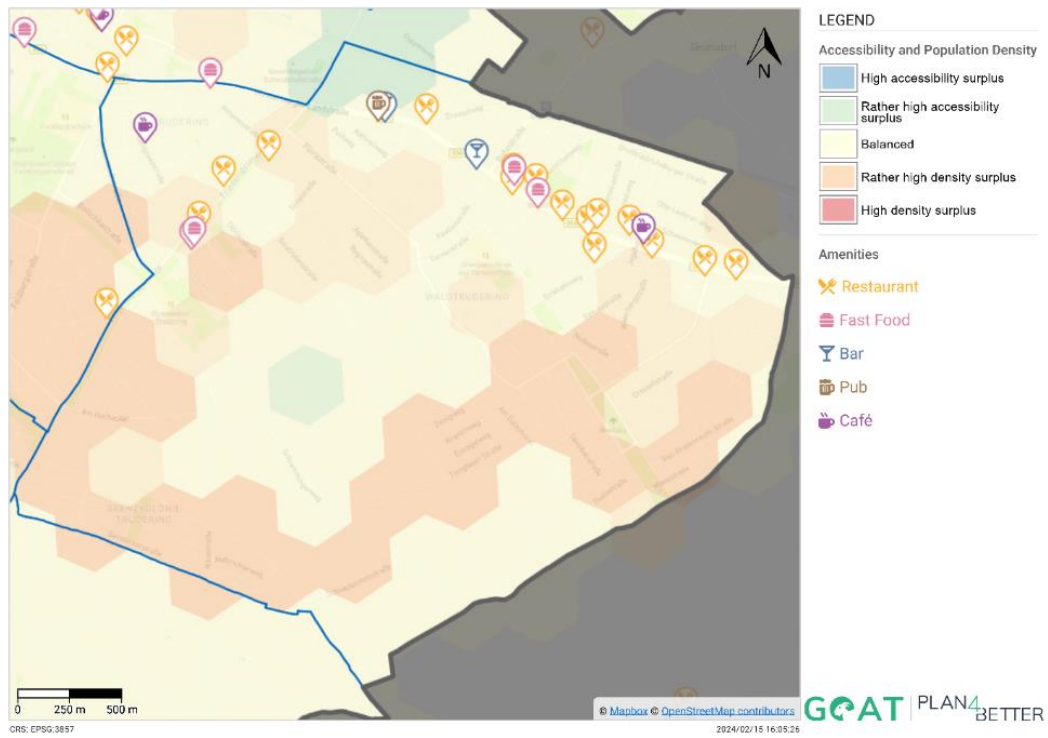


Fig 3: Accessibility and population density – Cafés and restaurants.

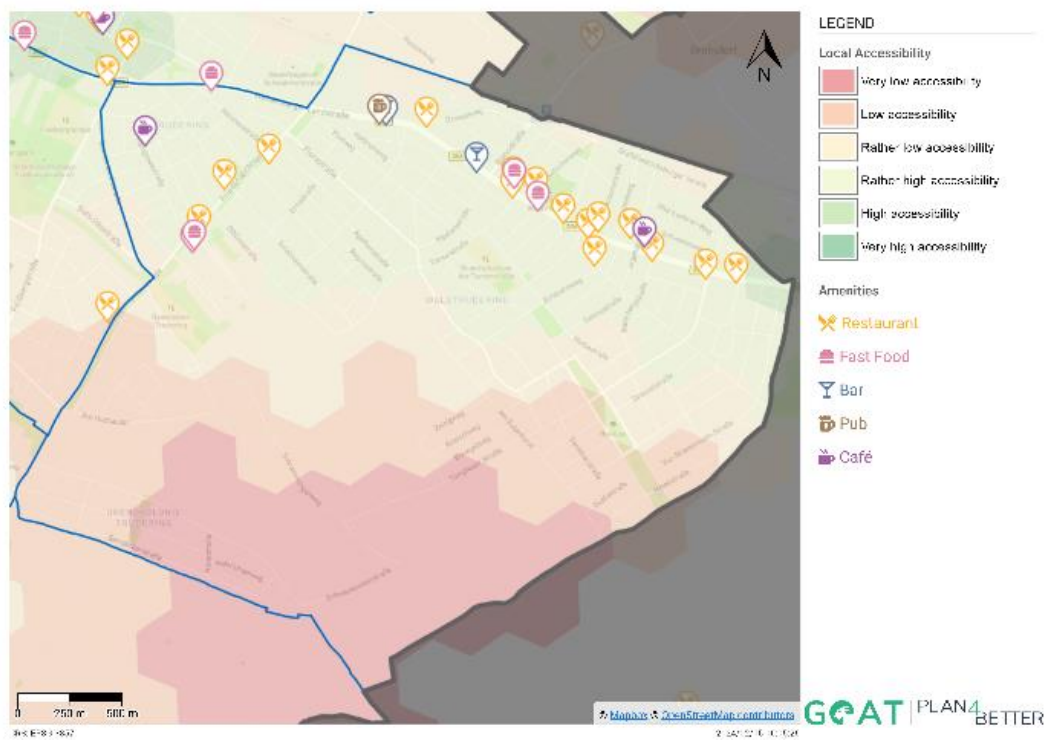


Fig 4: Accessibility - Cafés and restaurants.

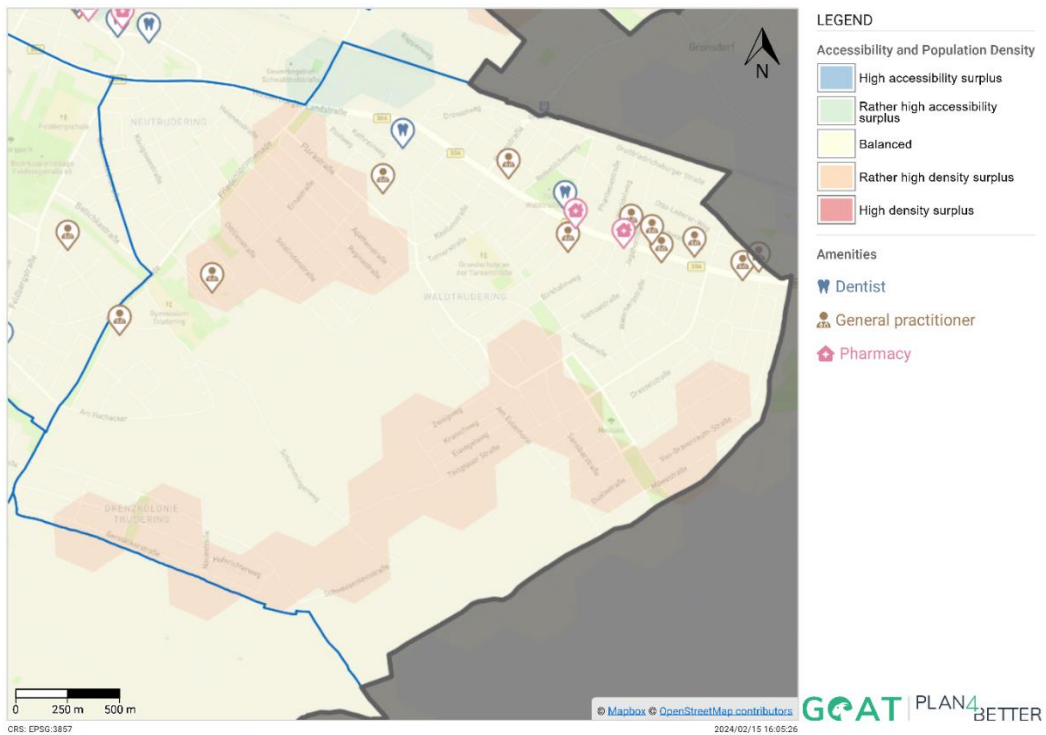


Fig 5: Accessibility and population density – Healthcare.

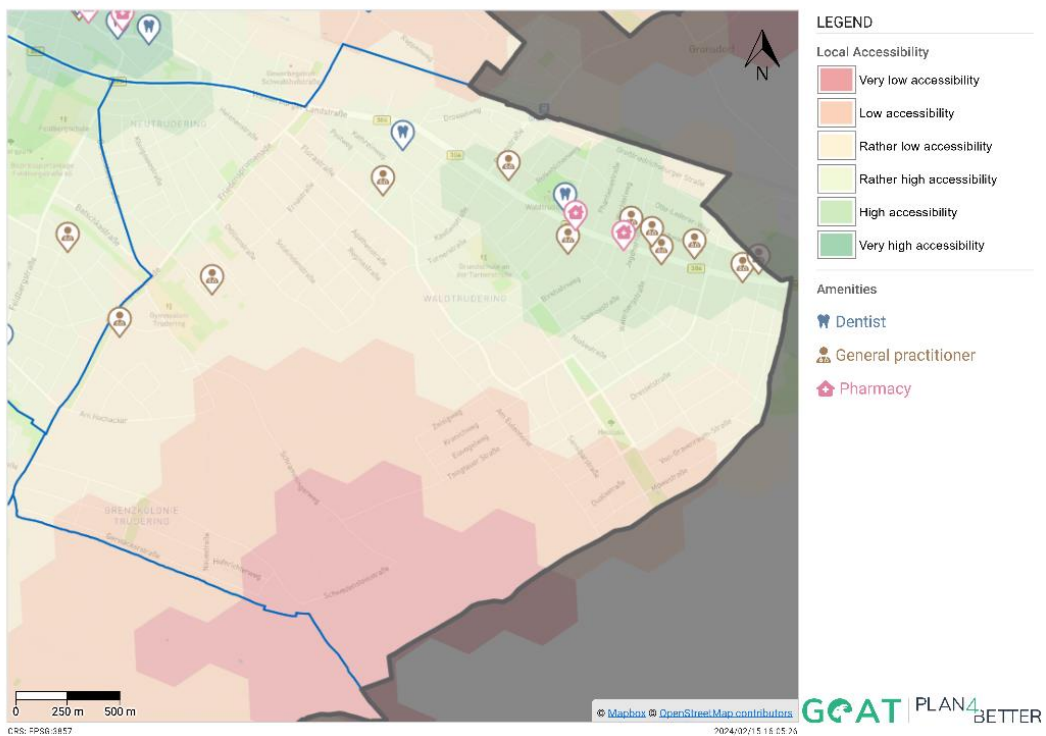


Fig 6: Accessibility - Healthcare.

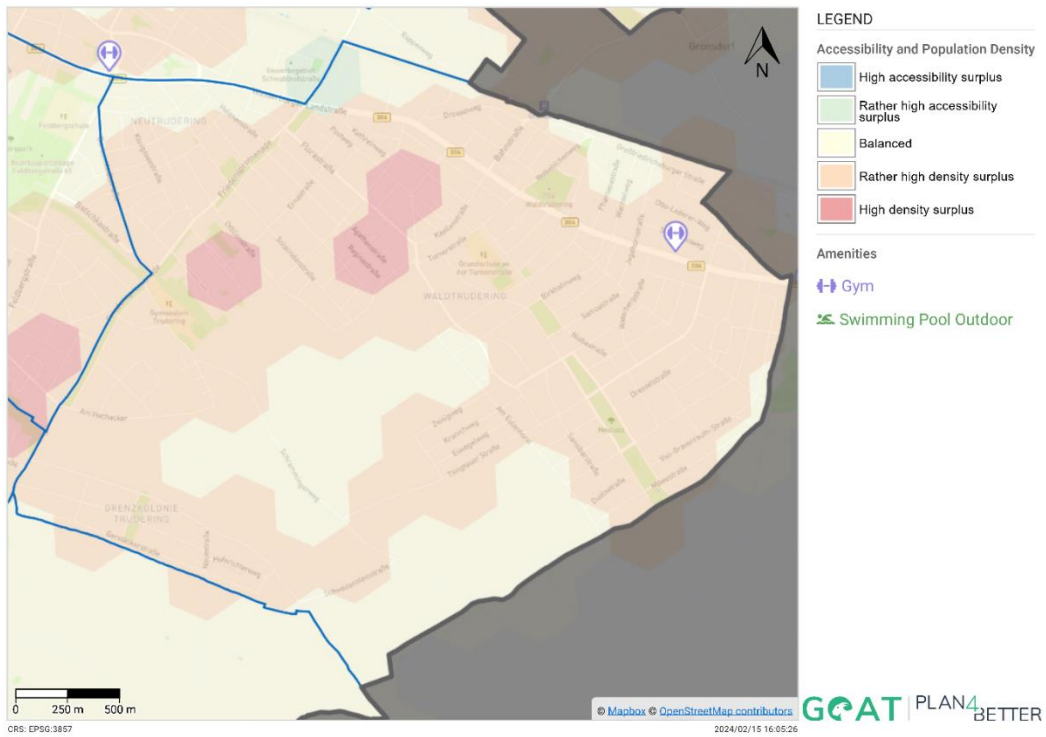


Fig 7: Accessibility and population density – Sports.

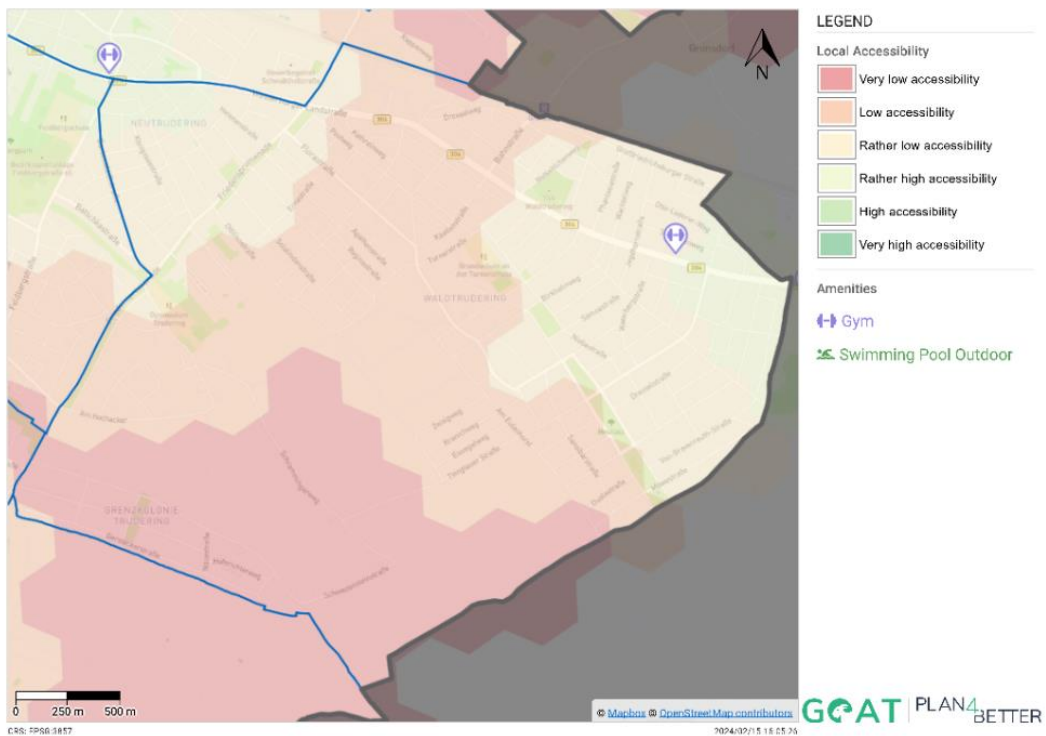


Fig 8: Accessibility - Sports.

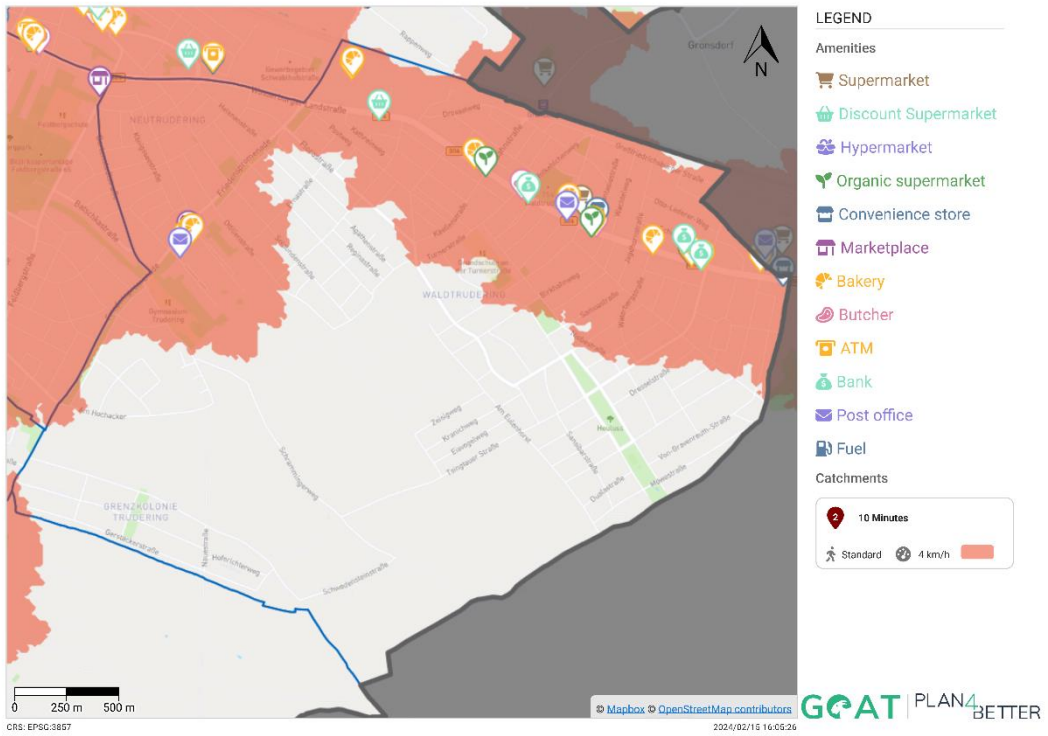


Fig 9: Catchment area for Groceries and services within a 10 minute walking distance.

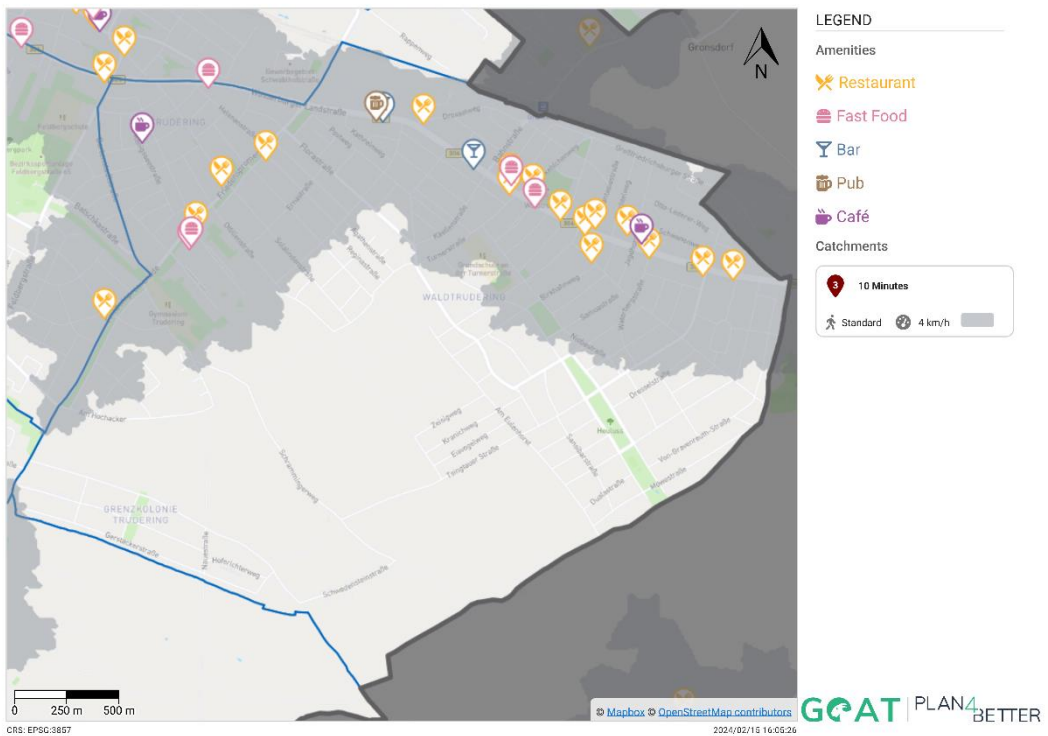


Fig 10: Catchment area for Cafés and restaurants within a 10 minute walking distance.



Fig 11: Catchment area for Healthcare within a 10 minute walking distance.



Fig 12: Catchment area for Sports within a 10 minute walking distance.

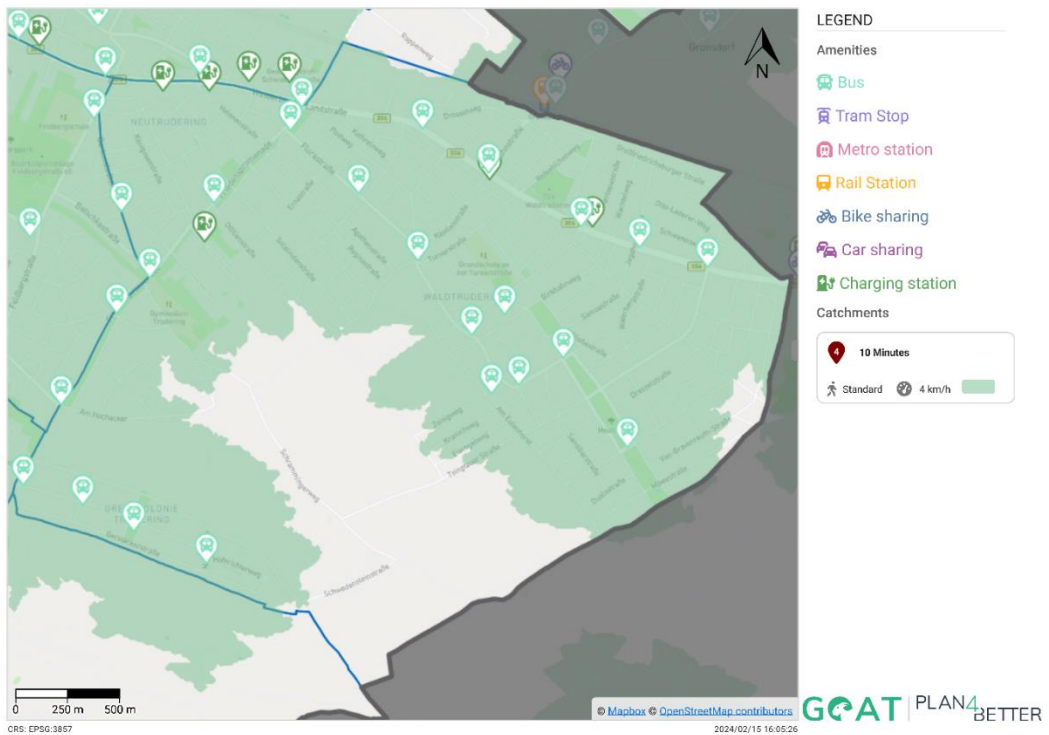


Fig 13: Catchment area for PT stops within a 10 minute walking distance.

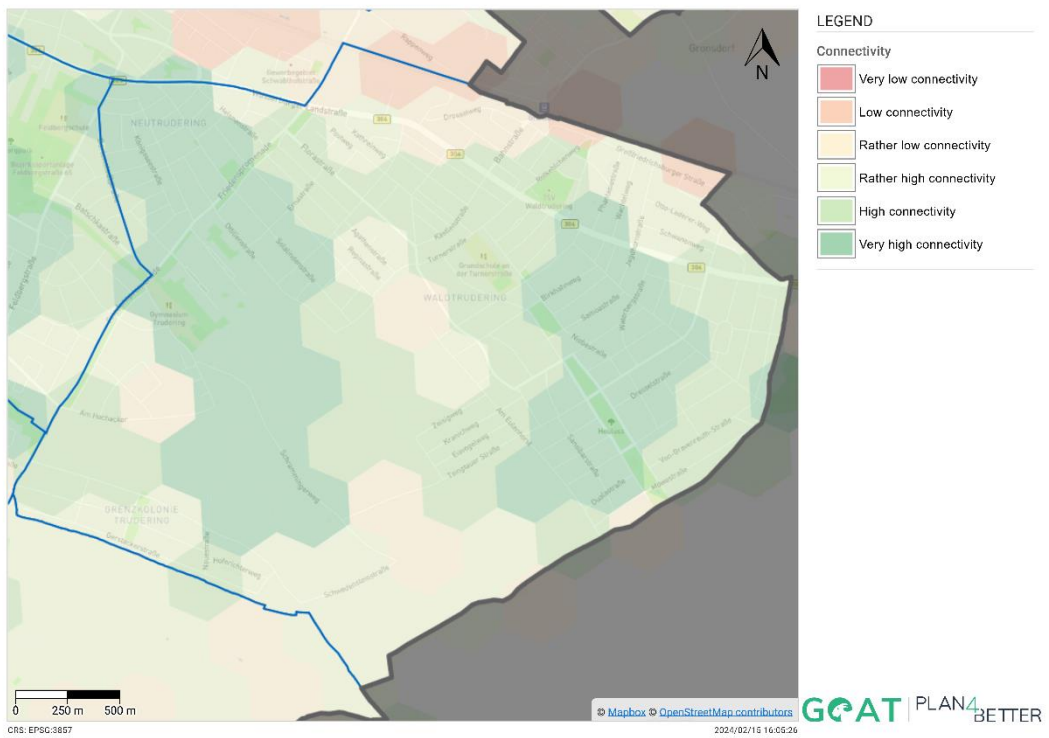


Fig 14: Connectivity.

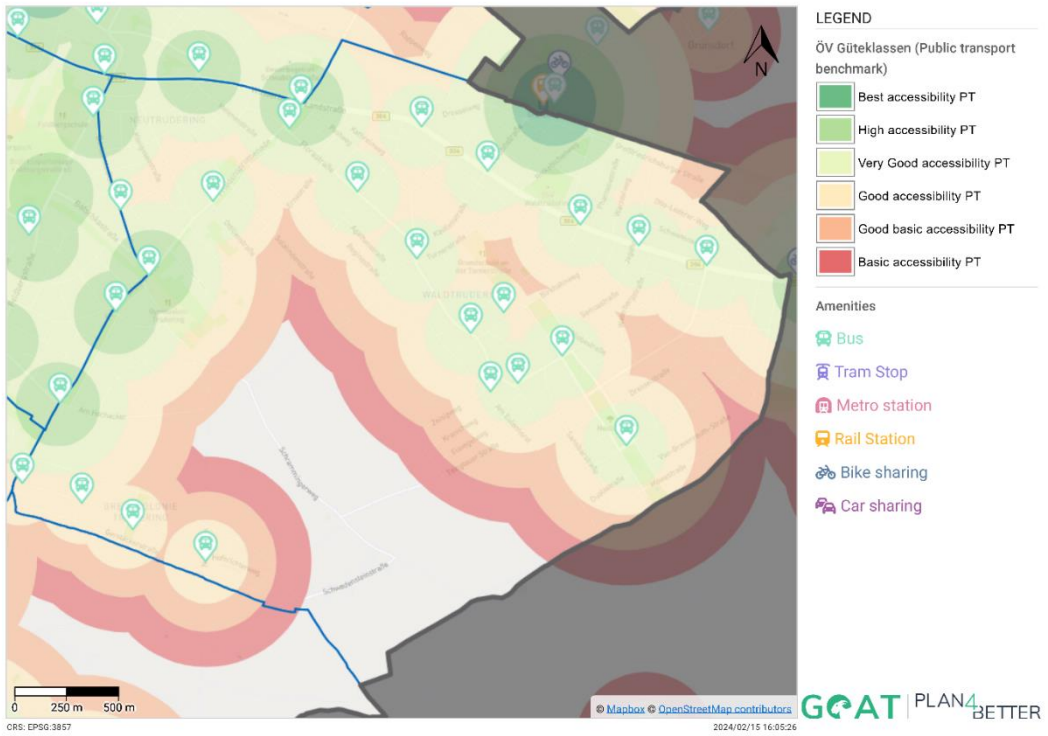


Fig 15: PT quality, based on service frequency and accessibility. Monday, morning.

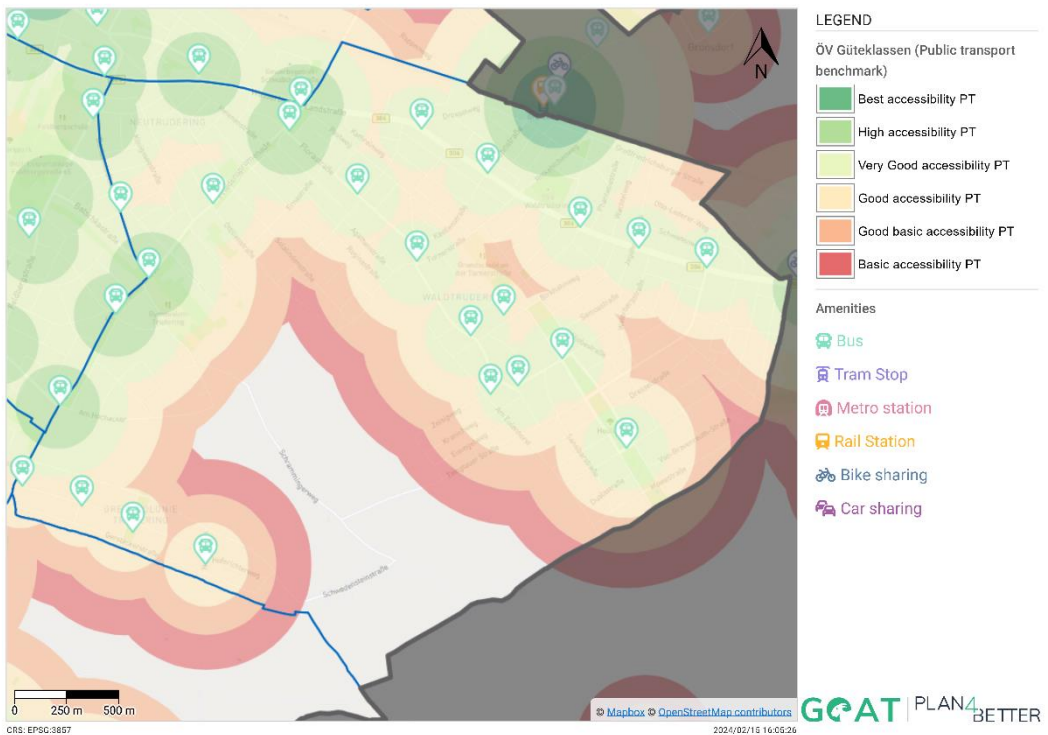


Fig 16: PT quality, based on service frequency and accessibility. Monday, afternoon.

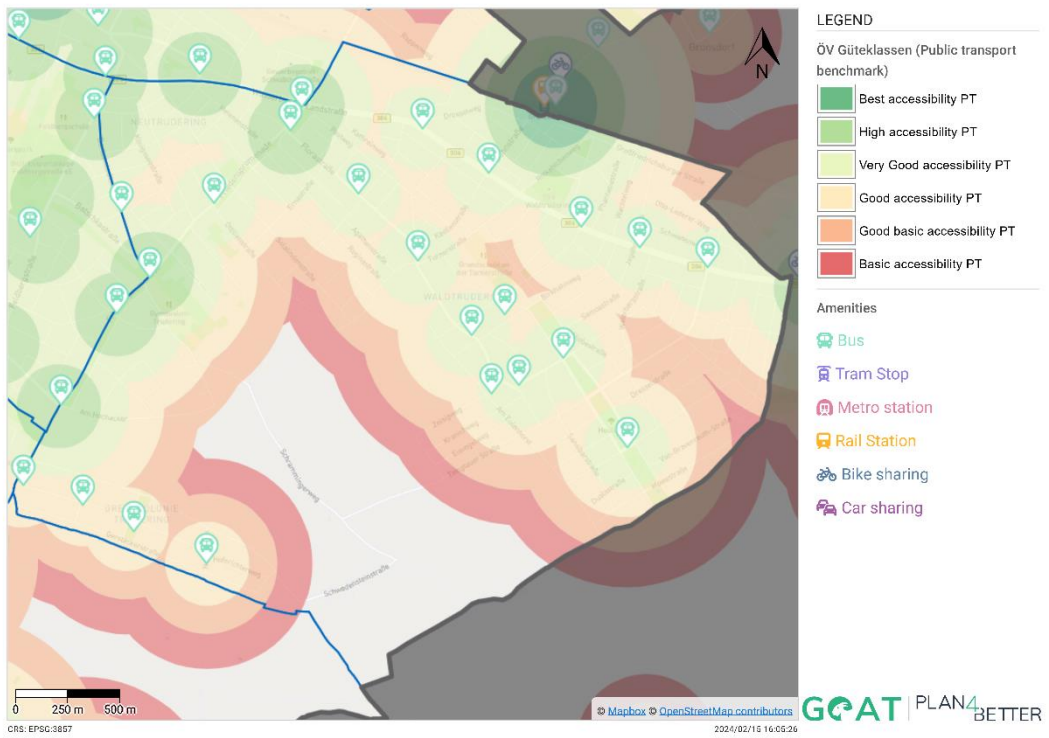


Fig 17: PT quality, based on service frequency and accessibility. Monday, night.

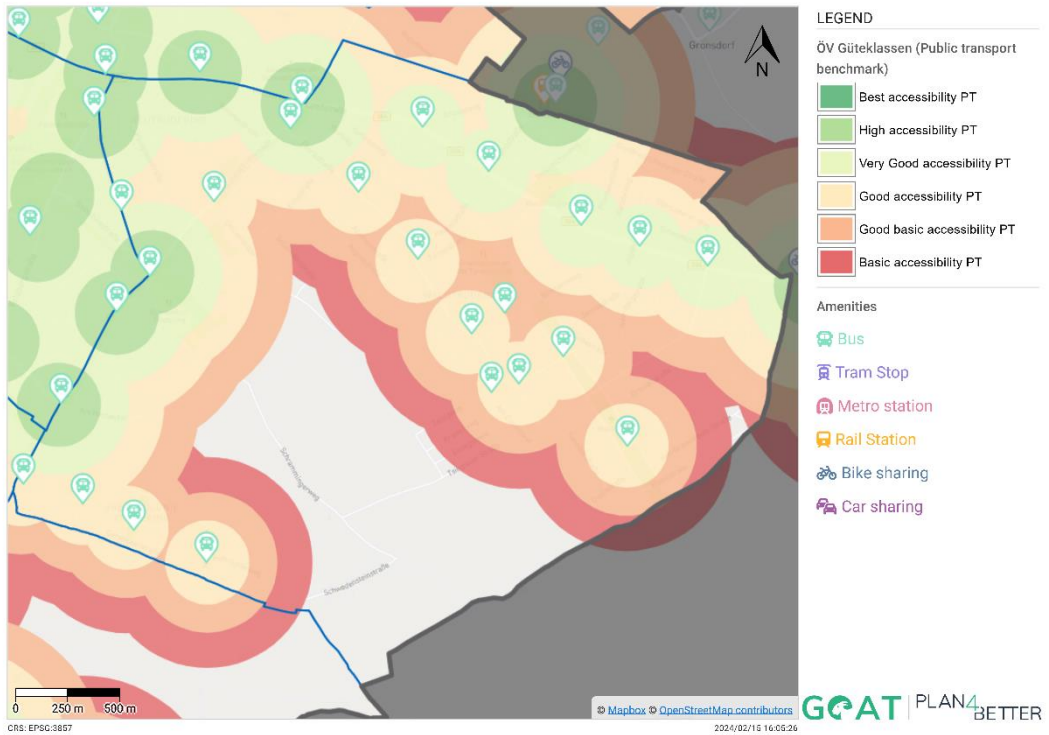


Fig 18: PT quality, based on service frequency and accessibility. Sunday, morning.



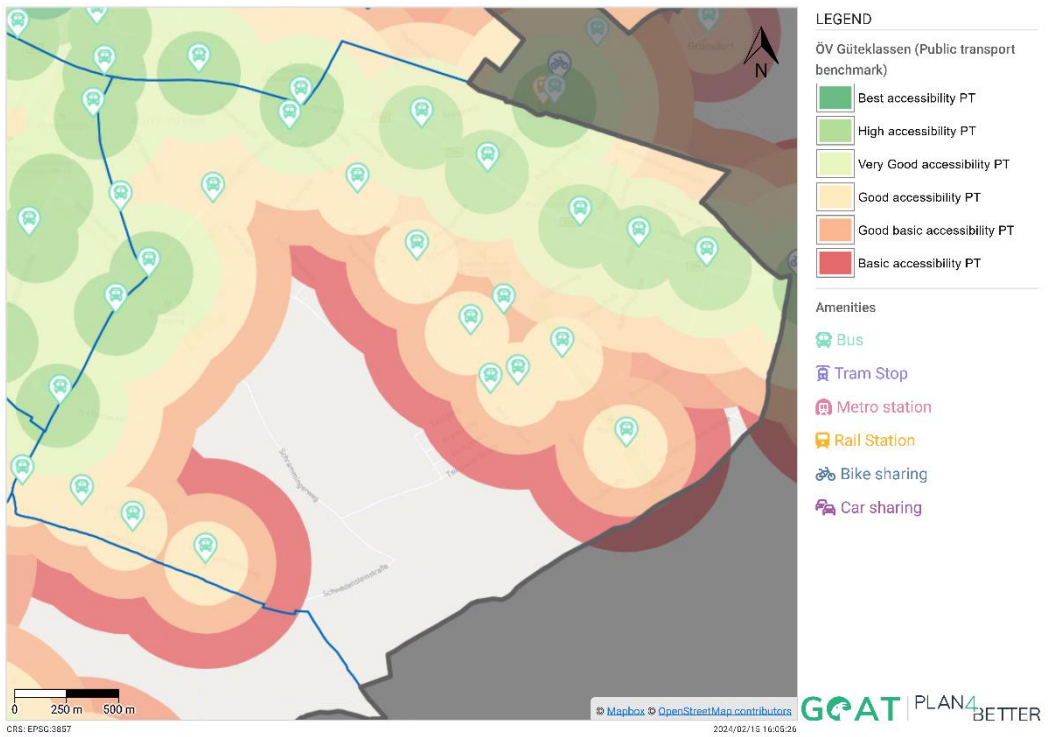


Fig 19: PT quality, based on service frequency and accessibility. Sunday, afternoon.

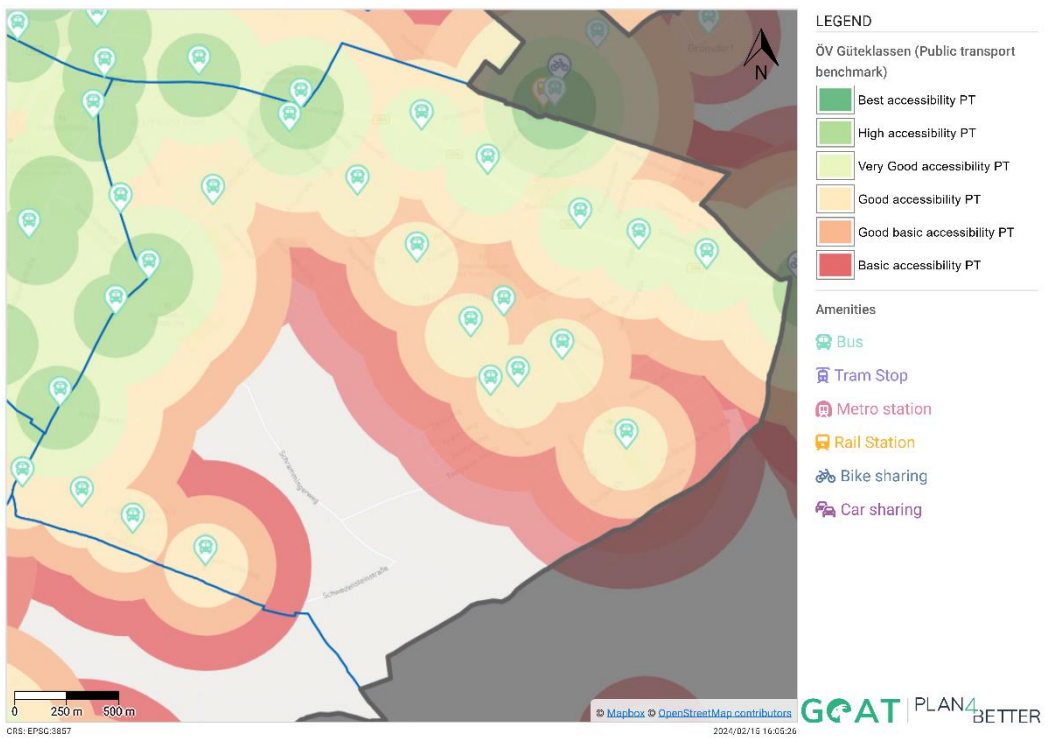


Fig 20: PT quality, based on service frequency and accessibility. Sunday, night.

## Appendix 2: Interview question set – Residents

### (1) Personal / demographic data

### (2) General mobility patterns

- a. Please describe your mobility routines on a typical day this week.
- b. Which one of your trips feels especially positive to you?
  - A. Can you explain this example further?
- c. Do you encounter problems on these trips?
  - A. Can you explain an example for a way that you dislike?

### (3) Perception of “justice”

- a. What can be done in your neighbourhood to improve your experiences?
- b. What do you perceive as unjust to access your basic needs?
- c. What do you suggest in order to make your mobility, or mobility for older persons, more just?
- d. What is important for you when being mobile?

### (4) Availability

- a. You told me before that you mostly use (Mode) for (Purpose). Can you tell me why?
  - A. What would be disadvantages of other modes on this route?
- b. What is your opinion on other transport options (Public transport / walking / cycling, depending on preferred modes in question 2a) in your neighbourhood?
  - A. Do you think there are enough (bus stops / sidewalks / cycling lanes)?
  - B. Is it convenient for you to access public transport? What is important for you on a public transport station? (seating / escalators / elevators)
- c. Are you satisfied with your transport options?
  - A. What are you lacking?

### (5) Accessibility

- a. You told me before that you regularly travel to (POI).
  - A. Is it difficult for you to access (POI)?
  - B. What do you think about the quality of (POI) in your neighbourhood?

- b. Which other services are relevant for your daily life?
  - A. Is your neighbourhood well-equipped with those?
- c. How do you cope with (POI) being badly accessible for you?

(6) Exposure

- a. What is important for you to feel safe on your trips?
  - A. What makes you feel unsafe?
- b. Which role do costs play for your mobility?
  - A. How would you be affected if the costs for your (public transport ticket / car) were higher? (for users of public transport and car drivers)
- c. How does traffic noise impact your daily life?
  - A. Where is this especially the case?
- d. What is your perception of the air quality in your neighbourhood?

(7) Urban design

- a. What do you think of public places in your neighbourhood?
- b. Where do you enjoy yourself?
  - A. What makes you feel comfortable there?
- c. Can you exemplify a situation that makes you feel overwhelmed or uncomfortable?

(8) Information, knowledge, consideration

- a. Can you explain your experiences with digital devices?
  - A. How important are these digital services for your travels?
  - B. How confident are you with these devices?
- b. What is your preferred way to receive information on your travels?
- c. Do you feel as if your needs are being acknowledged by other travellers?
  - A. Do you feel as if your needs are being acknowledged by transport planners / urban planners?
- d. Do you feel as if you can actively participate in urban and mobility planning projects in your neighbourhood?

### Appendix 3: Interview timeline – Residents

Table 9: Timeline of the residents' interviews.

Inter- view Nr.	Date	Place	Inter- view Nr.	Date	Place
1	18.10.2023	Public places	21	15.11.2023	Familienzentrum
2	18.10.2023	Public places	22	15.11.2023	Familienzentrum
3	19.10.2023	Public places	23	15.11.2023	Familienzentrum
4	22.10.2023	Public places	24	15.11.2023	Familienzentrum
5	22.10.2023	Public places	25	15.11.2023	Familienzentrum
6	25.10.2023	Public places	26		
7	26.10.2023	Promenadentreff	27	21.11.2023	Familienzentrum
8	26.10.2023	Promenadentreff	28		
9	08.11.2023	Familienzentrum	29		
10	08.11.2023	Familienzentrum	30		
11	08.11.2023	Familienzentrum	31		
12	08.11.2023	Familienzentrum	32		
13	09.11.2023	Familienzentrum	33		
14	09.11.2023	Familienzentrum	34	21.11.2023	Familienzentrum
15	09.11.2023	Promenadentreff	35	21.11.2023	Familienzentrum
16	14.11.2023	Familienzentrum	36		
17	14.11.2023	Promenadentreff	37	22.11.2023	Familienzentrum
18	14.11.2023	Promenadentreff	38	22.11.2023	Familienzentrum
19			39	23.11.2023	Promenadentreff
20			40		

## Appendix 4: Coding scheme – Inductive and deductive codes

Table 10: Inductive and deductive coding expressions.

<b>Inductive</b>	<b>Deductive</b>
<b>Routines</b>	
Mode choice Distance travelled Times for travelling Route choice	Are alternatives available?
<b>Personal affection</b>	
Personally affected No personal limitations	Consideration towards other seniors
<b>Satisfaction</b>	
Satisfied Not satisfied	
<b>Suggested improvements</b>	
Positive examples Negative examples Senior-specific support Support for digital technologies	
<b>Impacts on mobility behaviour</b>	
(Lack of) Information Consideration Costs Walking distances Reliability, PT headway Weather Health, personal limitations	Electric Scooters Traffic volume Vehicle speed
<b>Mobility benefits</b>	
	Safety, comfort Independence Flexibility, spontaneity Social interactions, participation Health, exercise
<b>Neighbourhood</b>	
	Personal connection with neighbourhood Neighbourhood development, land-use Developments in the past
<b>Infrastructure</b>	

<p>Urban design</p> <p>Walkability, cyclability</p> <p>Traffic lights, street crossings</p> <p>Quality of stay</p> <p>Green infrastructure</p> <p>Parking spots – bicycle</p> <p>PT stop design</p> <p>Elevators, escalators, stairs</p> <p>PT changes, inter-/ multimodality</p> <p>Noise, air pollution</p> <p>Digital services</p>	<p>Parking spots - Car</p>
<b>Accessibility, POIs</b>	
<p>Groceries, weekly markets</p> <p>Specified stores, facilities</p> <p>Healthcare, pharmacies</p> <p>Cafés, restaurants</p> <p>Leisure, sports, recreation</p> <p>Social interactions, community centres</p> <p>Are (daily) services accessible?</p> <p>Diversity, proximity</p>	<p>Destinations in other neighbourhoods</p>
<b>Modes of transport</b>	
<p>Pedestrians</p> <p>Cyclists</p> <p>Car – Ownership</p> <p>Car – Sharing</p> <p>PT – Bus</p> <p>PT – S-Bahn, U-Bahn</p> <p>PT – Train</p> <p>PT – Ticket type</p>	<p>Being given a ride, taxi, Uber</p>
<b>Injustice</b>	

## Appendix 5: Interview question set – Experts

- (1) What does mobility justice mean for your planning practices?
  - What is specific when striving for mobility justice for seniors?
  
- (2) Older residents of Waldtrudering encounter injustices in the following fields
  - Walkability, infrastructure design for pedestrians
  - Cycling
  - Public transport
  - Diversity of residential areas
  - a. Which measures can improve the experiences of older people, in those fields of action?
  - b. Which additional factors, that are relevant for seniors' mobility routines, do they take into account?
    - Costs
    - Consideration amongst traffic participants
    - Information, comprehensibility
  - c. What are the priorities and the states of planning / feasibilities for those measures?
    - High priority, Specific actions, already part of local planning
    - Medium priority, Planning taken up / measures developed in corresponding fields
    - Low priority, No plans available at the moment
  
- (3) The further objectives are especially relevant for seniors when being mobile. How can they be part of local planning?
  - Maintaining health, fitness
  - (Perceived) safety, comfort
  - Independence
  
- (4) What are common challenges / barriers on the pathway to implementing measures for senior-friendly mobility?
  
- (5) Which senior-specific measures for mobility justice have been implemented in other neighbourhoods of Munich? Have they proven useful, and why / why not?

(6) The majority of older persons is not satisfied with the rebuilt centre of Trudering. This affects the following fields. Are improvement activities planned for these fields, and if yes, what is meant to be done?

- Lack of cycling infrastructure
- High traffic volume and unclear traffic situations

(7) Which further measures are planned in Waldtrudering?

- How can they be implemented in a just way for seniors? (e.g. sharing stations, on-demand travels)



# Digital Appendix

Digital Appendix 1: Transcripts of residents' interviews, including coding

Digital Appendix 2: Audio recordings of residents' interviews

Digital Appendix 3: Transcripts of experts' interviews, including coding

Digital Appendix 4: Audio recordings of experts' interviews

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# Declaration of Authorship

I herewith formally declare that I have authored the submitted thesis independently. I did not use any outside support except for the declared literature and other sources mentioned in the paper.

I clearly marked and separately listed all of the literature and all of the other sources which I employed when producing this academic work, either literally or in content.

I am aware that the violation of this regulation will lead to failure of the thesis.

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Place, Date, Signature