



# Unmet needs, unjust journeys: Exploring mobility injustice perceptions among disadvantaged groups

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## ARTICLE INFO

### Keywords:

Justice  
Mixed-methods  
Mobility practices  
Social disadvantaged

## ABSTRACT

Justice in mobility has been conceptualized and assessed through various frameworks, yet it is also deeply influenced by individual experiences and perceptions. Achieving mobility justice, therefore, requires aligning top-down transportation policies with the lived realities of those directly affected. This paper examines how mobility justice is perceived and experienced by disadvantaged socio-economic groups, focusing on the interplay between spatial distribution and individual mobility experiences. Using a convergent parallel design for the mixed-methods approach, the study uses a neighbourhood-level survey and 16 in-depth interviews conducted in Berg am Laim, Munich. The findings reveal four key dimensions that lead to mobility injustice perceptions for disadvantaged socio-economic groups: (1) unequal distribution of street space for cyclists, (2) the dominance and prioritization of car-centric infrastructure in public street management, (3) even when affordable options such as the Deutschland ticket exist, the rigidity and inflexibility of public transport pricing schemes leads to perceptions of injustice, and (4) barriers within public transport systems for people with physical, cognitive, or linguistic challenges. In addition, despite policy improvements and the prerequisites for a more sustainable mobility system in Munich, disregarding perceptions of injustice among disadvantaged socioeconomic groups might risk causing more preference for cars. A more just public transport system would be tailored to the diversity of its users, as a one-size-fits-all approach often leaves the most disadvantaged feeling excluded.

## 1. Introduction

At a time when it is imperative to implement the transition towards sustainable mobility, many authors point out the risk of sacrificing the principles of social justice and democracy in this process (Ciplet and Harrison, 2020; Flipo et al., 2023; Eckersley, 2022). The challenge is to ensure the most vulnerable individuals do not suffer inequitably from the effects of these policies. At the same time, concerns about social equity and the implications of transport interventions continue to rise (Palm et al., 2021). With all citizens, including many diverse disadvantaged groups, being the potential users of the transportation system, social issues are at the core of the transport policy challenge.

However, the measurement and assessment of social implications of transportation policies in practice remain significantly limited (Lucas et al., 2022). This gap is particularly evident in the context of transport justice, where disparities in access to mobility options and exposure to environmental burdens disproportionately affect disadvantaged groups, including people of color, low-income individuals, people with

disabilities, older adults, and youth (Blumenberg and Manville, 2004; Golub and Martens, 2014). To have a sustainable transition in the field of transport that is economically, environmentally and socially beneficial, the field needs to consider the needs and justice perceptions of the most disadvantaged ones. Thus, it requires thinking about sustainable, low-carbon modes of transport that are not only available but also accessible to all (Nikolaeva et al., 2019). However, sustainable mobility transformations have been found to have a disproportionate effect and not always consider the needs of the most vulnerable communities (Wågsæther et al., 2022). Moreover, there is a need to apply more subjective evaluation mechanisms to understand social injustices in mobility and, therefore, contribute to the mobility justice field. Drawn from liberal political philosophy, the two dominant theories of justice are utilitarianism, which maximises utility for the majority, and Rawls' difference principle, which maximises benefit for the least well-off. However, when applied to the transportation field, these principles tend to be limited to the issue of access and the distribution of mobility resources and burdens.

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<https://doi.org/10.1016/j.jtrangeo.2025.104396>

Received 7 November 2024; Received in revised form 25 July 2025; Accepted 19 August 2025

Available online 25 August 2025

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This normative evaluation approach fails to account for the diverse needs, aspirations, and reasons that motivate mobility (Verlinghieri and Schwanen, 2020). So far, what is just or unjust in mobility is highly theoretical, with very little direct insight from the individuals who are the main beneficiaries of the transport system (Haxhija et al., 2025). This absence of marginalised voices represents a form of epistemic injustice, as described by Fricker (2007), where systemic biases in knowledge production result in the exclusion or misrepresentation of disadvantaged groups. Sheller (2018) brings this concept into the field of mobility research, showing how dominant ways of knowing can obscure or silence the lived experiences of those most affected by mobility injustices. Building on this, Lindberg et al. (2023) argue that adopting a reflexive approach, one that critically examines whose knowledge is heard, can help researchers uncover these injustices and work towards reducing, or ideally preventing, their continued reproduction. In response, this study employs a mixed-methods approach to critically examine the factors shaping perceptions of mobility injustice among socio-economically disadvantaged groups, to amplify marginalised voices and contribute to more reflexive, just mobility research.

Therefore, the main question guiding the methodological design of this study focused on exploring the underlying reasons behind specific mobility needs within the system that contribute to perceptions of injustice among socio-economically disadvantaged groups. To address these broader questions, this article uses the district of Berg am Laim as a case study, a district with a high presence of disadvantaged socio-economic groups in Munich. The study applies a mixed-methods approach using a convergent parallel design to integrate and interpret the results from the survey and in-depth interviews developed for the purpose of this research.

The article proceeds as follows: The theoretical background section provides an overview of equity and justice, to later dive into mixed-methods research, which addresses mobility needs and justice perceptions. The next section describes the case study and the reasons for its selection in more detail. The mixed-methods approach used to design this study, as well as the design of the survey and in-depth interviews, is explained in the third section. The fourth section, Findings and Results, initially dissects the reasons behind mobility needs linked to sustainable modes of transportation. It later links these mobility needs to mobility injustice perceptions from the survey. Section 5 provides a discussion on structural and infrastructural reasons linked to mobility injustices and concludes on the benefits and limitations of the mixed-methods approach.

## 2. Theoretical background

Research on justice-related mobility and transport focuses on two key concepts: transport/mobility justice and transport/mobility equity. In practice, justice framing in mobility has a more activist notion and finds stronger use in non-governmental contexts; equity, on the other hand, is more common in state-centric discourses (Karner et al., 2020). The latter often relies on large-scale simulation models on future land use and travel behaviour and favours technological fixes as solutions for transport injustices (Karner, 2016; Martens et al., 2012). However, such technocratic approaches can be limited in their ability to capture the complexities of lived experiences and the multiple value systems that shape perceptions of justice (Aledo-Tur and Domínguez-Gómez, 2017). Justice is usually perceived through a subjective lens that consists of individualised beliefs, where cultural attributes and demographic characteristics play a significant role in determining the perception of justice (Primeaux et al., 2003). In mobility justice, however, direct perception of justice from an individual perspective by asking respondents about the elements they consider just or unjust is yet to be employed in evaluation methods such as surveys (Haxhija et al., 2025).

This gap in approach to understanding, from a more subjective point of view, what is perceived as unjust and the reasons that lead to such perceptions, can lead to a disconnect between the theoretical

frameworks of justice and the practical realities of mobility. For instance, while research and practice might focus on distributing resources or services equally, it may not adequately address the deeper socio-spatial injustices of how built environments and infrastructure can privilege certain individuals and bodies over others (Hidayati et al., 2021; Kristensen et al., 2023). In this case, the failure to consider movement capacity and the varied needs of different population groups can perpetuate injustices, despite efforts to promote equity. Thus, a more comprehensive approach to transport and mobility justice would require integrating subjective perceptions of justice and the lived experiences of individuals into planning and evaluation methods.

We developed a mixed-method approach for this study to specifically address methodological issues to capture the mobility experiences of the most disadvantaged socio-economic groups and their perceptions of mobility justice. Even though it is less frequently used than other methodologies, mobility researchers focusing on disadvantaged socio-economic groups have used mixed-methods research designs to capture subjective mobility experiences and identify transport disadvantages. For instance, (Lucas et al., 2022) used GIS-based spatial analysis, participatory exercises with residents, and stakeholder interviews to deepen the understanding of the road project's social impacts by uncovering local concerns and amplifying 'hard-to-reach' voices overlooked in the formal consultation process. Kristensen et al. (2023) also highlight the need to include the citizens' experience and ensure that the needs of those with limited mobility are integrated into planning decisions. Otherwise, social inequalities could be further exacerbated despite efforts to improve things. Other studies have highlighted the importance of considering mobility needs that are directly tied to individuals' bodily and cognitive capacities when navigating transportation options (Dilian et al., 2024; Plyushteva, 2023; Bocarejo and Oviedo, 2012; Ratering et al., 2024). In a study where older adults' satisfaction with public transport was being investigated, results from the thematic analysis of the open-ended questions were added to the survey results by bringing forward issues related to physically accessing the transit service (Ravensbergen et al., 2021; Ravensbergen et al., 2023). Similarly, people with disabilities encounter significant barriers in accessing transport, which can severely limit their community participation and overall well-being (Hwang, 2022; Sundar et al., 2016). By combining census-based geospatial data with qualitative interviews, Shay et al. (2016) pointed out that socially vulnerable populations living in peri-urban areas may rely on informal solutions to get around, such as family and friends.

By using a mixed-methods approach (survey data and focus groups), Núñez et al. (2022) attempted to demonstrate the importance of subjective evaluations that should be included when designing urban planning mechanisms. The study focused on dissecting individual needs and barriers linked to accessibility, clearly identifying barriers to mobility related to infrastructure such as routes and modes in poor conditions, non-availability of special vehicles, long travel distances, bad attitudes of drivers, low frequency and poor service to users. Though a large body of mixed-methods studies focused on understanding mobility preferences/aspirations/needs for disadvantaged socio-economic groups, little research focuses on understanding reasons leading to specific mobility needs and injustice perceptions.

This paper extends its contribution to the mobility justice literature by emphasising mobility needs and reasons linked to perceptions of injustices. It also provides an overview and comparison among different socio-economic disadvantaged groups, who, with a few exceptions, are usually analysed and studied separately. Moreover, the study contributed to a small but growing amount of research that uses mixed-method methodologies to explain mobility and justice perceptions from the individual point of view.

## 3. Case study area

This research is part of the Mobility Justice in Metropolitan Regions

project (MGEM), which focuses on Munich, Germany. Munich has a population of 1,558,395 as of 2020 and is Bavaria's capital and most populous city. The city has 25 districts and 108 neighbourhoods. This research focuses on disadvantaged socio-economic groups and aims to capture their perceptions of daily mobility and injustice using a mixed-methods approach. The criteria used to identify disadvantaged socio-economic groups for this study were based on factors such as the geographical location (hence the focus on Berg am Laim), physical or social vulnerability in accessing mobility options, and the financial capacity to afford transportation. Neighbourhoods with a high percentage of residents with disadvantaged socio-economic backgrounds were studied using the Mobility Justice Framework to prioritise areas for mobility interventions, as proposed and developed by Haxhija et al. (2024). The proposed framework analyses different neighbourhoods in the city based on principles of distribution and recognition justice, highlighting neighbourhoods with a mixture of a high concentration of disadvantaged socio-economic groups and low mobility resources / high mobility burdens. Based on this approach, the Mobility Justice Framework is aimed at policy-makers to help them prioritise areas for mobility interventions. Three neighbourhoods that comprise the Berg am Laim district were considered for this analysis, namely Berg am Laim Ost, Echarching and Josephsburg (Fig. 1).

While similar patterns of people with a disadvantaged socio-economic background were observed in other districts, Berg am Laim was chosen as an interesting example due to its proximity to the centre of Munich and the availability of various modes of transport, including bicycles and public transport. For this research, the availability of mobility resources was a prerequisite to further explore what is considered unjust in mobility, even when the primary resource is available. Berg am Laim serves as a critical case in the study of mobility injustice due to its objectively favourable infrastructural conditions juxtaposed with reported experiences of exclusion and inequality. According to Flyvbjerg's (2006) framework, critical cases are selected to test hypotheses in "most likely" or "least likely" scenarios. Such cases provide insights that can either confirm or challenge widely held assumptions. In this context, Berg am Laim represents a "least likely" case for experiencing significant mobility injustice, making it an ideal critical case for examining the persistence of such inequalities.

When compared to Munich's average, all three Berg am Laim neighbourhoods show a higher percentage of socio-economic disadvantaged groups such as single-parent households, low-income people, older people, and people with a migration background. Another important social aspect that is included in this study is people with mobility restrictions.

## 4. Methodology / research design

### 4.1. Mixed-methods approach

The mixed-methods approach is appropriate for this study as it allows for a more comprehensive understanding of the research problem by examining reasons why certain mobility needs lead to mobility injustice perceptions. In parallel to the quantitative study (survey), a qualitative study is conducted to better understand the reasons that lead to specific mobility needs in the transportation system. The study employs a convergent parallel design to mix the data from the quantitative and qualitative datasets. The convergent parallel design ensured that the strengths of one dataset could compensate for the weaknesses of the other, finding a more comprehensive response to the research problem (Şahin and Ozturk, 2019). Fig. 2 While the design of the quantitative survey and qualitative research guide was developed collaboratively, the data collection and analysis were conducted independently to ensure that insights from one method did not shape the outcomes of the other. Both approaches were intended to carry equal weight in the analysis process (Johnson and Onwuegbuzie, 2004). The equal weighting of both datasets assumed that the qualitative and quantitative data would align perfectly, which was not always the case. For instance, some quantitative findings, such as dissatisfaction with walking infrastructure, did not emerge as prominent themes in the qualitative data. This could be a result of the open scope of interview questions, which enabled the researchers to see what the participants deem important when they are not directly asked for it. The two sets of results were compared only after the independent analyses were completed. In instances where qualitative insights provided additional or contrasting perspectives, these were documented separately to ensure their distinct contribution was highlighted. The aim of this comparison was not to quantify the qualitative data but to offer a richer interpretation of the survey findings, particularly by exploring the underlying reasons for the observed mobility needs and perceptions of injustice.

Simultaneously, this study used non-random sampling strategies for both quantitative and qualitative data collection phases. This reflects the objective of this study, which specifically aims at obtaining additional insights into mobility needs and injustice perceptions from disadvantaged socio-economic groups. For the quantitative data collection, two strategies were followed: (1) an online survey was distributed to 10,000 households in the Berg am Laim district, and (2) face-to-face surveys were conducted with individuals from the pre-defined socio-economic groups. Similarly, participants for the qualitative study were selected using a non-random sampling strategy based on predefined criteria. The quantitative and qualitative samples were designed to have a nested

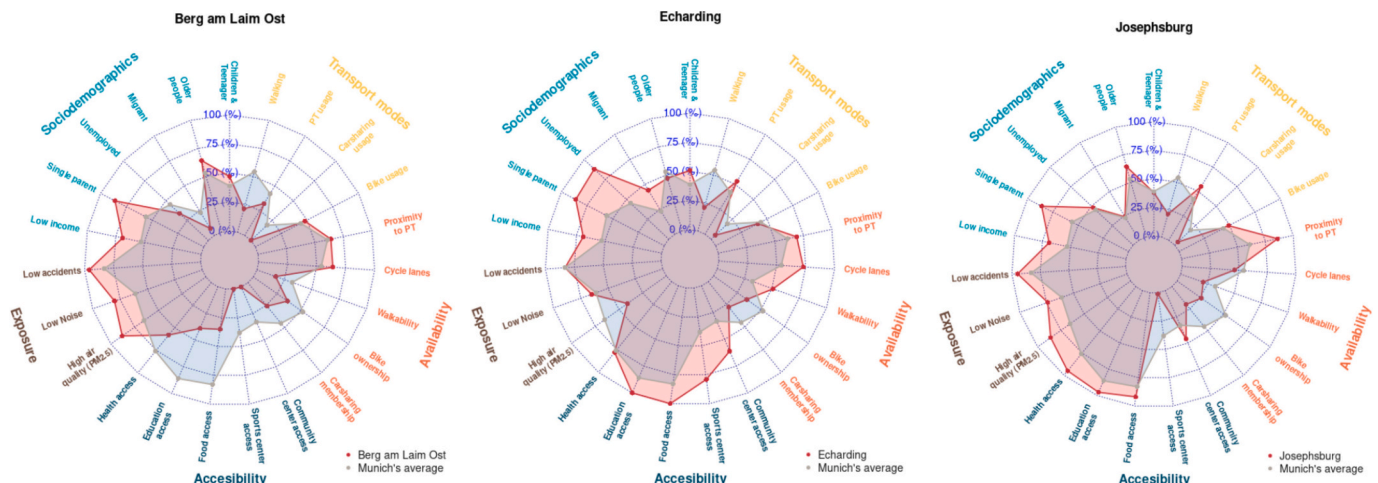


Fig. 1. Mobility and socio-economic disadvantages in Berg am Laim compared to Munich's average.

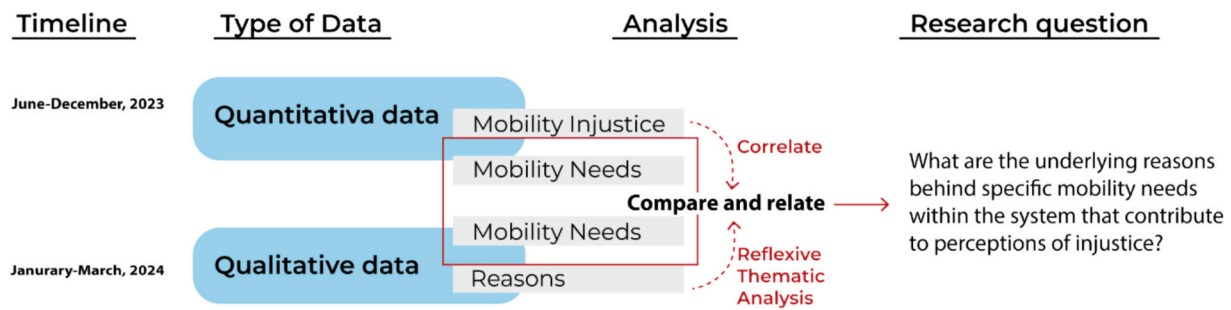


Fig. 2. Convergent parallel design approach for this study.

relationship, meaning that the sample members selected for the qualitative phase of the study were chosen from the survey respondents whenever possible.

#### 4.1.1. Quantitative study

For this study, an innovative survey instrument was developed that asked respondents about their direct perceptions of what they perceive as unjust in the distribution of mobility resources. The survey is designed to take less than 12 min and consists of three modules: (1) Socioeconomic characteristics, (2) Mobility needs, and (3) Distributive justice. Questions on the 'Mobility needs' module were divided into three main subcategories: Public transport, cycling infrastructure and walking infrastructure. The 'Distributive justice' module aimed at capturing respondents' views of justice and whether they felt that the current mobility system in their neighbourhood was just or not. The questions ask for their direct perceptions of the distribution of resources based on accessibility, availability, affordability, subsidies, and public space allocation. These types of questions were gathered using ordinal questions from 1 to 5, with one (1) being fair and five (5) being unfair, or using a range of two opposite responses on two opposite sides of the scale and keeping 'fair' in the middle.

The data collection process spanned over three months (November 2023–January 2024) and included online and on-site data collection. The online data collection covered the Berg am Laim area and was conducted in collaboration with a survey distribution company. The on-site data collection in Berg am Laim targeted specific locations and events, making identifying and interacting with the target groups easier. At the end of the data collection process, we had a valid sample size of 734 responses. Socio-economic characteristics were surveyed based on the following seven factors: gender, age, household size, number of children, marital status, income, mobility restrictions and migration background (see Appendix 1).

Out of the full sample size of 734 responses, only 392 were considered for this study, including respondents with one or more disadvantaged socio-economic characteristics. Descriptive and correlation analyses were performed using Chi-Square and Wilcoxon tests for the disadvantaged socioeconomic groups (392) and the rest of the survey variables. Simultaneously, Pearson correlation and statistical significance analyses were performed to identify significant relationships between the mobility needs and injustice perceptions variables. The survey instrument developed for this study is one of the few mobility surveys that includes direct measures of justice, capturing respondents' perceptions of injustice (see also Souche et al., 2012). However, it's important to note that justice-related questions can be difficult for participants to fully grasp due to the abstract nature of these concepts, leading to varied interpretations and potentially inconsistent responses. This could lead to lower correlations among the different variables being analysed.

#### 4.1.2. Qualitative study

The data collection process involved qualitative semi-structured microstory interviews with 16 participants, selected to represent

diverse perspectives based on their self-identification with specific social categories. The sample included four individuals from the following groups: low-income households, older people, people with a migration background, and single parents, with some participants also identifying as experiencing mobility restrictions and/or exhibiting intersections among all five categories. Fig. 3 illustrates the distribution and intersections among these categories, highlighting the relationships and overlaps between different groupings.

Most participants were recruited from the quantitative survey respondents who expressed willingness to participate in further research. Participation was voluntary, and one was rewarded with an interview participation voucher worth 30 € for a local supermarket or drug store. Interviews were conducted primarily in person, with interview durations ranging from 25 to 80 min, allowing for in-depth exploration of the participants' experiences. The semi-structured format of the interviews facilitated a flexible yet focused discussion, covering a wide range of topics relevant to the research objectives.

Inspired by Vecchio's (2020) microstory interview approach, we have adopted a similar structure to explore individual mobility experiences. In this line, for our study, we have structured the interviews into the same three key categories:

- (1) **Subject:** This section captured participants' social characteristics, including gender, age, educational background, employment status, economic situation, and living arrangement to provide context for their mobility experiences.
- (2) **Valued Activities:** Questions in this category explored the types and frequencies of activities participants engaged in, both for daily needs and leisure, and identified the places where these activities occurred.
- (3) **Mobility Practices:** This part examined how mobility facilitates or hinders access to desired places, detailing features such as modal alternatives, services, travel times, and costs.

By structuring the interviews this way, we aimed to capture the different relationships between mobility needs and individual experiences, aligning with Vecchio's (2020) emphasis on understanding personal mobility through detailed and context-rich narratives. This approach also allowed us to address two important aspects often overlooked in mobilities research, as highlighted by Lindberg et al. (2023). First, it challenged the common assumption that participants are inherently hyper-mobile by acknowledging that they may, in fact, have relatively static routines and limited movement radii. Second, by framing questions around their mobility needs for currently valued activities and what would make these movements easier, we avoided overstating the degree of choice they may or may not possess.

All interviews were transcribed verbatim and anonymised to protect the participants' identities. The data was analysed using reflexive thematic analysis (Braun and Clarke, 2006; Braun and Clarke, 2019), with the coding process facilitated by MaxQDA software and manual coding on printed transcripts. We structured the thematic analysis around three main themes: Mobility Justice Themes, Mobility Needs and Reasons



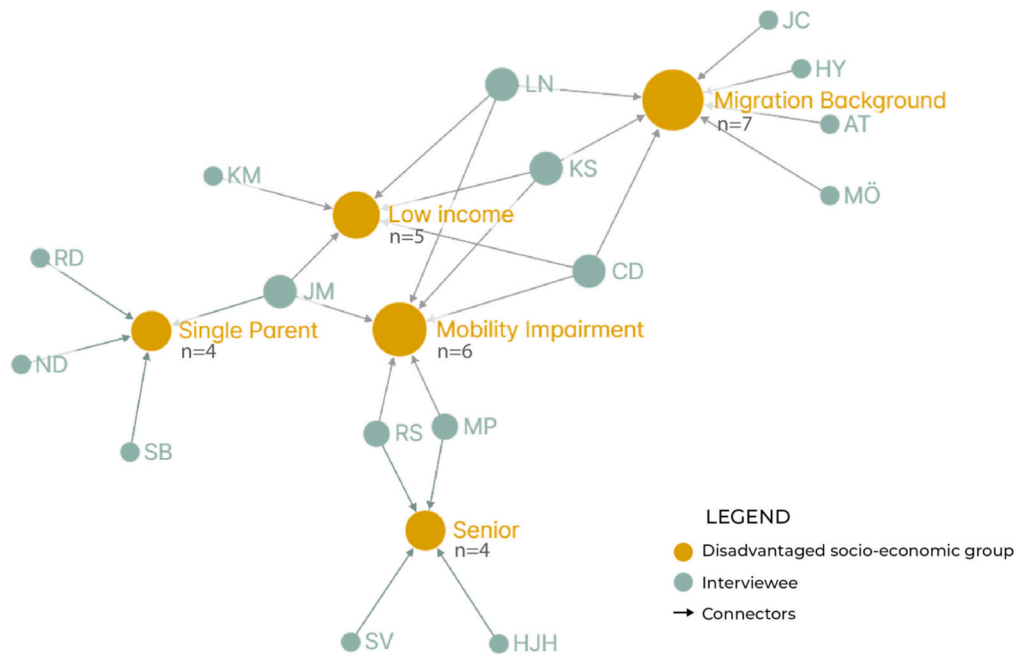


Fig. 3. Interviewee affiliation with socio-economic group.

behind those, and Suggestions for Mobility Improvements for each mobility mode. All transcripts were thoroughly reviewed and discussed among the research team to refine the thematic codes and ensure a comprehensive understanding of the data. This iterative process facilitated the identification of key patterns and insights across the interviews. We recognise that thematic analysis is inherently interpretative, with our research choices and perspectives shaping emerging themes. By engaging in a reflexive approach, we continually reflected on our biases and assumptions throughout the coding and theme development process, embracing the subjective nature of qualitative analysis.

5. Findings

5.1. Exploring mobility needs

Mobility needs were captured using three multiple-choice questions in the survey, in which respondents were asked specifically what they would need to use more often: (1) public transport, (2) cycling infrastructure, and (3) pedestrian infrastructure. The qualitative data feeds into the quantitative data variables by providing additional information on the specific mobility needs per social category and their reasons, and provides information on aspects that were not covered in the quantitative survey but emerged in the interviews.

5.1.1. Mobility needs linked to public transport

The correlation analysis of the survey data (Table 1) for the disadvantaged socio-economic category shows that cheaper tickets, fewer delays, less crowded vehicles, more frequent service, the possibility to reach more destinations and cleaner facilities are the most frequent priorities linked to public transport infrastructure and services. Except for single parents, for whom ‘Fewer delays’ and ‘Less crowded vehicles’ are the main priorities, all four other categories prioritise their need for ‘Cheaper tickets’.

In line with the quantitative data, cost was also a recurring theme in the qualitative data among almost all participants. The opinions on the

Table 1 Mobility needs linked to public transport infrastructure and service (quantitative).					
I Would Use the PT More Often If I Had...	Migration Background (n = 186)	Older People (n = 88)	Low-Income (n = 43)	Mobility Restrictions (n = 204)	Single Parents (n = 41)
*Multiple choice question	%	%	%	%	%
Cheaper tickets	46	38	53	47	39
Fewer delays	43	20	49	33	46
Less crowded vehicles	35	21	47	38	44
More frequent service	30	11	35	30	39
Possibility to reach more destinations	30	12	35	28	34
Cleaner facilities	18	13	23	16	20

affordability of the Deutschland-ticket (49<sup>1</sup>€ per month) varied among participants. Some found it relatively affordable, particularly when compared to the costs associated with car ownership and appreciated the practicality of unlimited travel for a fixed price. However, the financial burden of public transport significantly shaped public transport use and evaluations for low-income participants, (single-) parents and older people. First, for some low-income participants, the price of the Deutschland-Ticket was too high, leading them to apply for the München-Pass, which provides them with discounted single-day tickets. As a result, these participants were restricting their travels within the boundaries of the inner city and bundling appointments on single days to minimize the cost and number of tickets they needed to purchase:

*When you only have 500 euros, you have to plan everything in one day, and then I might have a bad day. It would be great if the price didn't increase for a few years. 3.10 euros sounds stupid, but that's quite a lot of money. (CD).*

<sup>1</sup> Changed to 58 € per month as of January 2025

*I collect the appointments, stamp a day ticket and do everything as far as I can. (KS).*

This underscores how even relatively small amounts can become mobility barriers when living on a tight budget and how participants actively manage mobility under economic constraints, shaping their mobility routines.

Second, parents argued that purchasing several tickets for one household, including children, was financially straining and might even push families to opt for a car over public transportation:

*If you do the math, that's 600 in twelve months... You can do something with those 600. Moreover, I can't even pick up my son with this Deutschland-Ticket. [...] I don't think the children should have to pay. [...]. (LN).*

This suggests that even discounted tickets may fail to address the cumulative financial pressures of family mobility.

Third, older people compared themselves to other groups and their peers in other countries, leading them to perceive paying the full price for the Deutschland-ticket as unfair.

*I think public transport is expensive. I also think it's terrible that the 49-euro ticket is not discounted for senior citizens. Every idiot and student gets it for half price. I bought the 9-euro ticket last year, though. But that was nine euros. Now it's 49 euros. (MP).*

*I think it would be good, for example, as it is in Austria, where all seniors over 65 travel for free. (RS).*

Here, the contrasts between past and current as well as national and international ticket prices emphasize a perceived erosion of fairness.

As in the quantitative data, in the interviews, the delays in public transport were a main concern. Here, this topic was often connected to unreliability and lack of information, which led to them not being able to plan properly. First, many participants stated that relying on public transport to reach their workplaces on time was hard. This was particularly an issue for single parents:

*You're always fighting against time to get somewhere. It's only an issue because of my son. If I'm alone, then it doesn't matter. But because of my son, I'm afraid he'll come home and won't find anyone there. (LN).*

*I always check there, and if it says that the bus is coming in 40 min, you can walk. You can also walk from the school to the subway in 20 min. Although I rarely do that because I'm still hoping the bus will come and I won't have to walk all the way. My son also says after school: I don't like walking. Let's just wait. (ND).*

These considerations reflect the emotional and logistical strain of unreliable transport on caregiving responsibilities and further illustrate how children's preferences shape parents' mobility decisions.

Second, participants were more concerned with the lack of information on cancellations and delays, wishing for real-time information on delays through announcements and on the apps.

*This is annoying...not the delay itself, but the missing information. Why? What is coming now? When is something coming? That is annoying. [...] This applies to the announcements. There are loudspeaker systems at every stop and timetable displays at the stops. [...] On the mobile app, information is only displayed according to the official timetable. (HJH).*

Third, most cancellations were an additional issue as they led to overcrowding. In this line, crowded vehicles were another significant issue for many interview participants. This was particularly important for participants with mobility restrictions who need space to accommodate their needs:

*You have to be careful when the bus is full. It has already happened to me that I couldn't get on. I always think about where the signs are to get a seat [for mobility-restricted people] and not obstruct people so much. They also do stand up for me. The best place for me is where the single seat is. (RS).*

This reflects how physical needs shape users' spatial strategies in crowded transit systems.

Moreover, parents with strollers felt that taking additional space is causing frustration among other public transport users. Additionally, older people acknowledged that in their case, using public transport during crowded times was a choice as they had more flexibility than students or working people to choose when they needed to travel:

*I find it unpleasant at peak times when it's endlessly crowded. But since I can choose, it's my own fault. I realise the students all have to go somewhere in the morning and at lunchtime. People come home from work in the early afternoon. (MP).*

This quote reveals a nuanced understanding of crowding as a situational rather than structural burden for retirees - unlike for other public transport users.

An interesting point by one of the older people was that his friends chose not to commute by public transport, not due to overcrowding, but due to who the crowd consisted of:

*They refuse to use public transport because only Kanacken<sup>2</sup>-German is spoken on the U-Bahn. [...] There are too many people with a migration background who behave this way or that way and who are loud. (SV).*

This quote illustrates how racialized perceptions of public space influence mobility choices and reveals underlying exclusionary attitudes. It underscores how public transport is shaped by symbolic boundaries of social (dis)comfort and how such perceptions contribute to everyday forms of exclusion, reflecting broader issues of racism and social division in urban mobility spaces.

The frequency of public transport services was also a key theme in the qualitative data. On the one hand, this was to reduce the overcrowding in public transport. On the other hand, this was to improve the flexibility in choice, both referring to increasing the choice of public transport means, for example, in favour of above-ground options such as the tram, as well as the choice of living in the outer rings of the city without losing access to regular public transport:

*I find buses and streetcars the most accessible because I don't have to go underground and because they are quicker to get into. [...] Perhaps more frequent travel times, for example, on the streetcar, would help though. (KM).*

This comment highlights how above-ground options like buses and trams are often perceived as more physically accessible and user-friendly, particularly for those with mobility constraints or time-sensitive routines.

The qualitative data showed some differences regarding the preference to reach more destinations. Many of the interviewees evaluated the connectivity of public transport in Munich as quite good, while some criticised that there was no connection to the East, mainly because they lived at the end of the U-Bahn or tram line. Parents also complained that they could not reach their destination easily and quickly after getting off public transport, especially if they had to transfer with a stroller or balance their child and pet. In general, the theme of reaching more destinations was not the most common theme in the qualitative data; here, participants rather focused on how quickly destinations could be reached. Often, participants compared the time spent in public transport to the time spent using their car, leading to them preferring to use cars instead of public transport:

*That would be a ten-minute drive by car. You can get there by bus, but it takes half an hour to 40 min by public transport. I don't want to*

<sup>2</sup> The term "Kanacke" is a colloquial and derogatory term used in Germany to refer to people of immigrant backgrounds, mainly from West Asia and North Africa.

exaggerate, but it definitely feels very long because you also have to change and then wait for public transport. (HY).  
If it takes me 20 min by car and 40 min by public transport, I could almost be back from my trip. Then, I usually opt for the car. (RD).  
Such comparisons reinforce the perception that public transport is inefficient, especially for those juggling multiple responsibilities.

5.1.2. Physical, linguistic & cognitive accessibility

In addition to the survey results, qualitative data highlights two further important themes: (1) Physical Accessibility and (2) Cognitive and Linguistic Accessibility. First, physical accessibility issues were a prominent concern among the participants, particularly regarding the physical barriers in Munich’s public transport system, referring to missing or broken elevators and escalators, making navigating with a stroller or walker difficult. In some cases, participants with mobility restrictions were planning their routes based on the availability of accessible infrastructure, thus taking longer to plan journeys with public transport.

Access must be made easier. I think it’s good that you can travel for free with a disabled person’s pass. But I don’t need free travel if I can’t get everywhere. So that’s a vicious circle. (RD).

This points to the gap between formal rights and practical accessibility, highlighting systemic shortcomings in public transport systems. Additionally, other participants with mobility restrictions needed sheltered stops to protect themselves against prolonged exposure to the sun, maintenance of tram rails to avoid shakiness causing headaches and dizziness and windows that could be opened for more fresh air.

Second, in addition to physical barriers, participants also pointed out challenges related to the complexity and understandability of the public transport system. On the one hand, some participants generally found public transport too complicated, mentioning that checking connections often took longer than simply walking, especially as no clear information was provided at stations and on public transport vehicles in the form of intuitive labelling and information signs. On the other hand, most information is only provided in German. Thus, the absence of labels and announcements in other languages further exacerbates these issues, especially for international residents and visitors. At times, this demotivated participants from using public transport, pushing them to rely on cars.

I was on the U-Bahn, I think it was the other week, and there was some fire or accident around Sendlinger Tor. In the station, the announcement came on, right? We were just sitting there, and I had to ask someone next to me, what did they say? (JC).

This example shows how language barriers can erode users’ sense of security and autonomy.

5.1.2 Mobility needs linked to cycling.

Regarding mobility needs linked to cycling infrastructure, the correlation analysis gives diverse results for disadvantaged socio-economic groups (Table 2).

Except for older people, whose priority is ‘wider cycle lanes’, the rest of the social groups prioritise a ‘connected network of cycle paths’, indicating the need for investments in additional cycling infrastructure in Berg am Laim. ‘Wider cycle lanes’ are a second priority for the rest of the social categories. These themes are also relevant to the qualitative data. First, most participants mentioned the need for a connected network of designated cycle paths, some specifically holding the city accountable based on past promises to create more cycle lanes:

The city committed itself to establishing more cycle paths. In my opinion, very, very little has happened. There is room for improvement. (HJH).

This quote underscores the perceived gap between city promises and actual implementation, leading to frustration and distrust among residents. This topic was especially important for parents cycling with their

Table 2  
Mobility needs linked to cycling infrastructure (quantitative).

I Would Cycle More Often If I Had...	Migration Background (n = 186)	Older People (n = 88)	Low-Income (n = 43)	Mobility Restrictions (n = 204)	Single Parents (n = 41)
*Multiple choice question	%	%	%	%	%
Connected network of cycle paths	36	21	37	37	39
Wider cycle lanes	34	27	37	34	34
More trees separating cycle and car lanes	26	10	37	26	29
Safer crossings	26	12	12	29	32
Cycle paths through parks	25	18	18	26	27
More secure cycle parking	20	20	30	25	24
More cycle parking	31	19	19	24	22
More bushes separating cycle and car lanes	25	9	33	22	22
Traffic lights favouring cyclists	21	16	23	32	24

children. A connected cycle path network could lead to a safer path, free of obstacles and other vehicles. Additionally, they had to navigate the challenge of cycling on the road versus the sidewalk, which depended on their child’s age and the applicable road traffic regulations. Second, the width of the current cycle lanes is widely criticised. Some participants believed that the current cycle paths did not allow for a wide variety of cycles, such as cycles with trailers or riding next to their child:

Interaction with the child is better in the car than on the bike because she is behind me. Riding side by side is rare. (JM).

This highlights how narrow cycle lanes exclude caregiving configurations and limit interaction during rides.

Others stressed that wider cycle lanes would improve safety: on the one hand, currently, cyclists are trying to overtake each other despite a lack of space; on the other hand, cars are coming too close, leading to worry in physically vulnerable cyclists:

My bones are old and rotten. I fall once and break something again. That’s why I’m always very careful. I only ride my bike with a horn and bell and shout at drivers if they come too close to me. (MP).

This points to a deep sense of physical vulnerability and the need for better separation between cyclists and cars.

People with a migration background also rank high in the need for ‘More cycle parking’ in their neighbourhood (31 %), and ‘More secure cycle parking’ is ranked high for low-income (30 %) and older people (20 %). While ‘more cycle parking’ is barely relevant in the qualitative data, the theme of ‘more secure parking’ is highly relevant for various groups. First, this feeling was heightened when participants had heard about such experiences from friends and family:

The neighbour and her husband arrived with the bikes and parked them. The husband wanted to drive off again, and within five minutes, the bike was gone. It was locked, and it was broad daylight. (JM).

Such stories reflect widespread concerns about theft, which reduce the willingness to cycle, especially with more expensive bikes. Especially, as second, most interviewees with more expensive (e-)bikes

stressed that parking outside, for example, at the cycle parking space at Ostbahnhof, was not secure enough. Third, even in cases where underground parking existed, it was not considered comfortable, as it was tedious to bring it downstairs and back upstairs:

*But we don't have a bike shed here like some others. Taking it down to the cellar, bringing it back up and hanging it up again is too much effort. It's easier to get in the car and drive off. Some blocks have a bike shed to lock up. It would be much easier. I would ride my bike a lot more. (JM).*

Safety and security issues linked to 'safer crossings' and 'traffic lights favouring cyclists' rank high among different social categories. Single parents (32 %) say they would cycle more often if they had safer crossings. People with mobility restrictions also highlight the need for traffic lights favouring cyclists (32 %) and 'safer crossings' (29 %). The theme of traffic lights favouring cyclists was also prominent in the interviews. Many participants believed that *"there should be a green traffic light for cyclists"* (SB) to avoid long waiting times and cycle jams at traffic lights, with an additional wish for cycle lane traffic lights, which included a yellow light to allow cyclists to get on their bike before the green light. Participants were generally concerned with the safety of cycle lanes, with no specific focus on safer crossings. Parents and older people especially stressed that cycling was dangerous because other cyclists and cars were driving quickly.

Another important element influencing mobility needs linked to cycling is the presence of green infrastructure along the cycling network. Survey data shows that the presence of 'more trees/bushes separating bike and car lanes, and 'cycle paths that go through parks' are important aspects for single parents, people with mobility restrictions, as well as low-income individuals. The interview data showed that most participants favoured cycling over other forms of transportation as they could enjoy the fresh air. Reasons regarding this were specifically linked to health-related issues.

*I make sure I cycle somewhere where there are few cars because I notice how it smells. You don't notice the exhaust fumes when you're in the car. (JM).*

*It also depends on whether it's a busy road. I would avoid driving along the Mittlerer Ring for two hours. Then there is no health benefit in the end. (RD).*

Cycling here is framed not just as transport but as a health-preserving practice, dependent on air quality and shaping route selection based on the environmental quality of infrastructure.

An additional theme occurring in the qualitative data was the wish for subsidies for tricycles.

*I dream of a bike with three wheels to carry my son and then go shopping. That's something I want. Maybe electric, that could be nice too. [...] The city can also finance it, and we contribute something, even monthly. (LN).*

This idea speaks to the role of affordability and public support in enabling family inclusive cycling mobility.

5.1.3 Mobility needs linked to walking.

Except for older people and single parents (listed as a second priority for both), mobility needs related to walking infrastructure were linked to having more destinations within walking distance (Table 3). In the qualitative data, the need to have more destinations within walking distance was only mentioned when referring to shorter walking distances to public transport stations. For instance, participants with a general distaste for walking mentioned that they planned their routes according to the shortest walking distance, even if transferring more often. In addition, mothers commuting with their children explained that longer walking distances were an issue for them as their children got distracted on the way to the stations, thus increasing their total commute time.

Similar to the cycling infrastructure results, results linked to walking infrastructure highlight the importance of green infrastructure (more trees to provide shade from the sun and walking paths that go through

**Table 3**  
Mobility needs linked to walking infrastructure (quantitative).

I Would Walk More Often If I Had...	Migration Background (n = 186)	Older People (n = 88)	Low Income (n = 43)	Mobility Restrictions (n = 204)	Single Parents (n = 41)
*Multiple choice question	%	%	%	%	%
More destinations within walking distance	41	17	42	31	24
More traffic lights favouring pedestrians	25	17	19	25	20
More trees (providing shade from the sun)	24	13	35	24	24
Better separation of cycle lanes and sidewalks	24	19	33	23	22
Walking paths through parks	24	11	28	24	27
Safer crossing options	26	13	19	24	20
Better lit sidewalks	11	3.4	33	14	22
More seating options	8	10	33	16	12

parks) as a mobility need, specifically for single parents, people with mobility restrictions and low-income individuals. Qualitative data shows that the reasons behind such needs are particularly linked to the physical abilities of the individuals:

*"I have lupus, so I can't go out in the sun. I can't go out in the sun, and when it's cold and then warm, I get dizzy." (LN).*

This illustrates how weather exposure intersects with health conditions, making shaded or green infrastructure critical for safe walking.

Safety issues such as 'more traffic lights favouring pedestrians', 'better separation of bike lanes and sidewalks', 'safer crossing options' and 'better-lit sidewalks' also came up as an important point for consideration. First, in the qualitative data, some participants mentioned that the green light time for pedestrians is too short and irregular.

*"Then sometimes, when you are walking, there is a situation where this green is too fast [...] then I must wait in the sun. The traffic light doesn't give enough time for people to walk." (LN).*

The quote points to the mismatch between signal timing and pedestrians' walking speed, particularly affecting those with physical limitations.

Second, some participants stressed that bike lanes and sidewalks in Berg am Laim were often not visibly separated, making it unclear who could use the lane. Third, most parents remarked that there were not enough safe crossing options in Berg am Laim, especially where many people were crossing the street regardless. One participant even mentioned taking a longer route such that her child would avoid crossing the street at an unsafe location.

Finally, some participants criticised that sidewalks were often too dark even when the street lighting was on, and as a result, one of the older women preferred to carry her own lamp with her:

*I always look to the left and to the right, and especially when it's dark, it's good to have a lamp with you. (RS).*



This highlights how inadequate public lighting leads individuals to create personal safety solutions, especially in low-visibility conditions.

An additional theme for safety from the qualitative data is the dangers of ice and snow on sidewalks.

*Ice is a challenge. You wouldn't believe how many people have called me and told me not to go out and to be careful with the rollator so that I don't fall and end up in hospital. (RS).*

This underscores the heightened risks that winter conditions pose for older people, especially those using mobility aids.

Additionally, the qualitative data reveals a need for more physically accessible infrastructure like seating options and smoother sidewalks, for people with mobility restrictions. For instance, participants with pain-related health issues remarked that they needed seating options on longer-distance walking paths, while others also expressed that walking lanes should be smoother to easier move with a stroller or wheelchair.

Another major theme is e-scooters. While the quantitative and qualitative data reveal that the frequency of use is very low, and e-scooters are mainly mentioned as an unfavourable means of transport, the topic of e-scooters still took a major role. Interviewees highlighted safety concerns about unclear driving spaces (pedestrian or cycle lanes) and complained about scooters being left on sidewalks, calling for more regulation.

## 5.2. Mobility needs and injustice perceptions

The core module of the survey was the distributive justice module. This module was divided as follows: distribution of public street space, distribution of time to cross the street, cost of public transport, availability of urban elements and inclusive infrastructure, time spent to reach destinations and subsidies (check [Appendix 2](#)). To understand mobility needs that lead to injustice perceptions, variables from both datasets (quantitative and qualitative) were first analysed independently and then underwent a triangulation process ([Fig. 4](#)).

The section above focused on understanding mobility needs based on both quantitative and qualitative analysis. They underwent a triangulation process in order to understand where the data converged and diverged and to have a more holistic understanding of the structural and infrastructural factors that emerge from such mobility needs. In this section, data analysis is aimed at identifying the most prominent mobility injustice perceptions among disadvantaged groups.

These key injustice perception variables were then correlated with the main mobility needs variables that were identified in [Tables 1, 2, and 3](#). A Pearson correlation analysis ([Fig. 5](#)) was conducted to assess linear relationships between the variables of perceived injustice and mobility needs. Additionally, statistical significance was determined by calculating  $p$ -values ( $p < 0.05$ ).

No strong correlations were observed ( $r > 0.7$  or  $r < -0.7$ ); most of the identified relationships indicated moderate correlations. This result likely reflects the inherent complexity of human behaviour, particularly in relation to perceptions of injustice. Social phenomena are shaped by a diverse range of factors, including individual behaviour, emotions, and external socio-environmental conditions, all of which contribute to significant variability in responses ([Krehbiel, 2004](#)). This variability can obscure stronger correlations, as perceptions of injustice are influenced by a multitude of interconnected and often subtle factors. Therefore, correlations between mobility needs and injustice perceptions where the coefficient satisfied the condition  $|r| > 0.3$  or  $|r| < -0.3$ . The table below ([Table 4](#)) shows these links and offers a more comprehensive overview of the mobility needs linked to injustice perceptions.

Based on the table above some key drivers for mobility injustice perceptions among the interviewed disadvantaged socio-economic groups can be observed and will be discussed further in Chapter 6. These drivers of mobility injustice perceptions are linked to:

1. Unjust distribution of street space for cycles, including bike parking space, especially for parents with children and individuals with

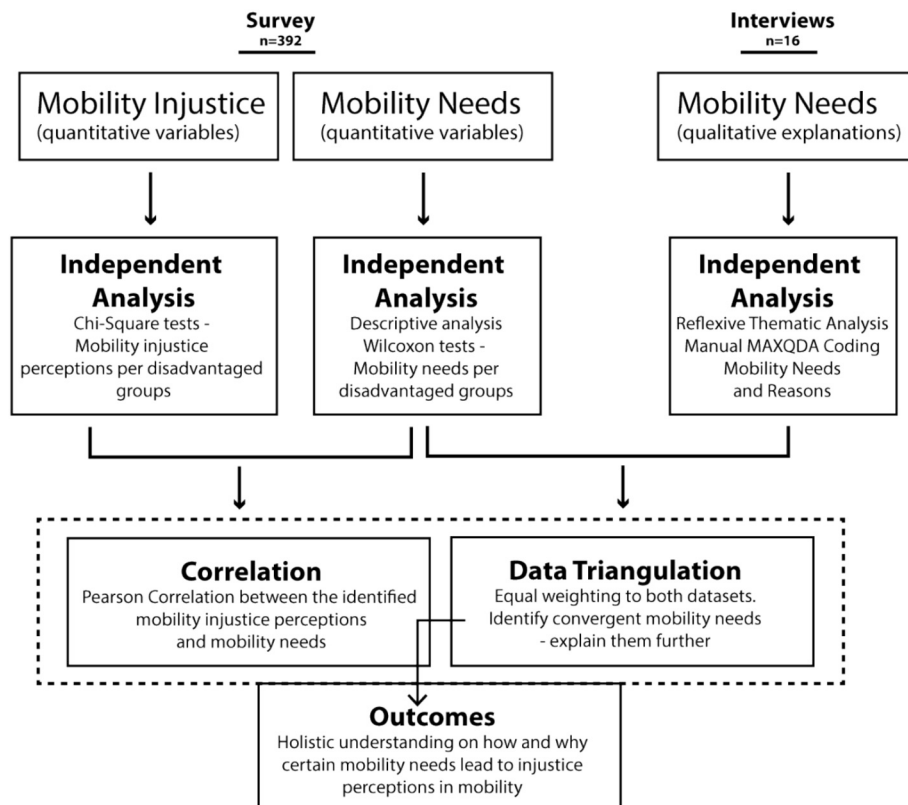


Fig. 4. Data analysis process.

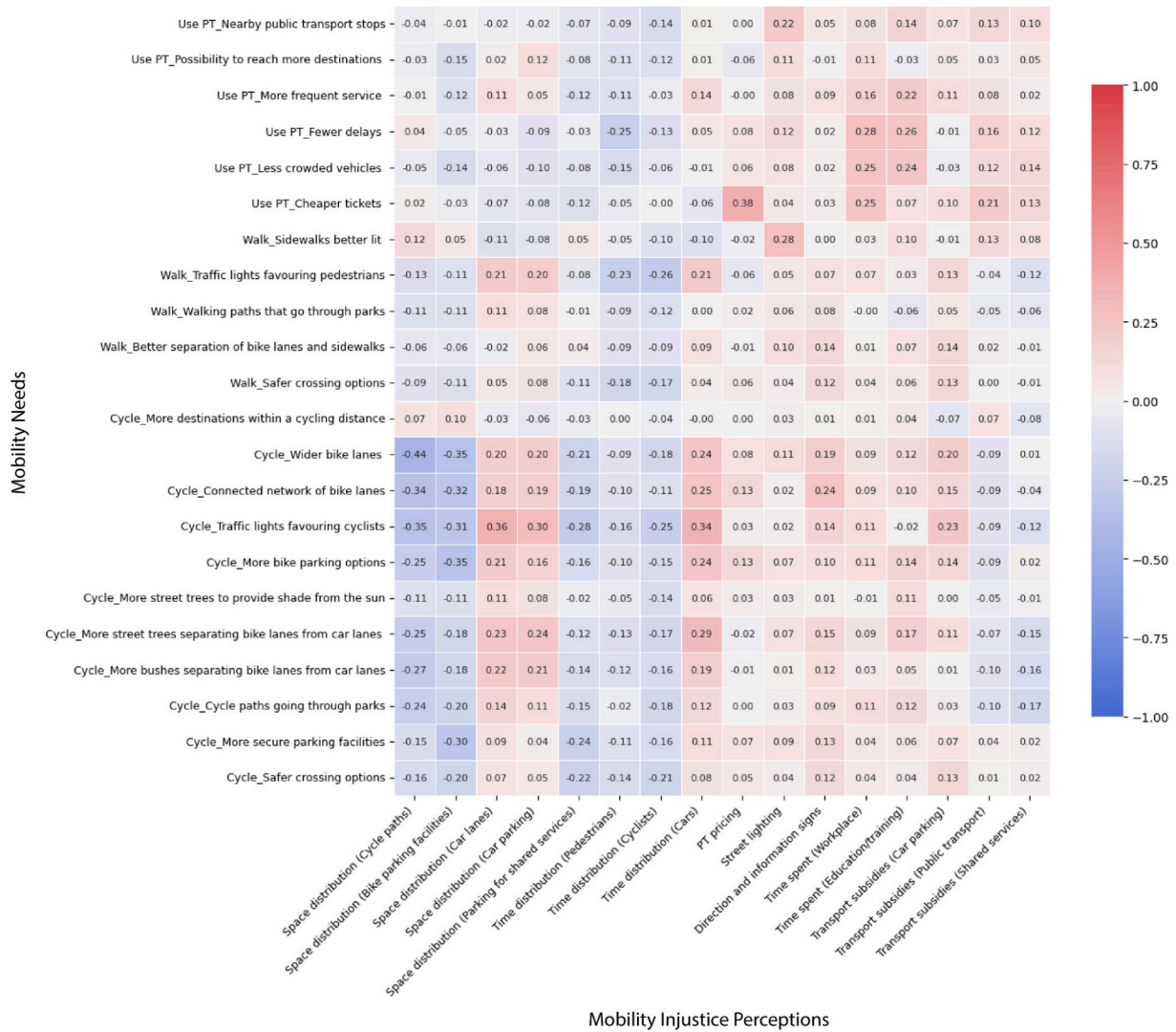


Fig. 5. Pearson correlation matrix for mobility needs and injustice perceptions.

physical disabilities which require wider cycle lanes to accommodate their tricycles;

2. Injustice perceptions as a result of the car-based infrastructure, especially when making comparisons to other neighbourhoods or comparing among different road users;
3. Perceived injustices related to public transport pricing emerged as a key concern across all respondents, regardless of socio-economic status, with low-income groups reporting additional burdens in the interview phase, that negatively impact other areas of their lives;
4. Injustice perceptions linked to physical, cognitive and linguistic accessibility for public transport users, reported by individuals with physical disabilities, parents with children and people with a migration background.

## 6. Discussion and conclusion

### 6.1. Drivers of mobility injustice perceptions for disadvantaged socio-economic groups

Based on the above findings, four main themes of mobility injustice can be identified: (1) injustice linked to the distribution of street space for cycles, (2) injustice linked to the car-based infrastructure, (3) injustice linked to the public transport pricing and, (4) better physical, cognitive and linguistic accessibility for public transport users.

#### 6.1.1. Unjust distribution of street space for cycles

A strong perception of injustice is tied to the distribution of street space, particularly regarding cycling infrastructure. Issues raised included inadequate width of cycle lanes, insufficient secure bike parking, and a disconnected network of cycle lanes. For example, parents expressed frustration about the narrowness of cycle lanes, which prevents them from cycling alongside their children, a safety concern that often leads them to opt for car travel instead. Others wished to use other cycles, such as tricycles or cycles with trailers, further stressing the need for wider cycle lanes. Additionally, older adults and individuals with disabilities expressed heightened feelings of insecurity due to the risks associated with cycling near motor vehicles. These concerns echo existing research, which emphasises how the design of the built environment often favours certain groups while marginalising others (Hidayati et al., 2021; Kristensen et al., 2023).

One key finding that deserves additional focus in future mobility research is the preference for traffic light time favouring cyclists, which is emerging as a significant factor in shaping perceptions of injustice. The preference for traffic lights favouring cyclists seems to have deeper links with the need for cyclists to be more represented in the traffic management system, with many respondents favouring dedicated yellow lights for cyclists.

Furthermore, the demand for more bike parking options is closely tied to security issues, particularly for owners of expensive bikes.

**Table 4**  
Explaining mobility needs that lead to injustice perceptions.

Mobility justice variable	Is it unjust?	Correlated mobility needs*	Thematic explanations
Distribution of public street space 1: way too little space, 2: too little space, 3: fair, 4: too much space, 5: way too much space			
Distribution of space for cycle paths	Yes, too little space	Wider bike lanes to cycle	Lanes are too narrow to accommodate a variety of cycles (e.g., those with trailers). Do not allow safe overtaking. No side-by-side cycling with children. Cyclists feel insecure due to proximity to cars. Participants hold the city council accountable for unfulfilled promises regarding cycle lanes. Designated paths are essential for families, as children under a certain age must cycle on sidewalks, making navigation unsafe and inconvenient.
		A connected network of cycle lanes	Participants hold the city council accountable for unfulfilled promises regarding cycle lanes. Designated paths are essential for families, as children under a certain age must cycle on sidewalks, making navigation unsafe and inconvenient.
		Traffic lights favouring cyclists	Cyclists need an in-between yellow light phase to get ready. Longer green phases to reduce cycle jams and minimize the need to stop frequently, especially in busy city areas.
Distribution of space for bike parking facilities	Yes, too little space	Wider bike lanes to cycle	Lanes are too narrow to accommodate a variety of cycles (e.g., those with trailers) and do not allow safe overtaking or side-by-side cycling with children. Cyclists feel insecure due to proximity to cars.
		A connected network of cycle lanes	Participants hold the city council accountable for unfulfilled promises regarding cycle lanes. Designated paths are essential for families, as children under a certain age must cycle on sidewalks, making navigation unsafe and inconvenient.
		Traffic lights favouring cyclists	Cyclists desire a yellow light phase to start moving before green and longer green phases, reducing cycle jams and minimising the need to stop frequently, especially in busy city areas.
		More bike parking options	Above-ground parking is preferred over underground options, which are often difficult and time-consuming to access. More easily accessible bike sheds would increase usage.
	Yes, too little space	More secure bike parking options	Due to prior incidents or thefts experienced by others, participants with

**Table 4 (continued)**

Mobility justice variable	Is it unjust?	Correlated mobility needs*	Thematic explanations
Distribution of space for car lanes	Yes, too much space	Traffic lights favouring cyclists	expensive bikes are reluctant to park in unsecured areas, stressing the need for safer, more reliable parking facilities. Cyclists desire a yellow light phase to start moving before green and longer green phases, reducing cycle jams and minimising the need to stop frequently, especially in busy city areas.
Distribution of space for car parking	Yes, too much space	Traffic lights favouring cyclists	Cyclists desire a yellow light phase to start moving before green and longer green phases, reducing cycle jams and minimising the need to stop frequently, especially in busy city areas.
Distribution of traffic light time 1: way too little time, 2: too little time, 3: fair, 4: too much time, 5: way too much time			
Distribution of traffic light time for cars	Yes, too much time	Traffic lights favouring cyclists	Cyclists desire a yellow light phase to start moving before green and longer green phases, reducing cycle jams and minimising the need to stop frequently, especially in busy city areas.
	Yes, too much time	More street trees separating cycle lanes from car lanes	The presence of trees would create safer and more pleasant cycling environments, offering natural separation between cyclists and motor vehicles and shade to those needing it, especially due to health restrictions.
Cost of public transport 1: too cheap, 2: cheap, 3: fair, 4: expensive, 5: too expensive	Yes, too expensive	Cheaper public transport tickets	Deutschland-Ticket is considered too expensive by some participants, leading to a reliance on discounted single-day tickets and limiting travel to inner-city areas. Families feel burdened by the need to purchase multiple tickets, while older participants compare their fares unfavourably to discounted rates available to their peers in other countries.

\* P-value <0.001 for all variables.

Concerns about theft and bad experiences from their peers have heightened risk perceptions among cyclists. It is important to note that when underground cycle parking is available, many find it inconvenient to use, leading to a preference for above-ground, secure cycle sheds, especially among parents with children and individuals with mobility

challenges.

#### 6.1.2. Injustice perceptions linked to the car-based infrastructure

Previous studies show that a mobility system favouring car-centric infrastructure leads to injustice in mobility (Guzman et al., 2021; Kristensen et al., 2023). Respondents highlighted the disproportionate favouring of car infrastructure over other street users, with results showing excessive space allocated to cars, excessive car parking and traffic lights prioritising cars over cyclists and pedestrians. Despite clear evidence from literature promoting cycling as a sustainable and healthy means of transportation, our findings show that perceptions of imbalanced and unjust street space distribution foster a culture where cycling is perceived as less safe and less convenient. As some participants' experiences illustrate, when infrastructure fails to support the diverse spectrum of needs linked to active mobility (i.e. cycle lanes that can accommodate a wide variety of cycles), individuals are compelled to rely on cars, perpetuating a cycle of dependence that undermines broader environmental goals.

Previous findings suggest that striped or painted buffers offer some level of increased comfort, whereas buffers with some sort of physical protection significantly increase the perceived comfort for cyclists with safety concerns (McNeil et al., 2015; von Stülpnagel and Rintelen, 2024). In addition, our findings suggest that the preference for additional green buffers separating cycle and car lanes is linked to perceptions of unjust distribution of traffic light time for cars. Qualitative data reveals that green infrastructure along cycling routes boosts safety perceptions and provides additional comfort, such as shade, which is especially beneficial for individuals with mobility restrictions. Combining green infrastructure and traffic management strategies may mitigate perceptions of injustice related to car-dominated infrastructure.

#### 6.1.3. Injustice perceptions linked to public transport pricing

As previous findings on disadvantaged socio-economic groups suggest (Mattioli et al., 2017; Plyusheva, 2023), affordability issues about public transport pricing is closely linked to injustice perceptions in mobility. While low-income participants express additional concerns, our results show that the perception of injustice in public transport pricing is similar across respondents with different socio-economic characteristics within the disadvantaged group. Discounted transport fares, such as the Deutschland-ticket, did not seem to alleviate the burden of public transport costs for low-income individuals. On the contrary, other fares were preferred by this group, resulting in them paying for day tickets and trying to fit various appointments into short periods of time to avoid having to buy multiple tickets. The inability to afford public transport tickets or flexible options led to feelings of exclusion and frustration. These findings bring into focus the tension between universalist pricing approaches (Fischer, 2012), such as flat-rate discount schemes, and more differentiated systems that account for varying levels of need and vulnerability (Pereira et al., 2017; Lucas, 2006). While universal schemes aim for equality, they may fail to achieve equity, particularly from a Rawlsian perspective that prioritises support for the most disadvantaged. Our results suggest that without targeted adjustments, universal pricing models risk reinforcing existing inequalities rather than addressing them.

Perceptions of injustice often arise from comparing one's own circumstances to those of other individuals, groups, or situations perceived to be more advantaged (Smith et al., 2012). Older people found public transport pricing unfair, especially when compared to other groups receiving discounts or their peers in other countries where public transport is free for seniors. Furthermore, the rigidity of current ticketing options may drive individuals to opt for cars as a more flexible and cost-effective alternative (Yaman and Offiaeli, 2022). Families considered it cheaper to own a car than pay for public transportation tickets for every family member, even when they were aware of public transportation's environmental and societal benefits. The cumulative cost of individual tickets for multiple family members often outweighs the

convenience and affordability of owning a single car. Overall, findings suggest that despite the availability of lower-cost alternatives such as the Deutschland ticket, to become more inclusive, public transport in Germany needs to offer more adaptable solutions that cater to the diverse needs of commuters.

#### 6.1.4. Injustice perceptions linked to physical, cognitive and linguistic accessibility for public transport users

The qualitative analysis also highlighted critical barriers related to physical, cognitive, and linguistic accessibility for public transport users, particularly people with a migration background, older individuals and those with mobility restrictions. Concerns about the adequacy of signage, the availability of lifts and ramps, and the overall accessibility of public transport systems were prevalent among respondents. These concerns extended beyond just local metro lines or nearby segments; participants raised issues regarding the entire city of Munich's public transport system, revealing a significant gap in the urban infrastructure, which frequently fails to accommodate individuals who require additional support. One of the participants suggested that involving diverse community members in the design process reflects a broader recognition of the need for participatory approaches in urban planning that prioritise accessibility. While spatial data analysis reveals that areas like Berg am Laim are well-served in terms of public transport stops, there is a notable disconnect between objective spatial measures of accessibility and subjective perceptions, leading to feelings of injustice in mobility. This distinction highlights that accessibility analyses must consider not only the physical presence of infrastructure but also how effectively these spaces serve all users (Curl, 2018), particularly in terms of the absence of barriers such as lifts and ramps, adequate signage, and the use of inclusive language at public transport stops.

#### 6.2. Reflecting on the methodological approach

This study employed a convergent parallel mixed-method design to explore mobility needs and perceptions of mobility injustice. Quantitative data collected via the survey enabled us to identify broad patterns and correlations. A nested sample design was used, with most qualitative participants selected from the survey respondents, ensuring better alignment between datasets. While the study design assumed an equal weighting of qualitative and quantitative data, we found that the two did not always align. For instance, dissatisfaction with walking infrastructure emerged as a significant concern in the survey but was not prominently raised in the interviews, which is also reflected in the length of the mobility needs linked to the walking infrastructure section. Initially, this discrepancy was interpreted as a possible limitation of the open interview format, where participants often did not explicitly frame walking as part of their mobility. However, after analysing the data, it became clearer that this divergence is an important finding in itself. It points to a mismatch between researchers' assumptions, shaped by expert knowledge and normative frameworks of what constitutes 'mobility', and participants' lived realities, in which walking may not be perceived as a distinct or pressing mobility concern. Rather than undermining the survey data, this discrepancy highlights how disadvantaged groups may experience and articulate mobility and mobility injustice differently. In line with our aim to centre their perspectives, this insight calls attention to the need for reflexivity in knowledge production and for rethinking how mobility is framed in both research and policy.

Non-random sampling in the qualitative interviews might have skewed the data towards individuals more motivated to participate, potentially over-representing certain mobility types (e.g., active mobility) and under-representing others (e.g., car owners). Especially as the responses show a significant preference for car-free cities, favouring cycling and public transport over other forms of mobility. Purposive sampling of specific mobility modes (e.g., preferences for car driving) might improve this. Similarly, the specific location chosen to collect data



for the quantitative survey, while ensuring a stronger representation of disadvantaged groups often overlooked in transport research, might have led to some overrepresentation of one disadvantaged group (migrants and people with mobility restrictions) over the other. Berg am Laim, where the study was conducted, has a high proportion of Turkish migrants, which influenced the composition of the sample. As data collection was largely embedded in community spaces such as cafés, mosques and churches, green areas and open markets, the survey naturally captured the experiences of these groups in more detail.

Finally, it can be assumed that a sequential explanatory design, where qualitative data collection follows the quantitative phase, could have offered more explanatory depth. While the convergent parallel design allowed for the simultaneous comparison of datasets, it limited our ability to dive deeper into certain themes as they emerged, generally, to more specific answers regarding potential reasons for certain perceptions. In conclusion, while the convergent mixed-methods approach was effective for this study's objectives, a sequential approach could yield additional insights into mobility needs and justice perceptions, particularly in data gaps. Ultimately, this study highlights the value of integrating both qualitative and quantitative approaches to understand complex mobility issues, while also pointing to the potential for future research to further refine and deepen our understanding of mobility justice.

## CRediT authorship contribution statement

**Sindi Haxhija:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Esma Geliş:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

None.

## Acknowledgements

We thank Nureşan Yılmazoğlu and Johanna Hopp for their contribution to on-site data collection for both the face-to-face survey and interviews. We also extend our gratitude to the participants who generously shared their time and insights, making this research possible.

This study was conducted as part of the Munich Cluster for the Future of Mobility in Metropolitan Regions (MCube). The authors acknowledge financial support from the Future Cluster Initiative Clusters4Future of the German Federal Ministry of Education and Research.

## Appendix 1. Descriptive analysis of the socio-economic module

Socio-economic characteristic	Category	Percentage (%)
Gender	Female	49 %
	Male	49 %
	Other	1.8 %
Age Group	18–24 years old	4.9 %
	25–45 years old	44 %
	46–65 years old	38 %
	Above 65 years old	12 %
	Not answered	1.8 %
Household Size	1 member	26 %
	2 members	35 %
	3 members	18 %
	4 members	16 %
	5 members	4.3 %
	6 members	0.8 %
Number of Children	No children	66 %
	1 child	17 %
	2 children	13 %
	3 children	2.8 %
	4 children	0.7 %
Marital Status	Married	49 %
	Single	37 %
	Divorced	7.4 %
	Widowed	2.5 %
	Other	1.8 %
	Not answered	1.6 %
Migration Background	Non-migrant	72 %
	Migrant	26 %
	Not answered	2.2 %
Income	Less than 1000	5.9 %
	1000–2999	35 %
	3000–5000	29 %
	More than 5000	12 %
	Not disclosed	18 %
Mobility Restrictions	No restrictions	69 %
	Parents with strollers	12 %
	Chronic diseases	9.7 %
	Physical difficulties	4.2 %
	Visual difficulties	3.3 %
	Hearing difficulties	1.9 %
	Cognitive and organic disabilities	1.8 %

**Appendix 2. Survey questions ‘Distributive justice module**

14. Do you think the **public space** dedicated to the following categories in your neighbourhood is too little, fair, or too much?

	Way too little space	Too little space	Fair	Too much space	Way too much space	No answer
Sidewalks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cycle paths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bike parking facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car lanes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car parking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public transport facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parking for shared services (e.g. car-sharing)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

15. Do you think the **green traffic light time** allocated to the following categories to safely cross the road is too little, fair or too much?

	Way too little time	Too little time	Fair	Too much time	Way too much time	No answer
Pedestrians	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wheelchair users	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cyclists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cars	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. Do you think the current **pricing of public transport** in Munich is cheap, fair or expensive?

	Too cheap	Cheap	Fair	Expensive	Too expensive	No answer
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. Do you think the **availability of the following urban elements** in your neighbourhood is fair?

	Fair	1	2	3	4	5	Unfair	No answer
Accessible public toilets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Seating options	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Street lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Green spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water elements (e.g. fountains)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. Do you think the **availability of the following inclusive infrastructures** in your neighbourhood is fair?

	Fair	1	2	3	4	5	Unfair	No answer
Flat and smooth path	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Zebra crossings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tactile paving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Direction and information signs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

19. Based on your trips from last week, do you think the **time that you spent** to reach the following destinations is fair?

	Fair	1	2	3	4	5	Unfair	No answer
Workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education / training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business (official channels during work)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shopping / errands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accompanying other people (e.g. to daycare)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leisure destinations (e.g. club, cinema, friends)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leisure activity (e.g., bike tour, hiking)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20. In Munich, the costs for transportation and related services are paid from various sources, such as taxes and fees. Do you think it's fair that you have to contribute to certain transportation services through your taxes?

	Fair	1	2	3	4	5	Unfair	No answer
Walking infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cycle lanes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bike parking facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Road infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car parking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shared services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Data availability

Data will be made available on request.

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