



Driving Equitable and Accessible 15 Minute Neighbourhood Transformations

WP3. 15-minute City Decision Support Tool

T3.1. Layer 1: Normative 15mC Accessibility

T3.2. Layer 2: Perceived 15mC Accessibility

Deliverable D 3.1

The DREAMS Accessibility Modeling Framework for Decision Support in X-Minute City Planning

Version: 1.0

Date: 08.05.2026

Responsible partner: Technical University of Munich (TUM) & University of Twente (UT)

Authors: Bartosz McCormick (TUM), Daniela Arias-Molinares (UT), Dylan van Bezooijen (UT), Karst Geurs (UT), David Duran-Rodas (TUM), Benjamin Büttner (TUM)

TABLE OF CONTENTS

| | | |
|------|---|----|
| 1. | INTRODUCTION..... | 6 |
| 1.1. | Integration of Layers 1 and 2 in the DREAMS Decision Support Tool | 7 |
| 2. | METHODOLOGY | 9 |
| 2.1. | Layer 1: Calculated Accessibility | 9 |
| 2.2. | Layer 2: Perceived Accessibility..... | 10 |
| 3. | LIVING LAB ACCESSIBILITY ANALYSES..... | 13 |
| 3.1. | Budapest: Rákosmente..... | 13 |
| 3.2. | Brussels: Haren & Neder-Over-Heembeek..... | 15 |
| 3.3. | Munich: Geretsried | 17 |
| 3.4. | Paris: Évry-Courcouronnes | 20 |
| 3.5. | Utrecht: Overvecht | 22 |
| 3.6. | Vienna: Liesing..... | 24 |
| 3.7. | Average Multi-Amenity Compliance Across DREAMS Living Labs..... | 26 |
| 4. | CONCLUSIONS..... | 28 |
| | REFERENCES | 29 |
| | APPENDIX A | 30 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: DREAMS Decision Support Tool (DDST) implementation overview..... | 6 |
| Figure 2: Overview of the modeling framework..... | 9 |
| Figure 3: Number of survey respondents per living lab (source: Arias-Molinares et al., 2026) | 11 |
| Figure 4: Rákosmente living lab preference sets..... | 13 |
| Figure 5: Rákosmente multi-amenity compliance map based on preference set of adults..... | 14 |
| Figure 6: Rákosmente multi-amenity compliance distributions..... | 14 |
| Figure 7: Haren & Neder-Over-Heembeek living lab preference sets. | 15 |
| Figure 8: Haren & Neder-Over-Heembeek multi-amenity compliance map based on preference set of adults..... | 16 |
| Figure 9: Haren & Neder-Over-Heembeek multi-amenity compliance distributions. | 16 |
| Figure 10: Geretsried living lab preference sets..... | 17 |
| Figure 11: Geretsried multi-amenity compliance map based on preference set of migrants. | 18 |
| Figure 12: Geretsried multi-amenity compliance map based on preference set of older adults.. | 18 |
| Figure 13: Geretsried multi-amenity compliance distributions..... | 19 |
| Figure 14: Évry-Courcouronnes living lab preference sets..... | 20 |
| Figure 15: Évry-Courcouronnes multi-amenity compliance map based on preference set of young adults..... | 21 |
| Figure 16: Évry-Courcouronnes multi-amenity compliance distributions..... | 21 |
| Figure 17: Overvecht living lab preference sets. | 22 |
| Figure 18: Overvecht multi-amenity compliance map based on preference set of low-income residents..... | 23 |
| Figure 19: Overvecht multi-amenity compliance distributions..... | 23 |
| Figure 20: Liesing living lab preference sets..... | 24 |
| Figure 21: Liesing multi-amenity compliance map based on preference set of frequent grocery shoppers..... | 25 |
| Figure 22: Liesing multi-amenity compliance distributions..... | 25 |
| Figure 23: (Population-weighted) multi-amenity compliance matrix by preference set and living lab. | 26 |
| Figure 24: Rákosmente amenity compliance by preference set..... | 30 |
| Figure 25: Haren and NOH amenity compliance by preference set..... | 31 |
| Figure 26: Geretsried amenity compliance by preference set..... | 31 |
| Figure 27: Évry-Courcouronnes amenity compliance by preference set..... | 32 |
| Figure 28: Overvecht amenity compliance by preference set..... | 32 |
| Figure 29: Liesing amenity compliance by preference set..... | 33 |

LIST OF TABLES

| | |
|--|----|
| Table 1: Alignment of Layers 1 & 2 with SUMP process. | 7 |
| Table 2: Living lab target user groups..... | 12 |
| Table 3: Rákosmente multi-amenity compliance (population-weighted) summary statistics. | 15 |
| Table 4: Haren & Neder-Over-Heembeek multi-amenity compliance (population-weighted) summary statistics. | 17 |
| Table 5: Geretsried multi-amenity compliance (population-weighted) summary statistics. | 19 |
| Table 6: Évry-Courcouronnes multi-amenity compliance (population-weighted) summary statistics..... | 22 |
| Table 7: Overvecht multi-amenity compliance (population-weighted) summary statistics..... | 24 |
| Table 8: Liesing multi-amenity compliance (population-weighted) summary statistics..... | 26 |

1. INTRODUCTION

Introduced by Carlos Moreno in 2016, the 15-Minute City has popularized a chronourbanist approach to planning by promoting a vision for cities “where locals are able to access all of their basic essentials at distances that would not take them more than 15 min by foot or by bicycle” (Moreno et al., 2021). The “X-Minute City” is an umbrella term that encompasses variants and adaptations of the 15-Minute City concept, retaining the core premise of integrated urban and transport planning that prioritizes access to essential needs by active modes. The DREAMS Decision Support Tool (DDST) aims to support “X-Minute City” planning within the framework of a Sustainable Urban Mobility Plan (SUMP).

The DDST is comprised of five layers, with the focus of this report being the first two.

1. **Calculated Accessibility (Layer 1):** this layer estimates accessibility to amenities within and outside 15-minute travel time by different transport modes, based on current infrastructure performance (travel speeds) and spatial distribution of amenities. This layer is based on existing (open) data.
2. **Perceived Accessibility (Layer 2):** this layer extends layer 1 by estimating accessibility to amenities for different groups of people, taking into account differences in travel and amenity preferences across various population segments;
3. **User-optimized Accessibility (Layer 3):** this layer builds on Layer 2 and allows estimation of 15mC scenarios co-created by residents and other stakeholders, e.g. including changes in activities, needs, and desired mobility services for different population groups;
4. **Feasible (constrained) 15mC accessibility (Layer 4):** this layer builds on Layer 3 and adds constraints considering business models and government policies for new mobility services, mobility and activity hubs;
5. **Strategic Objectives & Societal Impacts (Layer 5):** This layer will estimate the impacts of interventions and 15mC scenarios on a set of KPIs to estimate the societal impacts.

To accommodate the Layers’ diverse range of quantitative and qualitative approaches, the DDST is implemented through the DREAMS Accessibility Tool (DAT), a web-based GIS accessibility tool, and the Interactive Knowledge Platform (IKP), a website that provides users with tailored information to help them follow the SUMP process. Map- and Accessibility-based layer outputs are implemented into the DAT, with the remainder implemented into the IKP (Figure 1). Consequently, the DDST is highly flexible and capable of fully leveraging the outputs of the five layers.

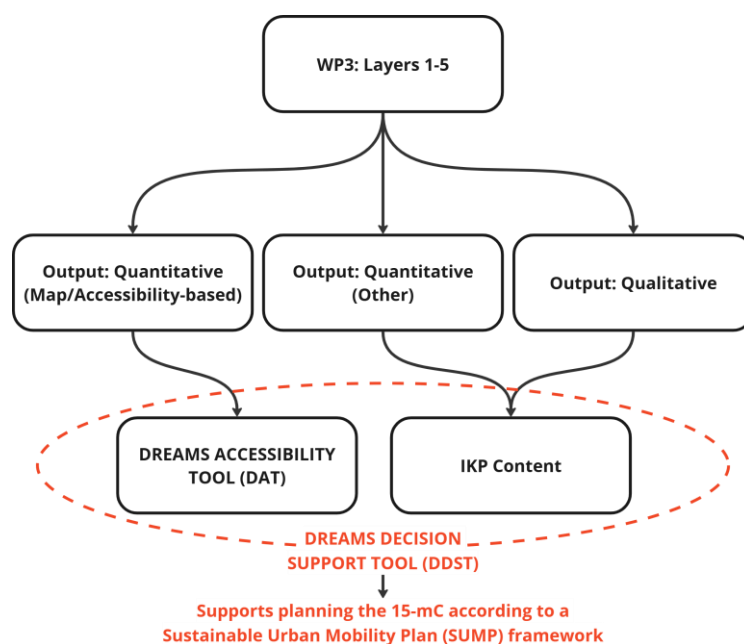


Figure 1: DREAMS Decision Support Tool (DDST) implementation overview.

1.1. Integration of Layers 1 and 2 in the DREAMS Decision Support Tool

Accessibility is central to “X-Minute City” planning. It refers to a potential for interaction with opportunities (Hansen, 1959) and is shaped by four components: land use, transport, temporal, and individual (Geurs & Van Wee, 2004). The land use and transport components are the primary determinants of accessibility, as they represent the opportunities and the connections between them. Accessibility is further influenced by temporal factors, including weather, opening hours, and the service span of public transport, and individual characteristics (i.e., needs, abilities, capabilities). Here, we distinguish between calculated and perceived accessibility. Calculated accessibility is typically estimated from spatial and transport data using GIS-based tools. Calculated accessibility metrics have been criticised for assuming that individuals know all the costs and benefits of all the different alternatives, have the same ability to use the transport system, and for ignoring perceptions of accessibility. To address these criticisms, the concept of “perceived accessibility” has received increasing attention in accessibility studies (see for literature reviews Geurs & Van Wee, 2026; Negm et al., 2025); Perceived accessibility can be interpreted as “the perceived potential to participate in spatially dispersed opportunities” (Pot et al., 2021, p.2). The use of the term “participate” emphasizes the necessity for an alignment between opportunities and an individual’s characteristics, which includes aspects like the ability to use different modes of transport, willingness to travel (and pay), and the relevance of a given opportunity to the individual. However, even if all conditions related to abilities and preferences are theoretically met, accessibility is ultimately shaped by an individual’s perception.

Layers 1 and 2 of the DDST are fully integrated into the DAT, with the goal being to represent calculated accessibility (layer 1) in a way that is conducive to planning the “X-Minute City”, and perceived accessibility (layer 2), as needs-based adaptations of calculated accessibility measures. Accordingly, the focus of the modeling framework is on location-based approaches, which describe the accessibility of points in space. They are relatively simple to interpret and can be calculated using widely available data, making them a practical choice. The key limitation is that they estimate the accessibility of places, rather than people. Layers 1 and 2 provide an “X-Minute” accessibility model capable of representing a normative and perceived perspective, respectively. The layers feature a “compliance” indicator that summarizes accessibility to multiple amenities (e.g., doctors, schools, parks) by determining their alignment with variable travel time and quantity thresholds. Layer 1 utilizes normative thresholds that can stem from theory or policy objectives. For example, being able to reach a set of key amenities within a 15-Minute walk. Layer 2 aims to represent the perception of residents by setting thresholds based on their preferences.

In combination, the layers can support all four main steps of the SUMP process: preparation and analysis, strategy development, measure planning, implementation and monitoring (Rupprecht et al., 2019). The integration of the layers into the four main steps of the SUMP process is detailed in Table 1. Evaluating accessibility from the perspective of residents’ perceptions can inform policy priorities and targets in a way that is sensitive to their needs and preferences. The ability to highlight the perspectives of different demographic groups allows for implications on equity to be considered, so that marginalized groups are not overlooked. After setting targets, accessibility can once again be re-evaluated from a normative perspective that aligns with the adopted policy targets, enabling the identification of areas for improvement. In addition to analyzing the current accessibility, the layers can be used to evaluate future scenarios (hypothetical or realized). This allows for different measures (i.e., changes to the land use or transport network) to be evaluated as well as monitoring progress.

Table 1: Alignment of Layers 1 & 2 with SUMP process.

| SUMP Step | Description | Layer(s) |
|----------------------------------|--|-----------------|
| 1. Preparation and Analysis | Analyze accessibility from perspective of residents’ needs and preferences | 1 & 2 |
| 2. Strategy Development | Set and evaluate accessibility KPIs based on planning goals | 1 |
| 3. Measure Planning | Evaluate how measures impact accessibility KPIs | 1 & 2 |
| 4. Implementation and Monitoring | Monitor how accessibility conditions evolve over time | 1 & 2 |

The aim of this deliverable is to introduce and demonstrate the accessibility modeling framework of the DAT. The framework is demonstrated by applying it to analyze accessibility in the DREAMS living labs (LLs). The LLs are located in the outskirts of six European cities (Budapest: Rákosmente, Brussels: Haren & Neder-Over-Heembeek, Munich: Geretsried, Paris: Évry-Courcouronnes, Utrecht: Overvecht, Vienna: Liesing) representing a variety of local conditions.

The remainder of this report is structured as follows:

- **Chapter 2** introduces the methodology
- **Chapter 3** uses the layers to analyze accessibility in the living labs
- **Chapter 4** concludes with a comparison analysis of the living labs

2. METHODOLOGY

2.1. Layer 1: Calculated Accessibility

To calculate location-based accessibility indicators, a travel “cost” matrix from origins to opportunities is calculated for a scenario defined by the land use and transport network. Given the context of the “X-Minute City”, travel time and amenities represent cost and opportunities, respectively. The origins are defined using a uniform grid covering the planning area to allow for the spatial distribution of accessibility to be mapped and for a connection to underlying demographic data. Travel times are calculated using a shortest-path algorithm and by specifying an average travel speed. For this purpose, r5r (Pereira et al., 2021), an interface to the R5 routing engine for the programming language R, is used as it is suitable for multimodal routing and is highly performant. However, it’s noted that it can be interchanged with other routing algorithms.

This provides the foundation for the modeling framework (Figure 2), enabling the calculation of different types of indicators that represent either primal or dual forms of accessibility (Wu & Levinson, 2020). Examples include “cumulative opportunities” (e.g., 3 pharmacies within a 15-minute walk) and “travel-time-to-N-nearest” (e.g., 15 minutes to reach 3 nearest pharmacies) indicators, representing primal and dual forms, respectively. As indicated in the examples, these indicators are not fundamentally distinct from one another but rather highlight different perspectives: the quantity of amenities that can be reached and the time associated with reaching them.

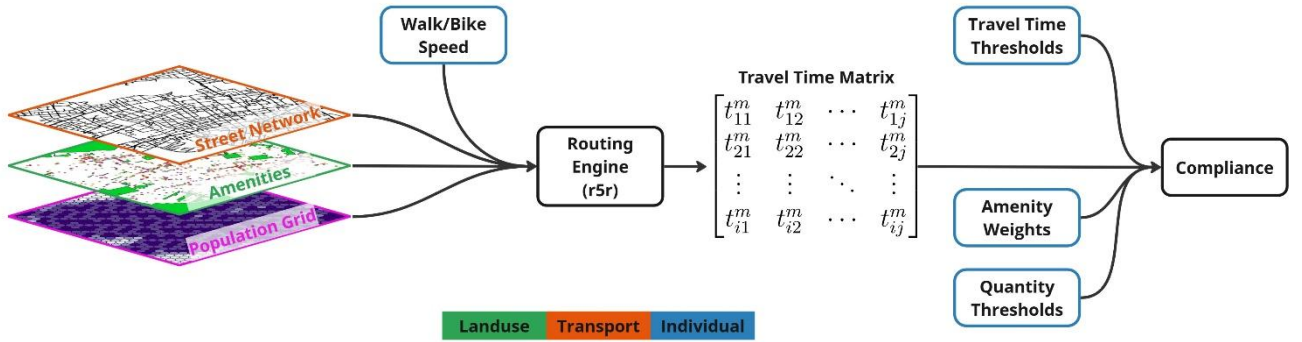


Figure 2: Overview of the modeling framework.

Compliance indicators are calculated by introducing thresholds, resulting in a binary (pass/fail) or continuous (share of the threshold achieved) output. These types of indicators are commonly used in “X-Minute City” accessibility analyses, particularly when considering access to multiple amenities simultaneously (Papadopoulos et al., 2023). In line with this, a multi-amenity compliance indicator (Equation 1) was formulated to serve as the primary indicator for Layers 1 and 2. Like Staricco (2022), the indicator allows for variable travel time thresholds and, and like Weng et al. (2019), it allows for the amenities to be weighted differently. The indicator is generalized to allow for any number of transport modes to be considered. Setting parameters based on residents’ preferences incorporates the individual component of accessibility into the model, providing insight into perceived accessibility.

Multi-amenity Compliance Indicator

$$A_i = \frac{\sum_{k \in K} \left(w^k \cdot \min \left(\max_{m \in M^k} \left(\frac{\sum_{j \in J^k} x_{i,j}^{k,m}}{X^{k,m}} \right), 1 \right) \right)}{\sum_{k \in K} w^k} \quad (1)$$

where A_i denotes the multi-amenity compliance of a location (origin) i .

Indices and Sets

| | |
|-------|---|
| i | origin node |
| j | destination node |
| k | amenity type |
| m | mode |
| J^k | set of destination nodes for amenity type k |
| K | set of amenity types |
| M^k | set of modes available for amenity type k |

Parameters

| | |
|-----------------|---|
| w^k | weight of amenity type k |
| $t_{i,j}^m$ | travel time from i to j using mode m |
| $T^{k,m}$ | travel time threshold for amenity type k , mode m |
| $X^{k,m}$ | quantity threshold for amenity type k via mode m |
| $x_{i,j}^{k,m}$ | $\begin{cases} 1 & \text{if } t_{i,j}^m \leq T^{k,m} \\ 0 & \text{otherwise} \end{cases}$ |

2.1.1. Open-Data Application

The framework is demonstrated using open-data, meaning it can be applied anywhere in the world (albeit, subject to data quality limitations). Open Street Map (OSM) data is used for the street network and amenities. The following amenities are the ones considered in the analysis:

- Grocery
- Bakery
- ATM / Bank
- Post Office
- Café
- Restaurant
- Bar
- General Practitioner
- Pharmacy
- Kindergarten
- School
- Library
- Park
- Sports Facility
- Playground

The origins are defined using the centroids of a H3 grid at a level 10 resolution that covers the planning area. By using the H3 grid, cells are consistently defined, making it easier to integrate other data sources. With an average cell size of 0.76 ha, it is considered appropriate for representing the spatial distribution of accessibility by active mobility. The population living in each grid cell is assigned by intersecting the 100-m-resolution WorldPop 2025 estimated population raster (Bondarenko et al., 2025).

2.2. Layer 2: Perceived Accessibility

Data collected through a survey distributed in six living labs (LLs) across Europe was used to represent aspects of perceived accessibility in layer 2. In the DREAMS survey residents living in urban outskirts were asked about the importance of amenities, their current situation, desired situation, as well as socio-demographic data. The details on the survey methodology, design and further exploration and analysis

of the survey results are not presented in this deliverable but can be found in DREAMS Deliverable 4.2 (Arias-Molinares et al., 2026). Instead, this section provides a brief introduction to the survey and focusses on the methodology applied to the survey data to provide input parameters for calculating the multi-amenity compliance indicator.

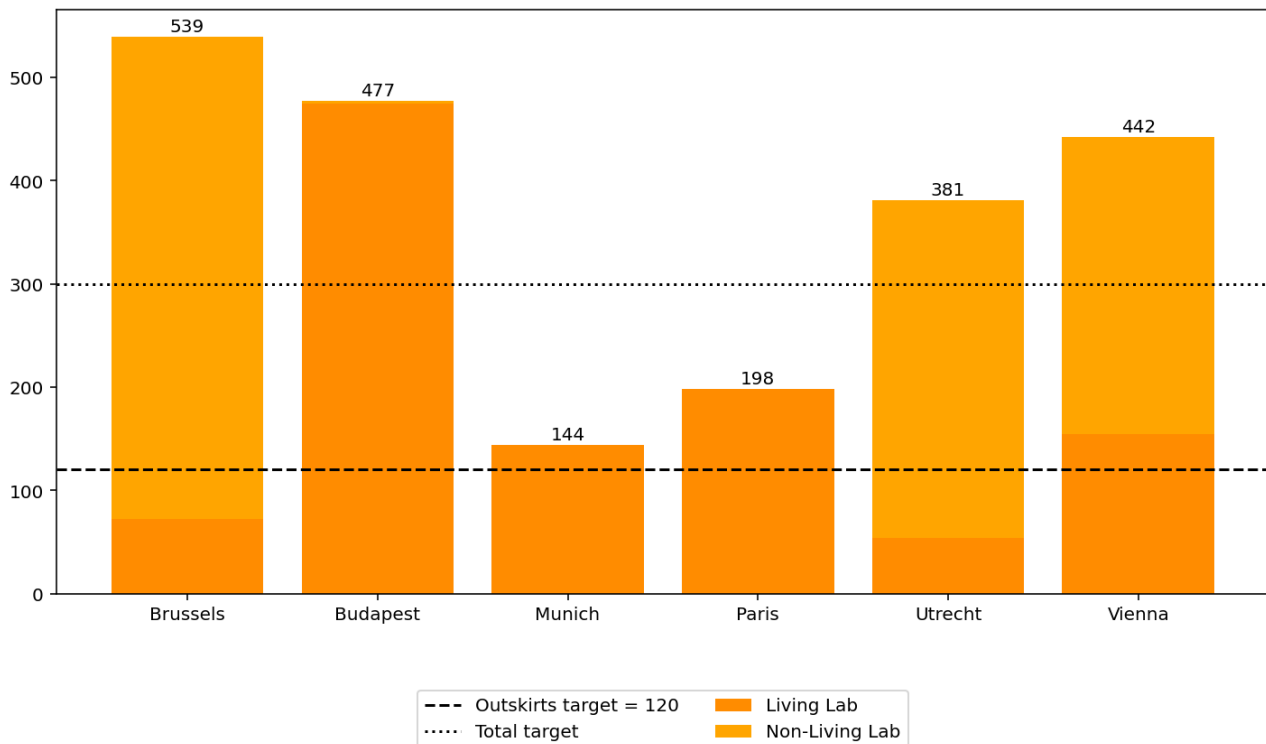


Figure 3: Number of survey respondents per living lab (source: Arias-Molinares et al., 2026)

Figure 3 shows the number of survey respondents in each living lab after data cleaning. In Utrecht, Vienna and Brussels the original spatial bounds of the survey were expanded to other city outskirts due to a limited response in the original living lab. The survey responses were then further split based on each of LL’s target user groups. These subgroups, their criteria and sample size, are given in Table 2. For each target user group, the following parameters were then computed for each amenity:

- **Weight:** The ratio of respondents indicating this amenity is important to the total amount of respondents for that focus demographic.
- **Time threshold:** The maximum amount of time respondents would walk to this amenity type. Only used responses that indicated this amenity type as important.
- **Locations:** The number of locations respondents would like access to for this amenity type. Only used responses that indicated this amenity type as important.

Some target user groups had an insufficient sample size to reliably use the computed parameters. For example, only one response was recorded for older adults in Munich indicating bars were an important amenity. To ensure reliable parameters, a minimum of 5 respondents was seen as acceptable. In cases where the number of responses fell below (10 out of 190), the computed parameters for the general population of the corresponding living lab were used.

Table 2: Living lab target user groups

| Living Lab | Focus Demographic | Data subset | Sample Size |
|---------------------------------------|----------------------------------|--|-------------|
| Munich: Geretsried | Older Adults | Respondents from LL, Age \geq 60 | 47 |
| Munich: Geretsried | Migrants | Respondents from LL, indicating migration background | 24 |
| Munich: Geretsried | General Population | Respondents from LL | 144 |
| Paris: Évry-Cour-couronnes | General Population | Respondents from LL | 198 |
| Paris: Évry-Cour-couronnes | Young population | Age \leq 25 | 32 |
| Vienna: Liesing | General Population | Respondents from LL & other urban outskirts | 442 |
| Vienna: Liesing | Frequent Grocery shopping adults | Age = 25-45 and shopping for groceries at least once per week. | 164 |
| Utrecht: Overvecht | General Population | Respondents from LL & other urban outskirts | 381 |
| Utrecht: Overvecht | Low income | Less than 3000 euros per month net income | 109 |
| Brussels: Haren & Neder-Over-Heembeek | General Population | Respondents from LL & other urban outskirts | 539 |
| Brussels: Haren & Neder-Over-Heembeek | Parents | Parents (single or couples) | 169 |
| Budapest: Rákosmente | General Population | Respondents from LL | 477 |
| Budapest: Rákosmente | Adults | Age 25-45 | 178 |

3. LIVING LAB ACCESSIBILITY ANALYSES

For each living lab, multi-amenity compliance was calculated using parameters representing:

- a normative, 15-Minute City perspective (Layer 1), where all amenities are equally weighted and one location of each amenity is to be reached within a 15-minute walk
- a perceived perspective (Layer 2), where amenity weights, location counts, and walking time thresholds are based on the preferences of LL residents.

3.1. Budapest: Rákosmente

The preferences of the Rákosmente living lab’s residents are depicted in Figure 4 and show the comparison to the normative, 15-Minute-City thresholds.

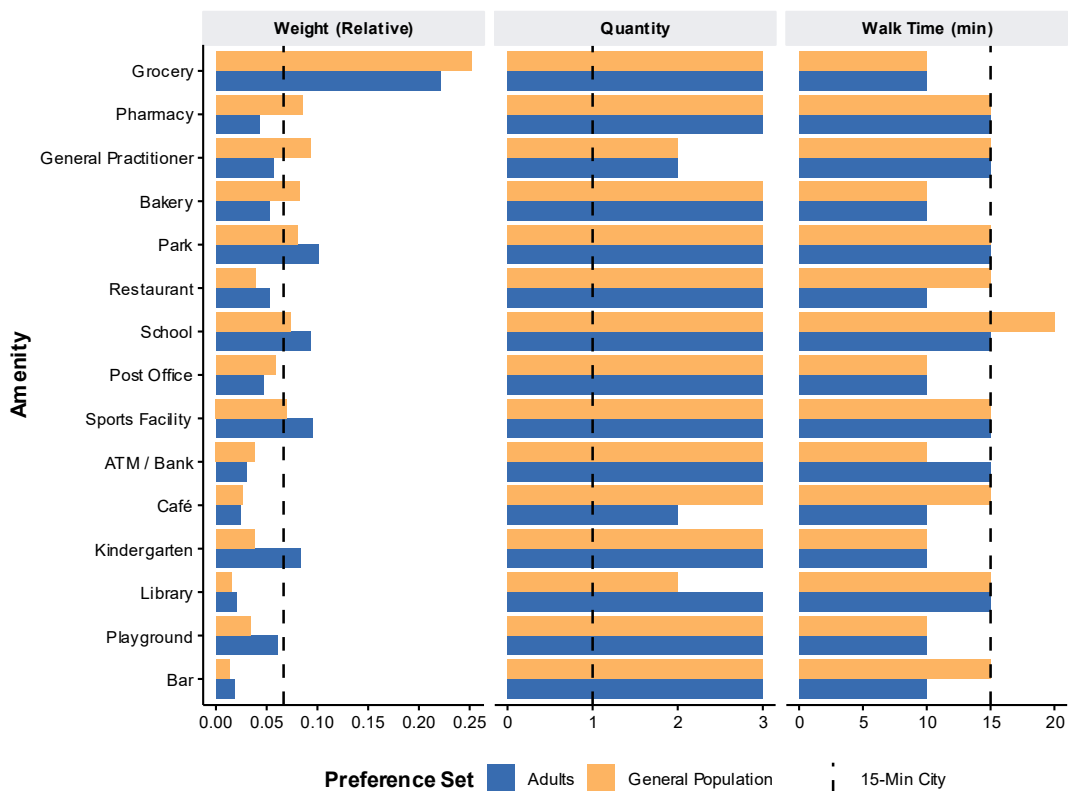


Figure 4: Rákosmente living lab preference sets.

On average, residents of Rákosmente can access at least one location within a 15-minute walk for 61% of amenities (multi-amenity compliance of 0.61). When considering the preferences of adults, the multi-amenity compliance falls to 0.34. A map of the spatial distribution is provided in

Figure 5. The distributions and corresponding summary statistics for all preference sets are provided in Figure 6 and Table 3, respectively.

This reduction in compliance is largely driven by access to grocery stores, which are highly weighted but have a low compliance (population-weighted average of 0.16). Other amenities with low compliance are post offices, cafés, libraries, and bars (refer to Figure 24 for more detail).

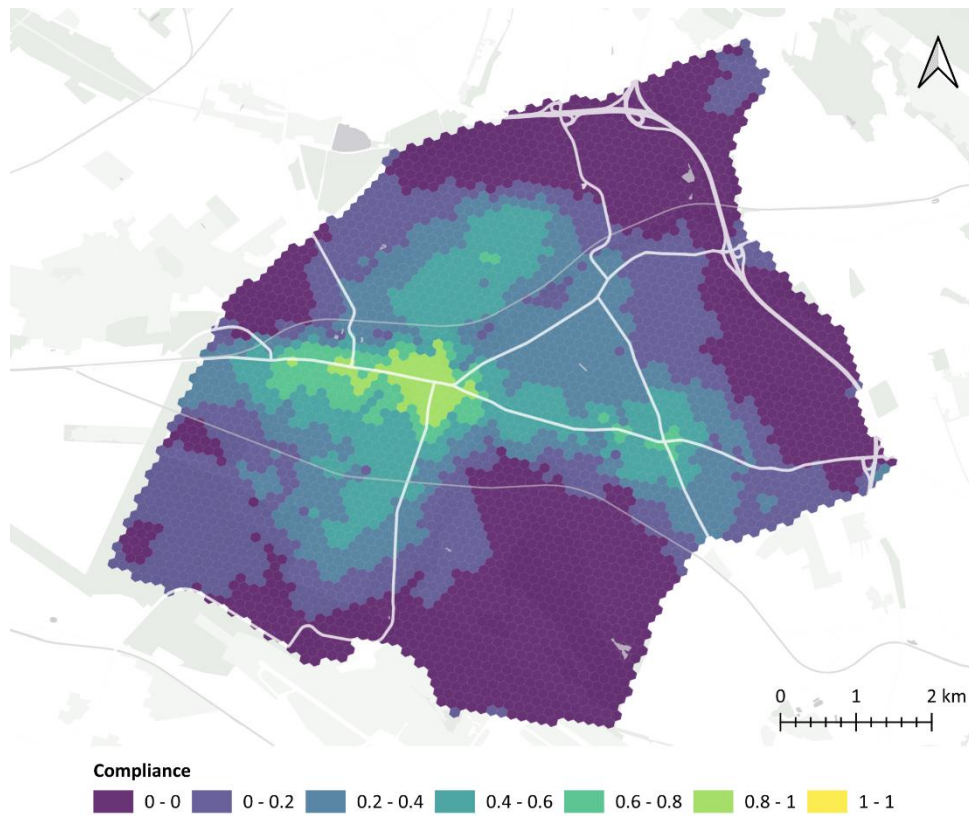


Figure 5: Rákospalota multi-amenity compliance map based on preference set of adults

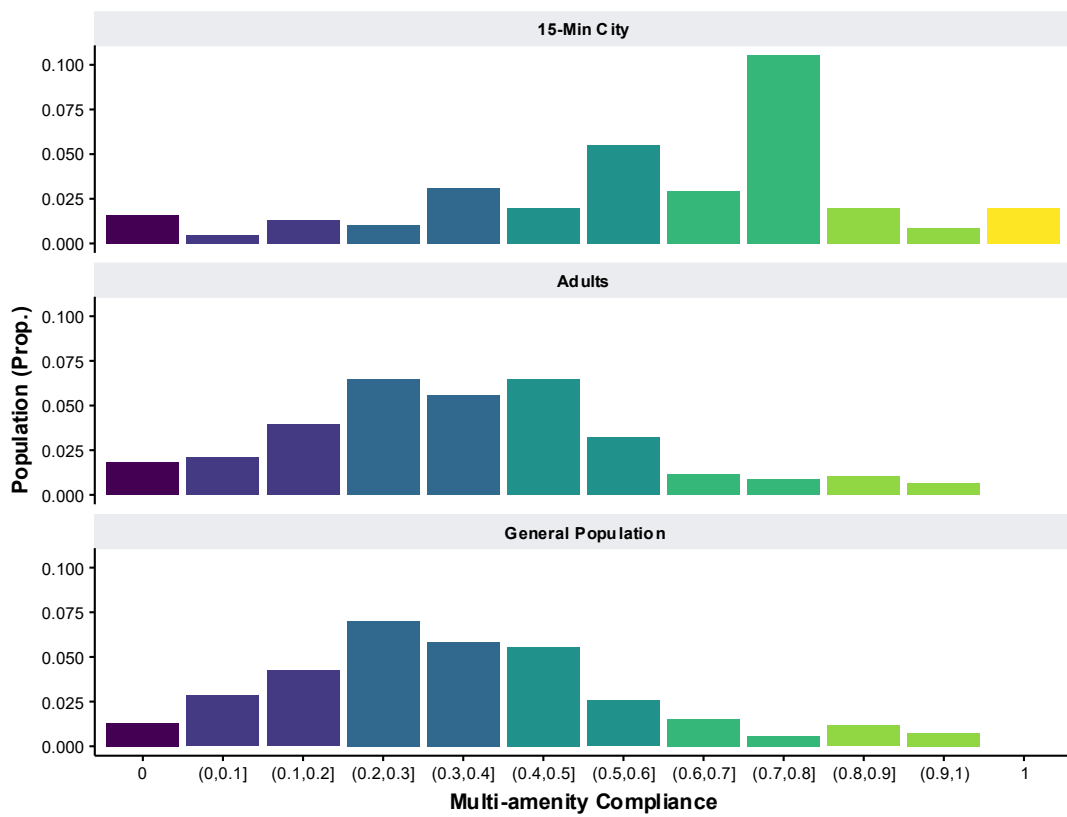


Figure 6: Rákospalota multi-amenity compliance distributions.

Table 3: Rákosmente multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|--------------------|------|------|--------|------|------|
| 15-Min City | 0.61 | 0.20 | 0.67 | 0.80 | 1.00 |
| Adults | 0.36 | 0.08 | 0.34 | 0.55 | 0.96 |
| General Population | 0.35 | 0.07 | 0.33 | 0.55 | 0.96 |

3.2. Brussels: Haren & Neder-Over-Heembeek

The preferences of the Haren & Neder-Over-Heembeek living lab's residents are depicted in Figure 7 and show the comparison to the normative, 15-Minute-City thresholds.

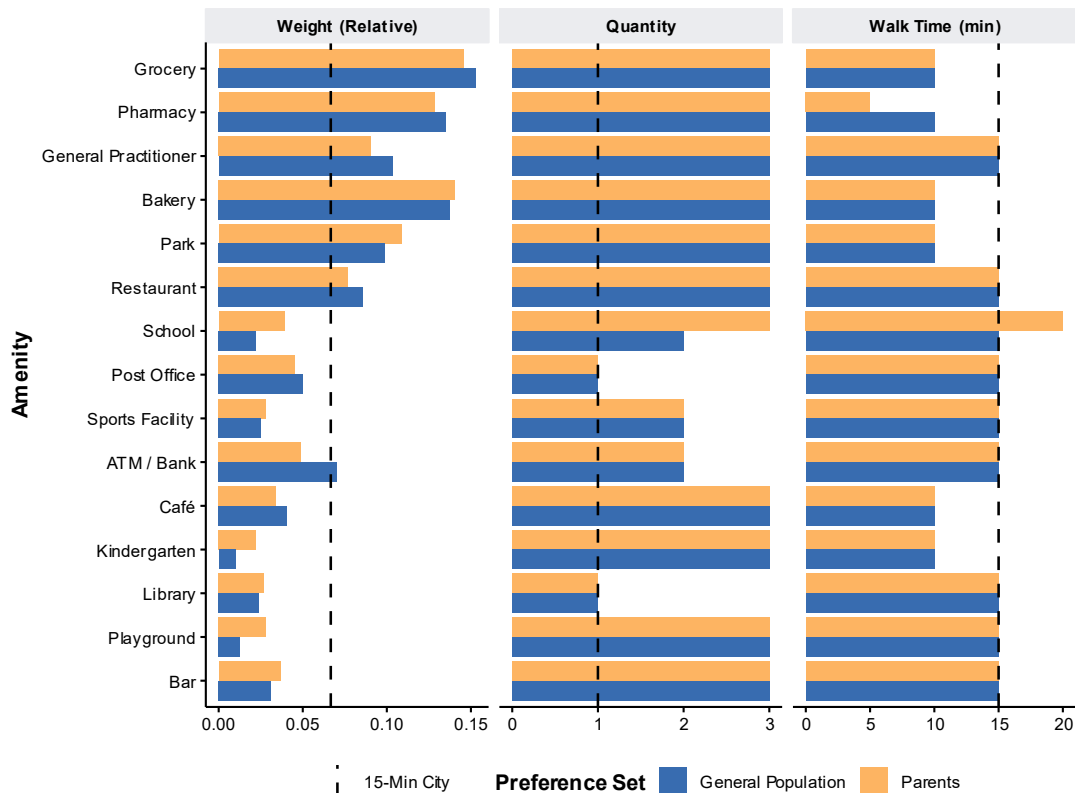


Figure 7: Haren & Neder-Over-Heembeek living lab preference sets.

On average, residents of Haren & Neder-Over-Heembeek can access at least one location within a 15-minute walk for 75% of amenities (multi-amenity compliance of 0.75). When considering the preferences of parents, the multi-amenity compliance falls to 0.46. A map of the spatial distribution is provided in Figure 8. The distributions and corresponding summary statistics for all preference sets are provided in Figure 9 and Table 4, respectively.

This reduction in compliance is largely driven by access to grocery stores and pharmacies, which are highly weighted but have a low compliance (population-weighted average of 0.09 and 0.14, respectively). Other amenities with low compliance are post offices and cafés (refer to Figure 25 for more detail).

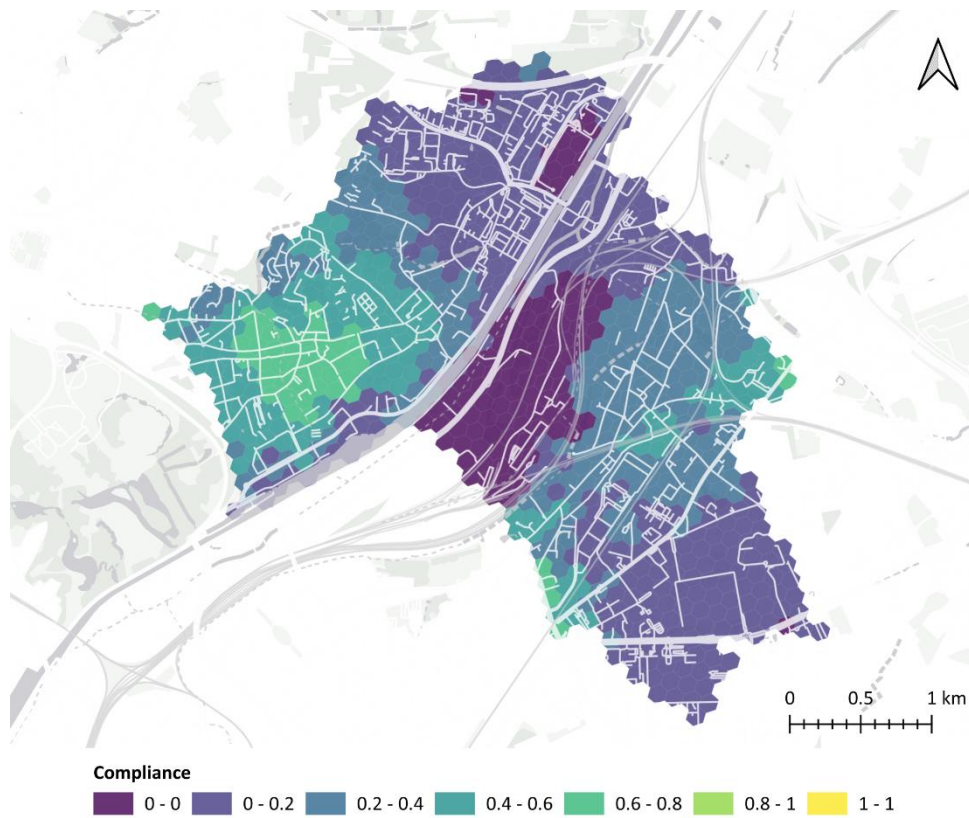


Figure 8: Haren & Neder-Over-Heembeek multi-amenity compliance map based on preference set of adults.

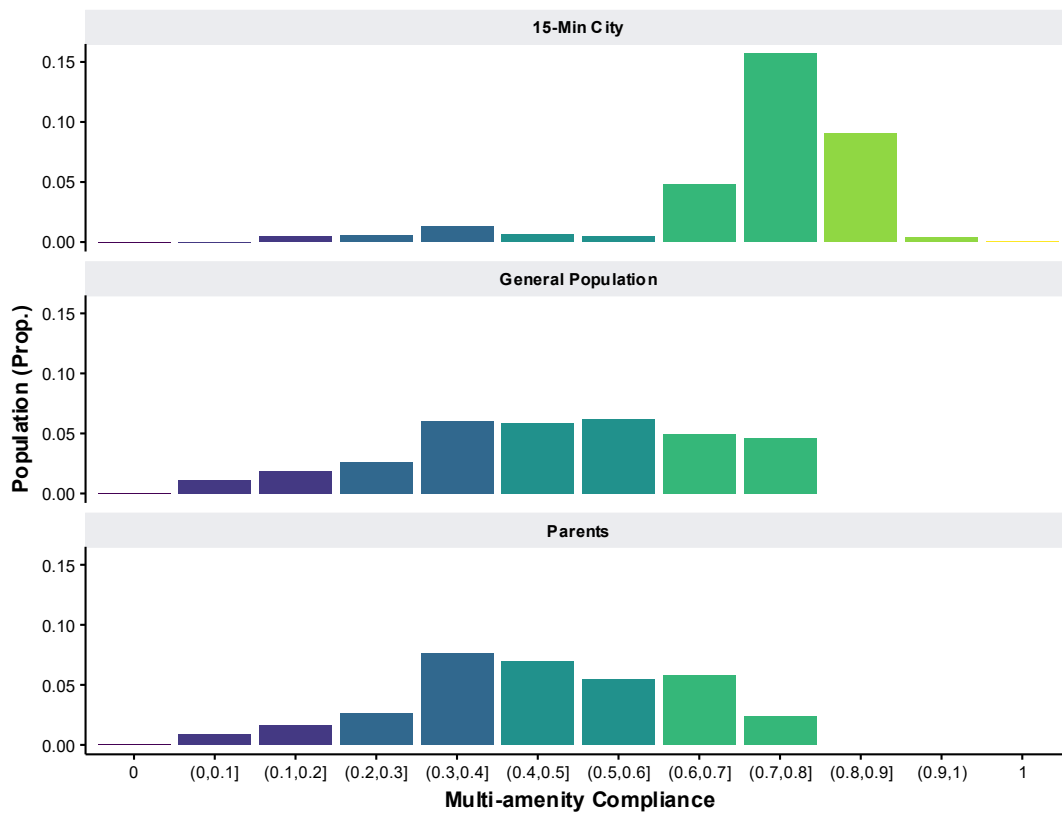


Figure 9: Haren & Neder-Over-Heembeek multi-amenity compliance distributions.

Table 4: Haren & Neder-Over-Heembeek multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|--------------------|------|------|--------|------|------|
| 15-Min City | 0.75 | 0.67 | 0.80 | 0.87 | 1.00 |
| Parents | 0.46 | 0.24 | 0.44 | 0.63 | 0.80 |
| General Population | 0.48 | 0.21 | 0.49 | 0.69 | 0.77 |

3.3. Munich: Geretsried

The preferences of the Geretsried living lab's residents are depicted in Figure 10 and show the comparison to the normative, 15-Minute-City thresholds.

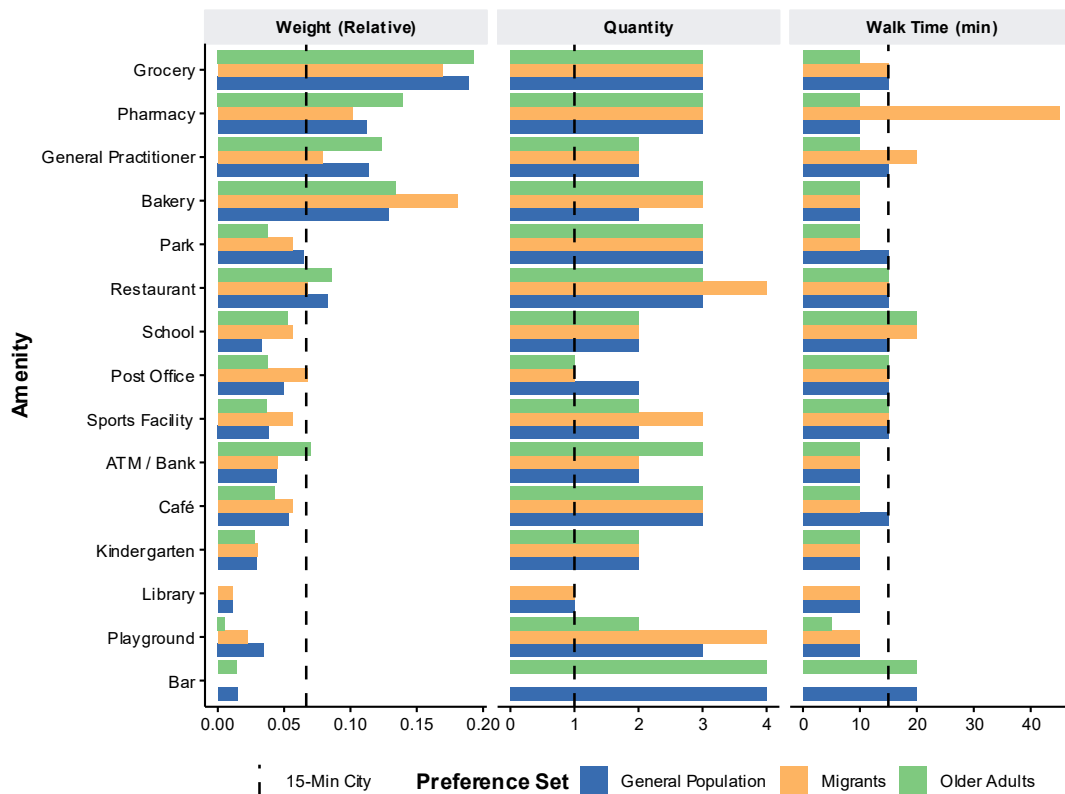


Figure 10: Geretsried living lab preference sets.

On average, residents of Geretsried can access at least one location within a 15-minute walk for 64% of amenities (multi-amenity compliance of 0.64). When considering the preferences of migrants and older adults, the multi-amenity compliance falls to 0.50 and 0.36, respectively. A map of the spatial distribution is provided in Figure 11 and Figure 12. The distributions and corresponding summary statistics for all preference sets are provided in Figure 13 and Table 5, respectively.

For migrants, this reduction in compliance is largely driven by access to grocery stores and bakeries, which are highly weighted but have a low compliance (population-weighted average of 0.52 and 0.29, respectively).

For older adults, this reduction in compliance is largely driven by access to grocery stores, pharmacies, bakeries, and general practitioners, which are highly weighted but have a low compliance (population-weighted average of 0.31, 0.19, 0.29, and 0.24, respectively).

For both groups parks and libraries have a low compliance (refer to Figure 26 for more detail), however they are not highly relevant to either group and therefore have relatively small impacts on the multi-amenity compliance.

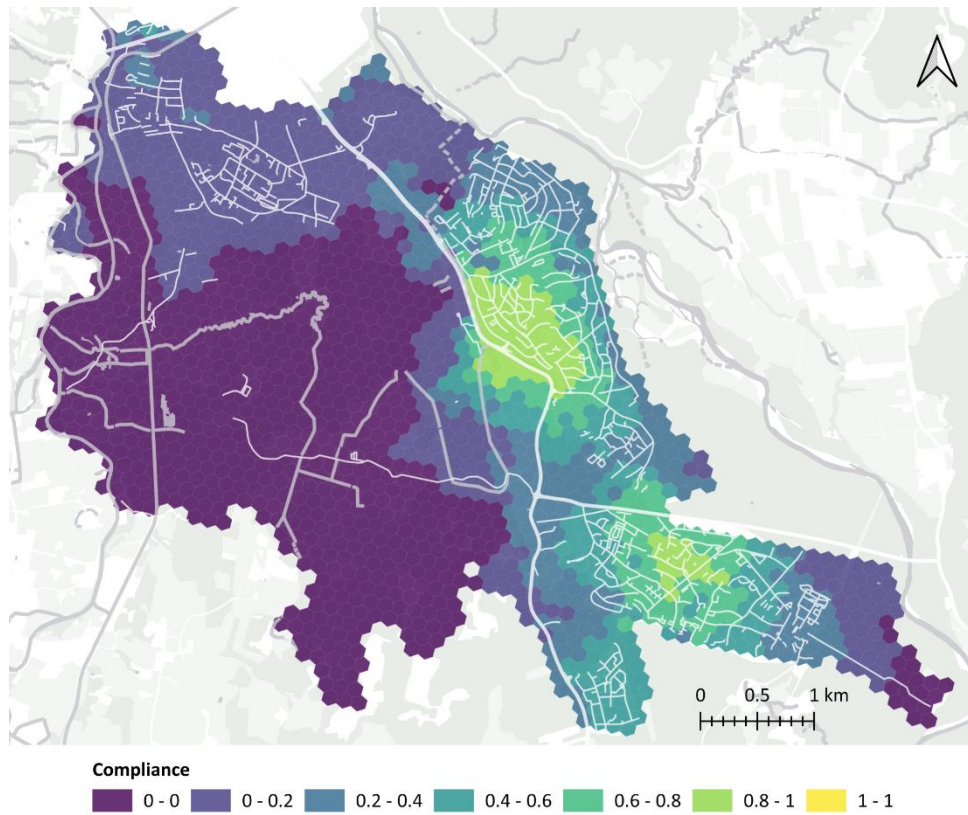


Figure 11: Geretsried multi-amenity compliance map based on preference set of migrants.

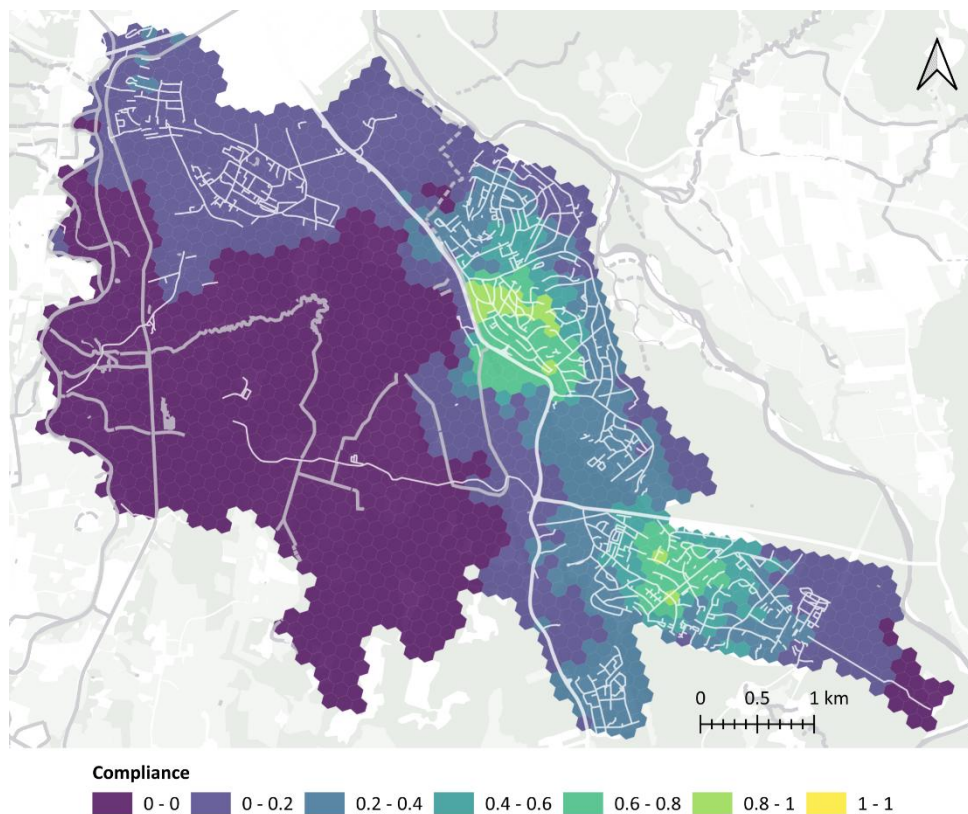


Figure 12: Geretsried multi-amenity compliance map based on preference set of older adults.

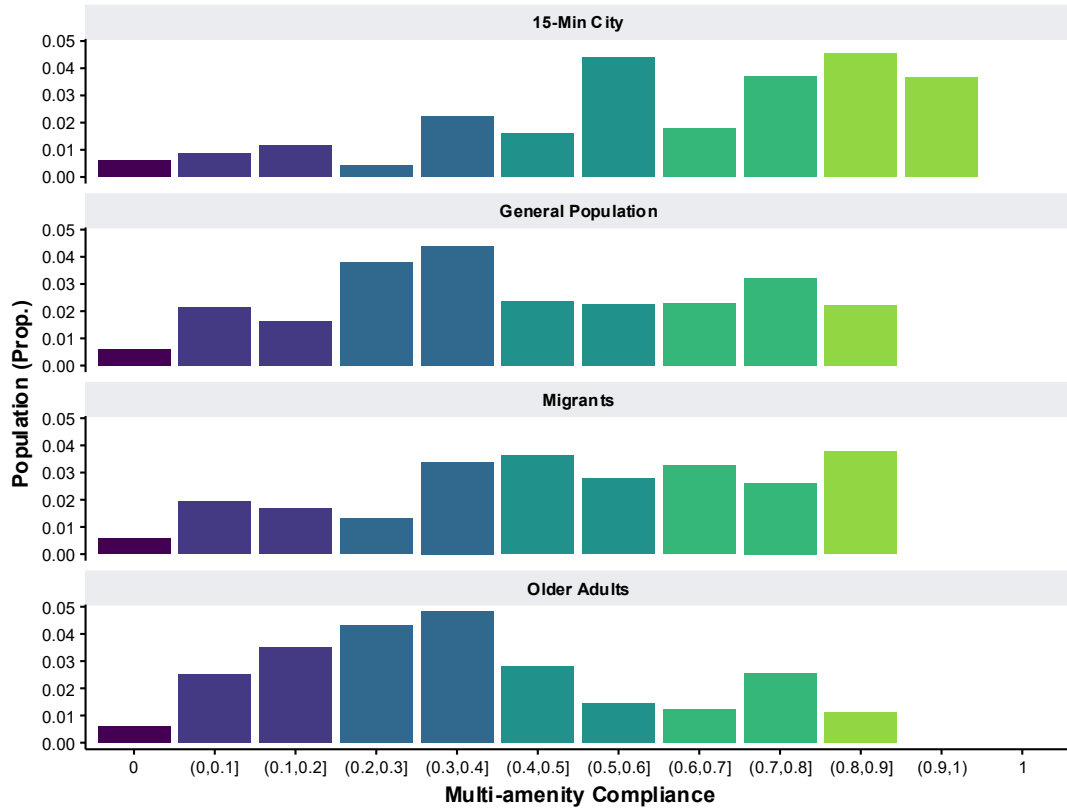


Figure 13: Geretsried multi-amenity compliance distributions.

Table 5: Geretsried multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|--------------------|------|------|--------|------|------|
| 15-Min City | 0.64 | 0.20 | 0.67 | 0.87 | 0.93 |
| General Population | 0.44 | 0.06 | 0.40 | 0.76 | 0.88 |
| Migrants | 0.50 | 0.10 | 0.49 | 0.81 | 0.90 |
| Older Adults | 0.36 | 0.05 | 0.33 | 0.69 | 0.89 |

3.4. Paris: Évry-Courcouronnes

The preferences of the Évry-Courcouronnes living lab’s residents are depicted in Figure 14 and show the comparison to the normative, 15-Minute-City thresholds.

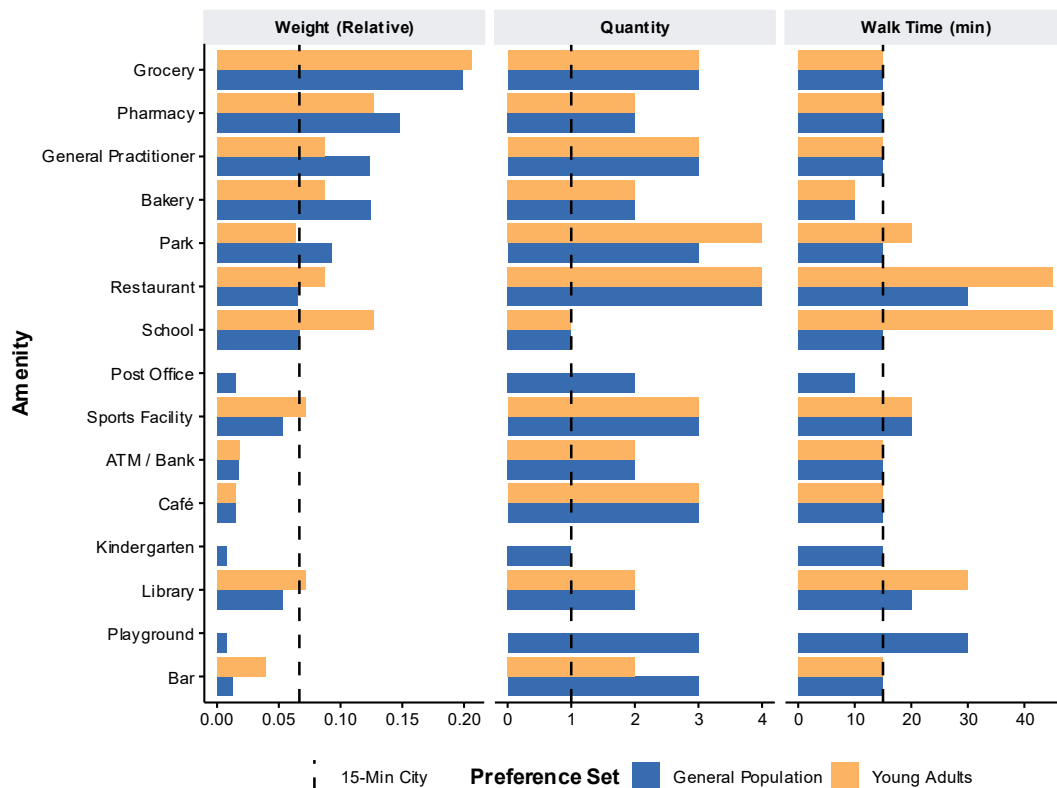


Figure 14: Évry-Courcouronnes living lab preference sets.

On average, residents of Évry-Courcouronnes can access at least one location within a 15-minute walk for 77% of amenities (multi-amenity compliance of 0.77). When considering the preferences of young adults, the multi-amenity compliance falls to 0.73. A map of the spatial distribution is provided in Figure 15. The distributions and corresponding summary statistics for all preference sets are provided in Figure 16 and Table 6, respectively.

This reduction in compliance is largely driven by access to grocery stores, which are highly weighted but have a population-weighted average compliance of 0.56. Overall, the multi-amenity compliance doesn’t change much. Many time thresholds remain 15 minutes (or increase) and many of the amenities have a low relevance to young adults (e.g., post office, ATM/bank, café, kindergarten). Despite increased quantity thresholds, the compliance for many of the individual amenities doesn’t decrease, indicating that there are usually numerous alternatives available (refer to Figure 27 for more detail).

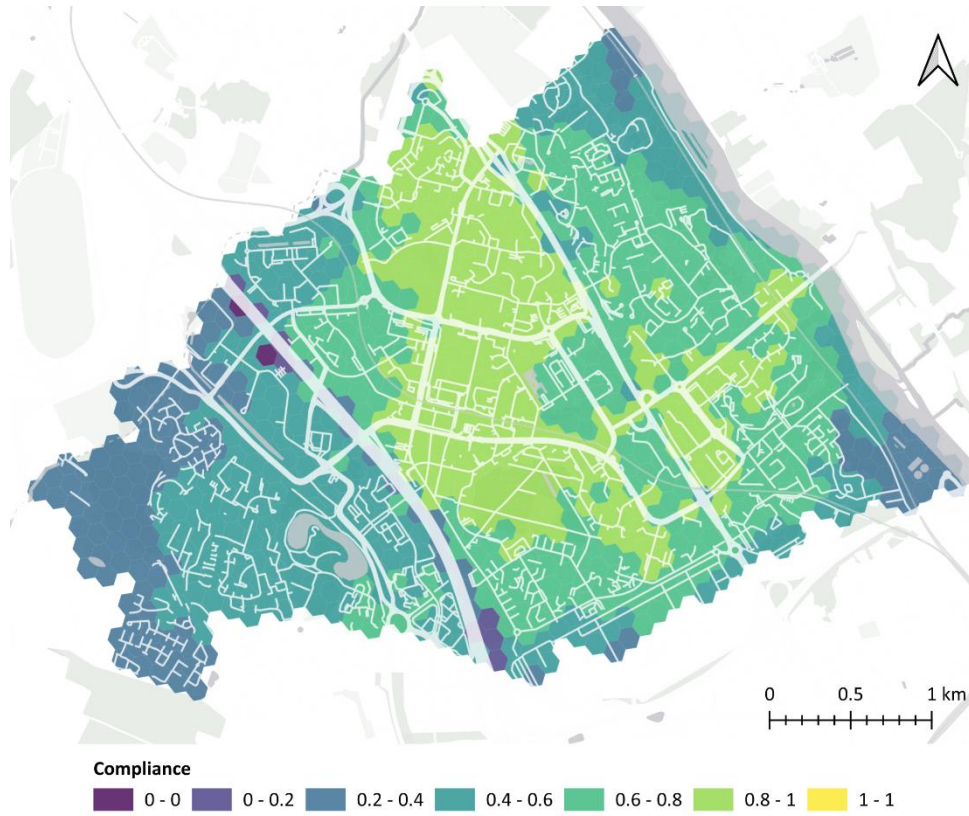


Figure 15: Évry-Courcouronnes multi-amenity compliance map based on preference set of young adults.

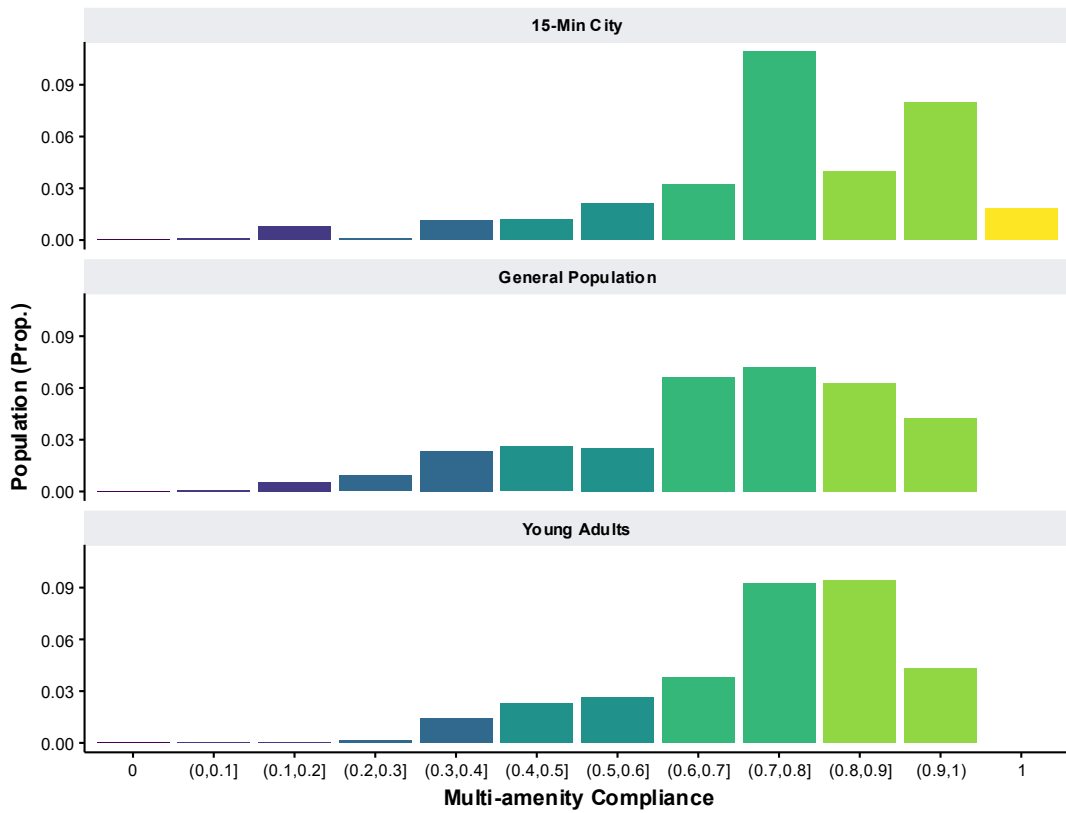


Figure 16: Évry-Courcouronnes multi-amenity compliance distributions.

Table 6: Évry-Courcouronnes multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|--------------------|------|------|--------|------|------|
| 15-Min City | 0.77 | 0.53 | 0.80 | 0.93 | 1.00 |
| General Population | 0.68 | 0.37 | 0.71 | 0.90 | 0.98 |
| Young Adults | 0.73 | 0.48 | 0.76 | 0.89 | 0.96 |

3.5. Utrecht: Overvecht

The preferences of the Overvecht living lab's residents are depicted in Figure 17 and show the comparison to the normative, 15-Minute-City thresholds.

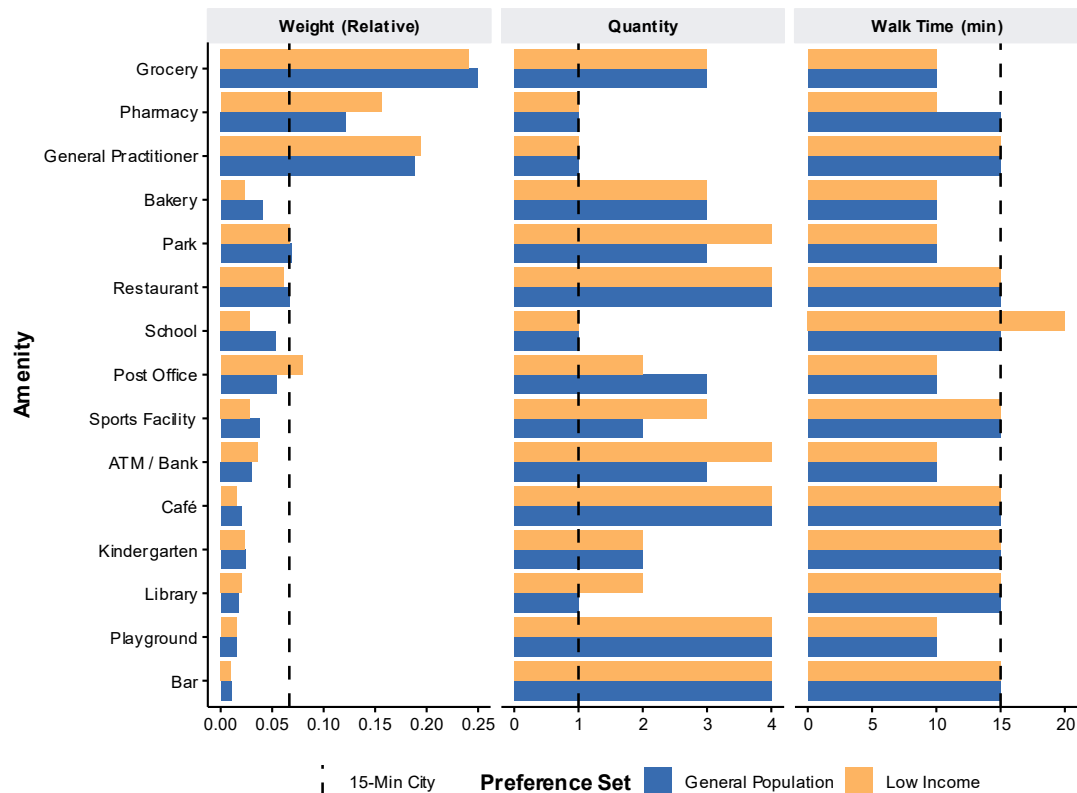


Figure 17: Overvecht living lab preference sets.

On average, residents of Overvecht can access at least one location within a 15-minute walk for 71% of amenities (multi-amenity compliance of 0.71). When considering the preferences of low-income residents, the multi-amenity compliance falls to 0.55. A map of the spatial distribution is provided in Figure 18. The distributions and corresponding summary statistics for all preference sets are provided in Figure 19 and Table 7, respectively.

This reduction in compliance is largely driven by access to grocery stores and pharmacies, which are highly weighted but have a low compliance (population-weighted average of 0.53 and 0.35, respectively). Other amenities with low compliance are bars, post offices, and libraries (refer to Figure 28 for more detail).

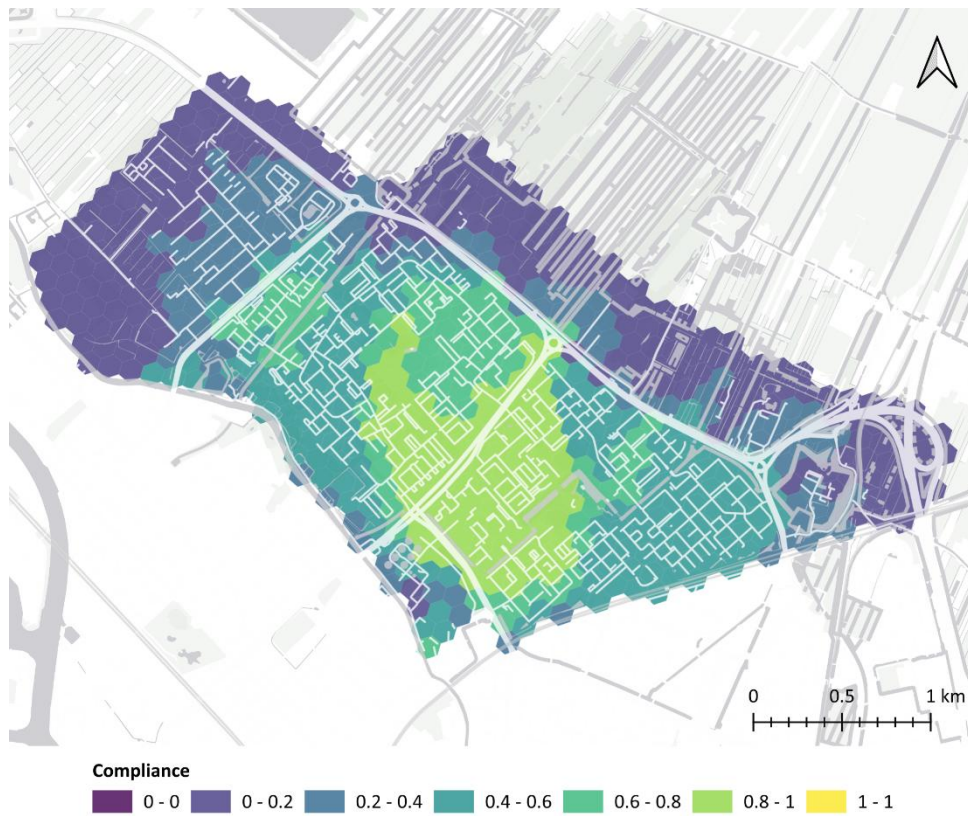


Figure 18: Overvecht multi-amenity compliance map based on preference set of low-income residents.

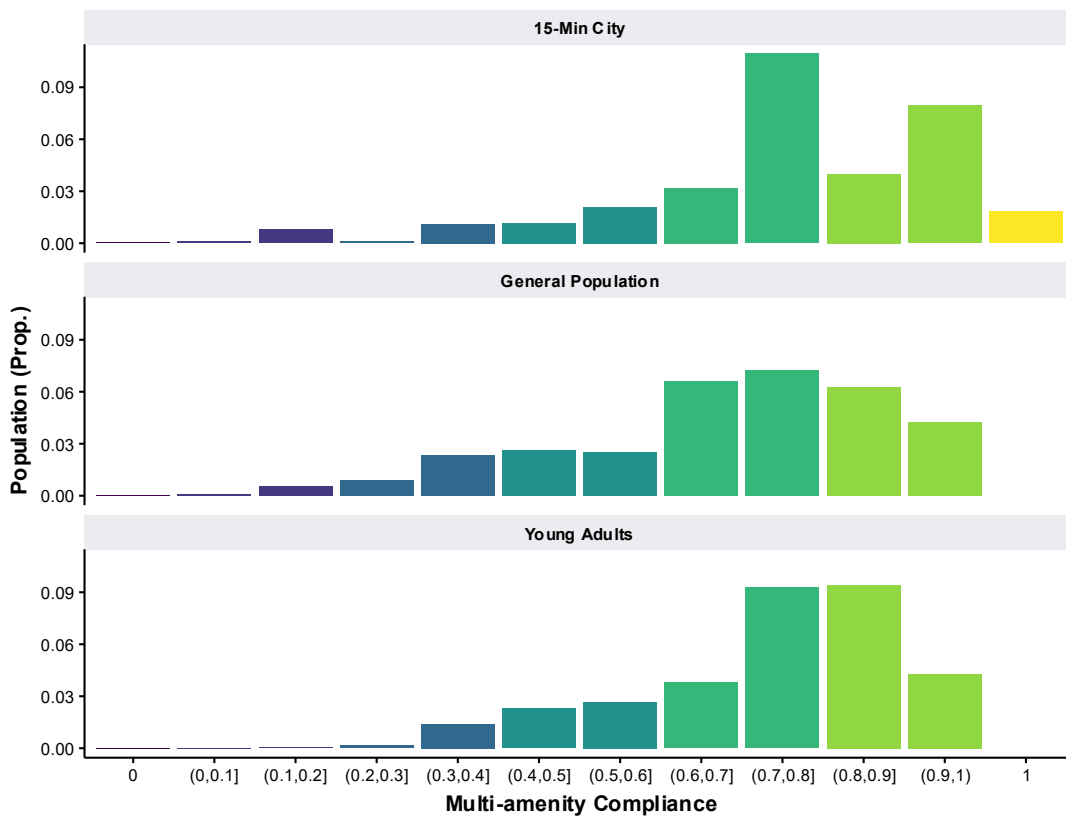


Figure 19: Overvecht multi-amenity compliance distributions.

Table 7: Overvecht multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|--------------------|------|------|--------|------|------|
| 15-Min City | 0.71 | 0.40 | 0.73 | 1.00 | 1.00 |
| General Population | 0.61 | 0.17 | 0.64 | 0.86 | 0.96 |
| Low Income | 0.55 | 0.14 | 0.56 | 0.83 | 0.96 |

3.6. Vienna: Liesing

The preferences of the Liesing living lab's residents are depicted in Figure 20 and show the comparison to the normative, 15-Minute-City thresholds.

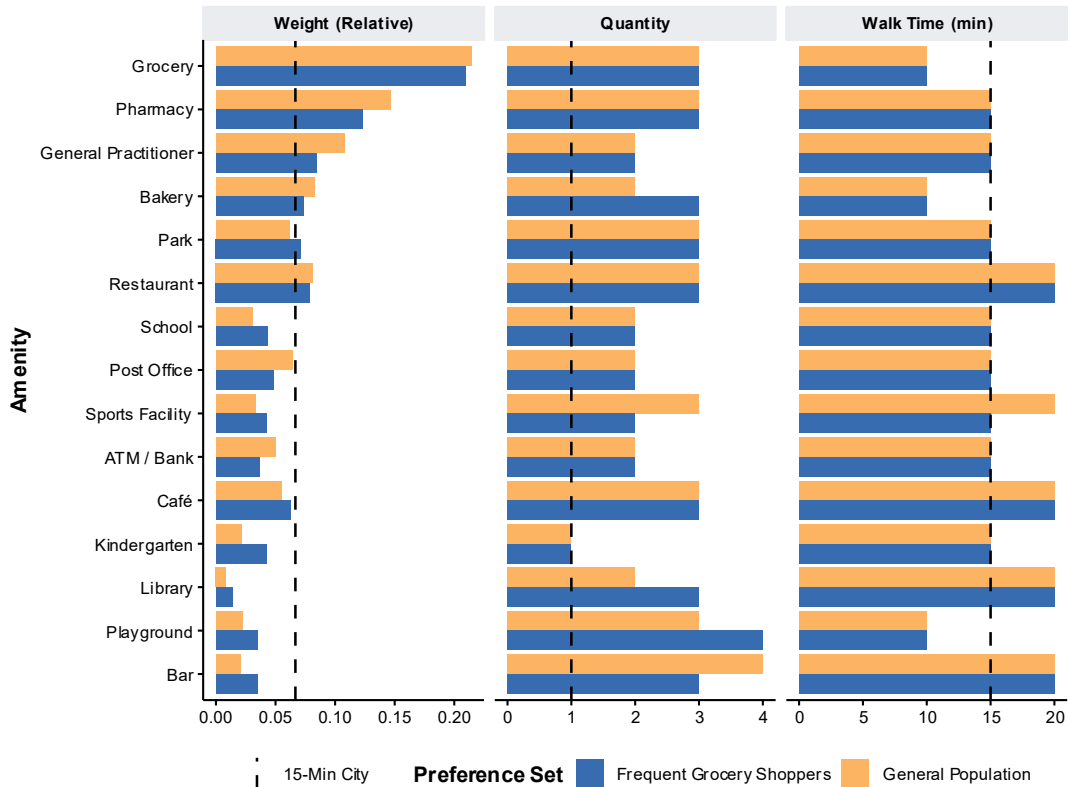


Figure 20: Liesing living lab preference sets.

On average, residents of Liesing can access at least one location within a 15-minute walk for 76% of amenities (multi-amenity compliance of 0.76). When considering the preferences of frequent grocery shoppers, the multi-amenity compliance falls to 0.62. A map of the spatial distribution is provided in Figure 21. The distributions and corresponding summary statistics for all preference sets are provided in Figure 22 and Table 8, respectively.

This reduction in compliance is largely driven by access to grocery stores and pharmacies, which are highly weighted but have a low compliance (population-weighted average of 0.52 and 0.50, respectively). Other amenities with low compliance are bakeries, bars, and libraries (refer to Figure 29 for more detail).

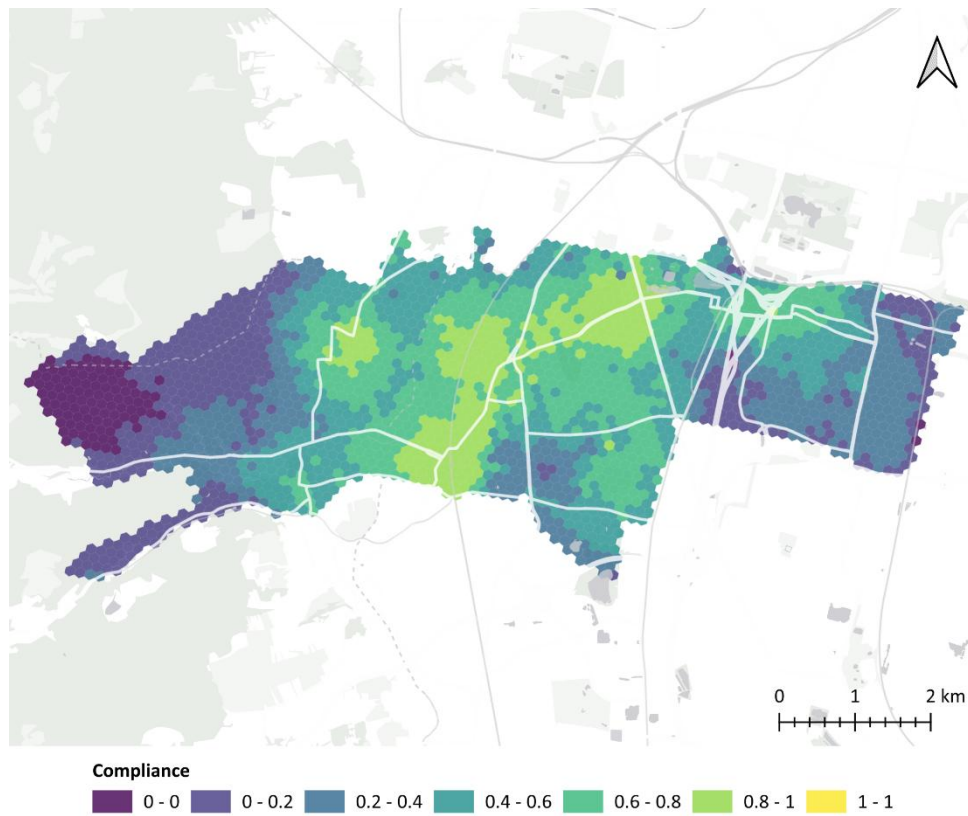


Figure 21: Liesing multi-amenity compliance map based on preference set of frequent grocery shoppers.

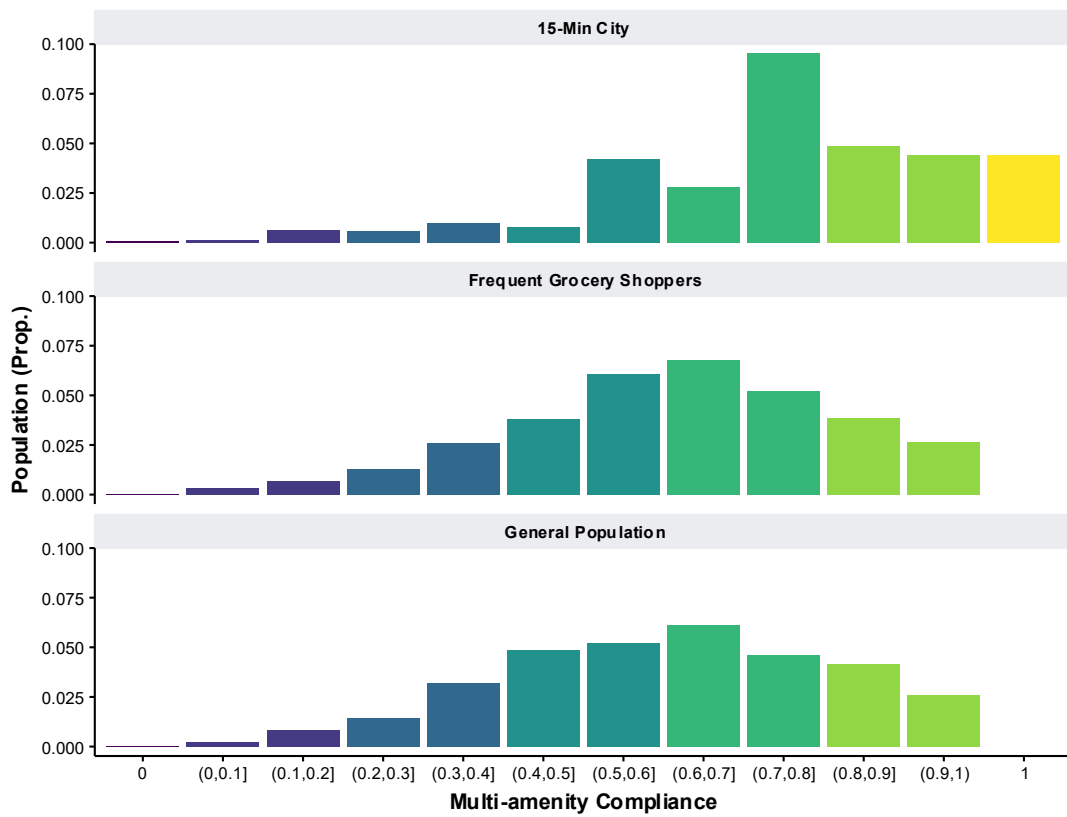


Figure 22: Liesing multi-amenity compliance distributions.

Table 8: Liesing multi-amenity compliance (population-weighted) summary statistics.

| Preference Set | Mean | P25 | Median | P75 | Max |
|---------------------------|------|------|--------|------|------|
| 15-Min City | 0.76 | 0.53 | 0.80 | 0.93 | 1.00 |
| General Population | 0.60 | 0.34 | 0.61 | 0.85 | 0.98 |
| Frequent Grocery Shoppers | 0.62 | 0.34 | 0.63 | 0.84 | 0.97 |

3.7. Average Multi-Amenity Compliance Across DREAMS Living Labs

A matrix of population-weighted average multi-amenity compliance across all preference sets and living labs is shown in Figure 23. The accessibility of each living lab was analyzed using all preference sets to allow for comparison between living labs. Results highlighted in red are ones where the preference set corresponds to the residents of the living lab.

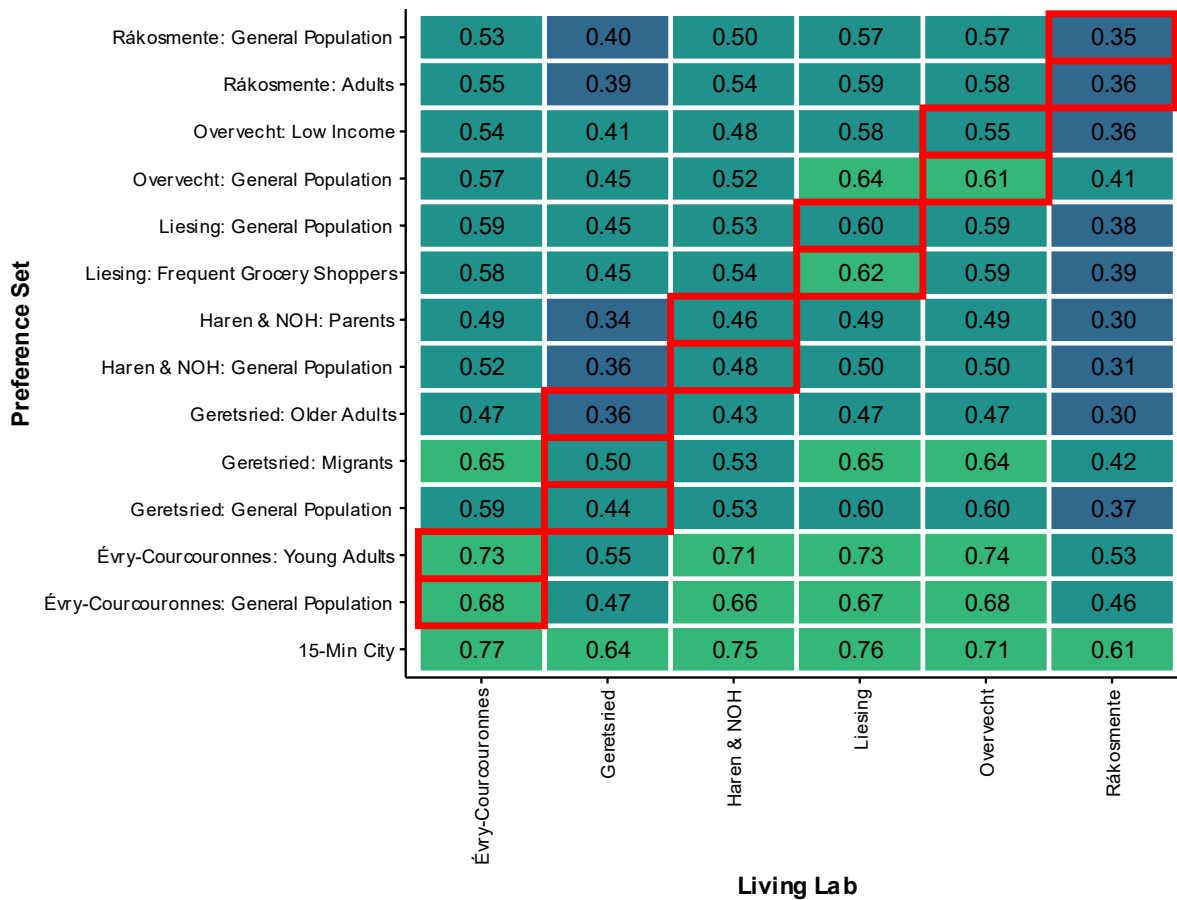


Figure 23: (Population-weighted) multi-amenity compliance matrix by preference set and living lab.

From a normative 15-Minute City perspective, Évry-Courcouronnes (0.77), Liesing (0.76), and Haren & Neder-Over-Heembeek (0.75) show the highest levels of compliance, followed by Overvecht (0.71), Geretsried (0.64), and Rákosmente (0.61).

When incorporating preference sets to model perceived accessibility, multi-amenity compliance declines across all living labs. Évry-Courcouronnes (young adults) shows the smallest reduction (-0.04), while other living labs range from -0.14 (Geretsried: migrants) to -0.29 (Haren & Neder-Over-Heembeek: Parents), with the average being -0.21. The lowest multi-amenity compliance was for older adults in Geretsried and adults in Rákosmente (both 0.36). Notably, only Liesing's focus demographic group (frequent grocery shoppers) achieves the highest compliance within its own living lab. Liesing

also performs best for the preference sets of Overvhect's low-income residents and Rákosmente's adults.

The reduction in multi-amenity compliance is due to stricter thresholds resulting from residents' preferences. While the normative, 15-Minute City analysis considers access to a single location of each amenity type, most preference sets require access to at least two or three, making it significantly more difficult to attain full compliance. In addition, the travel time threshold was lower than 15 minutes in more than half of the preference sets for the following amenities: bakery, playground, grocery, kindergarten, café, and park. Finally, amenities are weighted by their relevance to each demographic group, resulting in grocery access consistently having a strong influence on overall compliance.

4. CONCLUSIONS

The DREAMS Decision Support Tool (DDST) aims to support planning the X-Minute City according to a Sustainable Urban Mobility (SUMP) framework. This deliverable presented the methodology and results of the first two layers in the DDST: calculated and perceived accessibility.

Overall, calculated accessibility, estimated using the multi-amenity compliance indicator, reveals substantially lower accessibility levels when parameters reflect residents' preferences instead of a normative, "15-Minute City" perspective. This suggests that attaining a desirable level of (proximity-based) accessibility may be more demanding than having a single opportunity available within a 15-Minute walk (or bike ride). Having multiple alternatives is important to residents and should be reflected when setting X-Minute planning objectives. Furthermore, improving access to amenities most relevant to residents should be prioritized. While most living labs contain one (or more) cluster of amenities that provide relatively good access (80% or higher multi-amenity compliance), more peripheral areas remain underserved. The results indicate that the consideration of additional modes of transport (including the bicycle, shared micromobility, and public transport) is key in urban outskirts to (a) provide a basic level of access to key amenities and (b) expand the options available to residents, enabling their preferences to be met.

REFERENCES

- Arias-Molinares, D., Bobičić, O., Grigolon, A., Ulak, B., Charalampidou, G., Caixeta Szymanski Nogueira, A. C., McCormick, B., Duran-Rodas, D., Susilo, Y., Dörrzapf, L., Van Vessem, C., Keserú, I., Geertman, S., Adjeroud, H., & L'Hostis, A. (2026). *Perceived accessibility of 15-minute neighbourhoods from residents living in the urban outskirts. DREAMS deliverable 4.2.*
- Bondarenko, M., Priyatikanto, R., Tejedor Garavito, N., Zhang, W., McKeen, T., Cunningham, A., Woods, T., Hilton, J., Cihan, D., Nosatiuk, B., Brinkhoff, T., Tatem, A., & Sorichetta, A. (2025). *Constrained estimates of 2015-2030 total number of people per grid square at a resolution of 3 arc (approximately 100m at the equator) R2025A version v1.* [Dataset]. University of Southampton. <https://doi.org/10.5258/SOTON/WP00839>
- Geurs, K. T., & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: Review and research directions. *Journal of Transport Geography*, 12(2), 127–140. <https://doi.org/10.1016/j.jtrangeo.2003.10.005>
- Geurs, K., & Van Wee, B. (2026). A five-component conceptual model of calculated and perceived accessibility: Literature review and research directions. *Journal of Transport Geography*, 134, 104678. <https://doi.org/10.1016/j.jtrangeo.2026.104678>
- Hansen, W. G. (1959). How Accessibility Shapes Land Use. *Journal of the American Institute of Planners*, 25(2), 73–76. <https://doi.org/10.1080/01944365908978307>
- Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the “15-Minute City”: Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. *Smart Cities*, 4(1), Article 1. <https://doi.org/10.3390/smartcities4010006>
- Negm, H., De Vos, J., Pot, F., & El-Geneidy, A. (2025). Perceived accessibility: A literature review. *Journal of Transport Geography*, 125, 104212. <https://doi.org/10.1016/j.jtrangeo.2025.104212>
- Papadopoulos, E., Sdoukopoulos, A., & Politis, I. (2023). Measuring compliance with the 15-minute city concept: State-of-the-art, major components and further requirements. *Sustainable Cities and Society*, 99, 104875. <https://doi.org/10.1016/j.scs.2023.104875>
- Pereira, R. H. M., Saraiva, M., Herszenhut, D., Braga, C. K. V., & Conway, M. W. (2021). r5r: Rapid Realistic Routing on Multimodal Transport Networks with R⁵ in R. *Findings*, 21262. <https://doi.org/10.32866/001c.21262>
- Pot, F. J., van Wee, B., & Tillema, T. (2021). Perceived accessibility: What it is and why it differs from calculated accessibility measures based on spatial data. *Journal of Transport Geography*, 94, 103090. <https://doi.org/10.1016/j.jtrangeo.2021.103090>
- Rupprecht, S., Brand, L., Böhler-Baedeker, S., & Brunner, L. M. (2019). *Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition.*. Rupprecht Consult-Forschung und Beratung GmbH.
- Staricco, L. (2022). 15-, 10- or 5-minute city? A focus on accessibility to services in Turin, Italy. *Journal of Urban Mobility*, 2, 100030. <https://doi.org/10.1016/j.urbmob.2022.100030>
- Weng, M., Ding, N., Li, J., Jin, X., Xiao, H., He, Z., & Su, S. (2019). The 15-minute walkable neighborhoods: Measurement, social inequalities and implications for building healthy communities in urban China. *Journal of Transport & Health*, 13, 259–273. <https://doi.org/10.1016/j.jth.2019.05.005>

APPENDIX A

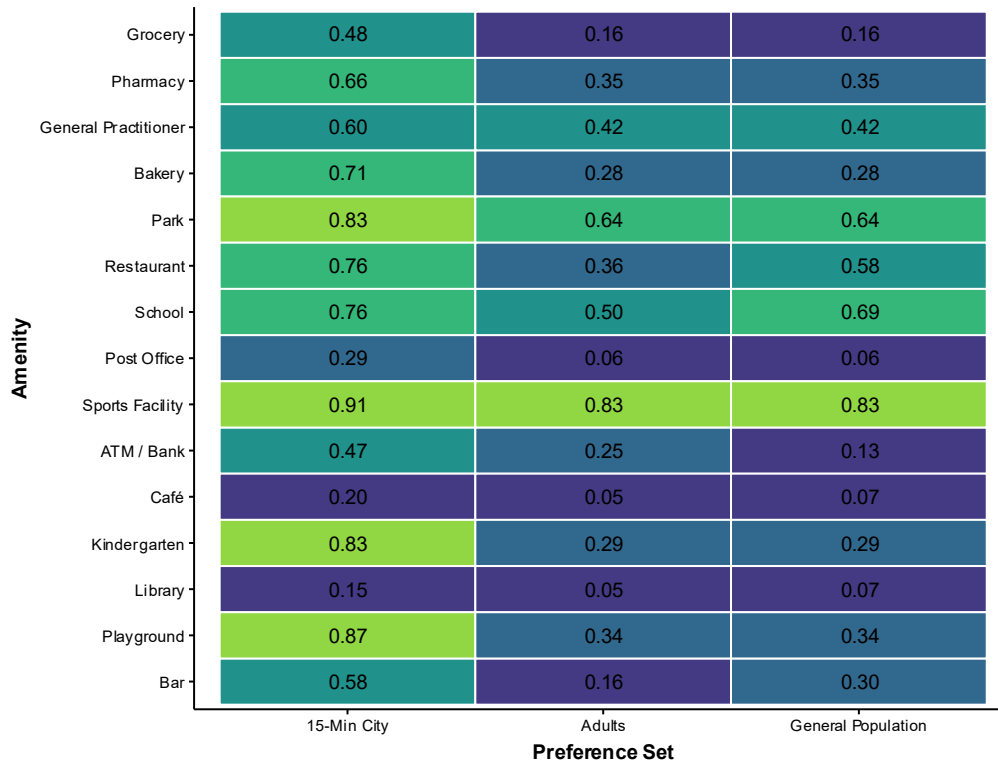


Figure 24: Rákosmente amenity compliance by preference set.

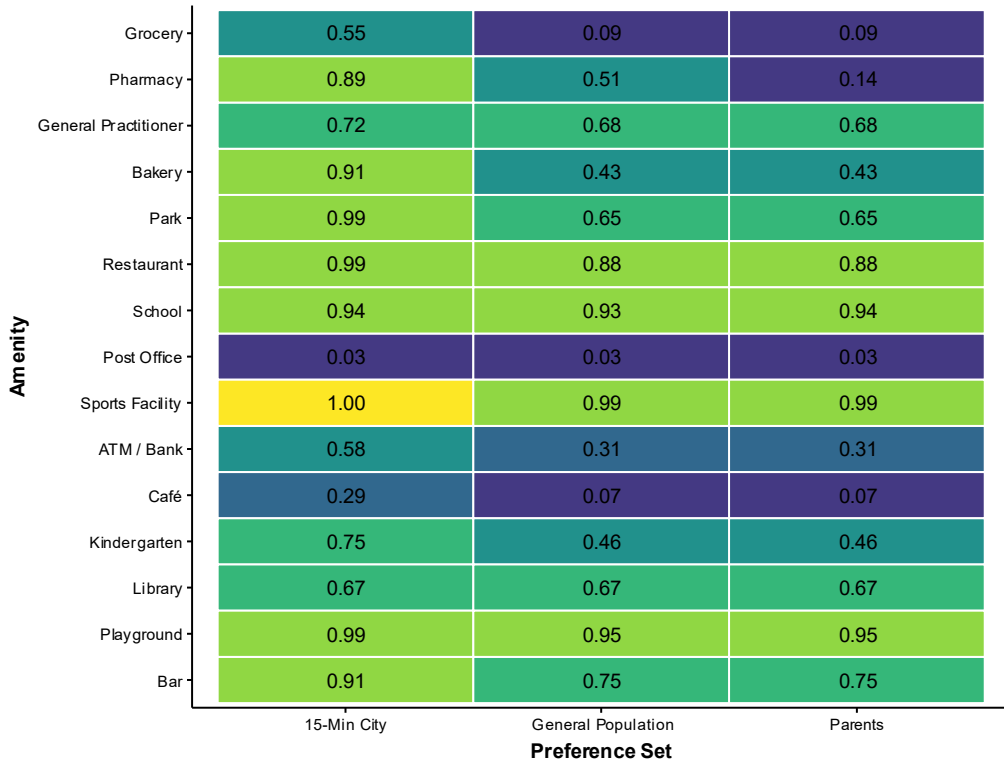


Figure 25: Haren and NOH amenity compliance by preference set.

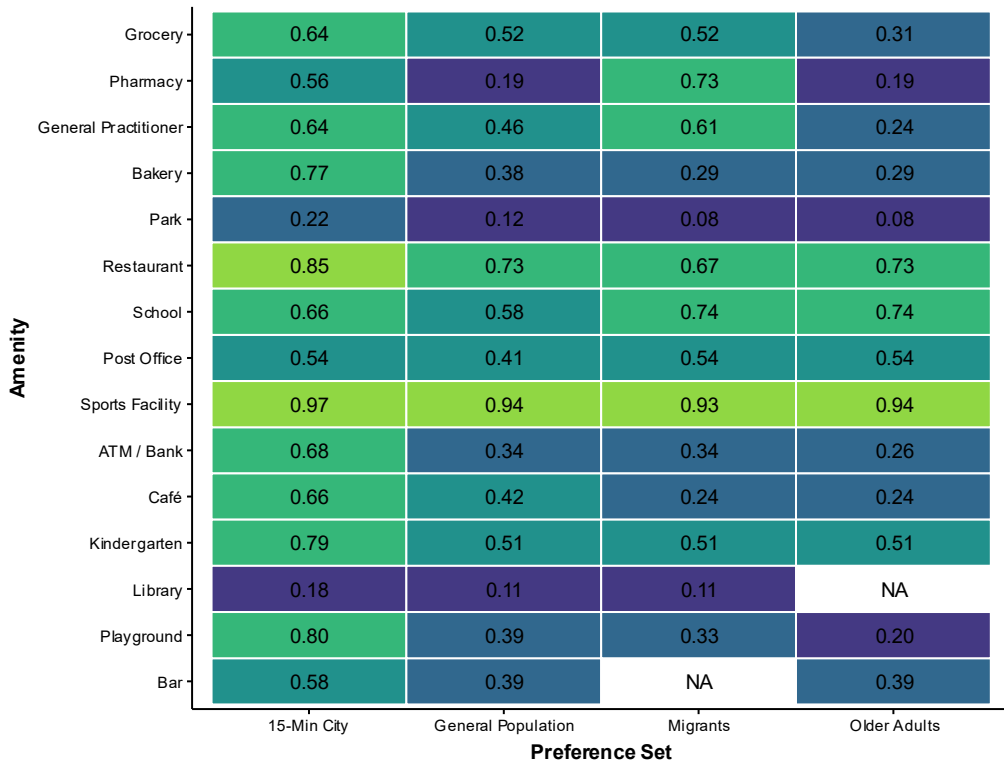


Figure 26: Geretsried amenity compliance by preference set.

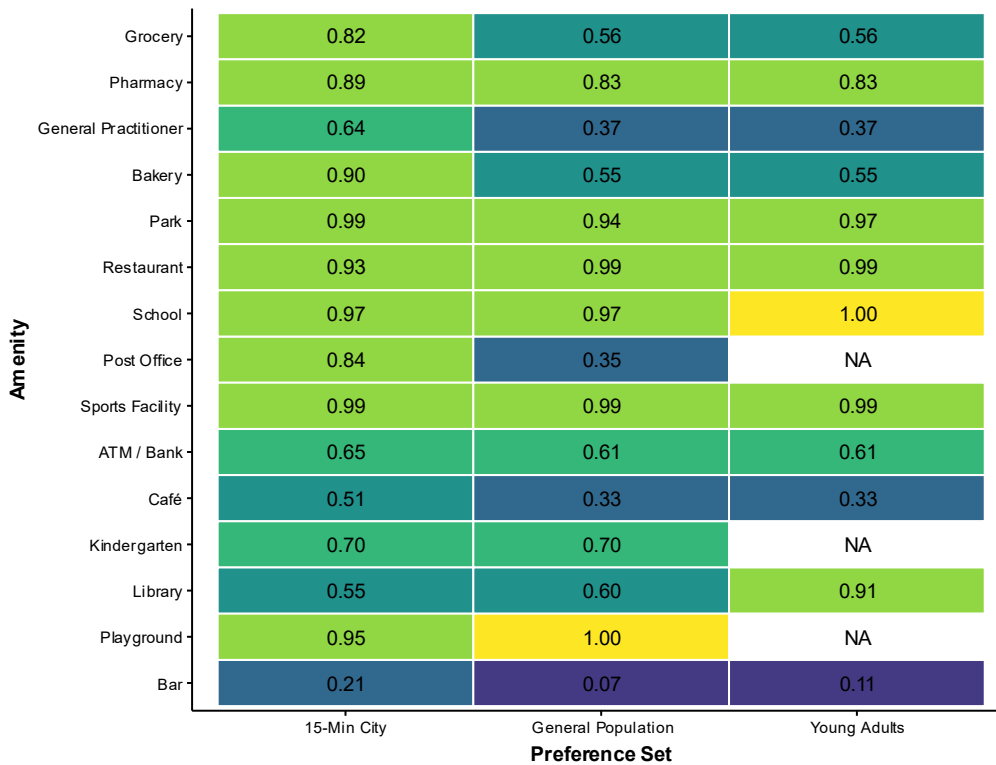


Figure 27: Évry-Courcouronnes amenity compliance by preference set.

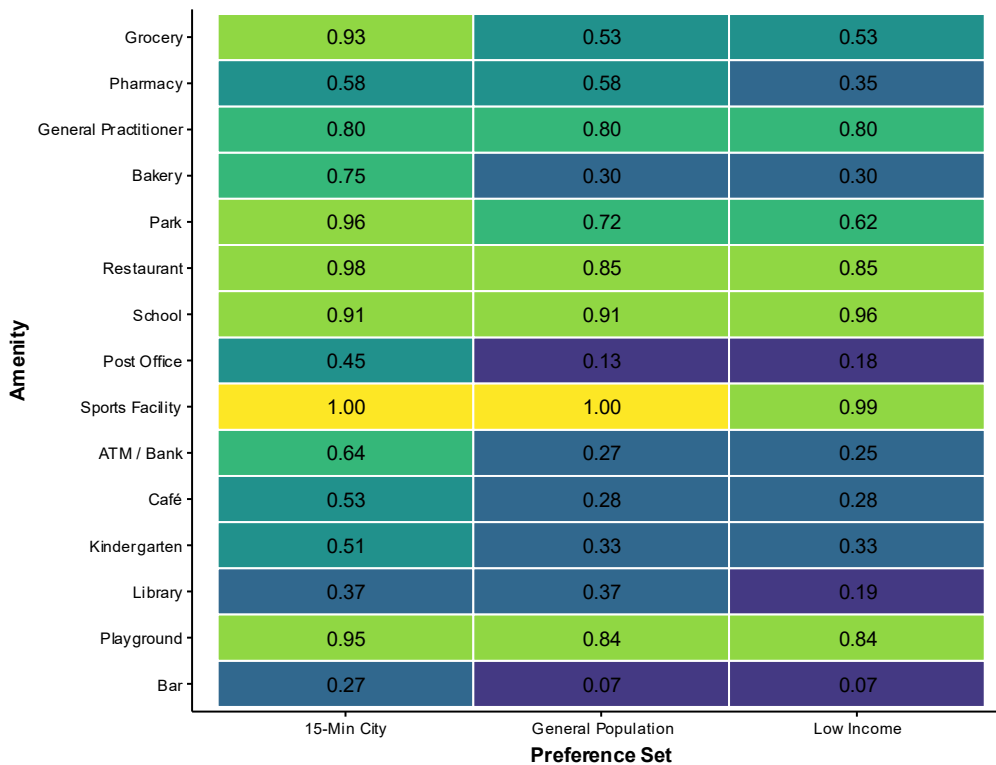


Figure 28: Overvecht amenity compliance by preference set.

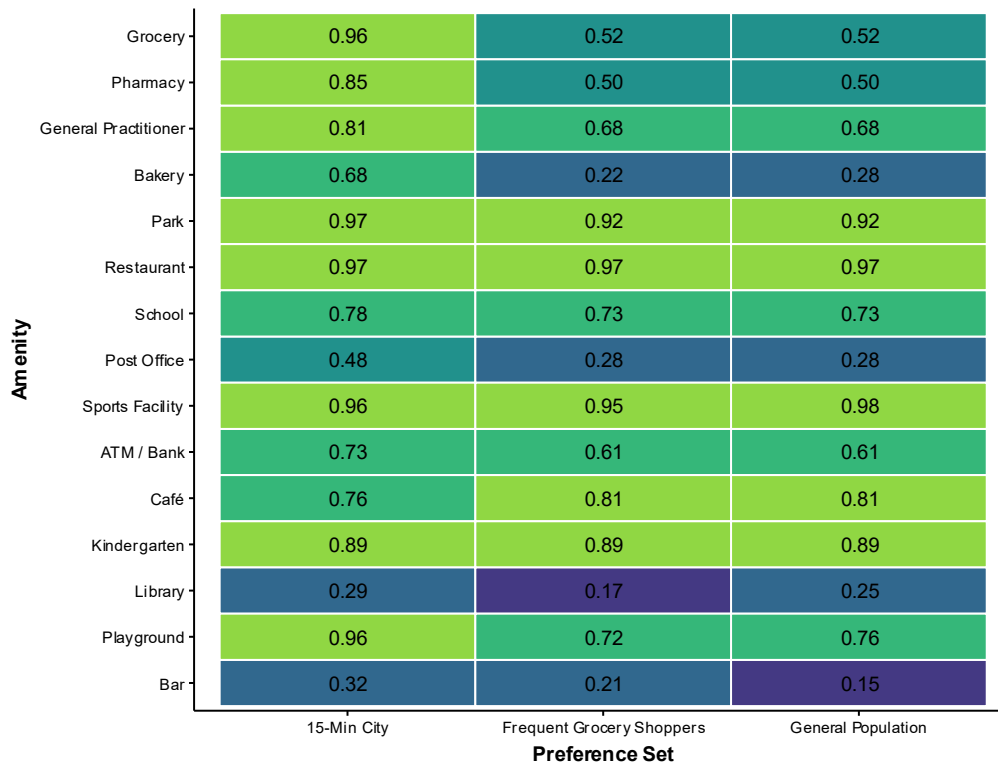


Figure 29: Liesing amenity compliance by preference set.