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Measuring active mobility: Why data matters for sustainable urban mobility plans

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SUMP training for cities

Module 3: Collection of data for active modes

Interreg Baltic Sea Region

Co-funded by the European Union

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SMART GREEN MOBILITY SUMPs for BSR

Active mobility: present in cities, absent in data

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Walking and cycling are the most universal forms of urban movement — yet they remain the least systematically measured and invisible in data.

Historical focus in transport planning and modelling has been on motorised traffic and decreasing travel time.

Pedestrians and cyclists were not considered equally legitimate object of measurement, investment, or policy intervention.

Data-related limitations and methodological complexities in transport modelling to cover walking, cycling, or multimodality

Scattered responsibility and institutional fragmentation – urban vs transport planning, national public health institutions vs local municipality

P. Drucker

What happens when active mobility is invisible?

Infrastructure underinvestment — Without evidence of demand, it is difficult to justify dedicated cycling infrastructure or pedestrian improvements in budget negotiations.

Flawed evaluation — Without baseline data, it is impossible to assess whether a new cycle lane, school street, or public space intervention changed travel behaviour.

Inequity in planning — Groups relying most on active mobility — children, seniors, low-income residents — are disproportionately affected by the absence of data that would reveal their travel patterns and barriers.

Safety blind spots — Pedestrian and cyclist crashes are often underreported. Without complementary data, dangerous locations go unidentified and uncorrected.

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Why objectives come before data collection?

What do you aim to achieve? What matters to your community?

Which data do you need to know what is important and whether the objectives are achieved?

This understanding guides and anchors your data strategy.

Well-defined objectives create accountability – did the investment in active mobility infrastructure pay off?

Data collection without clear objectives is expensive and inconclusive. Data may remain as a cost rather than an asset – yet new horizons of understanding may emerge if data exists.

Start with the question, not the tool.

The most common failure in active mobility monitoring is beginning with the technology — a sensor, an app, a dataset — rather than with the planning question it is meant to answer.

Risk for a weak position in SUMP processes

Active mobility targets risk becoming aspirational rather than evidence-based, with no monitoring framework capable of tracking progress toward SUMP goals.

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Types of objectives

Modal shift — Increase the share of trips made on foot or by bicycle as part of a sustainable urban mobility transition.

Safety — Reduce the number of serious injuries and fatalities among pedestrians and cyclists on the urban road network.

Health & wellbeing — Grow the proportion of residents meeting physical activity guidelines through active travel.

Environment & climate — Monitor and reduce transport-related air pollution by substituting motorised trips with active modes.

Translating objectives into measurable KPIs

① **Define the policy goal —** State what the municipality wants to achieve in plain language (e.g. 'increase cycling modal share to 15% by 2035').

② **Identify observable phenomena —** What can actually be measured that would confirm progress? (e.g. km bike lanes, bike share trips per day per 1000 inhabitants, trips made by bicycle and other modes)

③ **Choose an indicator type —** Decide between **output** indicators (infrastructure built), **process** indicators (data collected), and **outcome** indicators (modal share achieved).

④ **Set a baseline and target —** Confirm what the current value is, and what success looks like within the SUMP planning cycle.

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A taxonomy of active mobility data

Volume & flow

Answers: how much active travel is happening and what is its share in all movements?

Safety

Answers: how safe is active travel in practice?

Network & infrastructure quality

Answers: does the built environment support walking and cycling?

Environmental & urban design quality

Answers: does the physical environment support walking and cycling and human health?

User experience & social impacts

Answers: how do people experience active travel?

Who are the users?

Accessibility

Answers: does land use and mobility service provision support walking and cycling?

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A taxonomy of active mobility data

Volume & flow

Trip counts/rates by mode (walking, (e-)cycling, micromobility), location, direction, network utilisation, time of the day/week/…, purpose, count of cycle-ticket on train/bus

Safety

Collision rates, near-miss incidents, perceived safety scores or danger hotspots, crime incidents

Network & infrastructure quality

Network coverage, continuity, connectivity, surface quality, width, skid resistance, slope, kerbs, tactile paving, barriers, separation from car lanes, signage, lighting

Environmental & urban design quality

Greenery level/green view index, traffic noise, perceived air pollution, thermal comfort, aesthetics

User experience & social impacts

Travel satisfaction, comfort/healthiness/pleasantness ratings, reasons/deterrents for not walking or cycling, equity indicators, perception of social norms, visibility of other pedestrians/cyclists. Socio-demographics+!

Accessibility

Spatio-temporal accessibility indicators to mobility services (e.g., transit stops, bike share stations, mobility hubs) and destinations

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Volume & flow

What to count — Pedestrians and cyclists at defined locations, often disaggregated by direction of travel, time of day, and day of week.

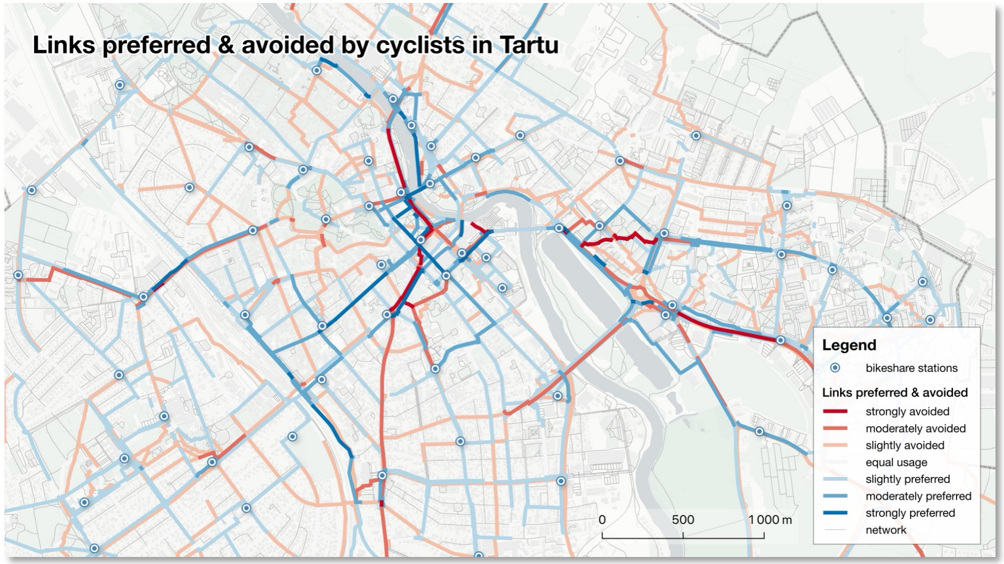
Where to count — Key nodes end edges (junctions, access points, bridges), representative corridors, and locations near major travel flow generators (schools, stations, parks).

When to count — Peak hours, off-peak, weekday vs weekend, seasonal campaigns to capture variation throughout the year, monitor continuously.

How to report — Annual average daily volumes, pedestrians or cyclists per hour / peak hour flows, directional splits, growth indices relative to a baseline year.

Advance from points to trips, routes and origin-destination matrices

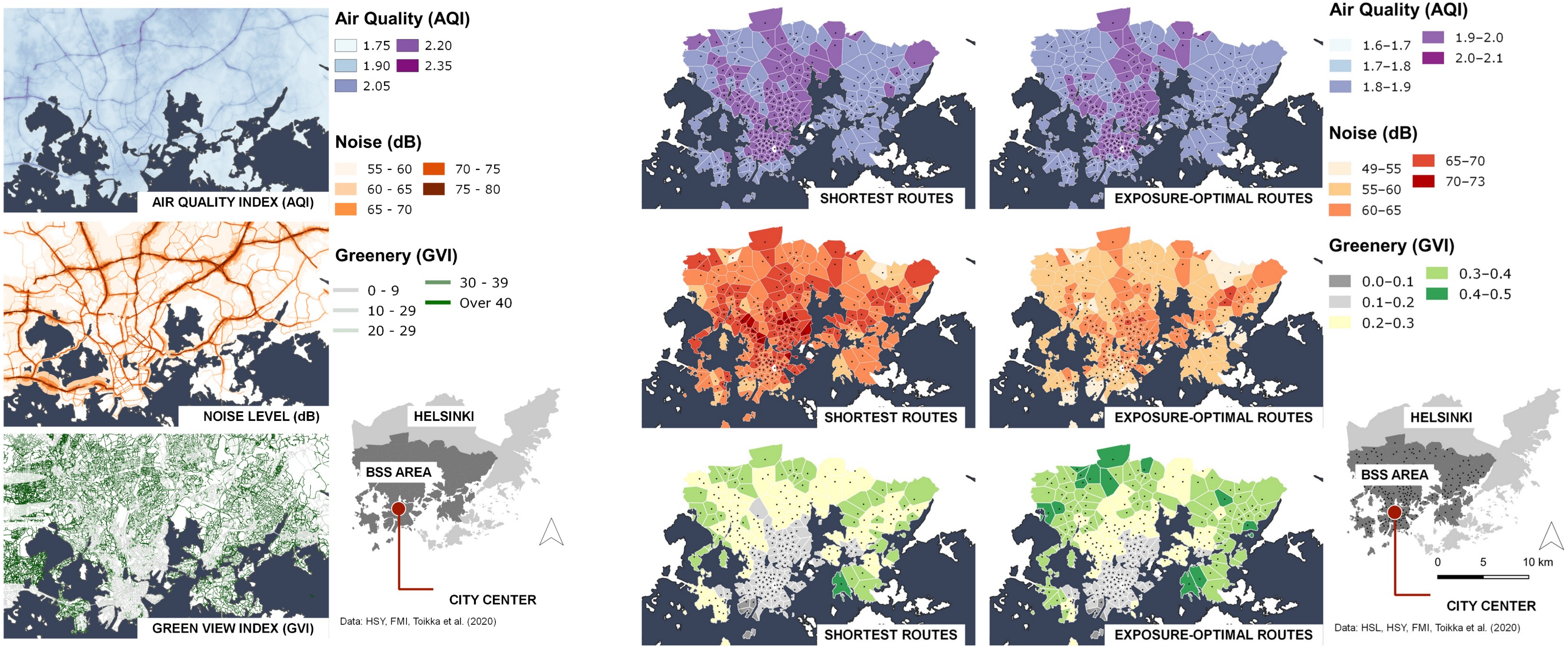
Volume data is the backbone of active mobility monitoring. Without reliable counts, it is impossible to assess modal share or evaluate the impact of infrastructure investments.



Haamer 2025. Comparative Modelling of Cycling Route Choice by Bikes and E-bikes: The Case Study of Tartu, Estonia: LBS Conference

Environmental & urban design quality – example

How can cycling route choice reduce exposure to pollution and increase exposure to greenery?



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Accessibility – examples

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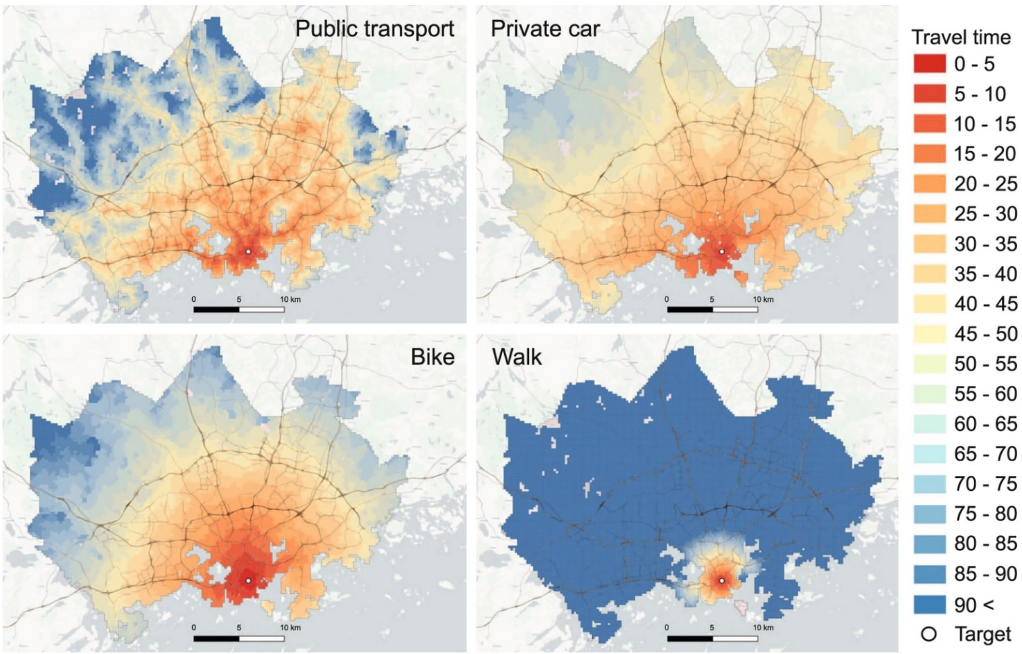
How does accessibility vary by travel modes?



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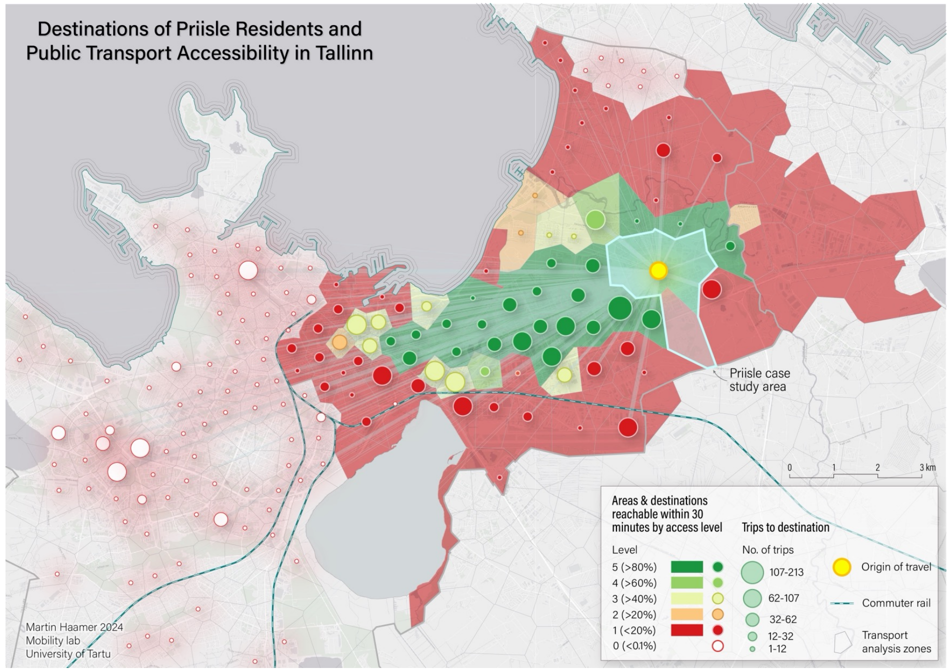
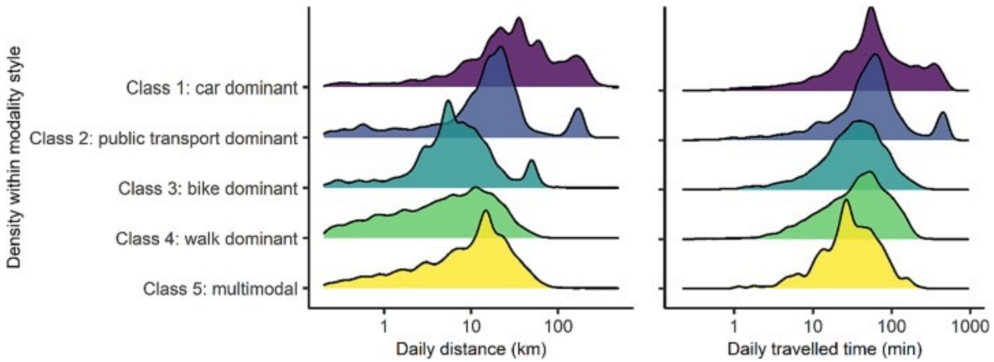
How well are daily destinations accessible by walking and public transit?



Haamer et al. 2025. Assessing public transport accessibility using GPS data https://doi.org/10.1186/s12544-025-00733-w

Dominant travel modes – example

What is the dominant travel mode? In daily life, we are all multimodal. Modality styles are formed over a longer period.



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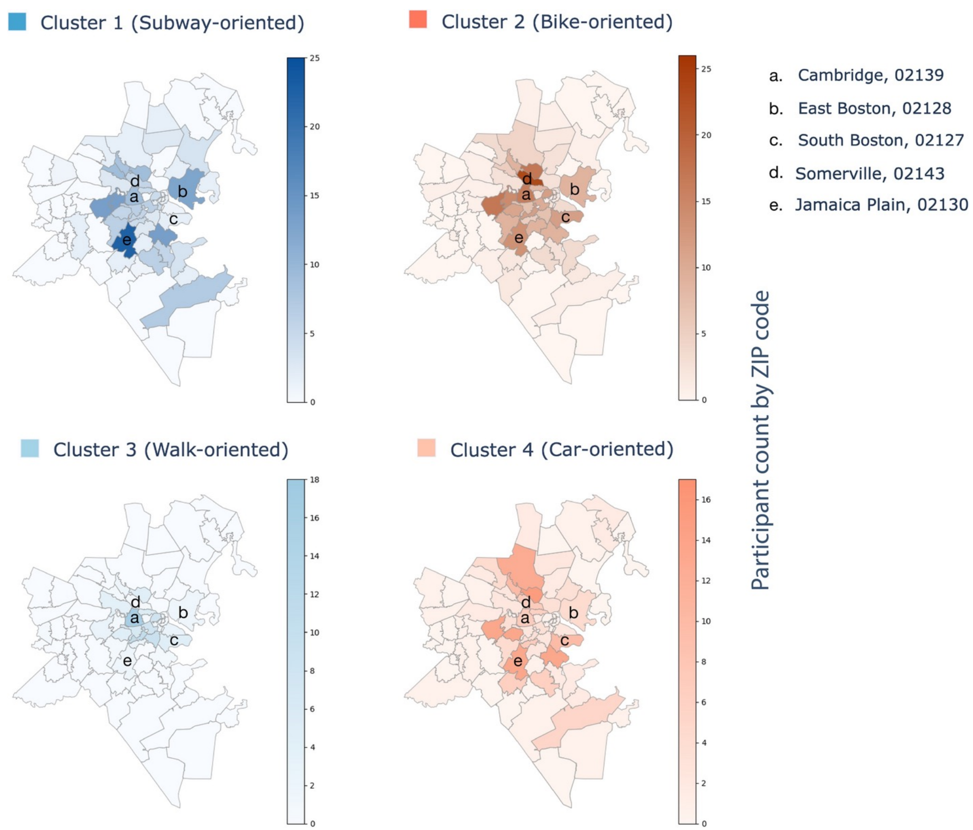

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Overview of data collection methods

Manual counts

Direct observation by trained enumerators.

High accuracy, flexible, location-specific — but labour-intensive and limited in temporal coverage.

Automated sensors

Cameras, radar, infrared, inductive loops, drones.

Enables continuous/regular monitoring at fixed points/routes. Higher upfront cost but low ongoing effort once deployed.

Digital traces

Smartphone data/GPS traces, fitness/navigation apps, mobile network operator data, bike share data, social media data.

Large spatial coverage but requires careful handling of bias and privacy.

Surveys & self-report data

Travel diaries, online/postal questionnaires, PPGIS surveys, walking interviews.

Captures purpose, demographics, values or perception — higher one-time sampling and execution costs.

Registers

Administrative data — population, employment and education statistics.

Captures full population and demographics — high access barrier and data quality issues.

No single method is sufficient – various types data and methods are mostly complementary. Robust monitoring programmes combine automated continuous counts with periodic manual campaigns and user surveys.

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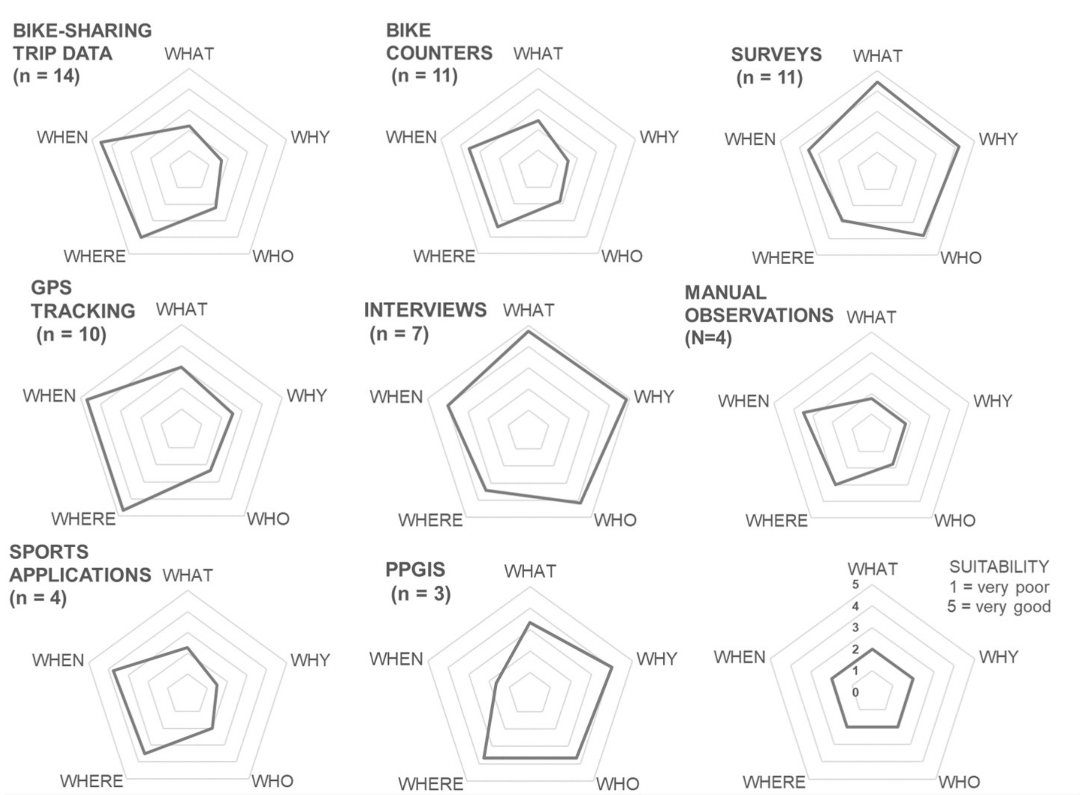
What do different types of data tell us?



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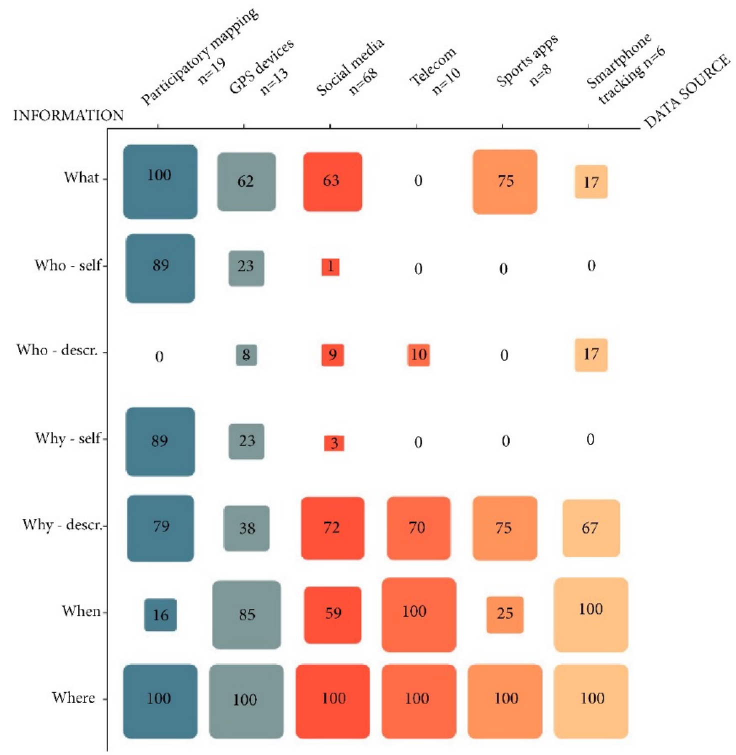

Rinne et al. 2025. Stronger together: integrating geospatial data to understand human outdoor recreation https://doi.org/10.1080/15022250.2025.2484715

Data governance & privacy

A data governance framework defines roles, responsibilities, and processes for the full data lifecycle.

Data ownership — Who/which body is the owner of the data?

Personal data — Does the data include personal data (GDPR applies)?

Data controller and data processor — Who makes decisions and is responsible for GDPR compliance?

Access and sharing — Who can have data access rights to raw data (typically restricted) and aggregated outputs (typically open)? How are the conditions set? Do you facilitate collaboration and data sharing?

Collection standards and data quality assurance framework — Are the approved methods, locations, timings, access protocols, other metadata and data quality criteria documented, communicated and followed by all related parties? Is there sufficient resources (personnel, skills, time, data infrastructure, etc.) to ensure sufficient data quality and continuity?

Review and update cycle — Is the data governance framework reviewed with the SUMP planning cycle? As new technologies emerge and priorities evolve, the framework must adapt accordingly.

Key principles for responsible data collection:

- data minimisation (collect only what is needed);
- purpose limitation (use data only for stated planning purposes);
- anonymisation and aggregation before storage;
- transparent communication to the public about what is collected and why.

Data quality

Data quality determines whether monitoring outputs can be trusted for planning and reporting decisions.

Two core dimensions:

Reliability — consistency of results under the same conditions

Accuracy — how closely the measured value reflects the true value

Example: common sources of error in active mobility counter data:

- miscounting due to sensor occlusion or clustering;
- misclassification of cyclists as pedestrians (or vice versa);
- equipment malfunction or data gaps;
- temporal bias from counts conducted at unrepresentative times.

Calibration & validation — All automated sensors must be regularly calibrated against manual counts. A minimum annual validation campaign is recommended, with immediate revalidation after equipment replacement or repositioning.

Data cleaning procedures — Establish documented rules for flagging anomalies: implausibly high counts, zero-count periods inconsistent with typical patterns, equipment downtime, duplicate records, future dates.

Gap-filling & imputation — When data is missing due to equipment failure or maintenance, apply statistically defensible imputation methods based on reference station patterns and seasonal factors.

Audit trails & metadata — Maintain logs of all data collection events, equipment or counter location changes, and processing steps. Without this, it is impossible to interpret trends or investigate anomalies retrospectively.

Standardisation and interoperability

Common definitions — What counts as "a cyclist", "a pedestrian trip", or "active travel"? Inconsistent definitions across departments, time or data collection types undermine comparability.

Benchmarking standards — Have you identified whether there are available national or European indicator frameworks to align with to enable cross-city comparison and/or EU funding reporting?

Data schemas & formats — Have you adopted open, machine-readable formats and standards (e.g., CSV, GeoJSON, GTFS-like schemas) and documented metadata – field names, units, and coding conventions in a data dictionary?

FAIR-principles – Are **f**indability, **a**ccessibility, **i**nteroperability, and **r**euse of digital data for both humans and machines ensured?

System integration — Have you aimed at connecting active mobility data to the broader transport and mobility data ecosystem — GIS platforms and dashboards, traffic management systems, public transit schedules and accessibility, urban planning performance review, open data portals — to increase utility, visibility?

Standardisation does not require waiting for a national mandate if yet nonexistent. Municipalities that agree on local definitions and formats now will find it easier to integrate into national systems later.


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Cycle4Climate

CYCLE 4CLIMATE

Co-creating Sustainable Cycling Solutions for Reducing CO_2 Emissions

Traffic counts | 2-wave travel survey | Focus groups

Cycling behaviour in the C4C partner cities:
Travel survey insights

Veronika Mooses, University of Tartu, Estonia
Karl Samuelsson, University of Gävle, Sweden

Soft cycling interventions in 4 BSR cities + monitoring

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What did we ask in the survey?

- Travel habits
- Attitudes about travel modes and infrastructure
- Values
- Health
- Opinions and awareness about initiatives
- Sociodemographic data

Espoo and Gävle

Focus on work commuting

Emails to employees in the area

Pärnu and Riga

Focus on daily travel

Letters sent to 5000 postal addresses

Two waves:

spring 2025 and **spring 2027**

1st wave: 1200 responses

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Access to bicycles as "vehicles"

- Regular **bicycle** ownership is high across all cities (81-91%) depending on the city.
- **Electric bicycles** are more common in Gävle and Espoo when compared to Pärnu and Riga.
- Owning and renting **cargo bicycles** is rare in all cities.

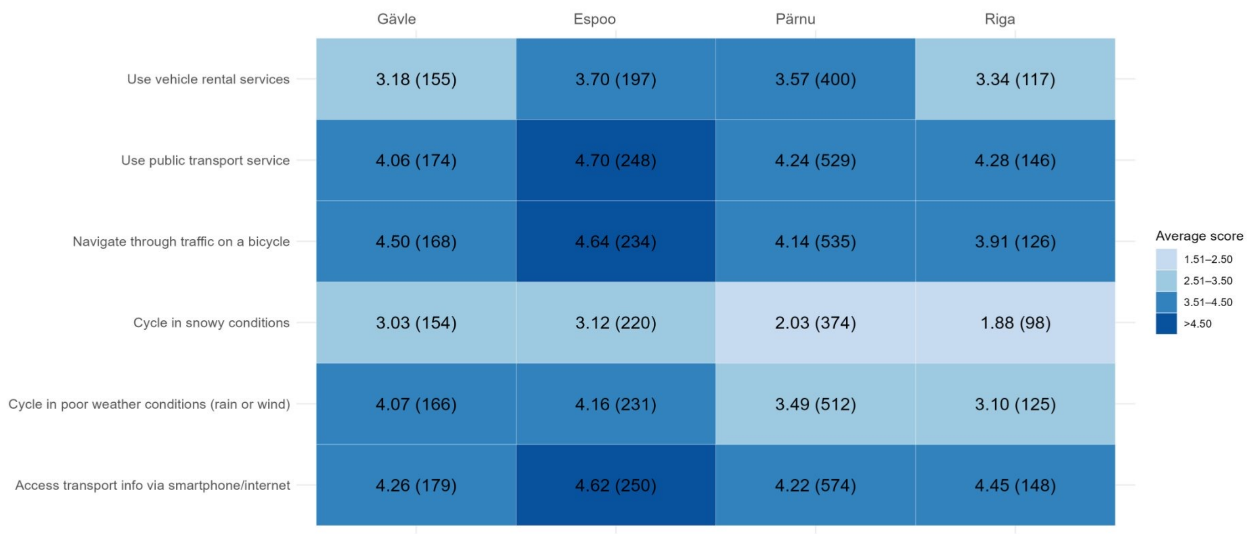
Skills of cycling

- Not everyone had skills or confidence to cycle.
- Skill in **navigating through traffic by bicycle** was rated high across all cities.
- People feel less confident in **cycling in snowy conditions**, especially in Pärnu and Riga.

Specific mobility services or conditions

Use of rental/shared mobility services

Use of digital transport apps (navigation, ticketing)



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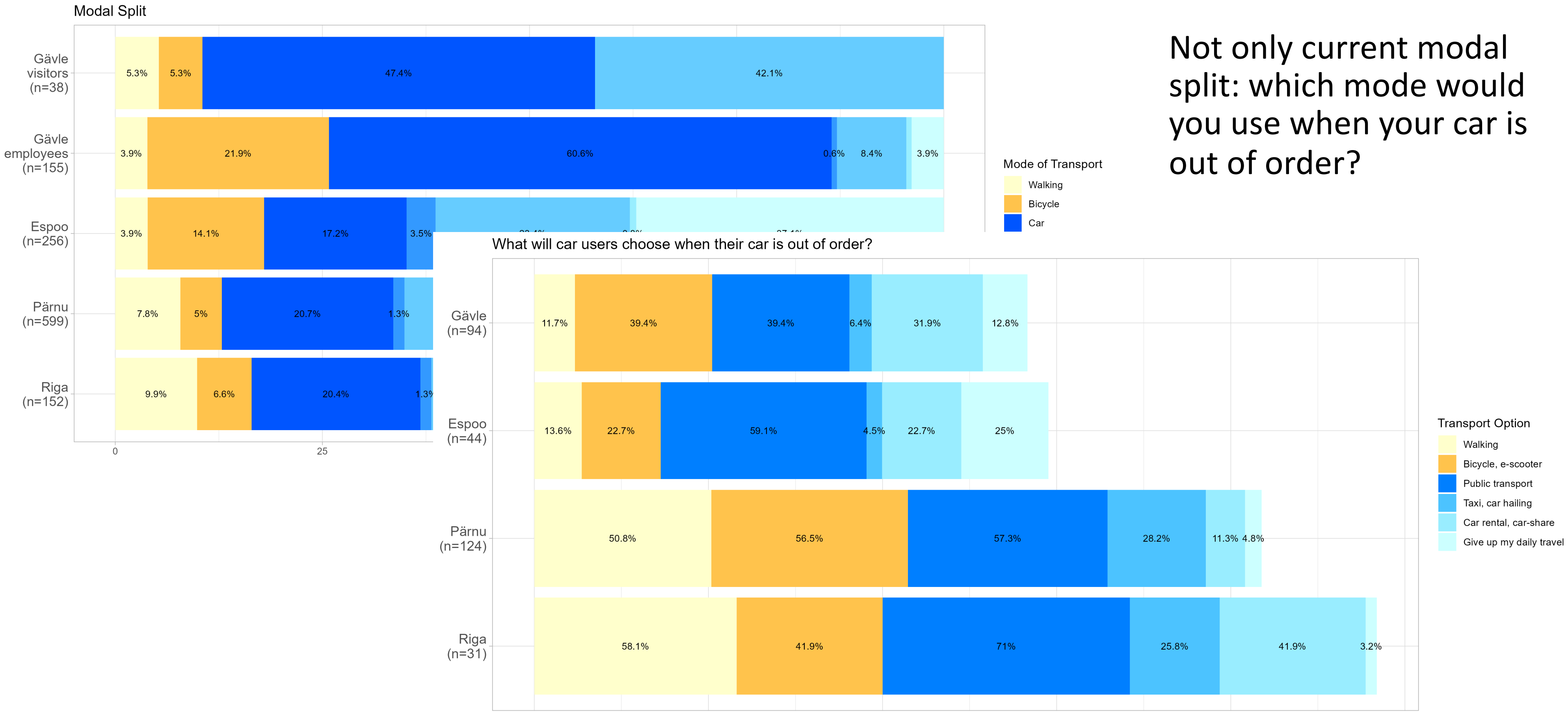

Not only current modal split: which mode would you use when your car is out of order?

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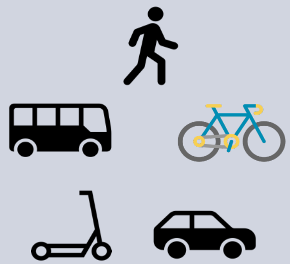
How to define modal split or dominant travel mode?

Count of all trips per mode (how?)? Declare the number of days when specific mode was used? Calculate distances or travel times used per mode?

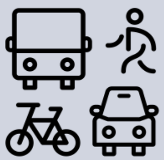
Dominant travel mode

- Having one travel mode used 3-5 days a week + using other modes 1-2 days a week



Multimodal

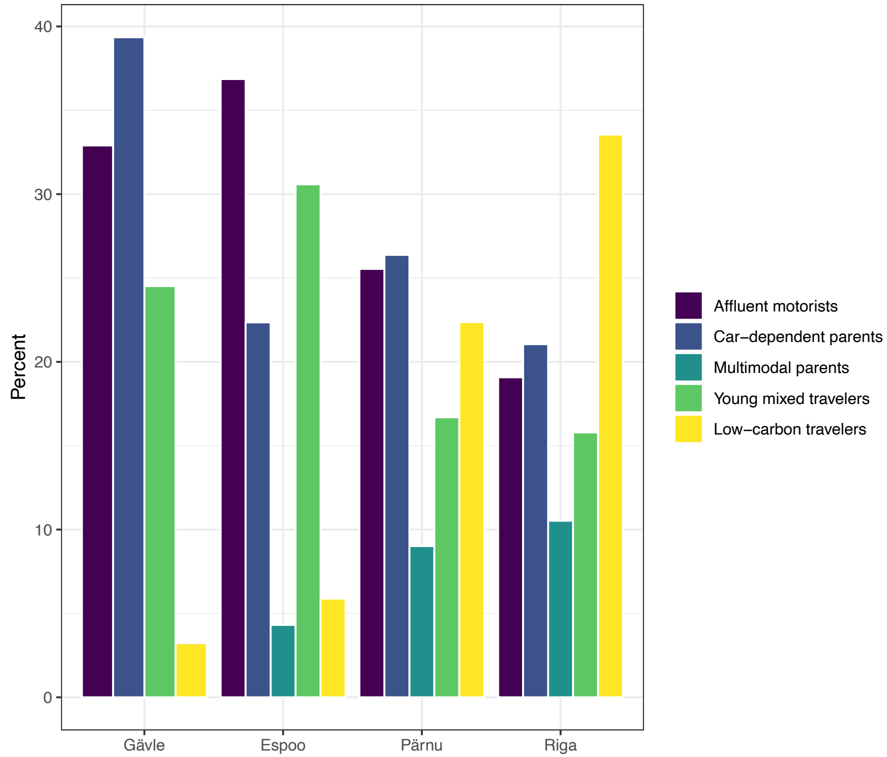
- Having two or more travel modes each used 3-5 days a week
- Having two or more travel modes each used 1-2 days a week



Less mobile

- No modes used at all
- Using one mode 1-2 days a week
- Working at home at least 3 days a week + no modes used
- Working at home at least 3 days a week + using some travel modes 1-2 days a week

Go beyond individual modes: identify travel profiles, clustered by travel behaviour and characterised by sociodemographics and origin



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Travel profiles

1. Affluent motorists (28%)
- Aged 55-64
- High incomes
- Two-person detached households
- Strong reliance on private cars

2.Car-dependent parents (27%)
- Parents aged 35-54
- Low incomes
- Strong reliance on private cars

3. Multimodal parents (7%)
- Parents aged 35-54, more women
- Low incomes
- Diverse travel modes
- Highest rates of cycling

4. Young mixed travelers (21%)
- Under-35s
- One- or two-person apartment households
- Middle incomes
- Diverse travel modes

5. Low-carbon travellers (18%)
- Women and apartment dwellers
- Varied in age, income and household size
- Highest rates of walking
- Highest rates of public transport use

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Most common barriers to cycling

1. Affluent motorists

- 33%: Takes too much time / too far
- 33%: Transporting items (shopping bags, etc.)
- 28%: Bad weather

2. Car-dependent parents

- 51%: Transporting others (children, pets, etc.)
- 40%: Takes too much time / too far
- 33%: Transporting items (shopping bags, etc.)

3. Multimodal travellers

- 35%: Bad weather
- 30%: Transporting items (shopping bags, etc.)
- 27%: Takes too much time / too far

4. Young cyclists

- 25%: Takes too much time / too far
- 21%: I do not feel presentable, I get sweaty
- 18%: Bad weather

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Thank you!

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