Urban Mobility Practices in Small, Medium and Large European Cities

The Mediating Roles of Urban Form and Car Ownership

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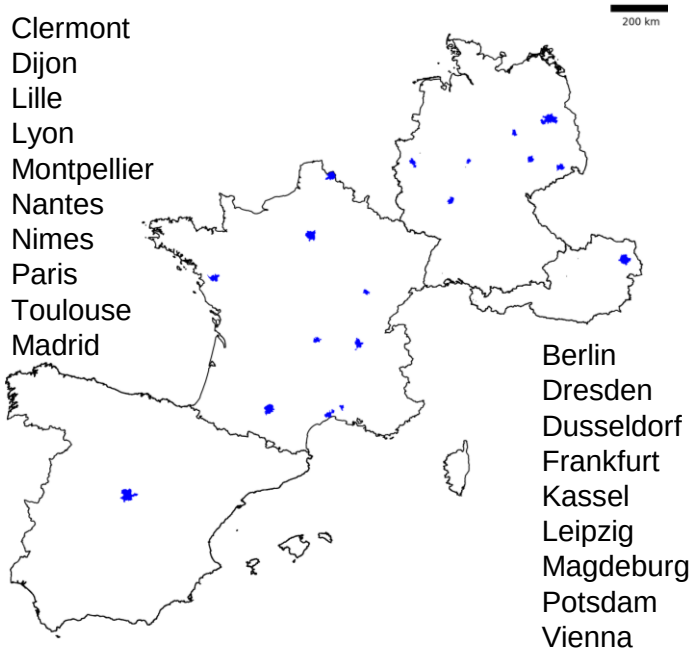
Motivation

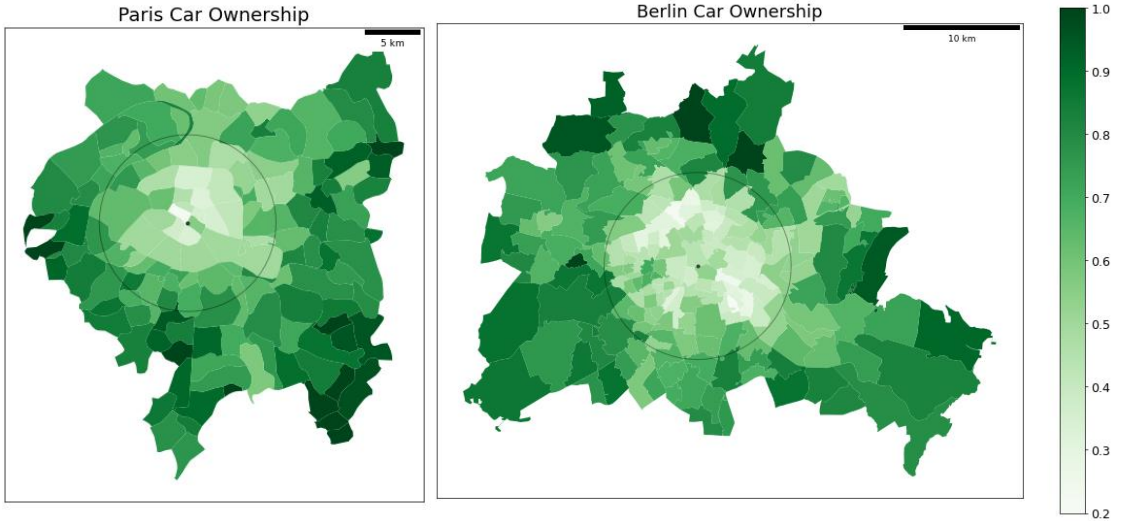
- Addressing the link between residential location and travel demand/emissions
- Transport is only sector in Europe where emissions continue to grow.
  96% from road transport
- Emissions from urban mobility arguably easiest to mitigate, but cars still dominate urban travel
- Which ***urban form*** features contribute to (un)sustainable mobility outcomes, and do these influences differ by location?

Resolution & scope

Scope – 19 cities in FR, DE, AT, ES



Resolution – Postcode or similar. ~5km^2 mean area



Data

- Urban form features
  - **A**ccessibility to attractions (**D**istance to city center & local subcenters)
  - **A**ccessibility to Transit (level of service and distance)
  - **D**ensity (population, built-up)
  - **D**iversity (land use mix)
  - **D**esign of street networks (street length, street intersection density, bike lanes)

- Urban mobility surveys, dependent variables:
  - Car ownership (per household)
  - Trip distance (average by postcode, individual commute trips)
  - Mode choice (individual trips)

Research Questions

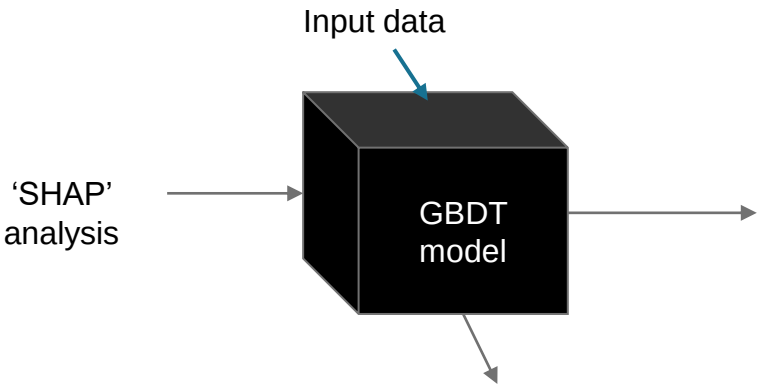
1. How do aggregate trends compare? (car use, ownership vs density, income, etc.)

2. Importance and variation of (urban form) features on:
   - Avg. trip distance by postcode
   - Commuting trip distance
   - Car ownership
   - Mode choice

3. How do demographic/trip characteristics influence mobility practices?

Methods

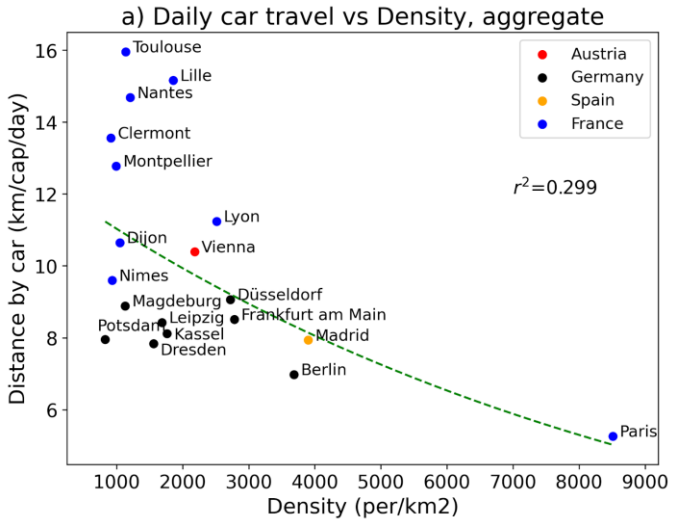
- Gradient Boosting Decision Tree classification/regression models
- Linear, logistic, multinomial logistic regression models
- SHAP values for explainable machine learning; interpret the black box

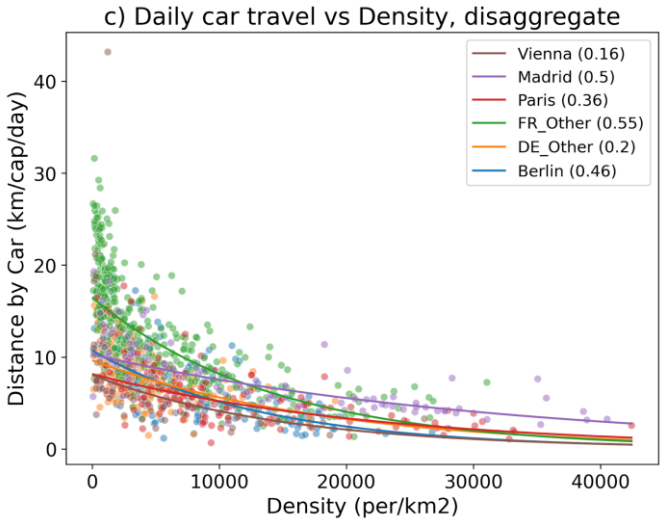


'Explainable AI'
Feature importance (FI) calculated for every obs.
Allows for non-linear relationships,
Local estimates of FI

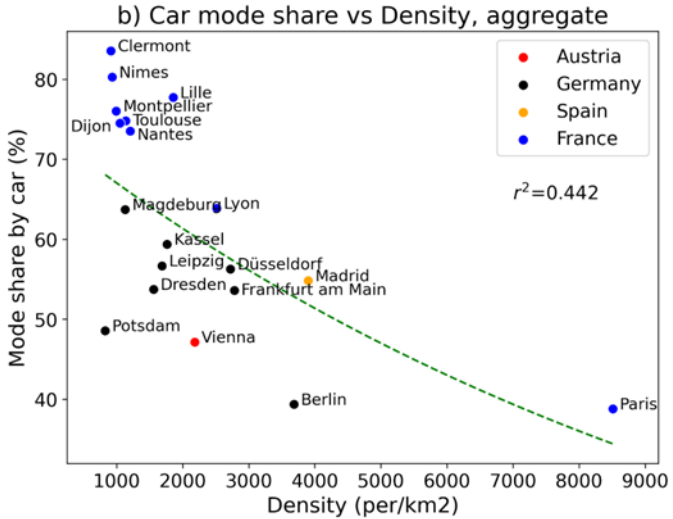
https://shap.readthedocs.io/en/latest/

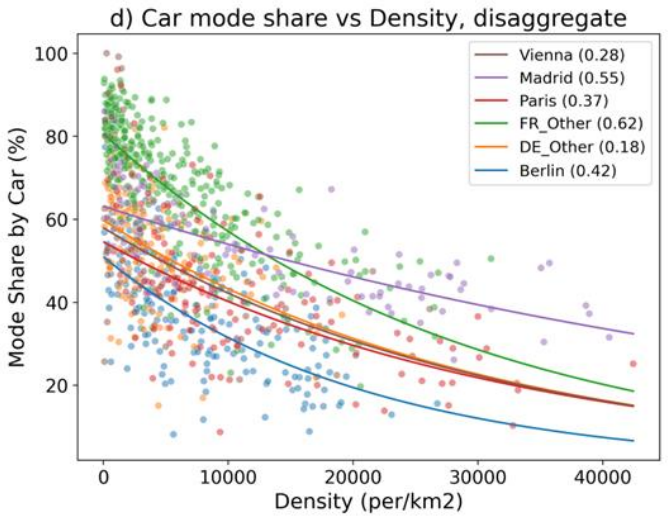
Car travel vs Population density



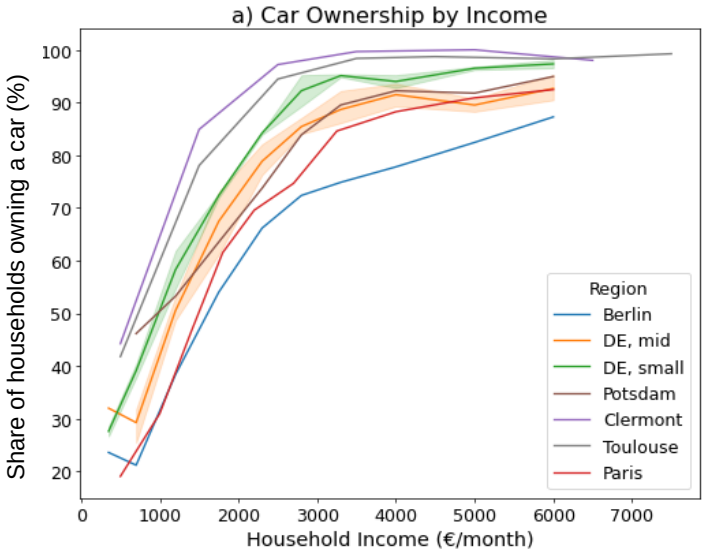


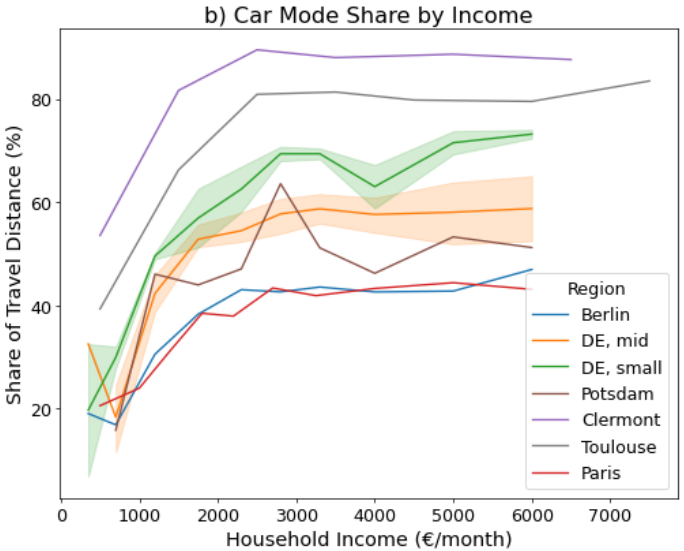
Car mode share vs Population density



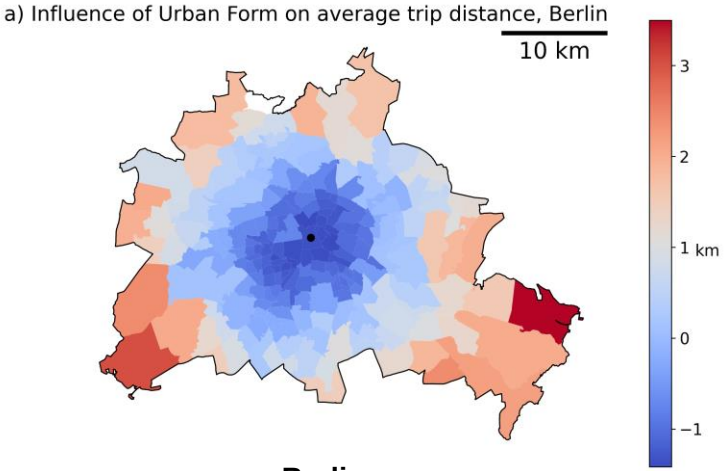


Car ownership and mode share vs income

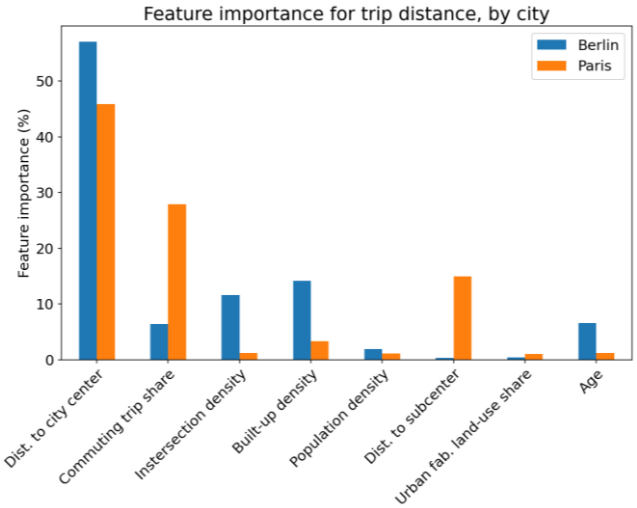


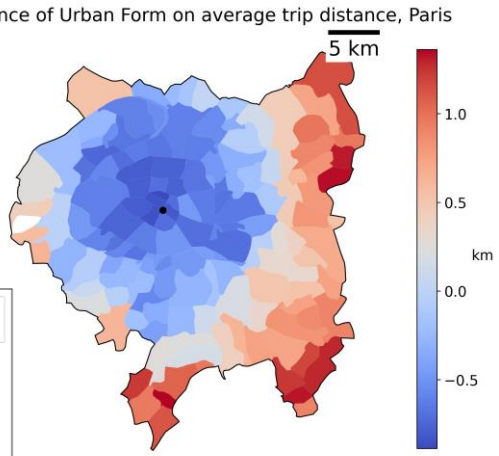


Model results: Urban form and trip distance



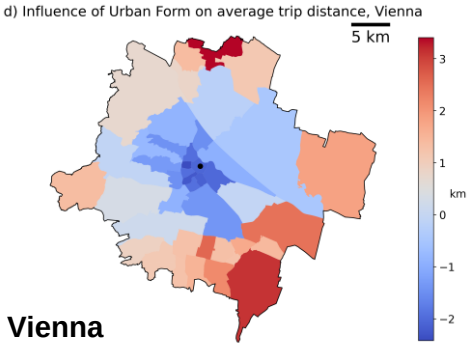
Berlin

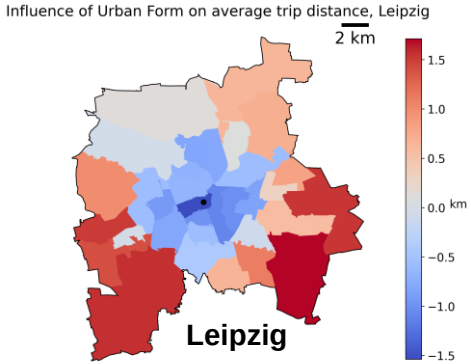


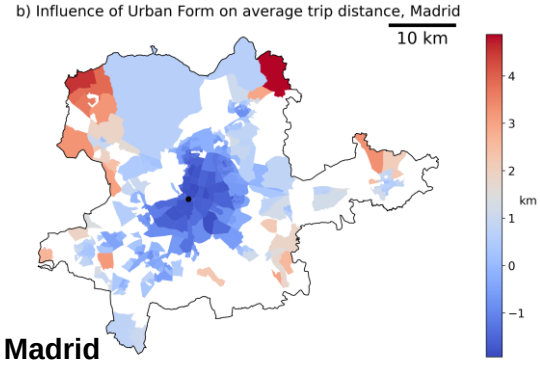


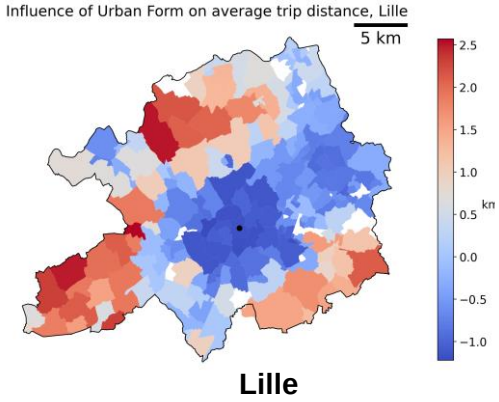
Paris

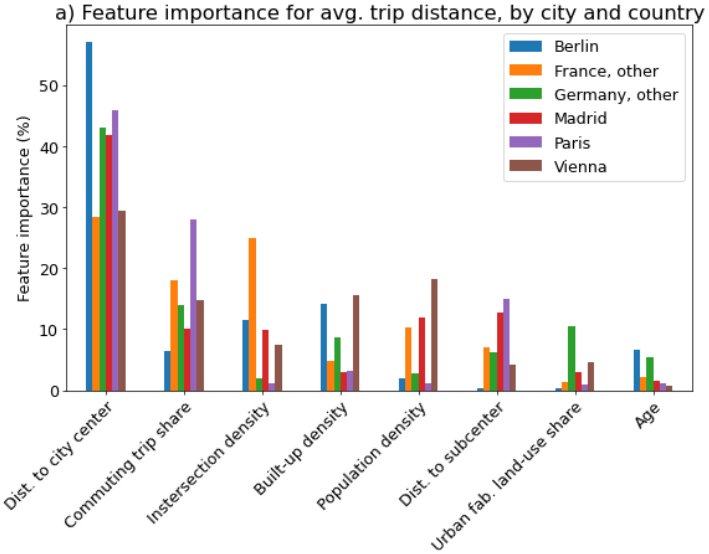
Model results: Urban form and trip distance





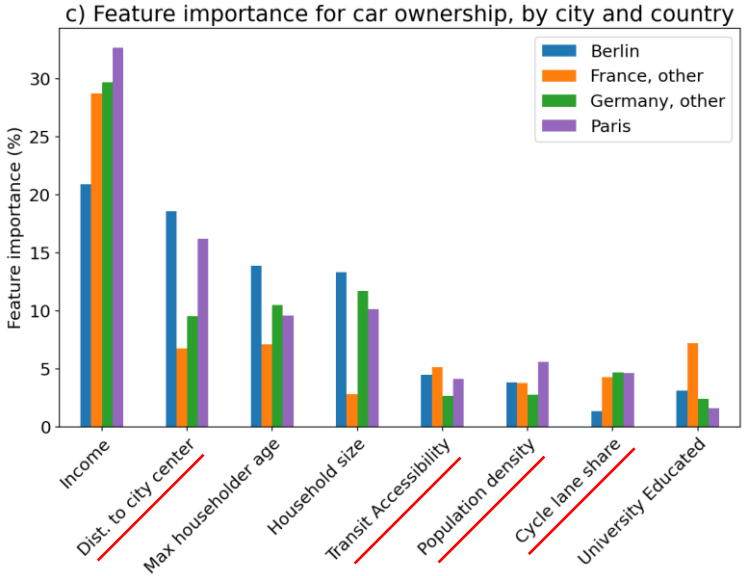


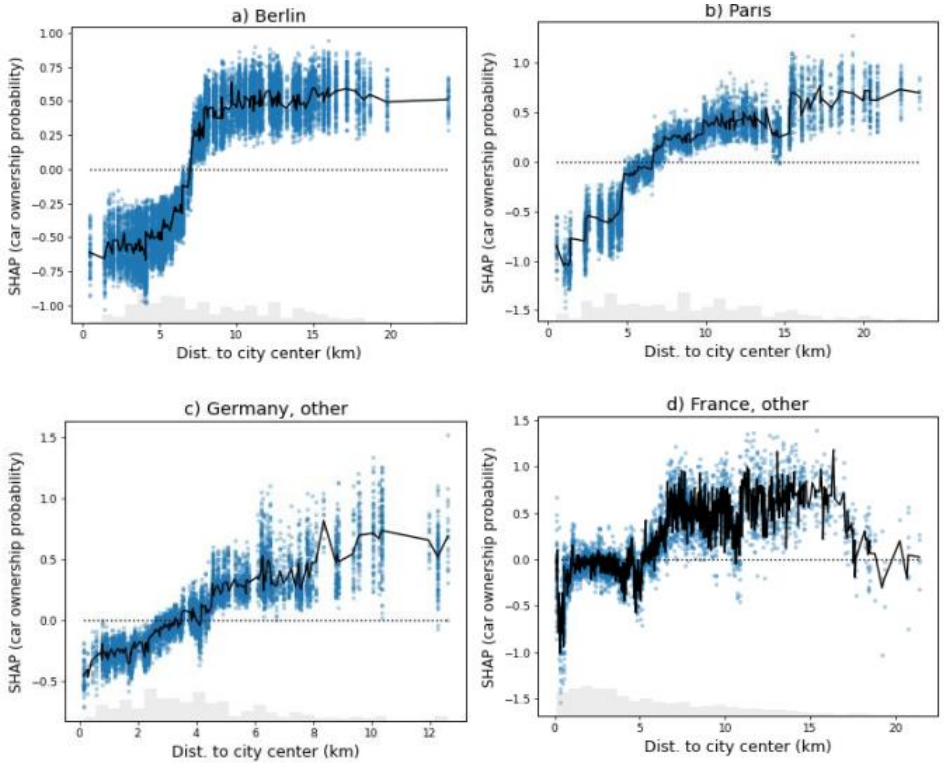




Model results: Distance to center and car ownership

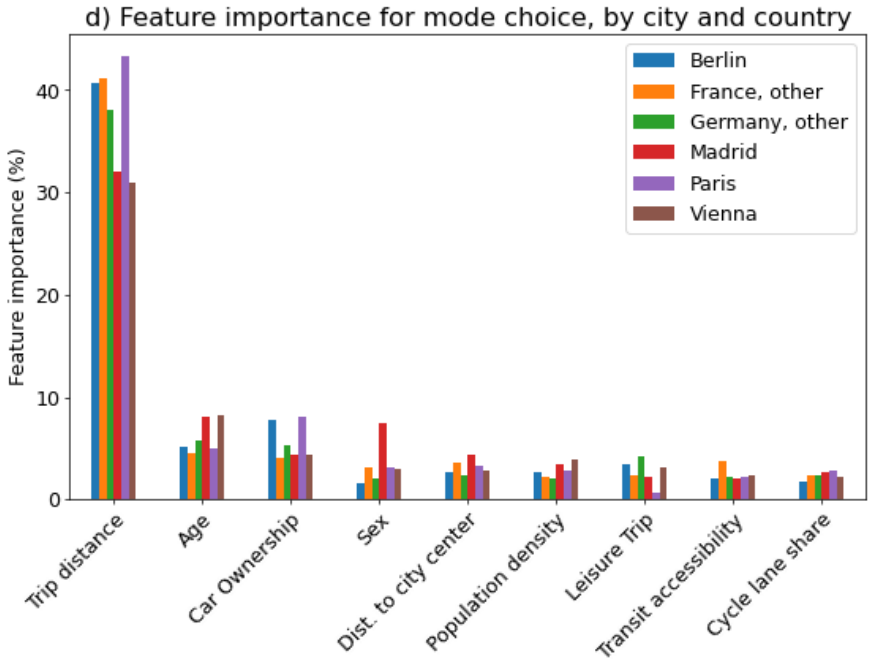
Non-linear effect of distance to center on car ownership, with visible thresholds e.g. ~7 km in Berlin





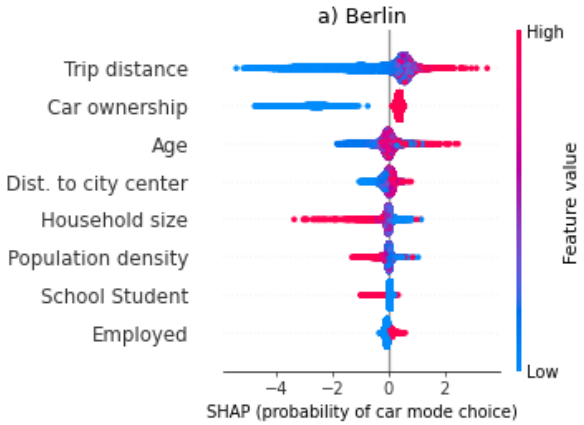
Model results: Mode choice

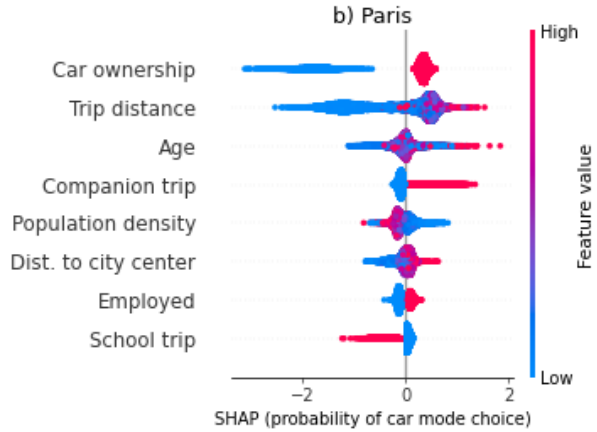
- Trip distance, age, and car ownership most influential

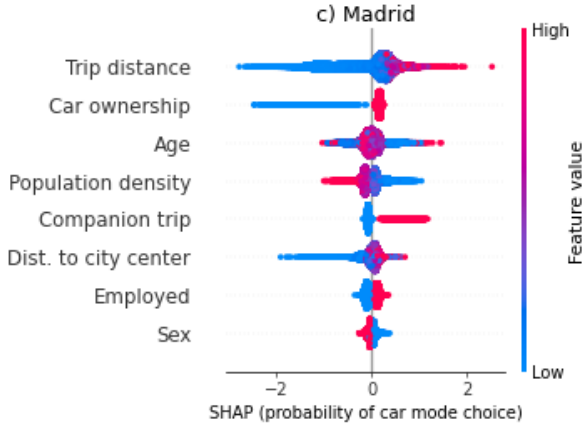


Model results: Car mode choice

- Car ownership and trip distance most important for car mode choice
- Age, Distance to center, Companion trip purpose, Pop density also relevant

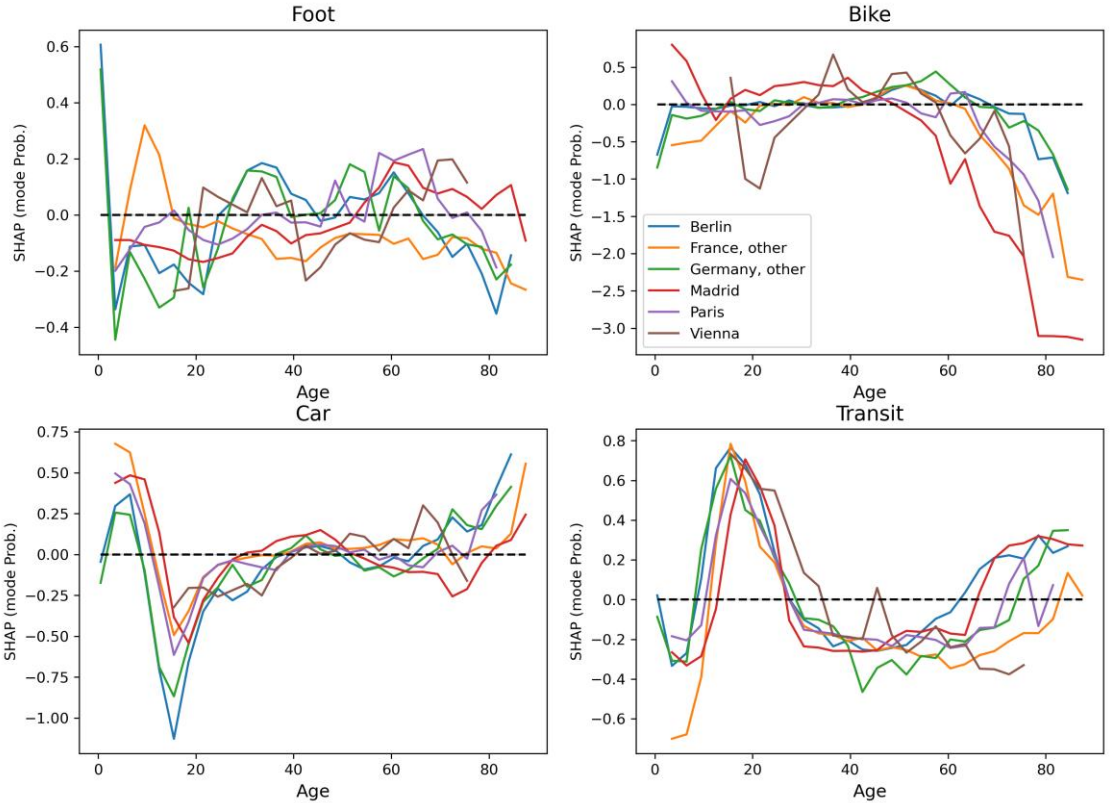






Non-linear effects of age on mode choice

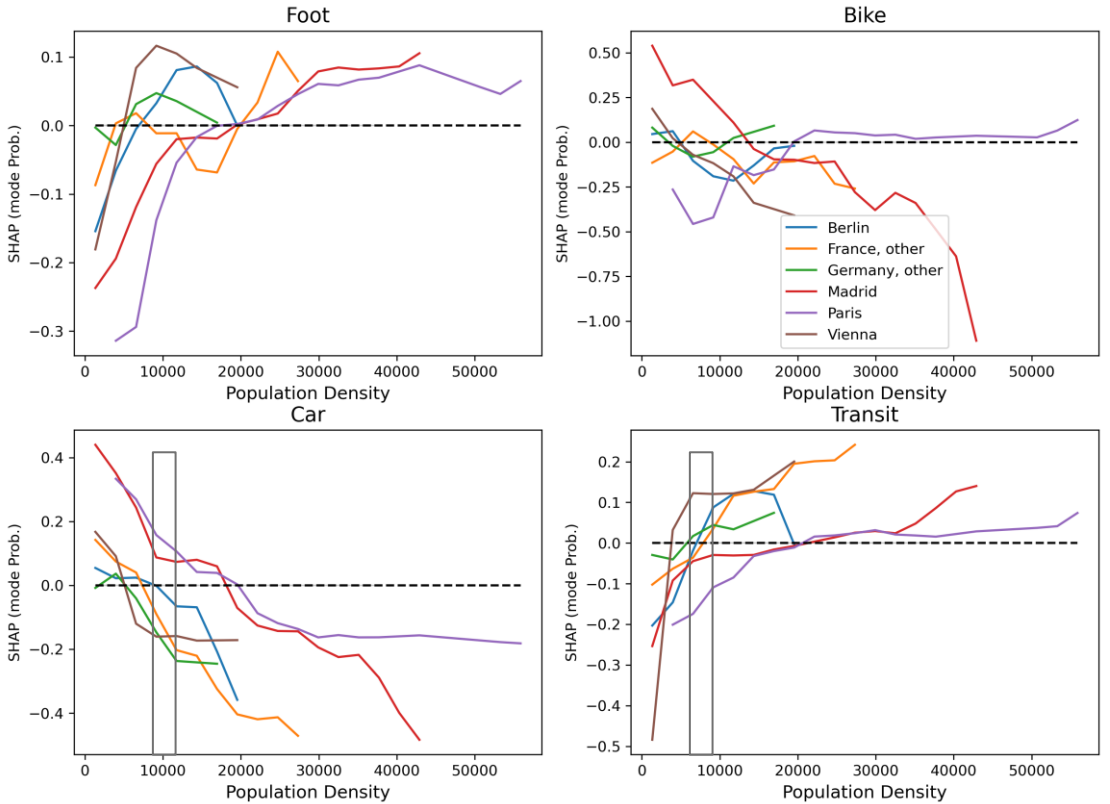
Change in probability of mode choice with Age



Non-linear effects of density on mode choice

Change in probability of mode choice with population density

Estimated range of threshold values



Findings summary

1. Income and density important for car ownership and use, also country and city size

2. Distance to center is the most important urban form feature for all outcomes. Non-linear thresholds exist @ ~5-7km for car ownership and mode choice, ~10km for trip distance

3. Companion trips most car dependent. Female and older travellers less likely to bike.

Recommendations

1. Concentrate future urban growth close to center

2. Increase transit mode share for longer trips, by increasing transit accessibility, and locating growth close to transit stations with pop. density >75/ha

3. Targeted solutions to promote active travel, esp. biking, among less engaged groups.

Thank you

Contact:
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Project website:
https://peterberr.github.io/sufficcs/

Preprint:
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